EXECUTIVE SUMMARY

INTRODUCTION

This Environmental Assessment has been prepared on behalf of Concrete Recyclers (Group) Pty Ltd (**Concrete Recyclers**) in support of a Part 3A Project application.

Concrete Recyclers seeks the approval of the Minister for Planning and Infrastructure to establish a Materials Recycling Facility at Newbridge Road, Moorebank.

The objectives of the proposal are:

(a) To establish a commercially viable Materials Recycling Facility which is capable of recovering recyclable concrete, brick, asphalt, sandstone and sand from the waste stream for reuse.

(b) To assist the NSW State government in achieving its objectives for the recovery and recycling of waste as detailed in the *NSW Waste Avoidance and Resource Recovery Strategy 2007*.

(c) To establish an environmentally responsible and sustainable industry which would create employment.

THE SITE

The Site is Lot 6, DP 1065574 and has an area of approximately 20.5 hectares.

The Site is located on the southern side of Newbridge Road to the east of the intersection of Newbridge Road with Governor Macquarie Drive and has frontage to Newbridge Road by way of an access handle which leads from Newbridge Road to the main body of the Site to the south.

The Site is bound by:

- the Georges River to the east,
- Benedict Sand and Gravel to the north of the main body of the Site and to the east of the access handle to the Site,
- a large area of environmentally sensitive vegetation to the west of the Site,
- a small section of the Georges Fair residential estate which is located on the former Boral quarry to the west of the Site, and
- New Brighton Golf Club to the south of the Site.

THE PROPOSED DEVELOPMENT

It is proposed to establish a materials recycling facility on the Site with intended capacity of 500,000 tonnes per annum. The proposed facility would receive concrete, brick, asphalt, sandstone and sand from the building and construction industry in the Sydney metropolitan area. No domestic loads would be received at the facility.

Waste material would be delivered to the Site by truck, usually with a capacity of 7 tonne to 30 tonne. Trucks would stop at a receival point where the load would be inspected to ensure loads comply with the materials which the

facility is licenced to receive pursuant to the Environment Protection Licence. If accepted, the driver would be instructed to proceed to the weighbridge office where a docket would be issued. If rejected, the driver would be instructed to turn around and leave the Site.

Once a docket is issued, the truck driver would be directed to a designated stockpile depending on the type of waste the truck is carrying. The load would be tipped and the truck would leave the Site via the wheel wash.

A wheel loader would push the deposited waste up into the main stockpile awaiting processing.

If waste received is too large for the primary crusher, it would be broken down in size using a mechanical pulveriser fitted to an excavator prior to loading into the primary crusher. Sprinkler systems would be utilised to dampen the waste material in order to control dust.

The primary crusher would be contained within a purpose built building. The crushing plant would be controlled by an employee in a control room on the primary crusher. Inside the building where the primary crusher is housed, a fogging system would be employed to control dust.

The initial processing stage would see waste crushed to about 100mm minus from where it would be conveyed to a magnet where scrap metal would be removed. Once the material has passed over the magnet, it would pass through a picking station where employees would remove any foreign material such as wood, plastic, paper and the like.

The material would then be transported by conveyor to the secondary crusher where it would be reduced to about 30mm minus in size. The secondary crusher would also be located within a purpose built building. The material would then be passed under a second magnet prior to being transferred by conveyor to the first screen where 20mm minus material would be conveyed to the second screen where it would be split into sand and aggregates. Any 25mm plus material would be returned to the secondary crusher for further processing.

Processed materials would be transferred by conveyor stackers to product stockpiles of maximum height 10m. Product would then be transferred by wheel loader to designated stockpile locations.

Product would be loaded onto delivery trucks by a wheeled loader. The delivery trucks would travel through the wheel wash and onto the weighbridge where the driver would receive a docket and leave the Site.

Component Requirements

The key elements of the proposal are as follows:

- 3 x wheel loaders.
- 5 x excavators.
- 2 x water carts.
- 1 x 10,000 litre capacity fuel tank.
- Weighbridge office where dockets would be issued.
- Weighbridge (x2).
- Wheel wash.
- Workshop for general repairs.
- Store where spare parts would be housed.
- Staff lunch room and associated amenities.
- A 10m high shed containing the primary crusher.
- Picking station where labourers would hand pick waste from the product stream.
- An 8m high shed containing the secondary crusher and screens.
- An 8m high shed containing the second screen.
- Car park for 16 vehicles.
- 4 x 250,000 litre stormwater storage tanks.

Hours of Operation

The proposed hours of operation would be:

Monday to Saturday 7:00 am to 6:00 pm.

Operation of the crushers would be restricted to 7:00 am to 5:30 pm.

Employees

There would be forty five (45) employees comprising:

- Two (2) administrators.
- Two (2) weighbridge operators.
- Two (2) sales staff.
- One (1) foreman.
- Seven (7) mobile plant operators.
- Seven (7) labourers.
- Four (4) fitters.
- Twenty (20) contract drivers who will arrive at the Site in their trucks.

Not all employees would be on the Site and any one time.

Stormwater Management

The following objectives have been adopted with regard to water management:

1. To minimise potential impacts on water quality of the Georges River.

2. To implement stormwater reuse to minimise the potable water requirements for the Site.

3. To ensure no negative impacts on flooding.

4. To ensure an effective flood evacuation procedure is in place.

Once the approved earthworks (Development Consent No.1417/2005) are complete, there would be a slight fall (about 0.3%) from the northern end of the Site to the southern end. There would also be a slight ridge which would run north to south (approximately through the middle of the Site). Consequently, runoff would drain to the south east and to the south west. The approved perimeter mound would prevent runoff from moving directly down the embankment on both sides of the Site, so runoff would be caught in various low lying depressions adjacent to the mound before it eventually finds its way to the southern end of the Site (where the runoff will escape through the mound openings).

Runoff on the south-eastern side would fall into the low lying riparian area adjacent to the Georges River and the runoff to the south-western side would either fall to the same riparian area or would drain back to the north via the existing drainage swale which runs along the western property boundary. This swale eventually drains into a drainage channel which runs beneath the entrance to the Site and then into the Georges River.

Once complete, the approved earthworks would ensure all operational activities associated with the Materials Recycling Facility are protected from flood waters.

The site access from Brickmakers Drive would require an embankment to transition between the level of Brickmakers Drive and the Site access handle which would be substantially at existing ground level. The levels adopted for the access road have been designed to minimise the loss of flood storage. Notwithstanding, the earthworks associated with the access road would lead to a loss of flood storage of 3,500m^3. The loss of flood storage resulting from the construction of the access road would be offset by lowering the surface level of the

southern section of the Site by rolling with a heavy roller.

Water Management and Pollution Control Strategy

To ensure potential sediment laden runoff is controlled and potable water use for site operations is minimised, the Site runoff would be collected at four appropriately sized collection sumps, from where it would be pumped to 4 x 250,000 litre capacity holding tanks for reuse.

In the event that the volume of runoff exceeds the design storm volume, overflow from the sumps would discharge via an outlet which ensures oil and other impurities are retained within the sump.

Overflow discharge from all sumps would be via non-return valves to ensure that external flood water does not enter the Site. All overflow would be directed into a grass swale or a bio-retention swale for supplementary treatment before discharging from the Site.

Erosion and Sediment Control

Temporary erosion and sediment controls would be implemented prior to the construction of the facilities which comprise the integrated water management system. A combination of localised controls including silt fencing and contour berms etc would be used.

The Water Management Strategy for the Site is discussed in more detail in **Part 9** of this Environmental Assessment.

Access and Parking

The existing access to the Site is via a gravel road from Newbridge Road. The access crossing is on the southern side of Newbridge Road some 120 metres east of Governor Macquarie Drive.

The access road is located within the access handle of the Site and is 10.064 metres wide. The pavement width varies but is approximately 5 metres wide. The access handle from Newbridge Road to the main body of the Site is approximately 870 metres in length.

The NSW Roads and Maritime Services has advised that it would not grant its concurrence to the proposed development having its ingress and egress from/to Newbridge Road.

As part of the development of the Boral Moorebank Precinct Structure Plan (refer **Part 1.3** of this Environmental Assessment), Liverpool City Council, as part of the rezoning of the former Boral quarry site for residential use, rezoned an 18 metre wide strip of land from the alignment of Brickmakers Drive to the access handle of the Site to provide for ingress to and egress from the Site.

The 18 metre wide strip of R3 zoned land connecting the access handle of the Site with Brickmakers Drive is the location of the proposed access to the Site.

Both the 18 metre wide strip of R3 zoned land (Lot 309, DP 1118048) and Brickmakers Drive (Lot 308, DP 1118048) are in the ownership of the Liverpool City Council.

Brickmakers Drive is about 1.8 metres above the existing ground level at the intersection of the link road and the embankment fill is retained by a split block gravity retaining wall. Fill material for the link road embankment is to be transported along the existing access road from cut and fill operations on the Site or from Newbridge Road in the construction stage of the facility.

Concrete, steel reinforcement and box culverts for the link road would have to be brought in from Newbridge Road to complete construction of the link road.

