EIS 1312 Vol 2

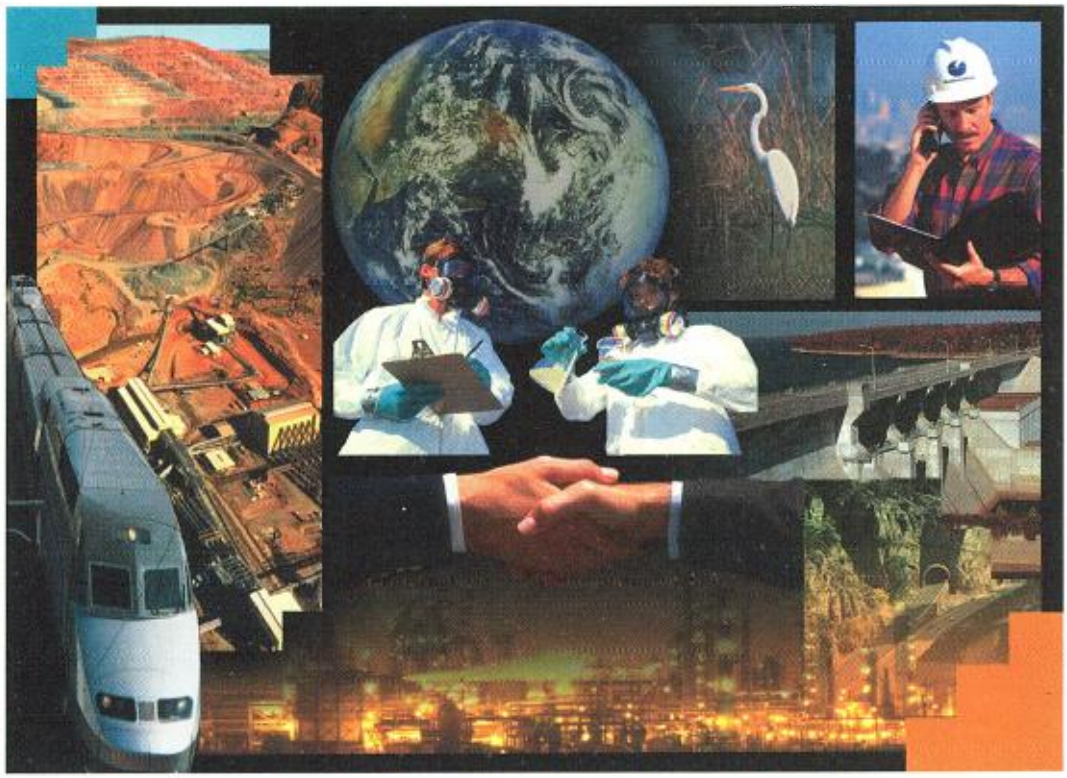
AB020066

Austral Brick solid waste landfill EIS, Horsley Park

REPORT

AUSTRAL BRICK SOLID WASTE LANDFILL EIS, HORSLEY PARK

Volume II - Appendices



Prepared for
Austral Bricks Company

20 November 1997

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Appendix A
Study Team Members

A1.1 STUDY TEAM

This Environmental Impact Statement was prepared for Austral Brick Company Pty Ltd by the study team listed below:

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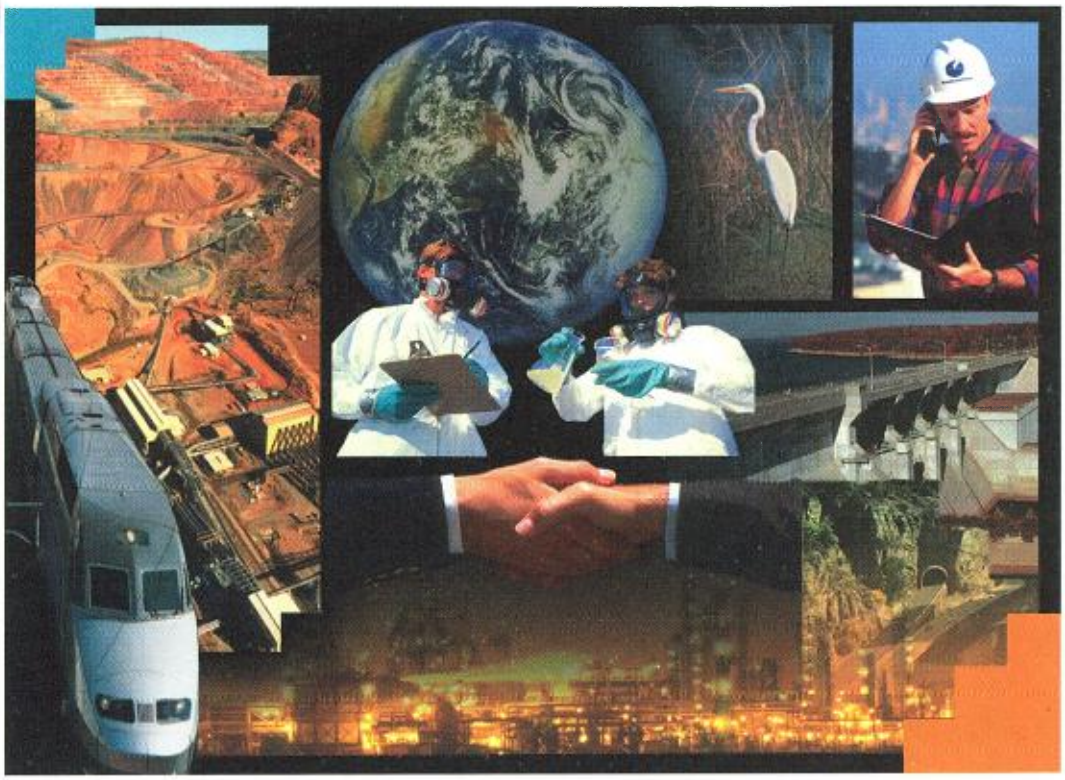
Appendix B

Draft Landfill Environmental Management Plan

DRAFT LANDFILL ENVIRONMENTAL MANAGEMENT PLAN, HORSLEY PARK



Prepared for
Austral Brick Co Pty Ltd

19 November 1997

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1.1 INTRODUCTION

This Draft Landfill Environmental Management Plan (LEMP) identifies the operating and management procedures that will be employed at the Austral Landfill. The Draft LEMP has been prepared to provide easily assessable information concerning the procedures to be established to control environmental emissions and to ensure efficient site operation.

The objective of the Draft LEMP is to document procedures aimed at:

- the control of discharges to waters (surface and groundwater);
- the control of atmospheric emissions;
- the provision of the greatest options for land-use following rehabilitation;
- the promotion of responsible land management and conservation; and
- the prevention of hazards and loss of amenity.

The Draft LEMP addresses the regulations under the following legislation and associated regulations:

- Waste Minimisation and Management Act, 1995;
- Waste Minimisation and Management Regulations, 1996 (formerly the Waste Disposal Act, 1970);
- Waste Processing and Recovery Act;
- Clean Air Act, 1961; and
- Clean Waters Act, 1970.

Additionally, the Draft LEMP identifies compliance with the likely conditions of Consent to be issued by Fairfield City Council.

The Draft LEMP addresses the daily routine tipping of waste. The long-term implications associated with a landfill are critical in assessing the most appropriate operating processes of a landfill. The Draft LEMP provides information on the systematic development of the site to ensure that both sociological and environmental impacts of the landfill are eliminated or controlled.

This document identifies the requirements for reporting to the regulatory bodies on matters associated with the ongoing landfilling operations and future plans for the landfill development.

The Draft LEMP addresses concerns including leachate monitoring and management, surface water runoff management, all of which are necessary in order to maintain the ongoing operational efficiency of the landfill

Specific management issues relevant to the site which have been addressed in this document include:

- potential saline discharges to water and soil;
- windblown litter and dust;
- gas generation and fire hazards;
- odours;

- disease vectors (flies, birds, pathogens);
- feral animals;
- noise control;
- post filling management and planning;
- environmental monitoring activities; and
- landfill operations reporting.

1.2 SITE OVERVIEW

1.2.1 Location

The Austral Bricks premises is located on the eastern side of Wallgrove Road, some 2.7 km south of the F4 Western Freeway. The land which is the subject of the proposal extends from Eastern Creek, west to Wallgrove Road (see Figure 1).