Once the link road is completed, construction traffic would be able to access the Site from Brickmakers Drive.

Engineering plans for the proposed access over the 18 metre wide strip of R3 zoned land and the southern section

of the access handle of the Site are provided with the project application and are discussed further in **Part 10** and **Appendix 4** of this Environmental Assessment. Notwithstanding the above preferred access to the Site, an alternative access option is available by way of an access ramp to the Site from Brickmakers Drive which would connect to the access handle of the Site and an exit ramp from the access handle of the Site to Brickmakers Drive.

Sixteen (16) car parking spaces are to be provided in a dedicated car parking area. Vehicles parked on Site would include service vehicles, water trucks and a fuel truck. Trucks delivering raw materials to the Site and delivering processed materials from the Site would be garaged off site.

A series of internal roads to facilitate the delivery of raw materials to the Site and the transport of processed materials from the Site are provided in the main body of the Site.

Traffic Generation

The estimated number of truck movements per day is 324 based upon an average load of 21.2 tonnes and 292 working days per annum. Daily estimated truck movements are as shown in the table below.

Table: Daily estimated truck movements

Movement type	In	Out
Raw material	81 loaded trucks	81 empty trucks
Processed material	81 empty trucks	81 loaded trucks

Directional distributions of trucks

The origin of trucks bringing raw material to the Site for processing and the destination of trucks taking processed material from the Site would vary. Notwithstanding, it is estimated that:

- 55% of trucks with raw materials are expected to approach the Site from the east along Milperra Road / Newbridge Road and depart to the east with processed material.
- 25% of trucks with raw materials are expected to approach the Site from the north and north west along Newbridge Road and depart with processed material along the same route.
- 20% of trucks with raw materials from the south are expected to travel on the M5 Motorway and Nuwarra Road / Newbridge Road to the Site and depart with processed material along the same route.
- All trucks would turn left from Brickmakers Drive onto the link road between Brickmakers Drive and the access handle of the Site when approaching the Site. When departing from the Site, all trucks would turn right from the link road onto Brickmakers Drive. The intersection design would prevent the Moorebank Recyclers trucks from turning left into Brickmakers Drive.

Estimated peak hour movements

Traffic data over a 2 month period in 2003 for a previous recycling facility on the Benedict Sand and Gravel site operated by Concrete Recyclers has been used to estimate the hourly distribution of truck movements for the proposed facility. The nature of the recycling industry is such that there would be daily variations in the number of truck movements per day and per hour.

The estimated number of truck movements per hour on a typical day when the proposed facility is generating 324 truck movements is as shown in the table below.

Table: Estimated Hourly and Daily Truck Movements

Time	Number of Truck Movements In and Out	% of Total
7:00 - 7:30am	9.7	3.0
7:30 - 9:00am	56.4	17.4
9:00 - 12:00 noon	115.3	35.6
12:00 noon - 3:00pm	100.8	31.1
3:00 - 5:00pm	41.8	12.9
TOTAL	**324**	**100**

The estimated truck volumes generated by Concrete Recyclers in the 8:00 - 9:00am and 4:00 - 5:00pm peak hours on a typical day is represented in the table below.

Table: Estimated Peak Hour Truck Volumes

Time	Traffic Generation		Total
	In	Out	
8:00 - 9:00am	19	19	38
4:00 - 5:00pm	10	11	21

Fire Control

Fire control facilities on the Site would be provided to meet the requirements of the Building Code of Australia.

Water Requirements

The primary mechanism for stormwater pollution control would be by means of the capture and re-use of stormwater runoff from the Site. A water balance model has been prepared to assess what portion of the Site water requirements can be met from onsite runoff and to quantify the volume and frequency of overflow discharge.

Based on experience at an existing operating site, a maximum of 130kL/day of water is required for dust suppression on stockpiles and haul roads. Initially, water would also be required for establishing landscaping.

The water balance model accounts for all the flows in the Site water management system on a daily basis using 33 years of rainfall and evaporation data. The model accounts for:

- Runoff from different surfaces.
- Runoff held in the collection sumps being pumped to storage tanks.
- Water from the storage tanks being used on a daily basis which accounts for variation of daily evaporation. The model assumes that, after accounting for rainfall and evaporation, sufficient water is required to maintain a moist surface on the working area and stockpiles, with a maximum daily requirement of 130kL.
- Any shortfall of water from the stormwater runoff storage tanks is assumed to be supplied by reserve tanks which would be either filled using approved industrial waste water imported by tanker or, as a last resort, topped-up over night from the mains supply.

The model keeps account of:

- The volume of water which overflows because it cannot be retained in the storage tanks or sumps.
- The number of overflow events, where any occasion on which overflow occurs on consecutive days is counted as a single event.
- The volume of supplementary supply required to meet the full water requirements for dust suppression on the Site.

For comparative purposes, a separate section of the water balance model carries out a water balance analysis for the Site for a hypothetical situation in which the Site drained to a series of sediment basins which were designed and operated in accordance with the requirements for 'Type F' sediment basins which retained all runoff from a 5 day, 95th percentile rainfall event as set out in Chapter 6 of Managing Urban Stormwater: Soils and Construction (Landcom, 2004).

This element of the water balance model assumes that the water retained in the basins would be treated and discharged within 5 days of the end of a runoff event, in accordance with the operational requirements. The model assumes that any runoff in excess of the capacity of the sediment basins would overflow from the Site. An account is kept of the volume of overflow and the number of overflow events.

The water balance model was run to identify the optimal size of the holding tanks which would provide for cost-effective retention of stormwater runoff while achieving overflow frequency which was comparable with that which would be achieved if the site pollution control was based on treating all runoff from a 5 day, 95th percentile storm.

The water balance model results show that:

- For an increase in storage tank volume from 500m^3 to 1,500m^3 there is only a small increase in the percentage of runoff which could be captured and re-used. The marginal additional proportion of water provided by larger storage tanks does not warrant consideration of tanks of greater than 1,500m^3 capacity;
- Similarly, the average annual volume of overflow does not reduce significantly with the increase of storage tank size. This occurs because overflow occurs as a result of periods of persistent heavy rainfall over several days when large volumes of runoff occur; and
- The range of tank storage sizes would provide for frequency of overflow from the Site which is comparable to that which would be achieved if stormwater pollution was achieved by a system which relied only on sediment basins which were designed and operated in accordance with the requirements for a site with an operational life in excess of three years which drained to a sensitive environment.

On the basis of the modelling results, storage tanks with a total capacity of 1,000m^3 are proposed. This would provide a system which, on average, would have only fractionally more overflow events per year than if pollution control was provided by sediment basins (3.5 overflow events per year as compared to 2.8).

The marginally elevated number of overflow events would be more than offset by the secondary treatment systems comprising grass swales and a bio-retention swale which are proposed. These would provide significant additional reduction in the residual suspended solids concentrations before water leaves the Site. Additionally, the overflows from the operational area would be conveyed to the swales within the Site area, and a small proportion of that flow would infiltrate into the ground within the swales, meaning that not all of the overflow volume would actually leave the Site.

The potential total suspended solids load within runoff from the developed site would be significantly reduced by the proposed water management system. The system would capture 72% of runoff, which effectively removes 71% of the suspended solid load in runoff from the Site. The proposed swale and bioretention swale would remove 70% of the suspended solids in the runoff which overflows to those swales (29% of runoff).

In combination, this means that the water management system would remove 91% of the suspended sediment load within runoff from the developed site. This means that only 9% of the suspended solids load from Site runoff would

enter the Georges River. In general, for urban catchments, a target reduction of 80% for suspended solids is set by local government.

The 1,000m^3 tanks would also ensure that about 55% of water required for site operations would be from stormwater runoff. This would equate to a potential saving of approximately 14,000m^3 of potable water annually.

Infrastructure Services

No services are currently available to the Site, however, water and electricity services would be connected as part of the development of the Site for the proposed Project.

Telephone facilities at the Site would be mobile services with a pump out sewage system installed.

Approvals Required

The *Protection of the Environmental Operations Act 1997* requires an Environment Protection Licence to be obtained from the NSW Office of Environmental and Heritage for the carrying out of *scheduled development works* which would enable a *scheduled activity* to be carried out.

The proposed project would fall within the category of Resource Recovery and, as such, an Environment Protection Licence is required to operate the proposed activity.

IMPACT OF THE PROPOSED DEVELOPMENT

Air Quality

Annually, winds can occur from most directions with winds from the northwest slightly more frequent. There are few winds from the north-northeast. The predominant winds are generally from the southeast in summer and from the northwest in winter.

Local Climatic Conditions

The BoM records climatic information at Bankstown Airport.

Temperature and humidity data consist of monthly averages of 9:00 am and 3:00 pm readings. Also presented are monthly averages of maximum and minimum temperatures. Rainfall data consist of mean, highest and lowest monthly rainfall and the average number of rain days per month.

Temperature data show that January is typically the warmest month with a mean maximum of 28.1^o C. July is the coldest month with a mean minimum of 5.1^{o}C.

Rainfall data collected at Bankstown Airport show that February is the wettest month with a mean rainfall of 108.5mm over 8.2 rain days. Annually the area experiences, on average, 869.6mm of rain.

The NSW Office of Environment and Heritage operates an air quality monitoring station at Rose Street, Liverpool which is approximately 5km to the west of the Site. A Tapered Element Oscillating Microbalance (**TEOM**) is used at the Liverpool site to continuously measure particulate matter (PM_{10}) concentrations.

Hourly TEOM data is available for 2005, 2006 and 2007. Monitoring from the Liverpool site shows that, in 2005, the annual average PM_{10} concentration was 21 µg/m^3 which is below the annual average PM_{10} criteria of 30 µg/m^3. Maximum 24-hour average PM_{10} concentrations have been above the 50 µg/m^3 criteria on two occasions; 51 µg/m^3 on the 3 May 2005 and 56 µg/m^3 on the 9 June 2005.

There are no measurements of TSP in the study so it has been assumed that 40% of the TSP is PM_{10}. This relationship was derived from monitoring data from areas in the Hunter Valley where co-located TSP and PM_{10} monitors have been operated for reasonably long periods of time. On this basis, a value of 53 $\mu g/m^3$ for annual average TSP has been derived from the annual average PM_{10} (21 $\mu g/m^3$).

Dust deposition data are not available for the Site, however, there is an approximate relationship between annual average TSP concentrations and annual average dust deposition. The relationship suggests that areas experiencing 90 $\mu g/m^3$ annual average TSP also experience annual average dust deposition of approximately 4 g/m^2/month. The annual average TSP concentration of 53 $\mu g/m^3$ would, therefore, relate to an annual average dust deposition of 2.4 g/m^2/month.

Operational Impacts

Dust concentrations and deposition levels are presented as isopleth diagrams in **Figure 6-3** and **Figure 6-4** of the Environmental Assessment showing the following:

- Predicted maximum 24-hour average PM10 concentration;
- Predicted annual average PM10 concentration;
- Predicted annual average TSP concentration; and
- Predicted annual average dust deposition.

In examining the maximum 24-hour average contour plot it should be noted that this does not represent the dispersion pattern for any particular day, but shows the highest predicted 24-hour average concentrations which occurred at each location for the worst day in the year. The maxima are used to show concentrations which can possibly be reached under the modelled conditions. It should also be noted that the contour plots show predicted concentrations due only to modelled dust sources.

For annual average PM_{10}, TSP and dust deposition, the model results demonstrate that cumulative impacts of the project would be below relevant air quality criteria at the selected receptor locations.

The predicted 24-hour average PM_{10} concentration from the modelled sources is low (13.7 $\mu g/m^3$ at R3). Dust emissions from the project are unlikely to cause exceedances of the 50 $\mu g/m^3$ criteria, however, the potential 24-hour average PM_{10} impacts have been investigated further by examining the time series of predicted concentrations at each receptor.

Assessment of cumulative 24-hour average PM_{10} air quality impacts is often complicated as there may be many occasions when background concentrations are already above the 24-hour average air quality criteria. For a more refined analysis, the then DECCW recommends that there should be no additional exceedances of the 50 $\mu g/m^3$ criteria. Contemporaneous hourly PM_{10} monitoring data are required for this assessment and these data are available for Liverpool, to the west of the Site. These data were collected by the then DECCW in 2005.

The assessment shows that it is only when the background levels approach 50 $\mu g/m^3$ that there is the potential for the project to cause an exceedance of 50 $\mu g/m^3$ at the selected receptor locations. The probability of maximum impacts coinciding with maximum background levels would be low and on this basis it would be acceptable to say that the project would not be the cause of exceedances of the 50 $\mu g/m^3$ criteria at nearest sensitive receptors.

Construction Impacts

Dust emissions from construction works have the potential to cause nuisance impacts if not properly managed.

Air quality impacts during construction would largely result from dust generated during earthworks and other engineering activities associated with the plant construction. The total amount of dust generated would depend on the silt and moisture content of the soil, the types of operations being carried out, exposed area, frequency of water spraying and speed of machinery. The detailed approach to construction would depend on decisions which would

be made by the successful contractor and changes to the construction methods and sequences are expected to take place during the construction phase.

As construction is likely to continue for approximately six months, it is important that exposed areas be stabilised as quickly as possible and that appropriate dust suppression methods be used to keep dust impacts to a minimum. It is desirable that monitoring be carried out during the construction phase of the project to assess compliance with DECCW criteria. Monitoring would include dust deposition gauges, at the closest residences or other sensitive receptors, to assess compliance.

Proper dust management would require the use of water carts, the defining of trafficked areas, the imposition of site vehicle speed limits and constraints on work under extreme unfavourable weather conditions, such as dry wind conditions.

Noise

Existing ambient noise levels were monitored at three residences between Tuesday 20 February and Monday 5 March 2007. Although some time has lapsed, these data are still considered relevant. The monitoring locations are as follows:

- Residence 1 37 Malinya Crescent, Moorebank;
- Residence 2 26 Elouera Crescent, Moorebank; and
- Residence 3 41 Martin Crescent, Milperra.

The logger determines L_{A1}, L_{A10}, L_{A90} and L_{Aeq} levels of the ambient noise. L_{A1}, L_{A10} and L_{A90} are the levels exceeded for 1%, 10% and 90% of the sample time respectively. L_{Aeq} represents the average noise energy during a measurement period. Times when there was rainfall or wind speeds above 5m/s were excluded in accordance with the INP.

Background noise levels may be expressed in terms of the Rating Background Level (**RBL**), a standard measure of background noise which is used in the INP. The table below shows calculated RBL levels over all time periods relevant for this assessment.

Noise levels were dominated by distant and local traffic, and typical suburban noise. There was little existing industrial noise during site visits to install and collect the noise loggers.

Table: Measured RBL and $L_{Aeq, period}$ Values

Location	RBL (dBA)			$L_{Aeq, period}$ (dBA)		
	Day	Evening	Night	Day	Evening	Night
1	44	43	41	54	56	48
2	43	41	37	59	56	49
3	43	39	36	56	59	47

At the proposed new residential receivers in the Boral and Benedict sites, future background noise levels will be affected by future traffic noise on Brickmakers Drive. Predicted traffic volumes on this road were provided by Lyle Marshall & Associates. The minimum hourly daytime traffic volume is predicted to be 950 vehicles per hour, with 15% heavy vehicles and a speed of 60 km/h.

An empirical formula has been used to estimate future daytime background noise levels due to this traffic, in the absence of intervening shielding, and results are shown in the Table below.

Table: Estimated Minimum L_{A90} Levels due to Traffic on Brickmakers Drive

Distance from Road	Estimated Minimum Daytime L_{A90}
20	55
40	52
60	51
80	50
100	49
150	48
200	47
300	45

Values in the above table can be used to estimate future RBL values at residences which are not shielded from Brickmakers Drive. Estimated daytime RBL's for each of the prediction locations are shown in the Table below.

Table: Estimated Future Daytime RBL Values

Location	RBL (dBA) Day
1 - Malinya	44
2 - Elouera	43
3 - Martin	43
4N - Boral	51
4SM - Boral	51
4S - Boral	51
5 - Benedict Sands	48

Operational Noise Impact

The predicted noise levels meet the relevant criteria at all receivers with the exception of proposed new residences within the Benedict Sand site, which are located near to the haul route and the link road to Brickmakers Drive.

Although a marginal 3dBA non compliance is indicated, it is expected that traffic noise from Brickmakers Drive would result in similar L_{Aeq} noise levels of 55dBA. The impact of intermittent truck passbys during the daytime is not considered significant.

Nevertheless, it is proposed to consider construction of a short length of barrier on the eastern side of the haul road in the vicinity of the Benedict Sand site on the basis of a detailed review of noise levels, once the Benedict Sand site is occupied. At that time, background noise levels could be measured, as well as noise levels from intermittent truck movements, to undertake a detailed barrier design.

For the present assessment (based on the assumed background noise levels and predicted truck noise levels) a 130 metre length of barrier (extending south from the intersection with the link road) 2 metres high would achieve the 53dBA criterion at this future residential development. The 2 metre height is sufficient to control engine noise to meet the criterion. It may be preferable to consider a higher barrier to also shield the truck exhaust.

Of course any barrier would not need to be constructed until the residential site is occupied.

Traffic Noise Impact

Brickmakers Drive

Brickmakers Drive has been construction. The northern section includes a 2.5 metre blockwork noise barrier on the western edge adjacent to the existing single storey residences located on Araluan Avenue and Elouera Crescent in this area. There is a short 3 metre section of barrier nearer to the intersection where two, 2 storey residences are located.

The shielded residences are set back typically 20-35 metres from the centre of Brickmakers Drive.

There are some residences on Elouera Crescent set back approximately 95 metres which currently have line of sight across Paine Park to the road alignment with a small angle of view.

Traffic volumes on Brickmakers Drive are currently approximately 6,500 vehicles per day and 1,000 at night time and 5-6% heavy vehicles. These are expected to increase in the future as a result of further residential development.