1.2.2 Legal Description

The project site is some 25ha in area and is registered as lot 3 in Deposited Plan 235478.

1.2.3 Operating Hours

The intended operating hours at the Landfill are as follows:

- Monday to Friday 6.00 am to 5:00 pm
- Saturday 6.00 am to 4:00 pm
- Sunday and Public Holidays 8.00 am to 4:00 pm

The depot will be open every day except Good Friday and Christmas Day.

Covering and compaction of wastes will take place within the normal opening hours and continue for 1 to 1.5 hours after the advertised closing time each day.

1.2.4 Site Access

The Austral Bricks premises is shown in Figure 2.

The site will be accessed from Wallgrove Road via a dedicated access road as shown on Figure 3. At the access point Wallgrove Road will be signposted and widened to include turning lanes.

The main access road from the Wallgrove Road entrance to the Transfer Station via the weighbridge and office as well as a carpark and external access road around the perimeter of the site will be sealed.

The vehicular access road to the disposal area within the landfill will be at a standard required for the selected haul trucks from the Transfer Station and the anticipated customer truck types. The road will be continually reconstructed, as filling operations progressively move within the landfill, to accommodate the needs of the customer trucks. The road will be unsealed.

1.2.5 Main Features

An office/weighbridge building will be located on the depot access road for the purpose of controlling vehicle movements to and from the site. There will be two weighbridges adjacent to this building, one to weigh incoming traffic and one for out going traffic. It is intended that the weighbridge will be the load cell type with computerised digital readout for efficient processing. Vehicles entering and leaving the site will pass over the weighbridge to determine their loaded and tare weight.

A full-time weighbridge supervisor will be employed and will be present during operating hours. The full-time operator at the weighbridge provides for an initial awareness of quantity and type of material being delivered to the waste management centre. The intended responsibilities for the operator related to waste screening are highlighted in Section 4.2.

A Waste Transfer Station will be located just inside the screening berm as shown on Figure 3. This facility will be constructed to minimise the number of vehicles travelling to the active face of the landfill. Cars, vans and smaller trucks without tipping capabilities will be directed to this facility. The Transfer Station will be accessed by an all weather road. The Transfer Station will be roofed and include a sloping concrete waste reception bay. All pavements will be sealed. The Transfer Station will accept waste from all vehicles requiring hand unloading including all cars, utilities, box trailers and most small commercial vehicles. Within the Transfer Station, wastes will be compacted in the waste pit by a small loader and pushed to a chute at the eastern end of the pit. This waste will then be loaded into a waste transfer vehicle to be hauled to the active face of the landfill.

Other buildings, for use by the employees of the waste management centre, will include a dining area, toilets and washrooms. All facilities will comply with the requirements of the Department of Industrial Relations and Employment and appropriate awards.

1.2.6 Recycling Areas

In order to maximise air space and promote land conservation, recyclable materials will be separated from incoming loads to the greatest extent feasible and practical.

In order to meet this recycling objective, a waste recycling depot will be established as a resident drop-off facility. Separate storage for quantities of materials such as glass, metal, plastics, waste oil and paper will be provided. Stockpiled materials will be removed for processing by contractors when the bins or vessels approach capacity. Access and use of the recycling facilities will be provided without cost to residents.

1.2.7 Green Waste and Timber Waste

The segregation of timber wastes and green wastes will be actively promoted at the Landfill. In this context timber waste refers to wooden crates, pallets and timber from construction and demolition activities. Green waste is comprised of trees, branches and miscellaneous garden wastes.

It is intended that timber waste be shredded on site, with the mulch to be screened and sold to the public, private contractors and government departments where possible (e.g. Roads and Traffic Authority). The mulch will also assist in retaining moisture and suppressing weed growth and will be used for erosion control on slopes on site. On this basis, the mulch will

also be available to assist in site revegetation, thereby reducing the amount of compost required by external purchase.

The green waste will be chipped and placed in separate "turned pile" stockpiles. The height of these green waste stockpiles will be maintained to a maximum of 3 metres to ensure all portions of the pile are oxygenated. Nitrogen (as urea) and water will be added to these stockpiles and it is intended that they be turned once each week. Following these procedures, pasteurisation temperatures of over 60° C will be achieved for between 3 and 5 days. These conditions are sufficient to limit pathogen number and density. The composted green waste can then be screened prior to use on-site or sale to commercial landscapers.

Excess screened compost which is not sold or used on-site will be mixed (50:50) with top soil and made available for sale to residents. Alternatively, it may be sold as a below grade soil mix for landscapers.

1.3 CLIMATE AND METEOROLOGY

Climatic conditions experienced at the site consist of warm to hot summers and cool to mild winters. A brief description of each climatic element is given below.

- Temperature

  Seasonal temperature variations range from mean daily maximum and minimum temperature of 28°C and 16 °C respectively in summer to a mean daily maximum and minimum temperature of 16°C and 6°C respectively in winter (July).

- Rainfall

  The annual average rainfall at Prospect Dam recorded over 110 years is 879 mm. The average rainfall varies seasonally. Rainfall is highest from January to March, with a mean monthly maximum of 99 mm in March. It is lowest from August to October, with a mean monthly minimum of 48 mm in September. The mean number of rain days is 111.5 days.

- Evaporation

  The mean daily pan evaporation is highest in summer, with a maximum of 6.2 mm in December, and a minimum of 1.8 mm in June.

- Wind

  The wind data obtained from Prospect Dam indicate that the strongest winds occur during late winter and early spring (August to October), however, these figures are based on twice daily recordings of wind speed (9 am and 3 pm) only.

  During winter, winds in the area occur most frequently from the southwest and the northwest quadrants. Light winds are common, with a significant proportion (31%) of calms (less than 0.5 m/s) recorded.

  Summer winds are predominantly from the east-southeast to southwest, and the proportion of calm days drops to 15%. There is also an observable occurrence of winds from the northeast quadrant as a result of the summer seabreeze effects, although these winds are not as frequent or as strong as they are closer to the coast.

During spring and autumn, winds are more widely distributed between the prevailing southwest to northwest winds of winter and the south to northeast winds of summer, due to the transition of the seasons.

1.4 PHYSICAL FEATURES

1.4.1 Topography

The subject site generally reflects topography of the Minchinbury/Horsley Park area which is characterised by rolling terrain with low to moderate relief. The property is dominated by a hill at the south-western edge of the study area, and Void 1 with an elevation of around 92 mAHD. From the hill top the ground surface generally slopes to the north-west and to the east, with typical ground slopes of between 4° and 8°.

An earth bund, running parallel to Wallgrove Road, separates the active quarry area from a landscaped buffer zone, approximately 60 m wide.

Void 1 is divided into two zones; the lower platform in the eastern portion from where material has been extracted for the brickworks, and the upper platform in the western portion which is being stripped in preparation for mining activities. The upper platform is at an elevation of approximately 70 mAHD. The western corner of the lower platform is at a lower elevation of some 55mAHD.

The north-western corner of the pit is currently inundated to an elevation of approximately 51 mAHD (as surveyed in late July, 1997). This water is predominantly stormwater which has accumulated at the lowest point within the quarry area.

Void 1 also contains a number of stockpiles.

1.4.2 Stability of Quarry Walls and Landfill

The quarry faces cut into the Bringelly Shale materials are expected to remain stable (both existing faces and those exposed during future quarry activities), at least for the duration of landfilling activities. The existing faces, particularly along the eastern boundary, have been exposed for some 37 years and no evidence of face collapse or other significant slope failure has been recorded by site personnel. Given the generally near horizontal dip of the bedding planes within the shale, and the absence of major unfavourably oriented geological structure (faults or shear zones), the risk of significant failure of the exposed faces is relatively low. However, the faces weather rapidly which increases the risk of minor slumps and spalling. Ongoing monitoring of the exposed quarry faces would be carried out as part of the LEMP to ensure their proper and safe management.

The stability of the landforms at a landfill site also refers to the stability of the backfilled material.

The stability of these slopes may pose a potential safety problem for site workers and will be monitored during the filling of the landfill. All plant operating in the landfill will be roofed for protection.

There may also be some lack of stability in the landfill surfaces due to the inherent slow and continuing decomposition of any putrescible material (very small quantities) and the subsequent compaction which accompanies the process. In order to control landform stability,

there is a need to ensure that suitable compaction is attained during the placement of the refuse. Higher compaction rates reduce problems associated with the final landform stability.