The residences to the north of Araluen Avenue would be affected by traffic noise from Newbridge Road as well as Brickmakers Drive. The increase in traffic noise levels as a result of the additional trucks would be higher at those residences south of Araluen Avenue.

Existing daytime noise levels were predicted using the Calculation of Road Traffic Noise (CORTN) predictive procedure to be 54-57dBA $L_{Aeq,1hr}$ depending on the residence. The proposed extra trucks would result in a 1dBA increase. The predicted future noise levels comply with the daytime base criterion as well as the allowance criterion. Negligible impact is therefore expected.

Newbridge Road

Residences front Newbridge Road to the west of the intersection with Brickmakers Drive. Many of these receivers are set back 10 metres from the edge of the closest lane. The existing peak hours along Newbridge Road are 7:00 am - 9:00 am and 4:00a - 6:00 pm based upon 2002 RTA published traffic volume counts. The two way hourly volumes are typically 5,200 - 5,700 vehicles.

Given the existing large traffic volumes on Newbridge Road, existing noise levels are likely to exceed the ECRTN base criterion. The increased noise level due to traffic from the proposed recycling facility based on the 45% / 55% split at the intersection has been calculated to be less than 0.2dB, which meets the allowance criterion. Negligible impact is therefore expected.

Construction Noise Impact

Construction of the earth mound around the boundary of the Site would generate the highest noise levels during the construction period. It is expected that the material will come from within the Site, so there is no need to import large quantities of fill during this stage. Noise generation will therefore occur from within the Site itself.

Predicted noise levels during earth mound construction at distances between approximately 600 metres to 1km, allowing no shielding, would be up to 40-45dBA at the existing residences depending on the section of earth mound which is being constructed. These noise levels are well within the relevant construction noise criteria of 53-54dBA.

Further review of potential construction noise impacts at any new residences on the Boral site can be considered once they are occupied. Even the closest future residences are over 400 metres from the Site and at this distance construction noise levels are predicted to be approximately 50dBA, which is within the relevant criteria.

Visual Impacts

A roughly rectangular part of the Site has been filled in the past and is of an open and predominantly grassy visual character. The northern, western and southern margins of the filled area approximately follow the Site boundaries.

An irregularly shaped edge exists between the filled portion of the Site and the eastern boundary beyond which is the Georges River. The north eastern portion of the Site is naturally vegetated.

Between the eastern boundary and the Georges River is also a naturally vegetated area.

The Site is effectively invisible from the Georges River and the reserve land between it and the Site as a result of the screening effect of riparian vegetation.

The land along the eastern boundary of the Site is covered with indigenous riparian vegetation consisting of mangrove forest, swamp forest with Allocasuarina and paperbark along the river bank and open woodland further away from the river bank. The vegetation along the Georges River provides a dense screen such that the Site and its future use are not visible from the waterway.

At the northern end of the Site, the vegetation is thickest and covers a large area between the waterway and the part of the Site where Materials Recycling Facility is proposed.

To the south of the Site, is the New Brighton Golf Course which also adjoins the former Boral Brickworks Site, now the newly developing Georges Fair residential development. The vegetation along the southern boundary of the Site, adjacent to the north eastern end of New Brighton Golf Club, is relatively open consisting mainly of mature trees on the boundary between the two.

Views from the golf course into the Site are restricted to a greater extent by an embankment between 1.5 metres and 2.5 metres high inside the boundary on the Site, however, there are some limited viewing opportunities into the interior of the southern part of the Site, where natural and cultural vegetation on both the golf course and the Site forms a more open screen. This area has been identified as environmentally significant land and is a potential wildlife corridor linking the riparian vegetation on the river and the native woodland and forest reserves to the east of the Site. Future growth of vegetation in the corridor would lead to greater and potentially total screening of the view into the Site.

To the west of the Site, is an extensive area of naturally vegetated land, which appears to be re-growth intermixed with areas of more mature vegetation. It is criss-crossed by a series of tracks in a rectilinear pattern. The predominant character is of natural flood plain and lower slopes forest and woodland. The tracks do not detract from this quality. On the boundaries in particular, it is clear that this vegetation is re-establishing a more mature vegetation structure with open to dense areas of sapling and small tree regrowth of the dominant species. It appears likely that clearing and burning in the past have reduced both the density and height of the predominant vegetation form, however, there is also variation in the typical height of the predominant communities, with the flood plain type being of generally lower canopy height with some emergent taller trees and the lower slopes forest being generally taller, but more even in height.

The former Boral site has undergone transformation from a brick pit and industrial landscape to the partly constructed stage of residential development. The land slopes generally downward from west to east, with a cross fall from the north western corner. The highest part of the land is adjacent to Nuwarra Road. The land generally has an aspect to the east. The proposed amendments to the final landform indicate an RL of approximately 26 metres at Nuwarra Road, falling in a south easterly direction to approximately RL 6 metres inside the embankment of the Brickmakers Drive.

The land surface on which the proposed development would exist is not visible from any existing residential location outside the Site because of the topographic relationships which exist between them and the Site, the screening effects of vegetation both on the margins of the Site and in reserve land between the sites and the effect of the link road embankment at the eastern edge of the developing Georges Fair residential development.

Visibility from existing residential areas

There is no visibility of the interior of the Site from the residential area to the west of Georges Fair, from Newbridge Road and from any reserves. Distant views in the direction of the Site are available but views into the Site are not available.

The Site is below the visual horizon of trees which are part of the extensive buffer area of reserve land on and between the Boral (George Fair) site and the Site. The proposed development on the Site would not be visible from these areas.

Visibility from Georges Fair

There are no views into the Site from the newly developing residential area on the former Boral site or the curved section of Brickmakers Drive which passes close to the existing access handle to the Site. The view from this section of Brickmakers Drive is confined by dense vegetation along the western and northern boundaries of the Site.

The proposed development on the Site would not be visible from these areas.

By comparison, in the main orientation of views eastward from parts of Georges Fair, for example from areas to the north of Hoy Street, the Benedict Sand and Gravel Quarry and recycling site is prominent in the views because of the presence of the upper parts of some of the stockpiles and machinery which can be seen above and beyond the dense vegetation.

The height of vegetation between the former Boral site (developing Georges Fair) and the Site which can screen visibility of the development proposed was surveyed in November 2003 and showed that, relative to the adjacent vegetation, the recycling crusher sheds and stockpiles with a maximum height of 10 metres would be considerably below the screening vegetation canopy height.

Surveyed sections of 2003 (appended to the Lamb Report - **Appendix 12**) show the effect of the vegetation and height controls on two locations on the former Boral site which are still representative of the 'worst case' effect on views when development is completed.

The subsequently constructed predominantly single and two storeys development in Georges Fair has further blocked any significant viewing opportunity in the direction of the Site and this effect will further increase as the construction of residences continues in this new locality.

Georges Fair also has some public domain areas on roads at approximately RL 22 metres. View lines from these would be similarly affected by the presence of intervening vegetation between the viewer and the Site and also by the residences already constructed and to be constructed in the future in the foreground of the views.

It is reasonable to conclude in assessing visibility from existing external residential locations that none of the structures on the Site, the stockpiles of materials proposed, or the activity associated with use of the Site would be likely to be visible.

Visibility from Benedict Sand and Gravel quarry and recycling site

There is visibility predominantly of the foliage of the vegetation on the margins of the Site from most parts of the Benedict Sand and Gravel Quarry and recycling site.

The Benedict site has been rezoned for potential residential development on part of that site under Liverpool LEP 2008 and is subject to Liverpool Development Control Plan 2008, Part 2.10, Development in Moorebank East. Figure 2, Street Network, of this part of the Development Control Plan shows that the residential development on the Benedict Site would be located in the northwest sector and would be separated from the Site by a large area of private recreation space.

The Benedict site would be likely to be filled and levelled and could provide some views toward the Site once the potential residential development is constructed in future.

Views from potential residential streets and residences located in the majority of the Benedict site would be blocked by intervening residential development in the foreground within this Site itself.

There would not be any significant visibility of parts of the proposed development including any structures or stock piles from the access road to the Benedict site because of the blocking effect of future development on this site and existing and likely future vegetation.

Further buffer planting appropriate to enhancing the existing screening effect along the northern boundary of the Site would assist in reducing any unreasonable visibility from this future residential area.

Visibility from Georges River

Thick riparian vegetation on the riverbank screens the Site from the waterway. Views from the waterway are at an upward viewing angle, which lessens the possible visibility of any structures which might be glimpsed through the vegetation.

There may be glimpses toward the most northerly part of the Site from part of the river to its north, across the existing dredge pond in the south eastern area of the Benedict Sand and Gravel quarry and recycling site. The Development Control Plan for this site shows the pond to be intended for future private recreation and it is likely that this use would be associated with further vegetation which would increase the existing screening effect.

Visibility from public reserves, parks and golf courses

There are limited and heavily screened views into the south of the Site from the New Brighton Golf Course and no significant views from along the river's edge within Riverlands Golf Course and adjacent land to the north, on the east side of Georges River.

Davy Robinson Reserve is located north-northeast of the Site. There are no views into the Site from the reserve. The proposed development would not be visible from here.

Informal access is possible from Davy Robinson Reserve to significantly degraded reserve land further to the south adjacent to the Benedict Sand and Gravel quarry and recycling site. There would be no view of the proposed development from this reserve.

Vale of Ah Reserve on the eastern bank of the Georges River has no views into the Site due to the screening effects of riparian vegetation. The proposed development would not be visible from here.

There is informal access to the river across the adjacent private land by tracks from the Vale of Ah Reserve. Despite providing the closest view in terms of distance across the river, there is no visibility of the Site or future development because of riparian vegetation in this view line.

There is no formal public access to the river from the Riverlands Golf Club. There is substantial riparian vegetation which screens the Site from any part of the golf course.

Malinya Park has limited views across the Georges Fair site towards the Site. Any future views towards the Site would be dominated by housing in the foreground. There would be no views of the proposed development.

Paine Park located on Elouera Crescent is screened from views towards the Site by an earth mound on the Georges Fair site and mature trees in the park and on the Georges Fair site. Future residential development would screen or eliminate views in the direction of the Site.

Traffic Impact

The bidirectional weekday average hourly volumes of light and heavy vehicles in Nuwarra Road, Governor Macquarie Drive and Brickmakers Drive are contained in Tables A, B and C respectively in Appendix D of the Marshall Report (**Appendix 4**).

Analysis of the data indicates an annual average compound reduction of 0.1% in Newbridge Road between 2002 and 2011. The 24/7 ADT Count in Nuwarra Road south of Junction Road in February 2011, indicates zero growth in Nuwarra Road between 2002 and 2011.

Intersection traffic volume counts were made from 7:00 am - 9:00 am, 12 noon to 2:00 pm and 4:00 pm to 6:00 pm at Nuwarra Road / Maddecks Avenue and Brickmakers Drive / Christiansen Boulevarde intersections on Monday 5 November 2012. The turning volumes at these intersections are shown in Figures 3A and 3B of the Marshall report for the am and pm peak hours respectively and are reproduced as **Figure 1** and **2** below.

The existing access to the Site is via a gravel road from Newbridge Road. The access crossing is on the southern side of Newbridge Road some 120 metres east of Governor Macquarie Drive. The access road is located in the access handle and is 10.064 metres wide. The pavement width varies but is approximately 5 metres wide. The access handle from Newbridge Road to the main body of the Site is approximately 876 metres in length.

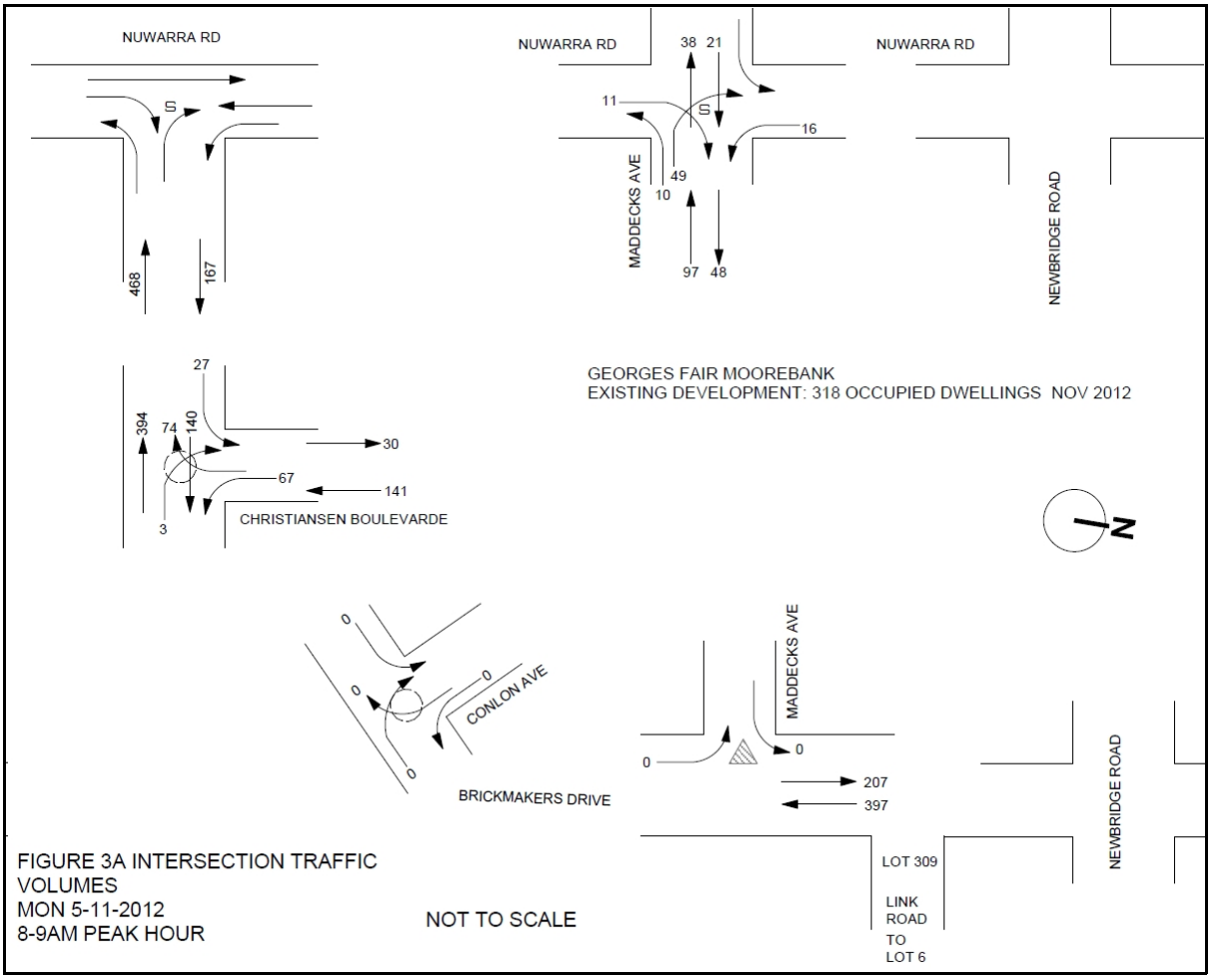

Figure 1: Intersection traffic volumes Monday 5 November 2012 in the 8:00 am to 9:00 am peak hours (refer to Figure 3A of the Marshall Report).