1.4.3 Geologic Setting

Regional Geology

The study area is situated near the central portion of the Sydney Basin, which is a broad geological province formed essentially by Permian and Triassic sedimentation. The general stratigraphic succession at this location comprises the Triassic Hawkesbury Sandstone, overlain by the Wianamatta Group, also of Triassic Age. The Wianamatta Group comprises, in ascending order, the Ashfield Shale, the Minchinbury Sandstone and the Bringelly Shale, with the latter forming the ground surface across the relatively flat terrain in the region. The elevation of the base of the Wianamatta Group in the region is given as around -80mAHD (Department of Minerals and Energy, 1991). The following table provides a breakdown of the general stratigraphy of the Wianamatta Group.

UNIT	THICKNESS (m)
Bringelly Shale	≈ 70 to 100
Minchinbury Sandstone	≈ 3
Ashfield Shale	≈ 50

The Bringelly Shale, the uppermost member of the Wianamatta Group, comprises, in decreasing abundance, claystone (often carbonaceous), siltstone, laminate, tuff and coal (Herbert, 1975). The Bringelly Shale is also considered to be more plastic than the Ashfield Shale, and it displays greater lithological variation than the underlying formations. Weathering of the Bringelly Shale produces grey and red silty suitable materials, with abundant siderite nodules.

Regional Geological Structure

The Penrith Geological Sheet (Department of Minerals and Energy, 1991) indicates that the study area is located approximately 2 km south-west of a regional synclinal structure referred to as the Penrith Basin (which has a trend of 150° at a point nearest the site). The study area is also close to a regional lineament (having a trend of 008°) which coincides with Eastern Creek, adjacent to its eastern boundary.

Site Geology

Based on investigation drilling and observation of the existing quarry faces of Void 1 carried out as part of this study, the site geology reflects the general nature of the Bringelly Shale, as described above. From the ground surface down, the stratigraphy at the site is described as:

- topsoil, comprising silty suitable material with high organic content, including vegetation, rootlets and other organic components. The topsoil is typically between 0.0m and 0.2m thick.

- residual soil, comprising dark grey to grey and mottled red-grey suitable material, which is derived from insitu weathering of the Bringelly Shale. Based on tactile assessment of tube samples and insitu tests (Standard Penetration Tests (SPT) the suitable material was typically assessed to have a firm to very stiff consistency (SPT results indicated N values between 16 and 41) and generally to be of low to medium plasticity; and
- the residual suitable material typically becomes harder with depth and progresses through extremely weathered to distinctly weathered and fresh shale. Various layers of claystone and siltstone/sandstone are exposed in the quarry walls of Void 1. However, the predominant lithology comprises a light grey claystone with occasional carbonaceous claystone layers.

At borehole locations MWAUS1 and MWAUS3 (shown in Figure 6.1 of the accompanying EIS), fill material was encountered to depths of 1.2m and 5.5m below the ground surface, respectively. The fill typically comprised suitable material and shale, with some sand, gravel, plastic and brick fragments. The fill was assessed to be moderately to well compacted, and is probably re-worked site soils.

During the site inspection carried out as part of this study, no evidence of major structural features were observed. Moderately to widely spaced sub-vertical joint planes were evident on remnant sandstone and siltstone faces, along the eastern boundary of the study area. The bedding planes within the shale formation visible in the quarry faces, indicated near horizontal structure, with a slight overall dip (in the order of 1° or less) towards the north-east.

1.4.4 Hydrogeology

Hydrogeological Summary

The hydrogeological assessment of the subject site shows that the quarry is located in the Bringelly Shale rockmass, that it is characterised by low hydraulic conductivity and semiconfined to confined conditions under the surface clays. These characteristics and the original nature of the sediments are responsible for poor recharge to the rockmass, for the persistence of high salinities around the site and for their uneven distribution.

The overall hydraulic gradient could not be determined with accuracy at the time of the study as the groundwater levels were still recovering from the drilling and purging and sampling carried out. However, it appears that a regional gradient from west to east towards Eastern Creek exists under the site, following the natural surface topography. Groundwater is located some metres below the creek level, indicating that, potentially, recharge could occur through the creek bed. Superimposed on the regional gradient, there is a depression in the water table coinciding with the quarry void. The water table depression results in an inward gradient towards Void 1, limiting the opportunity for migration of the pit water away from the site.

1.5 LANDFILL DESIGN STRATEGY

The proposed development is designed to meet all of the environmental goals identified in the *Environmental Guidelines: Solid Waste Landfills* (NSW EPA, 1996). These guidelines contain benchmark techniques which are intended to meet the requirements of individual environmental goals. The procedures to be employed to meet the environmental goals at the landfill either meet or exceed the requirements established in the benchmark techniques.

The landfill will be designed as a saturating, entombment landfill. Groundwater will be excluded from flowing into or out of the landfill. The waste will continue to 'wet up' via infiltration (which can be minimised but not totally avoided until the level of water within the fill reaches the level of groundwater surrounding the landfill). Pumping of leachate via the rising mains will maintain a water level within the fill lower than the surrounding groundwater thereby denying hydraulic head for water migration.

The landfill may be referred to as a containment landfill. Cover will be applied continuously to reduce infiltration and to minimise the moisture content of the waste. The low biodegradability of the waste to be received and the control of water, work in concert to reduce the volume and strength of any leachate generated.

The leachate control objectives set by the guidelines will be met through judicious site selection, strict environmental monitoring, intelligent on-site management, installation of an impermeable leachate barrier system and pumping of collected leachate to regulate the level within the waste. Operating at these high standards will permit the landfill to be classified as a Solid Waste Class 2 landfill.

1.6 WASTE ACCEPTANCE

1.6.1 Waste Classification

The Draft LEMP has been prepared during a transition period with respect to waste regulation. The types, or more specifically the nomenclature for waste types, may alter according to changes to waste regulations in NSW. The Site licence that is likely to be issued under the Waste Minimisation and Management Act, 1995 would permit the facility to take:

- Non-putrescible and demolition solid waste which is non-hazardous and non-toxic and excavated natural material;
- Cement matrix bonded asbestos waste (Class 3) including soil contaminated with Class 3 asbestos.

Additionally, bonded asbestos forms a subset of the non-putrescible material acceptable for disposal according to the conditions listed in the Chemical Control Order.

Following licensing as a Solid Waste Landfill Class 2, the landfill will be permitted to receive inert waste and all solid wastes with the exception of putrescible wastes. The landfill will be able to receive all wastes which meet the criteria that the EPA identifies as appropriate for Solid Waste Class 2 Landfills. The criteria for determining these waste thresholds are presented *Environmental Guidelines: Solid Waste Assessment* (NSW EPA, 1997).

In order to inform the public of the types of materials accepted for disposal at the landfill, Austral will erect signs in the road leading to the facility and at the weighbridge. Vehicles carrying hazardous or toxic wastes will be turned away at the weighbridge by the tipping supervisor at the Transfer Station or by the pit supervisor at the active face. All drums of liquid wastes will be banned from the waste management centre.

1.6.2 Waste Stream Composition

The landfill will be filled mainly with non-putrescible wastes derived from a catchment area covering western Sydney and extending from Liverpool in the south to Parramatta in the east,

Penrith in the west, Windsor and Richmond in the north and Baulkham Hills in the north-east (Mitchell McCotter, 1992). The sources of approved waste include:

- mixed wastes including small loads of non-recyclable and non-segregated paper wastes and front lift trucked materials;
- virgin excavated natural material;
- building and demolition wastes;
- miscellaneous commercial and industrial wastes;
- stabilised solid waste; and
- non-leaching contaminated soils.

The precise nature and composition of the waste stream will vary throughout the life of the landfill. It is expected that green wastes may be largely excluded as a result of composting and mulching and that recycling and resource recovery activities at the site, would preclude most ferrous and non-ferrous metals from the landfill activities.

1.6.3 Disposal Rates

At this stage, the expected waste disposal rate for the landfill is 300 000 tonnes per annum. Factors that will influence the filling rate of the Landfill include:

- community measures for recycling and reuse; and
- limited life of other existing landfills.

1.7 COMPLAINTS REGISTER

A complaints register will be maintained to log public complaints regarding odours, vermin, litter, dust and noise at the site. The date, time and nature of any complaint will be recorded and the subsequent actions taken to help minimise or eliminate the concerns will also be logged.

2.1 LEACHATE BARRIER SYSTEM

2.1.1 Objectives

The primary objective for a leachate barrier system is to contain leachate during the time that it poses significant environmental risk so that neither groundwater nor surface water are affected.

2.1.2 Management Strategy

It is an international best practice technique for landfills to be constructed with adequate liners to eliminate the percolation of leachate into groundwater. The NSW Environmental Protection Authority (EPA) *Environmental Guidelines: Solid Waste Landfills* (1996) identified the following liners as acceptable for Solid Waste Landfills:

- a liner at least 900 mm thick with an *in situ* coefficient of permeability of less than 1 x 10^{-9} m/s;
- a flexible membrane liner that is 1.5 mm thick and possesses a permeability coefficient of less than 10^{-14} m/s; or
- a natural geological barrier shown to be competent.

In line with best practice, the Austral Landfill will employ a liner with a permeability coefficient of less than 1 x 10^{-9}m/s over the landfill base. It will be demonstrated that the landfill walls are a competent geological barrier to leachate egress. The specific pattern of construction activities would be as follows:

- Water removal
- Preparation of the liner sub-grade
- Installation of the compacted liner system
- Leachate drainage and collection system
- Stormwater diversion drainage

The interaction between the landfill and the groundwater flow system at Horsley Park is considered to be minimal. With the provision of a low permeability compacted liner and drainage system as described in Section 2.2, and the low volume of leachate anticipated, the vertical migration of leachate into the groundwater will be effectively controlled.

Once the landfill begins to fill, the water table is expected to gradually recover to the regional groundwater level which is within the lower areas of the cells. As this will take a significant number of years to occur and as the regional groundwater gradient is quite flat, there should be no movement off-site of any leachate contained within the cells.

2.1.3 Task and Actions

Considering the existing arrangements aimed at controlling leachate escape from the site, there are no further tasks or actions necessary to meet environmental goals.

2.1.4 Performance Indicators/Responsible Party

Performance indicators to demonstrate that the leachate barrier is properly functioning will be included in the quarterly groundwater monitoring records. The Landfill Manager will be responsible for ensuring that groundwater monitoring is conducted and that these indicate groundwater at the site is not adversely affected.

2.1.5 Frequency/Monitoring

The frequency and timing for leachate barrier measures are:

ACTION	TIMING
Demonstration that the liner comprises a competent entity through QC testing	Once only for EPA approval.
Sampling and testing of groundwater	Quarterly

2.1.6 Review/Auditing and Reporting

A groundwater monitoring report will be prepared annually.

2.1.7 Corrective Actions

Section 2.9 identifies the actions to be undertaken if the monitoring results indicate that conditions have changed and leachate has a potential to cause environmental degradation of the groundwater or surface waters.

2.2 LEACHATE COLLECTION SYSTEM

2.2.1 Objectives

The primary environmental objective is to ensure that leachate in excess of field capacity of the waste is collected and managed in a responsible manner.

The benchmark techniques for leachate collection from the EPA's Solid Waste Guidelines (1996) include:

- installation of a drainage layer;
- use of appropriate drainage media for that layer;
- identification of a collection pipe strategy and design;
- recommendations for the opening of a window between daily or intermediate cover regions;
- leachate safe storage requirements;
- leachate testing requirements prior to disposal; and
- disposal recommendations.

2.2.2 Management Strategy

Stormwater infiltration is one of the major contributors to the generation and migration of leachate in landfills. The progressive development strategy of the landfill, diversion of external stormwaters (from outside the pit) and strict adherence to cover procedures will ensure that minimal stormwater infiltration into the waste occurs. Figures 4 and 5 show the management of leachate and dirty water (runoff from the landfill cover). During progression of the landfill there will always be a development area where excavation will be finished and the liner base will be prepared. Within this area as shown on Figures 4 and 5, temporary clean stormwater and dirty surfacewater ponds will be constructed to allow the collection and pumping to storage (on the surface) of the respective waters.

The rate of leachate generation by the landfilled waste is predicted to be very low due to the measures described above, the natural geology and the daily covering of the wastes, all of which prevent stormwater runoff infiltration.

When the dirty surfacewater and/or leachate is collected, it can be:

- evaporated from the leachate storage pond;
- used for dust control; and/or
- used for irrigation.

It may not be necessary to pump the leachate to the surface in order to accomplish these functions. Leachate will be diverted from the working area by the following procedures.

- The drainage media, collection pipe system and base grading will form preferential pathways directing any percolating liquids towards the leachate collection facilities. From the collection sump leachate can be pumped to the surface. Details of the collection sump and its relative location are shown on Figures 4 and 5.
- From the temporary collection pond on the lower level of the landfill the dirty water can be pumped to the surface. The relative location of the stormwater collection ponds are shown on Figures 4 and 5.
- Extracted leachate or dirty water can then be stored in the leachate pond (Figure 4 and 5) on the outer rim of the landfill. The pond has been nominally sized at a capacity of 100 m^3 and will be constructed of low permeability material to guard against percolation. The sizing of the pond will be finalised during detailed design using a leachate generation model.

It is stressed that unless there are compelling reasons for extracting and pumping the leachate to the surface, the preferred management option is to leave it in place. Due to the grading of the landfill base, leachate will gravitate to the leachate sump. Dirty water (flowing off the landfill surface), due to the grading of the working surfaces and landfill base will be directed to the dirty water collection pond where it will be pumped to a permanent stormwater sediment pond or may be reused as described above.

2.2.3 Task and Actions

The procedures to be put in place are sufficient to meet the environmental goals for controlling leachate discharge.

2.2.4 Performance Indicators/Responsible Party

Ongoing monitoring of the groundwater (Section 2.5) and leachate (Section 2.8) are considered to be sufficient performance indicators of the effectiveness of the proposed leachate barrier system.

2.2.5 Frequency/Monitoring

The frequency and timing for leachate collection system measures are:

ACTION	TIMING
Sampling and testing of groundwater	Quarterly
Sampling and testing of leachate	Quarterly

2.2.6 Review/Auditing and Reporting

The Landfill Manager will be responsible for the monitoring of leachate levels within the landfill, pumping rates and quantities of leachate and the surrounding groundwater levels which will be reported to the EPA in the annual report.

2.2.7 Corrective Actions

Section 2.9 identifies the actions to be undertaken if the monitoring results indicate that conditions have changed and leachate has a potential to cause environmental degradation of the groundwater or surface waters.

2.3 SURFACE WATER CONTROLS

2.3.1 Objectives

Modern landfill management includes siting, designing, constructing and operating such that no surface waters at or beyond the boundaries of the landfill become polluted by the landfill development. This is usually accomplished through interceptor diversion drains designed and put in place to prevent stormwater from mixing with waste or cleared areas of the landfill. Control of surface water will ensure that the generation of leachate occurs in a controlled and predictable way so that it poses little threat to the environment and to prevent the washout of waste or contaminated water from the landfill.

2.3.2 Management Strategy

Wherever practicable, clean runoff will be diverted around disturbed areas to minimise the volume of sediment laden water which has to be collected.

Provided that surface water does not come into contact with any of the waste materials and stockpiles and remains uncontaminated, it will be acceptable for discharge to the local watercourse, once sediment has been removed via sediment ponds located as shown on Figures 4 and 5.

The cut-off drains and sediment ponds will be designed to cope with a one in ten year "average recurrence interval" (ARI) storm, of a twenty four hour duration. A minimum grade of 1% will be used in sizing the drains and pipes.

Runoff From Disturbed Areas

Runoff from areas of the site which have been stripped of vegetation cover, either for cover material, unsealed haul road construction, or from stockpiles, will be directed by overland flow to the main stormwater sediment pond (Figure 4 and 5).

Runoff from areas to be excavated will be directed to a temporary sediment collection pond at the base of the landfill as shown on Figure 4. Any runoff from the active landfill area will be directed to a temporary dirty water collection pond at the base of the landfill as shown on Figure 4. Excess waters not required for dust suppression purposes will be pumped to separate permanent storage ponds.

The temporary collection ponds will be designed according to the DLWC's criteria for sediment basin design for small sites (<15 hectares contributing catchment).

2.3.3 Task and Actions

The procedures to be put in place will be sufficient to meet the environmental goals for controlling surface water flows.