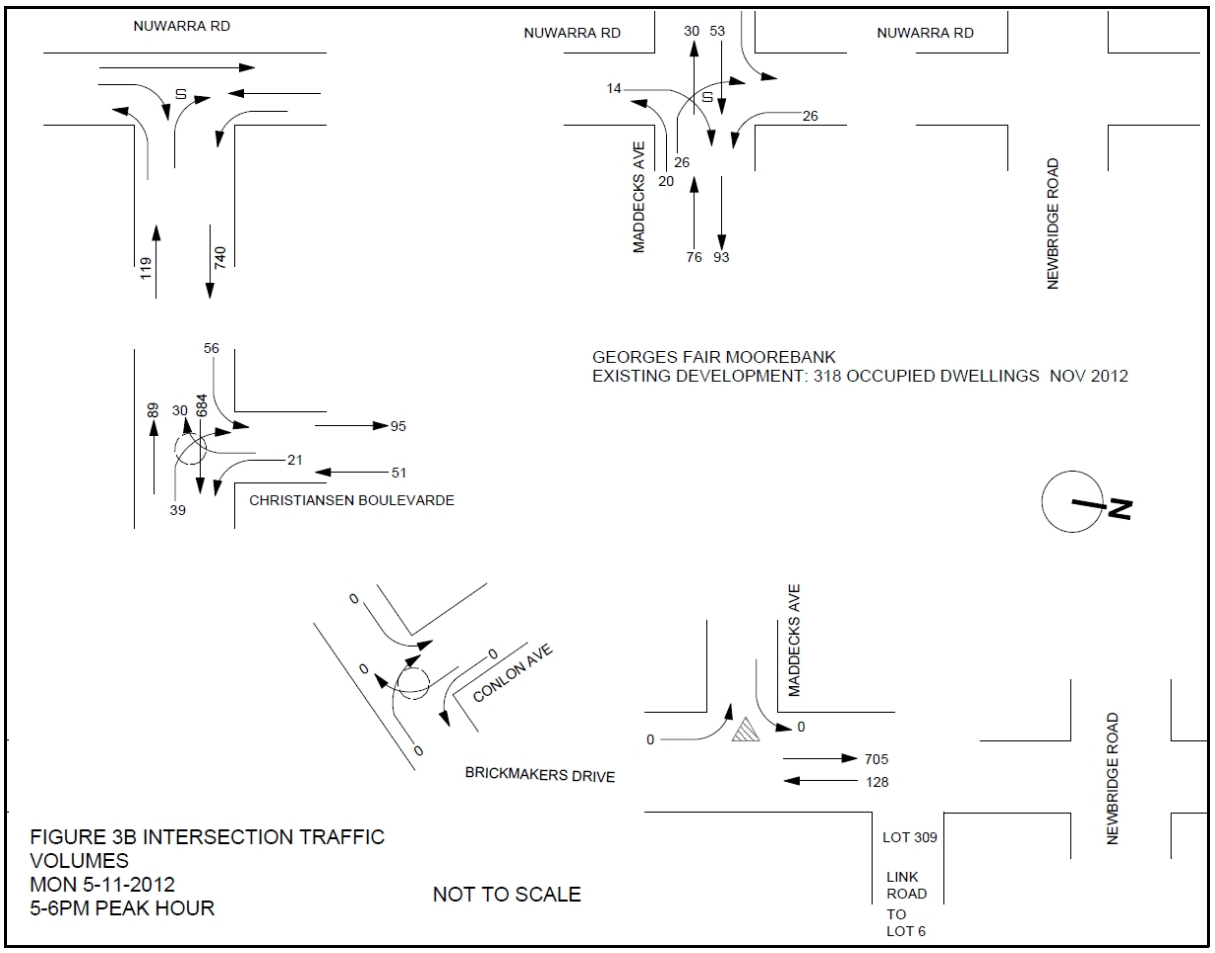

Figure 2: Intersection traffic volumes Monday 5 November 2012 in the 5:00 pm to 6:00 pm peak hours (refer to Figure 3B of the Marshall Report).

The 18 metre wide Lot 309 between Brickmakers Drive and the access handle to the Site is wide enough to permit two 15 metre long tri-axle semi trailers to pass each other on the 90 degree bends.

The 6 metre kerb return would prevent trucks from turning left into Brickmakers Drive to exit to Nuwarra Road. In addition, a "No Left Turn" sign would be erected to ban this movement. It is an offence to disregard a regulatory sign.

Increase in Heavy Vehicle Movements on Road Network

Brickmakers Drive

The increase in heavy vehicle movements due to trucks travelling to and from the Site would be from 7:00 am to 5:00 pm Monday to Saturday and be restricted to 300 metres of road south of Newbridge Road. In this section there are 8 existing dwellings and this will increase by 1 when Stage 5E of Georges Fair is developed.

The existing 2-way light and heavy vehicles from the count in October 2012 are shown together with the estimate of heavy vehicles generated by Moorebank Recyclers for each hour from 7:00 am to 5:00 pm in Table 6.2 of the Marshall Report, a copy of which is shown in the table below.

The general conclusions from the table are:

- The additional heavy vehicles generated by Concrete Recyclers do not reduce the Level of Service in any

hour.

- On weekdays, the addition of Concrete Recyclers trucks increases the number of heavy vehicle from about 1 in 2 minutes to 1 per minute.

- On weekdays, the percentage of total heavy vehicles to total vehicles ranges from a minimum of 6.2% from 4:00 pm - 5:00 pm to a maximum of 24.3% from 10:00 am - 11:00 am.

- The total number of heavy vehicles during each hour on Saturday is lower than weekdays. The percentage of heavy vehicles to total vehicles ranges from a minimum of 6.1% from 4:00 am - 5:00 pm to a maximum of 17.3% from 8:00 am - 9:00 am.

Table: Brickmakers Drive Bi-Directional Traffic Volumes (MR refers to traffic from Concrete Recyclers)

HOUR	Weekday Monday to Friday				SATURDAY			
	Existing		MR		Existing		MR	
	Light Vehs.	Heavy Vehs	Heavy Vehs	TOTAL Heavy Vehs	Light Vehs	Heavy Vehs	Heavy Vehs	TOTAL Heavy Vehs.
7 – 8.00am	1428	134.6	5.7	140.3	603	54	5.7	59.7
8 – 9.00am	1357.8	163.4	7.52	170.92	937	48	7.52	55.52
9 – 10.00am	1166.6	155.6	7.68	163.28	1169	67	7.68	74.68
10 – 11.00am	947	160.2	7.68	167.88	1304	51	7.68	58.68
11 – 12.00pm	993	179	7.68	186.68	1415	70	7.68	77.68
12 – 1.00pm	1020.6	174.4	6.72	181.12	1490	70	6.72	76.72
1 – 2.00pm	1058	164.4	6.72	171.12	1322	85	6.72	91.72
2 – 3.00pm	1323	163.4	6.72	170.12	1296	84	6.72	90.72
3 – 4.00pm	1701	146	4.18	150.18	1328	50	4.18	54.18
4 – 5.00pm	1858	102.8	4.18	106.98	1252	40	4.18	44.18

Nuwarra Road

The existing 2-way light and heavy vehicles from the count in February 2011 are shown together with estimate of heavy vehicles generated by Concrete Recyclers (MR) for each hour from 7:00 am to 5:00 pm Monday to Saturday in Table 6.2.2 of the Marshall Report, a copy of which is shown in the table below.

From the table it is concluded:

- The percentage of heavy vehicles per hour in 2011 between 7:00 am and 5:00 pm on weekdays ranged from a minimum of 5.2% between 4:00 am and 5:00 pm to a maximum of 15.3% between 11:00 am and 12:00 pm.

- The additional heavy vehicles generated by Concrete Recyclers and distributed to Nuwarra Road would increase the percentage of heavy vehicles to the total traffic on weekdays from 5.2% to 5.4% between 4:00 am and 5:00 pm and from 15.3% to 15.8% between 11:00 am and 12:00 pm.

  The increases are too small to change the Level of Service in Nuwarra Road.

- The percentage of heavy vehicles on Saturday in 2011 between 7:00 am and 5:00 pm ranged from a minimum of 3.1% between 4:00 and 5:00 pm to a maximum of 8.2% between 7:00 am and 8:00 am.

- The additional heavy vehicles generated by Concrete Recyclers and distributed to Nuwarra Road on Saturday would increase the percentage of heavy vehicles from 3.1% to 3.4% between 4:00 am and 5:00 pm and from 8.2% to 9.0% between 7:00 am and 8:00 am. There would be no change to the Level of Service in Nuwarra Road.

Table: Nuwarra Road North of Brickmakers Drive (MR refers to Concrete Recyclers)

HOUR	Weekday Monday to Friday				SATURDAY			
	Existing		MR		Existing		MR	
	Light Vehs.	Heavy Vehs	Heavy Vehs	TOTAL Heavy Vehs	Light Vehs	Heavy Vehs	Heavy Vehs	TOTAL Heavy Vehs.
7 – 8.00am	585.6	34.4	28.5	62.9	207	7	28.5	35.5
8 – 9.00am	571.4	32.6	37.6	70.2	252	15	37.6	52.6
9 – 10.00am	280.2	27.8	38.4	66.2	302	16	38.4	54.4
10 – 11.00am	195.2	24.2	38.4	62.6	378	14	38.4	52.4
11 – 12.00pm	203.6	27.4	38.5	65.9	419	15	38.5	53.4
12 – 1.00pm	245.2	27.2	33.6	60.8	393	8	33.6	41.6
1 – 2.00pm	276.8	27.8	33.6	61.4	372	4	33.6	37.6
2 – 3.00pm	433	38.8	33.6	72.4	411	7	33.6	40.6
3 – 4.00pm	700.4	35.6	20.9	56.5	362	3	20.9	23.9
4 – 5.00pm	735.2	28.0	20.9	48.9	399	5	20.9	25.9

Newbridge Road

In 2012, the eastbound AADT was 38055 and the westbound AADT was 25044. The AADT in both directions was 63099 vpd and 2.8 times the ADT of 22436 in Nuwarra Road.

Based upon the directional distribution of 55% of heavy vehicles generated by Concrete Recyclers to Newbridge Road east of Brickmakers Drive, the additional heavy vehicles between 7:00 am and 5:00 pm are estimated to be 89.1 in both directions. If the existing percentage of heavy vehicles during this period is 12% of total traffic, and total traffic is 59% of the AADT, then the existing number of heavy vehicle movements (both directions) is in the order of 4467. The Concrete Recyclers trucks amount to about a 4% increase in heavy vehicle movements.

Performance of Link Road / Brickmakers Drive Intersection

The intersection of the Link Road with Brickmakers Drive has been modelled as a tee intersection for 2021 am and pm peak hour traffic volumes under Give Way sign control and traffic signal control. The tee intersection kerb return design does not allow access to the residential area to the west and south to prevent trucks from passing these residential areas.

The Level of Service and Degree of Saturation shows that this intersection would provide satisfactory performance under traffic signal control.

Increase in Equivalent Standard Axle Loading (ESA's) on External Road Pavements

The estimated (ESA's) due to the passage of Concrete Recyclers trucks over a 20 year design period has been calculated in Brickmakers Drive between the Link Road and Newbridge Road (300 metres), Nuwarra Road, and three sections of Newbridge Road.

The pavement in Brickmakers Drive has been designed for 8.57×10^6 ESA's. The pavement in Nuwarra Road and

Newbridge Road would have been designed for very heavy traffic loading exceeding 10^7 ESA's.