2.3.4 Performance Indicators & Responsible Party

Performance indicators to demonstrate that the surface water controls are working include the quarterly surface water monitoring records. The Landfill Manager will be responsible for ensuring that surface water monitoring is conducted and that these indicate the surface waters at the site are not adversely affected by landfilling activities.

2.3.5 Monitoring, Frequency and Timing

The frequency and timing for surface water control measures will be:

ACTION	TIMING
Sampling and testing of surface waters	Quarterly
Evaluation of Sedimentation Dams	Annually during site audit.

2.3.6 Review/Auditing and Reporting

The Landfill Manger will be responsible for organising the sampling and determining the course of action necessary to clean the permanent and temporary sedimentation dams. The Landfill Manager, as part of the annual audit, will have the sedimentation dam and culverts inspected for silt levels. The results of monitoring will be reported on an annual frequency.

2.3.7 Corrective Actions

Inspections of the drains will be undertaken on an annual basis or more frequently, if conditions require. The following actions may be taken:

- Removing the material in the sedimentation basins;
- Cleaning out on-site drains and culverts;
- Repair of bare areas showing surface erosion; and.
- Repair of spillways from the sedimentation basins.

2.4 GROUNDWATER MONITORING NETWORK

2.4.1 Objectives

A groundwater monitoring network is necessary to demonstrate that there is limited potential for migration of hazardous constituents from a solid waste landfill to the uppermost aquifer, during the active life of the landfill and the post-closure care period. The wells employed for a groundwater network would be strategically located, to maximise the opportunity for intercepting any discharge from the landfill.

2.4.2 Management Strategy

An extensive groundwater monitoring network will be developed to provide surety that any material which may emanate from the landfill can be detected. The location of these wells will be selected in discussions between groundwater scientists and the EPA to ensure that the entire landfill is adequately covered by groundwater monitoring wells.

It is intended that this network will provide information for contaminant, fate and transport predictions of any leachate mixing with the groundwater, and will enable considerations to be made on the impacts on human health and environment. Additionally, the monitoring network will enable assessment of the quality of the background groundwater. These values may be statistically compared to downgradient monitoring stations at a later date to assess if there are any affects from the landfilling.

2.4.3 Task and Actions

The EPA will be requested to consider and approve the design of a groundwater monitoring network prior to its installation.

2.5 GROUNDWATER MONITORING PROGRAM

2.5.1 Objectives

The primary environmental objective for monitoring the groundwater around landfills is to assess water quality over time. This will show whether the landfill operations are having any measurable effects on the groundwater quality. This is accomplished through testing indicator analytes on a frequency sufficient to detect contamination so that the environment may be protected.

2.5.2 Management Strategy

The strategy for groundwater monitoring at the landfill will include consistent sampling and analysis procedures, which are designed to ensure monitoring results providing an accurate

representation of ground-water quality at all background and downgradient wells. The groundwater testing program will be conducted quarterly.

Sampling procedures

Groundwater samples will be collected by an appropriately qualified environmental consultant using standard groundwater monitoring techniques. Prior to the commencement of the sampling program, a plan, detailing all procedures to be adopted, will be submitted to the EPA for approval.

The monitoring program will incorporate water level measurement to determine fluctuations in the water table and laboratory testing of the groundwater quality.

Groundwater depths will be recorded for each well prior to sampling. Water levels will be measured with respect to a known surface level (the top of the PVC casing) which will have been surveyed to Australian Height Datum (AHD). This will permit an on-going comparison of water levels across the site.

Initial static water levels will be measured from the top of the casing with an accuracy of 0.3 cm. Each well will be purged by acceptable techniques (e.g. micropurge techniques or until the well is bailed/pumped dry). Purging will continue until successive pH reading differ by no more than 0.1 pH unit. Once purged, the groundwater monitoring wells may be sampled.

Before any monitoring well is sampled, the following information will be collected:

- static groundwater level in the monitoring well; and
- total depth of each monitoring well.

All groundwater samples will be tested in the field, at the time samples are collected for a range of indicator analytes, including pH, electrical conductivity (EC), dissolved oxygen, temperature and redox potential.

Analytical Program

Groundwater samples will be analysed in accordance with the conditions specified in the site licence. At this stage, it is proposed that the groundwater analytes listed in Table 2 of the EPA's *Environmental Guidelines: Solid Waste Landfills* (1996) be used.

Laboratory

Groundwater samples will be analysed by NATA accredited laboratories.

Sampling Handling

Once filled, all sample containers will be immediately tightly capped and stored at or below 4°C until arrival at the analytical laboratory. All sampling equipment for groundwater will be decontaminated between uses.

Unique sample numbers will be given to samples collected from each sampling location. Quality control samples (field duplicates, trip blanks and field blanks) will be disguised by assigning dummy sample identifications which are similar to existing unique sample numbers.

A chain of custody (COC) record will be utilised by field personnel to document possession of all samples collected for chemical analysis. The COC record may include, but is not limited to, the following information:

- name(s) of sampler(s);
- sample type, identification number and location;
- date and time of collection;
- number and type of containers;
- required analyses;
- preservatives;
- required detection limits; and
- signatures documenting change of sample custody.

The ice chest containing the samples will be sealed with tape and secured with a signed custody seal. The custody seal provides an indication as to whether the cooler has been opened by unauthorised personnel. During sampling events partially filled and unfilled coolers are kept within sight of the sample custodian or locked in a vehicle.

The original COC record will accompany the samples to the analytical laboratory and will be returned to the party contracted to perform sampling within 24 hours of sample receipt in the laboratory. The original, or a copy of the original, COC record will be placed in the appropriate project file. Samples will be delivered to the laboratory promptly to ensure the specified holding times are met.

The selection of the appropriate sample containers, preservation procedures, sample storage requirements and holding times will be in strict accordance with those recommended by the US EPA in the document *Test Methods For Evaluating Solid Waste (SW-846), Update II & IIA* (USEPA, 1994), *Standard Methods* (APHA, 1995), *Water Quality Investigations Manual: Preferred Methods for Sampling and Analysis* (EPA, 1994) or other validated procedures approved by the EPA.

Samples and associated QA samples will be shipped to a NATA registered analytical laboratory within the specified holding times. Samples will be packed in styrofoam or bubble wrap to minimise breakage.

Upon receipt of samples at the laboratory with the COC the following procedures will be carried out:

- ensure that the custody seals and tape on the cooler are unbroken and uncut;
- ensure that the signature on the external custody seal matches one of the sampler(s) signature(s) on the internal COC;
- determine if samples have been maintained at the appropriate temperature during shipment;
- ensure that the sample containers within the cooler are intact;
- ensure that the identification on the sample containers correspond to the entries on the COC;

- ensure that the number of sample containers received is equal to the number of samples listed on the COC;
- if sample custody is valid, the samples will be logged in by the laboratory as per standard operating procedures;
- completion of the COC by the laboratory; and
- delivery of a copy of the COC to the sampler within 1 working day.

Any problem with a sample will be noted on the COC Record.

Quality Control Program

Field QA samples will be collected at the ratio of 1:20 or one each day, whichever is more frequent. Sample quality control includes the following for all routine testing:

Trip Blanks - will be used to monitor the cross-contamination of volatile organic compounds of sample containers during transport, handling and storage. Analyte-free media will be from the laboratory to the sampling site in appropriate sealed containers and returned to the laboratory unopened for analysis.

Field Blanks - samples of analyte free media will be prepared by sampling personnel. Field blank water samples consist of purified water supplied or recommended for use by the respective laboratories. The water will be transferred directly into the same types of containers used for regular samples. The collection of field blanks will enable the measurement of incidental or accidental contamination during the whole process (sampling, transport, sample preparation and analysis).

Field Duplicates - Samples will be prepared in the field by splitting a field sample, then submitting to the laboratory as two independent samples. Field duplicates will be used to measure the precision of the whole process (sampling, sample preparation and analysis). Significant variation in field duplicate results is often observed (particularly for solid matrix samples) due to sample heterogeneity.

The laboratory subcontracted to perform the analytical component of this analysis must be NATA accredited for the analytes tested, have demonstrated proficiency in testing and have been audited by a professional environmental chemists prior to commencement. It is understood that besides those sample custody and management procedures described, the laboratory is to act in full accordance with the terms of its NATA Registration for Chemical Testing.

2.5.3 Task and Actions

The groundwater monitoring program to be put in place will meet the benchmark techniques for groundwater monitoring.

2.5.4 Performance Indicators & Responsible Party

The groundwater test parameters are the key indicators for determining if the groundwater conditions have been altered. Statistical comparisons of key indicator parameters may be undertaken utilising a parametric analysis of variance (ANOVA) followed by multiple comparisons procedures. This procedure is used to identify statistically significant evidence of contamination between key indicator parameters. Significant changes in indicators will

lead to groundwater assessment monitoring as identified in Section 2.6. It is usually necessary to gather at least 8 quarters of data prior to conducting statistical test procedures.

The Landfill Manager will be responsible for selecting an appropriately qualified groundwater specialist to conduct the quarterly monitoring and to interpret the results for the incorporation into the annual report.

2.5.5 Monitoring, Frequency and Timing

The frequency and timing for groundwater monitoring are:

ACTION	TIMING
Groundwater Sampling	Quarterly
Annual Report	Annually

2.5.6 Review/Auditing and Reporting

The Landfill Manager will be responsible for organising the sampling and determining the course of action necessary on the basis of test results as interpreted by an appropriately qualified specialist.

The Landfill Manager, as part of the annual audit, will ensure that the sampling has been conducted and reported.

2.5.7 Corrective Actions

A groundwater assessment program (Section 2.6) will be undertaken when there are indications that there are changes in indicator analytes.

2.6 GROUNDWATER ASSESSMENT PROGRAM

2.6.1 Objectives

The objective of an assessment monitoring program is to determine whether there may be effects on a groundwater aquifer as a result of changes in concentration of indicator analytes. The assessment program will verify anomalous results. If there is an indication that there has been a significant variation in the concentration of an indicator analyte, it will be necessary to determine whether there is a potential contamination issue.

2.6.2 Management Strategy

Assessment monitoring will be conducted whenever a significant change has been observed or statistically significant increases over background have been detected for one or more of the indicator analytes. Groundwater samples will be analysed for all priority pollutant contaminants. Priority pollutant contaminants refer to those compounds identified below:

- arsenic;
- cadmium;
- chromium;

- copper;
- lead;
- mercury;
- nickel
- zinc;
- cyanide;
- volatile organic compounds detected by USEPA Method 8260 A Primary Analyte List; and
- semi-volatile organic compounds detected by USEPA Method 8270 B.

The list of priority pollutants to be tested will be assessed by an environmental chemist to determine whether the list may be abbreviated. Criteria to be used in deleting analytes from the list will be determined on the basis of the specific indicator analyte showing significant changes. For instance, if the contamination is observed to be organic there is little reason to test for the metals and cyanide.

A minimum of one sample from all groundwater wells will be collected and analysed during each sampling event. For any contaminant detected in the downgradient wells as a result of this testing, a minimum of four independent samples from each well (background and downgradient) will be collected and analysed to establish background for the contaminants.

2.6.3 Task and Actions

The procedures to be put in place will be sufficient to determine the nature of potential aquifer contamination.

2.6.4 Performance Indicators/Responsible Party

Performance indicators for assessment testing are the analytical results. These results will guide the groundwater specialist in determining future actions.

The Landfill Manager will be responsible for selecting an appropriately qualified groundwater specialist to monitor results and provide recommendations for assessment testing.

2.6.5 Frequency/Monitoring

The frequency and timing for assessment measures are:

ACTION	TIMING
Assessment Investigation	Whenever a groundwater indicator analytes shows a significant change in concentration.

2.6.6 Review/Auditing and Reporting

The indicator analytical results will be reviewed quarterly and compared annually. The annual report will identify whether there have been significant changes in indicator analytes.

2.6.7 Corrective Actions

The development of a contingency plan is discussed in Section 2.9.

2.7 SURFACE WATER MONITORING PROGRAM

2.7.1 Objectives

The primary environmental objective for surface water monitoring around landfills is to document whether site operations are having any effect on water quality over time. This monitoring is accomplished though testing surface waters for contaminants on a regular frequency so that the environment may be protected.

2.7.2 Management Strategy

The site naturally drains in a predominantly easterly direction with some partial northerly drainage from the northwest portion of the site. Surface waters from undisturbed areas will be collected and diverted to Eastern Creek. Surface waters from disturbed areas or areas used for stockpiling purposes, will be directed to a stormwater sediment pond shown in Figure 4. Surface waters from areas being excavated will be collected in temporary sediment collection ponds (Figures 4 and 5) where waters can be pumped to the stormwater sediment pond or reused on-site.

Surface water samples will be manually sampled and collected in laboratory certified clean bottles that contain the appropriate preservative. All samples will be grab samples (Section 1060 in APHA, 1995) and collected on a quarterly frequency.

The selection of the appropriate sample containers, preservation procedures, sample storage requirements and holding times will be in accordance with those recommended by the US EPA in the document *Test Methods For Evaluating Solid Waste (SW-846), Update II & IIA* (USEPA, 1994), *Standard Methods* (APHA, 1995), *Water Quality Investigations Manual: Preferred Methods for Sampling and Analysis* (EPA, 1994) or other validated procedures approved by the EPA.

Samples will be transported to a NATA registered analytical laboratory within the specified holding times. The laboratory will be notified so that it will be prepared to receive the samples. Samples will be packed in styrofoam or bubble wrap to minimise breakage.

The following procedures will be performed upon receipt of samples at the laboratory with the COC:

- ensure the custody seals and tape on the cooler are unbroken and uncut;
- check that the signature on the external custody seal matches one of the sampler(s) signature(s) on the internal COC;
- determine if samples have been maintained at the appropriate temperature during shipment;
- ensure the sample containers within the cooler are intact;
- ensure the identification on the sample containers correspond to the entries on the COC;

- ensure the number of sample containers received is equal to the number of samples listed on the COC;
- if sample custody is valid, the samples will be logged in by the laboratory as per their standard operating procedures;
- ensure the COC is completed by the laboratory; and
- deliver a copy of the COC to the sampler within 1 working day.

Any problem with a sample will be noted on the COC Record.

Quality Control Program

Field samples will be collected at the ratio of 1:20 or one each day, whichever is more frequent. Sample quality control includes the following for all routine testing:

Trip Blanks - will be used to monitor the cross-contamination of volatile organic compounds of sample containers during transport, handling and storage. Analyte-free media will be taken from the laboratory to the sampling site in appropriate sealed containers and returned to the laboratory unopened for analysis.

Field Duplicates - Samples will be prepared in the field by splitting a field sample, then submitting to the laboratory as two independent samples. Field duplicates will be used to measure the precision of the whole process (sampling, sample preparation and analysis). Significant variation in field duplicate results is often observed (particularly for solid matrix samples) due to sample heterogeneity.

Field Blanks - samples of analyte free media will be prepared by sampling personnel in the same manner as regular samples. Field blank water samples consist of purified water supplied or recommended for use by the respective laboratories used to rinse the sample collection device after decontamination. The rinsate will be collected directly into the same types of containers used for regular samples.

The collection of field blanks enables the measurement of incidental or accidental contamination during the whole process (sampling, transport, sample preparation and analysis).

2.7.3 Task and Actions

The procedures to be put in place will be sufficient to meet the environmental goals for monitoring the surface waters at the landfill.

2.7.4 Performance Indicators/Responsible Party

The test results are the key indicators for determining if the surface water exceeded the limit conditions identified in the site licence. When these thresholds are exceeded, a qualified water quality specialist will assess the affects and may recommend further actions.

The Landfill Manager will be responsible for selecting an appropriately qualified scientist to conduct the quarterly monitoring and to interpret the results for the incorporation into the annual report.

2.7.5 Monitoring, Frequency and Timing

The frequency and timing for surface water monitoring will be:

ACTION	TIMING
Surface Water Sampling	Quarterly
Annual Report	Annually

2.7.6 Review/Auditing and Reporting

The Landfill Manger will be responsible for organising the sampling and determining the course of action necessary on the basis of test results as interpreted by an appropriately qualified specialist.

The Landfill Manager, as part of the annual audit, is to ensure that the sampling has been conducted and reported.

2.7.7 Corrective Actions

A qualified scientist will assess the results of sampling and recommend appropriate actions. These actions may be those identified in the surface water contingency plan.

2.8 LEACHATE MONITORING PROGRAM

2.8.1 Objectives

The primary objective for testing leachate is to chemically characterise the leachate. This action is necessary to provide Austral with a basis for beneficially using the leachate or ensuring that it is stored in a leachate pond. It is not planned to use this leachate for any other purpose.