Brickmakers Drive

The estimated traffic loading in Brickmakers Drive including Concrete Recyclers trucks over 20 years is 3.455 x 10^6 ESA's compared with the pavement design of 8.57 x 10^6 ESA's. The risk of poor structural performance is therefore low.

The life of a dense graded asphalt wearing surface is in the range of 8 to 20 years.

Nuwarra Road

The increase in ESA's due to the Concrete Recyclers trucks is 6.7% in the northbound direction and 6.5% in the southbound direction.

The impact of the additional heavy vehicles on the structural life of the road pavement and the asphalt wearing surface is low enough to be ignored.

Newbridge Road

There is insufficient data to estimate the current and future traffic loading on the most heavily trafficked lane of this busy 6 lane arterial main road. It is considered that the impacts of the additional heavy vehicles would be lower than Nuwarra Road because the vehicles have 3 lanes to travel on, compared with a single lane in Nuwarra Road.

Geotechnical Impact

The proposed development would be constructed on an old landfill. Notwithstanding the conclusions of the audit conducted as part of the State Environmental Planning Policy 55 assessment, there is potential for the proposed development to impact the integrity of the landfill and, in particular, the capping of that landfill.

As part of the approved bulk earthworks for the Site, the following issues would have been addressed:

- The control of groundwater/leachate from within the landfill during excavation at the southern end of Site;
- The stabilisation of the temporary cut batter slope at the southern end of Site;
- The potential for acid sulphate soil conditions within the fluvial soils;
- The control of groundwater/leachate prior to and following compaction at the northern end of Site; and
- The reconstruction of the western bund wall at the northern end of site and, if necessary, the northern bund wall.

As a result of these works, a Materials Recycling Facility could be constructed subject to the issues summarised below being adequately addressed as part of the detailed design process.

Integrity of the Landfill and Capping

On the basis of the assumptions noted above, the landfill capping would be adequate to support the proposed stockpiles, roadways and minor structures without loss of integrity. As long term monitoring of the Site will form part of the operating procedures, any loss of integrity could be quickly recognised and the operators' facilities would be available for remedial works. For example, stockpiling of materials may result in local settlements which adversely affect surface drainage. Correction of this would be part of the standard operating procedures.

Monitoring wells and surface drains would be sampled and tested routinely to identify any adverse environmental conditions which may develop.

As part of the detailed design works, an Operations Manual would be developed so that future operators of the Site are fully aware of the need to maintain the integrity of the landfill and capping. Provided that the earthworks are satisfactorily completed, stockpiles of crushed recycled building materials may be supported on the landfill cap, provided that the stability of the perimeter bund walls is not compromised by surcharge loading. Analysis of safe set-backs etc would form part of the detailed design. If it were desired to place stockpiles close to the bund walls, then it would be a relatively straightforward exercise to install some piles behind the crest of the slope to improve stability. It would probably be necessary to raise the height of the stockpiles gradually over time to allow the underlying fill to consolidate and gain strength.

The overall thickness of the capping layer would gradually increase with time as the landfill consolidates and design surface levels are maintained by adding to the cap. This would enhance the performance of the cap.

Management of Gas Migration in to the Proposed Buildings

Landfill gas is being generated from the buried waste at the Site. Landfill gas is typically managed by a combination of gas membranes and venting. All buildings on the Site would be constructed in a manner which would prevent the build-up of landfill gas. On-going monitoring of landfill gas within the final building structures may also be required.

The NSW EPA has prepared a document titled *Draft Guidelines for the Assessment and Management of Sites Impacted by Hazardous Ground Gases*. Reference would be made to this document (or the finalised document) during the design of buildings.

Foundations for Plant and Structures

Clearly, the compacted fill and capping would be subject to long term settlements, would have limited bearing capacity, and would not be suitable foundations for heavy plant and structures. Any heavy and/or vibrating plant and any structures such as office buildings would have to be supported on piled foundations. The investigations to date have revealed fluvial, mainly sandy soils below the landfill. The upper soil profile was generally very loose or loose but contained medium dense layers. At depths generally between 5.6 metres and 11.0 metres, medium dense sands were encountered with a thickness of several metres.

Driven piles produce the most economic solution in the soils present at the Site and have the benefit of not generating any spoil. As there are no adjacent structures which may be damaged by vibration, there is no reason not to use driven piles for this project. Pre-cast concrete piles are generally the most cost-effective option.

Some further assessment of groundwater conditions would be required to assess the potential aggressivity to buried steel and concrete.

The bearing capacity of driven piles will vary from point to point around the Site and will have to be designed on a case by case basis. Nevertheless, end bearing capacities of around 1,000kPa would generally be achievable with a "worse case" of about 500kPa if any zones of loose sand are encountered. Allowable skin friction in the sandy soils below the landfill would range from about 5kPa in loose sand to 15kPa in medium dense sand. The above values are adequate to achieve reasonable pile capacities and, in practice, may be improved upon as driven piles are "self-proving" by virtue of the driving characteristics which can be used to back calculate pile capacity by means of formulae such as Hiley.

There would also be a negative factor to consider in design, being the negative skin friction which arises due to consolidation of the fill. Again, due to the nature of the fill the negative skin friction would not be of sufficient magnitude to greatly reduce pile capacities.

Alternatives to pre-cast concrete piles include timber and steel tubes. Whilst timber piles may well be suitable for lighter structures, it is unlikely that steel tube piles would offer any economic advantages. Steel screw piles would be feasible if they could penetrate the fill, but as it would not be viable to remove obstructions we do not anticipate this type of pile to be practicable. Bored displacement piles such as Wagstaff Omega pile would be feasible but more expensive than driven piles and of lower bearing capacity. Some specialised (in-house) proprietary systems such as the Red Bull pile by Civil Foundations would be technically suitable, though it is doubtful whether they would offer any economic or performance advantages.

Water Table Monitoring

The number and location of wells to monitor the height of the water table and the composition of groundwater would depend on the final location of the facilities. As a minimum, it is expected that at least eight groundwater monitoring wells would be required.

Initially, samples would be obtained every three months for the first year of operation. At the end of the first year, the groundwater results would be reviewed and a decision made regarding the frequency of future monitoring.

In the event that published groundwater guidelines change in the future, these changes should be incorporated into threshold levels for the Site (if applicable). Any changes to the threshold levels should be documented.

Flora and Fauna

Flora

Cleared Area

Most of the Site is already cleared and covered with a significant depth of fill. Vegetation which has colonised the fill is mostly introduced grasses and weeds such as Kikuyu (*Pennisetum clandestinum*), Paspalum (*Paspalum dilatatum*), Couch (*Cynodon dactylon*) and Cudweed (*Conyza sp.*).

Wattle Scrub

The batter slope east of the cleared area is vegetated with Green Wattle (*Acacia decurrens*) to 6 metres with occasional Swamp Oak (*Casuarina glauca*) and a dense under storey of introduced shrub and groundcover species.

Ironbark Open Forest

To the west of the Site, on land owned by Boral, is an extensive stand of open forest dominated by Mugga (*Eucalyptus sideroxylon*), Broad-leaved Ironbark (*E.fibrosa*), Forest Red Gum (*E.tereticornis*) and Woolybutt (*E.longifolia*) with an under storey of Paperbarks (*Melaleuca decora & M.nodosa*). A small area of this forest protrudes onto the subject site about 250 metres north of the south-west boundary. In this location there are large Muggas and Forest Red Gum with a Paperbark under storey and grassy groundcover of Three-awn Spear Grass (*Aristida vagans*) and Weeping Meadow Grass (*Microlaena stipoides*). A Parramatta Red Gum (*E.parramattensis*) is also present.

Woolybutt - Blue Box Open Forest

This community occurs along the southern boundary and extends about 100 metres north along the western boundary. It is composed of Woolybutt, Blue Box (*Eucalyptus baueriana*) and Narrow-leaved Ironbark (*E.crebra*) to 25 metres tall with a small tree layer to 12 metres of Melaleuca decora. The groundcover is dominated by Blackberry (*Rubus ulmifolius*) and Balloon Vine (*Cardiospermum grandiflorum*) to 2 metres.

Cabbage Gum Open Forest

For a distance of about 50 metres east of the Wattle Scrub is an alluvial bench vegetated with open forest dominated by Cabbage Gum (*Eucalyptus amplifolia*) to 22 metres tall along with Grey Box (*E.moluccana*) and Forest Red Gum. There is a small tree layer of Green Wattle (*Acacia decurrens*), Cherry Ballart (*Exocarpus cupressiformis*), Melaleuca decora, M.styphelioides and Swamp Oak (*Casuarina glauca*).

There is a sparse, discontinuous shrub layer of Blackthorn (*Bursaria spinosa*) to 2 metres tall. The groundcover includes a variety of native grasses and herbs including Weeping Meadow Grass, Basket Grass (*Oplismenus imbecillis*), Entolasia marginata and Scurvy Weed (*Commelina cyanea*).

Weed infestation is moderate to high with African Love Grass (*Eragrostis curvula*), Florists Smilax (*Asparagus asparagoides*), Morning Glory (*Ipomoea indica*) and Balloon Vine (*Cardiospermum grandiflorum*) being common to

abundant.