2.8.2 Management Strategy

Leachate testing will consist of quarterly sampling for a range of organic and inorganic analytes as specified in the licence conditions. In addition, the height of leachate and groundwater in the riser (m AHD) will be monitored on a monthly frequency.

The quality control procedures, analytical laboratory and sample handling procedures will be the same as those identified for both groundwater and surface water monitoring programs as described in Sections 2.5 and 2.7 respectively.

2.8.3 Task and Actions

The procedures to be put in place will be sufficient to meet the benchmark techniques for leachate monitoring program at the landfill.

2.8.4 Performance Indicators/Responsible Party

The test results are the key indicators for evaluating the level of contaminates in the leachate in conformance with the site licence. An appropriately qualified environmental scientist will assess these results to determine whether there are limitations to the use of leachate.

The Landfill Manager will be responsible for selecting an appropriately qualified scientist to conduct the monitoring and interpret the results for incorporation into the annual report.

2.8.5 Monitoring, Frequency and Timing

The proposed frequency and timing for leachate monitoring will be:

ACTION	TIMING
Sampling Leachate from the Riser	Quarterly
Annual Report	Annually

2.8.6 Review/Auditing and Reporting

The Landfill Manger will be responsible for organising the sampling and determining the course of action necessary on the basis of test results as interpreted by an appropriately qualified specialist.

The Landfill Manager, as part of the annual audit, is to ensure that the sampling has been conducted and reported.

2.8.7 Corrective Actions

The landfill has been designed to minimise the movement of the leachate to the groundwater or the wider environment. The analytical test results of the leachate will document its strength and constituents and may be useful in designing a groundwater assessment program, if required.

2.9 WATER CONTAINMENT REMEDIATION PLAN

2.9.1 Objectives

The objective for a Water Containment Remediation Plan is to ensure that the any escape of leachate does not continue to affect groundwater or surfacewater quality following detection. In order to ensure that groundwater resources and surface water resources are adequately protected, individual contingency plans should be developed whenever leachate migration is suspected.

2.9.2 Management Strategy

Groundwater or surfacewater containment remediation plans will be developed on an individual basis dependent on the nature and degree of contamination detected. Rather than include a plan for any groundwater or surface water contingency, it is more important to define the concept and highlight responsibilities and likely actions. The plan can then be developed to suit the event.

Groundwater Contingency Plans

The need to develop a groundwater contingency plan will flow from the Groundwater Assessment Program (Section 2.6). The assessment program will define the nature and general extent of contamination.

A remediation plan will utilise the information obtained in the assessment program. A formal determination will be made if sufficient information is obtained in the assessment. Should a groundwater specialist determine that there are data gaps it will be necessary to fill these before developing the plan.

Data gaps for groundwater contamination may include insufficient mapping of the extent of contamination. In order to improve this situation, it may be necessary to drill additional monitoring wells in the zone that contamination has been detected.

There are three general options for controlling groundwater contamination in an aquifer. These options include:

- installation of groundwater extraction wells;
- installation of interception trenches; and
- use of bentonite slurry to encapsulate and contain the contaminants.

The Austral Landfill will contain waste to a depth of approximately 40 metres below the ground surface. The second and third options are only useful for controlling contaminants that are reasonably near the ground surface. Therefore, these options would be limited to localised contamination in the latter stages of landfilling. It is considered that, if required, groundwater extraction wells would be the primary means for controlling the movement of contaminants at the landfill. Similarly, if groundwater contamination has been confirmed, the height of leachate within the waste can be reduced (via the rising mains) to below the surrounding groundwater levels thus reducing the hydraulic head.

The contaminants extracted from the wells would need to be treated at the surface prior to discharge. The treatment system would be dependent on the nature of the contamination and allowable discharge limits.

Surface Water Contingency Plan

Surface water monitoring or visual observations may indicate the need to control surface water discharges to the environment. If monitoring results indicate that the allowable concentrations have been exceeded, it will be necessary to establish the cause for that exceedence.

Determining the source will require the development of a plan which may require sampling and testing from the point of the exceedence, moving progressively upstream until a source can be located. Once the source has been identified a plan can be developed to control the discharge. The discharge may be contained by mechanical means or by restricting flow off-site. Restricting off-site flow can include damming the stream with clean excavated natural material until treatment measures can be instigated.

There are 3 storage dams designed to 1 in 10 year storms, the leachate collection pond, the stormwater sediment pond and the wheelwash pond. Given this capacity for containing surface water flow, the most likely scenario to protect surface waters would be to contain and treat any accidental spillage or contamination event. This response path would include

placing the offending liquid in a pond for storage and either treating on-site or hauling off-site to an approved place of disposal.

Once the action has been taken to contain the pollution, Austral will submit a report to the EPA detailing the nature and source of contamination and the actions put in place to prevent recurrence.

2.9.3 Task and Actions

No action can be taken until an assessment program is required or an uncontrolled release is detected.

2.9.4 Performance Indicators/Responsible Party

Performance indicators for contingency programs relate to the time period following determination that successful control actions are established. The length of this time period will be a function of the severity of the incident and the nature of the controls.

2.9.5 Frequency/Monitoring

It is not possible to establish a monitoring frequency for a Water Containment Plan, until the plan has been devised. It is envisaged that the containment plan will contain a monitoring component to demonstrate that the uncontrolled releases has been contained.

2.9.6 Review/Auditing and Reporting

The landfill has been designed to control discharges to the environment in compliance with current industry practice and exceedences of limit conditions should not occur. Specific contingency plans are not necessary until uncontrolled release of pollutants have been identified. Review and reporting will be necessary to demonstrate that the situation is under control. It will be the Landfill Managers responsibility to engage qualified personnel to instigate the control measures and to report on the progress to EPA and Council.

2.9.7 Corrective Actions

The Water Containment Plan is the corrective action for an uncontrolled release to water.

3.1 LANDFILL GAS CONTAINMENT

3.1.1 Objectives

Landfill gas is generated by the anaerobic decomposition of biodegradable wastes and the chemical breakdown (dehydrohalogenation of solvents) within solid waste landfills. This gas is usually a mixture of methane and carbon dioxide with minor amounts of sulfidic compounds and trace levels of air toxics. The actual composition of landfill gas is dependent on the wastes disposed to landfill, density of the wastes and depth of the landfilled materials. Landfills which accept hard waste and wastes with low biodegradability will generate lower levels of gas than those which accept putrescible wastes.

The primary concerns for landfill gas relates to safety hazard concerns (*ie* explosions), potential nuisance odours and vegetation stress.

3.1.2 Management Strategy

The Austral Landfill will comprise, at completion, a 20 to 40 m thick pile of saturated and partially saturated non-putrescible wastes sealed with a low permeability compacted sealing layer. The low levels of biodegradable waste, the capping and the liner all work synergistically to minimise the movement of landfill gas. The intended site operating practices and locational characteristics have been designed to control the migration of gas out of the landfill.

Although the non-putrescible materials to be accepted at the landfill comprise predominantly inert wastes such as plastics, soil and concrete, there are expected to be significant quantities of paper and wood that will degrade over time and produce some landfill gas.

The gas movement within the landfill will be a function of the placement of materials. Compaction and daily cover will tend to direct the gas horizontally. A series of temporary gas extraction wells can be installed, if gas or odour becomes a problem, to permit flaring of the gases. Flaring of the gases extracted from the landfill will destroy the odorous traces associated with the landfill gases.

3.1.3 Task and Actions

The environmental goal to contain landfill gas will be met thorough accepting wastes with low biodegradable content, the integrity of the landfill liner acting as a barrier, the use of compacted daily cover and the planned final capping of the landfill at closure.

3.1.4 Performance Indicators & Responsible Party

The results from gas testing will act as performance indicators determining whether the conditions established for landfill containment are adequate. The Operations Manager will be responsible for ensuring that the waste is compacted, daily cover is applied and preferential pathways toward the landfill side walls are encouraged. The Landfill Manager will be responsible for quarterly testing of the landfill surface for methane emissions.

3.1.5 Frequency/Monitoring

The proposed frequency and timing for gas monitoring are as follows:

ACTION	TIMING
Surface gas emission monitoring	Quarterly
Annual Report	Annually

3.1.6 Review /Auditing and Reporting

The Landfill Manager will review monitoring report summaries as part of the annual review, which will include gas monitoring. These summaries will clearly state whether there have been changes in landfill gas concentration.