This community also covers the levee bank immediately adjacent to the Georges River.

Swamp Oak Woodland — Between the Cabbage Gum Open Forest and the river is a swampy, saline depression which is vegetated with a stand of Swamp Oak to 18 metres tall above Sea Rush (*Juncus krausii*) and Native Reed (*Phragmites australis*). Other saltmarsh plants, such as Austral Seablite (*Suaeda australis*) and Sea Celery (*Apium prostratum*), are also present.

Conservation Significance of the Vegetation

The Woolybutt - Blue Box Open Forest and Ironbark Open Forest are examples of Castlereagh Ironbark Forest. Castlereagh Ironbark Forest is an endangered ecological community listed on the TSC Act as Cooks River-Castlereagh Ironbark Forest.

The Cabbage Gum Open Forest is an example of Alluvial Woodland. Alluvial Woodland is a component of the TSC Act-listed endangered ecological community Riverflat eucalypt Forest on Coastal Floodplains.

Swamp Oak Woodland is also part of the Alluvial Woodland, however, due to the dominance of Swamp Oak, it is part of the TSC Act-listed endangered ecological community Swamp Oak floodplain forest.

Threatened Flora Species

No threatened flora species were detected at the Site.

Fauna

Fauna Habitat

As most of the Site is cleared and heavily modified, it is only able to support a narrow range of fauna species. These are mostly birds which are either introduced or native species adapted to open habitats.

The woodland and open forest habitats which surround the Site have a number of features which favour habitation by a range of fauna species. These are:

- Hollows and cavities in some of the large trees, which could be used by insectivorous bats, arboreal marsupials, and a wide range of birds.
- Patches of dense under storey vegetation which provide protective cover for small birds.
- Large trees providing roosting area for birds of prey. During the field survey a Peregrine Falcon (*Falco peregrinus*) was detected in one of the Muggas in the Ironbark Forest and a White-bellied Sea-eagle (*Haliaeetus leucogaster*) in a Cabbage Gum in the River-flat Forest.
- Depressions in the Cabbage Gum Open Forest which may fill with rainwater and form small, ephemeral ponds suitable for habitat by some frog species. The Mosquito Fish (*Gambusia affinis*) was detected in local freshwater ponds, precluding the likelihood of the threatened Green and Golden Bell occurring.

Threatened Fauna

No threatened fauna species were detected during the field survey. The Green and Golden Bell Frog may be located in the area of the Site.

Water Quality, Flooding and Stormwater Drainage

Water Quality

The reach of the Georges River adjacent to the Site is a transition zone between the upper freshwater and lower estuarine (salty) water of the River. It is used for a number of water based activities including water skiing, boating and fishing. Public health and safety is an issue of high importance in this catchment along with environmental and aesthetic values.

The water quality in this section of the Georges River is affected by both the level of development in the surrounding catchment and the degree of tidal flushing. Three STPs occasionally discharge effluent to the River during wet weather, however, this has been reduced during recent upgrades under the Sydney Water SewerFix program.

The influence of tidal flushing has a positive effect on water quality and faecal coniform levels usually return to levels acceptable for swimming within three days after a heavy rain event.

The *Georges River Data Compilation and Estuary Processes Study* (prepared by SMEC for the Georges River Combined Councils Committee, February 2010) summarises and interprets water quality for the Georges River, including a reach of the river at Milperra, which is adjacent to the Site. The report draws on data collected by Bankstown Council between 1997 and 2009. The report also references water quality data collected between 1973 and 1992 by Chipping Norton Lake Authority. A summary of the study's findings are presented in the table below.

Table: Water Quality Data for Georges River at Milperra

	DO (%)	pH	Turbibity (NTU)	Faecal Coliform (cfu/100mL)
ANZECC default guidelines (lower limit)	80	6.50	6	150
Percentage of water quality results beneath the ANZECC default guideline lower limit	67%	8%	44%	43%
ANZECC default guideline (upper limit)	110	8.00	50	1000
Percentage of water quality results above ANZECC default guideline upper limit	8%	18%	20%	33%
Total % outside ANZECC Guideline Limits	**76%**	**26%**	**65%**	**33%**

The findings show that water quality in this section of the River does not comply with the ANZECC default criteria for freshwater ecosystems up to 75% of the time for dissolved oxygen, 26% for pH, 64% for turbidity and over 76% of the time for faecal coliforms. These results indicate the water quality is generally poor.

Flooding

A flood study prepared for Development Application No.1417/2005 examined flood levels in the vicinity of the Site and the effect of the proposed earthworks on flood levels. In a 100 year ARI flood there is a gradient from about 5.49m AHD at the northern boundary of the Site to 5.39m AHD at the southern boundary.

As demonstrated in the flood analysis that supported Development Application No.1417/2005, the approved earthworks would result in no net loss of flood storage and would have no effect on flood levels in the Georges River.

Site Drainage

The existing site contains a raised area with a gentle ridge from north to south through the centre of the Site. Runoff flows generally east or west off the raised area of the Site, entering depressions which run along the eastern and western sides of the raised area. The depression on the eastern side is formed by the raised area and a natural "levee" adjacent to the Georges River. The depressions convey flow to drains which run along the north and south boundaries of the Site. These drains convey flow to the Georges River.

Once the approved bulk earthworks are complete and the Site is developed, runoff from the operational area would be collected in sumps with overflow being directed to the existing depressions on the east and west sides of the operational area. The runoff from the developed site would, therefore, maintain the existing runoff direction and the locations of inflow to the Georges River. Runoff from non-operational areas would flow directly to the depressions and be conveyed to the Georges River.

Impact on the Georges River

Pollutants which could potentially originate from the Materials Recycling Facility include suspended solids in site runoff, and oil, fuel or chemicals used on the Site.

All runoff from the operational area of the Site is captured in sumps. The sump design would prevent the escape of oils and fuels from the Site. The sumps also give the Site operator the opportunity to respond to any spills by preventing such spills flowing immediately off site. As such, the principal pollutant of concern to the Georges River is suspended solids.

The background water quality in the Georges River is poor, with turbidity outside the ANZECC range 65% of the time. Ninety one percent (91%) of the suspended solid load within runoff from the operational area would be captured on the Site. As a result, it is not envisaged that the proposed development would have any adverse impact on water quality in the Georges River.

Erosion and Sediment Control

Temporary erosion and sediment controls would be implemented prior to the construction of the facilities which comprise the water management system. A combination of localised controls including silt fencing and temporary sediment basins, etc would be used.

Following project approval, a detailed Erosion and Sediment Control Plan would be prepared in accordance with the requirements of *Managing Urban Stormwater: Soils & Construction* (Landcom, 2004).

Waste Water

Wastewater would be held in a storage tank and periodically pumped out by a licensed contractor. The tank would be protected from flooding in a 100 year ARI flood event by having all inlets and outlets sealed and any openings located above the 100 year ARI flood level. These measures would minimise the potential for any wastewater pollution from the wastewater holding system.

The design and operation of the storage tank would be in accordance with Liverpool City Council's on-site sewage management requirements. Liverpool City Council would be given the opportunity to conduct inspections in line with its obligations under the Local Government Act.

Waste Impact

Little waste is generated in the operation of the proposed development. The proposed development has been designed such that the vast majority of materials delivered to the Site are recycled. Approximately 0.5% of the material delivered to the Site is material which cannot be recycled. Material is either:

- processed on Site for reuse,

- placed in a bin in the case of waste metal and wood, and transported off site for recycling, or
- in the case of general waste, stored in an appropriate waste bin for either recycling or transportation off site for disposal at landfill.

Social and Economic Impact

The social impact of the proposed development would be positive in that:

- material which would otherwise be disposed of to landfill can be recycled.
- material which is recycled through the proposed materials recycling facility would reduce the amount of virgin material from quarrying activity which would otherwise be required to fulfil the market for such materials.
- recycling of such material would increase the life of existing landfill sites.
- having a recycling facility closer to the both the unprocessed material and the users of the recycled product would:
  - (i) limit the amount of truck traffic on many metropolitan roads,
  - (ii) result in the use of less fuel in the delivery of materials to and from the Site, and
  - (iii) result in less congestion on certain roads.
- the creation of up to 45 new jobs in the local area.

The economic impact would be positive in that:

- a number of employment opportunities would be generated during both the construction and operation of the proposed development.
- the proposed development is one where waste from the building and construction industry in the Sydney metropolitan area would be received as an incentive to recycle waste rather than dispose of that waste to landfill. The money saved by industry and the State government in waste disposal costs is such that there is an economic incentive to recycle waste.

CONCLUSION

Consultation with the Director-General of the then Department of Planning has resulted in a number of Key Issues being identified for assessment as part of the preparation of this Environmental Assessment.

This Environmental Assessment has, in accordance with the requirements of the then Director-General, considered the likely impacts to the environment which might potentially result from the use of the Site as a materials recycling facility.

It is concluded that the proposed development is an acceptable land use for the Site.