3.1.7 Corrective Actions

Landfill gas may be extracted in a series of temporary gas extraction wells, if gas emissions are determined to be significant.

3.2 EXTRACTION AND DISPOSAL OF LANDFILL GAS

3.2.1 Objectives

The objectives of a landfill gas extraction system are to ensure that the risk of explosion and fire is reduced, to control greenhouse gas emission and to lower the level of toxic organic compounds emitted at solid waste landfills. Methane is between 20 and 30 times a more potent green house gas than carbon dioxide. Extraction of landfill gas may produce energy under certain conditions, such as large biodegradable components in a deep landfill. Landfill gas extraction is compulsory at landfills should perimeter wells or on-site structures show methane at concentrations above 1.25 percent (25 % of the LEL).

3.2.2 Management Strategy

The rates of gas generation are expected to be low and may be managed through passive venting of the gas through the landfill cap. Monitoring of gas generation will be carried out as landfilling proceeds on a quarterly basis. Although excessive build-up of gas pressures may be relieved through the excavation of slots into the cap, it is anticipated that gas will escape by diffusion through the landfill cap without need for such works. The procedures for monitoring landfill gases are covered in Section 3.6.

A series of temporary gas extraction wells can be installed, if gas or odour becomes a problem, to permit flaring of the gases. Flaring of the gases extracted from the landfill will destroy the odorous traces associated with the landfill gases.

3.2.3 Performance Indicators & Responsible Party

The results of surface gas monitoring will be used as a check on the amount of methane leaving the site. Additionally, an increase in odour complaints will be used as an indicator of landfill gas escaping the site. This information may be used to assess if extraction of landfill gas needs to be considered.

The Landfill Manager will be responsible for organising testing and acting on odour complaints.

3.2.4 Frequency/Monitoring

The frequency and timing for gas monitoring as indicated in Section 3.6 are:

ACTION	TIMING
Odour Complaints	Continuously recorded
Surface gas emission monitoring	Quarterly
Annual Report	Annually

3.2.5 Review /Auditing and Reporting

The Landfill Manager will be responsible for evaluating the number of odour complaints and the reporting of landfill gas measurements as part of the Annual Audit. Gas monitoring will be reported to the EPA in Annual Reports.

3.2.6 Corrective Actions

Installation of a series of extraction wells will be undertaken should landfill gas become a nuisance or an occupational health and safety issue.

3.3 FIRE PREVENTION

3.3.1 Objectives

The goal for fire prevention is to minimise the emissions to the atmosphere and to ensure the safety of landfill staff and its clients.

3.3.2 Management Strategy

Compaction of the refuse to minimise air voids and recycling of leachate will reduce potential fire hazards at the landfill. In addition, rapid cover placement practices will minimise potential oxygenation of the fill. The operational procedures to be adopted at the landfill, incorporating the systematic cellular tipping routine, rapid cover placement and compaction of the refuse all synergistically combine to help ensure that the fire hazards will be reduced.

The lighting of fires will be banned at the site. Fire ban warning signs will be installed around the facility to ensure that no fires are lit. A detailed safety plan outlining fire fighting procedures, the location and access routes to water storage's, and the location of fire fighting equipment will be prepared.

Other considerations with respect to fire safety will include the selection of machinery operated at the site and the maintenance of open space buffer zones. Machinery operated on the premises will largely be diesel driven to minimise the ignition potential of any gases at the site, while the proposed buffer zones to the site boundaries will be maintained to provide additional fire safety.

All vehicle and equipment maintenance will be conducted outside the landfill area including welding or hot processes. Where it is unavoidable that such processes are undertaken, within the landfill, special precautions will be taken to remove any potential for fire generation.

It is intended that the landfill will stockpile compost and wood mulch. These stockpiles will be maintained to heights below 3 metres. Additionally, a 10 metre fire break will be in place between the rows.

All fuels and flammable solvents for site operations will be stored on unfilled land in conformance with the relevant regulations.

3.3.3 Task and Actions

The program of fire prevention to be employed at the landfill will comply fully to the Benchmark Technique in the Landfill Guidelines.

3.3.4 Performance Indicators & Responsible Party

The Operations Manager will be responsible for:

- maintaining signs in working order;
- ensuring that landfill cells are designed to a standard that protects against combustion;
- appropriately managing the stockpiles; and
- storing fuels and combustibles in accordance with regulatory requirements,

The identification of any problems associated with these tasks in the monthly operations report, will serve as a performance indicator that site operations with respect to fire prevention is under control.

3.3.5 Frequency/Monitoring

The condition of the site will be evaluated continuously by the Operations Manager. Problems with signs, site operation, stockpiles or fuel storage will be evaluated in the monthly operations report.

3.3.6 Review /Auditing and Reporting

The Landfill Manager will formally review the monthly report submitted by the Operations Manager as part of the annual audit.

3.3.7 Corrective Actions

The specific corrective action will be dependant on the circumstance requiring that action.

3.4 CONTROLLED BURNING

Burning will be banned at the landfill. Therefore, there are no requirements relating to controlled burning in this Draft LEMP.

3.5 SITE CLOSURE

3.5.1 Objectives

It is a goal that solid waste landfills are closed so that landfill gas emissions do not represent a significant threat following closure. The use of appropriate capping materials provide for the safe passive management of landfill gas.

The management strategy includes a final capping layer at least 2.2 m thick, including compacted impervious material ($k = 1 \times 10^{-8}$ m/s) to minimise escape of landfill gases. Final site capping is discussed in greater detail in Section 4.8.

3.5.2 Task and Actions

The program for capping will meet all environmental performance goals.

3.5.3 Performance Indicators & Responsible Party

The performance indicator following capping will be to employ a methane concentration of 1.25 % methane at the perimeter as an indication of a threshold requiring action.

The results of surface gas monitoring will be used as a check on the amount of methane leaving the site. Additionally, an increase in odour complaints will be used as an indicator of landfill gas escaping the site. This information may be employed to determine if extraction of landfill gas needs to be considered.

The Landfill Manager will be responsible for organising testing and acting on odour complaints.

3.5.4 Frequency/Monitoring

The frequency and timing for gas monitoring as indicated in Section 3.6 are:

ACTION	TIMING
Odour Complaints	Continuously recorded
Surface gas emission monitoring	Quarterly
Annual Report	Annually

3.5.5 Review /Auditing and Reporting

The Landfill Manager will be responsible for evaluating the number of odour complaints and the reporting of landfill gas measurements as part of the Annual Audit. Gas monitoring will be reported to the EPA in the Annual Report.

3.5.6 Corrective Actions

Installation of a series of extraction wells will be undertaken should landfill gas become a nuisance or an occupational health and safety issue.

3.6 SUBSURFACE GAS MONITORING DEVICES

3.6.1 Objectives

Subsurface gas monitoring devices are necessary to detect methane at sufficiently low concentrations to ensure that gas is not moving off-site. These devices comprise gas monitoring wells that are located around the perimeter of the landfill at the depth of landfilled materials or the water table.

3.6.2 Management Strategy

Due to the competency of the surrounding geological strata, it is not considered likely that methane would migrate laterally away from the side walls of the landfill. Additionally, the landfill will only accept wastes with low or no biodegradability which generate minute quantities of methane when compared to highly biodegradable wastes such as putrescible wastes. For these reasons, it is considered that there is no need to install or test subsurface gas monitoring wells at the perimeter of the landfill.

Therefore, the benchmark techniques of installing gas monitoring wells and monthly subsurface monitoring of the landfill gas is not considered appropriate for the landfill.

3.7 SUB-SURFACE GAS MONITORING

3.7.1 Objectives

The objective of a subsurface gas monitoring program is to detect gas moving off site.

3.7.2 Management Strategy

It is intended that the landfill will operate as a Solid Waste Class 2 landfill. On this basis, inert and non-putrescible solid wastes will be the only types of wastes accepted. Therefore, the rates of landfill gas generation are expected to be low and, as indicated earlier, may be managed through passive venting of the gas through the landfill cap.

It is not necessary to incorporate the subsurface gas monthly monitoring program as indicated in the Benchmark Techniques from the Landfill Guidelines.

3.8 SURFACE GAS MONITORING

3.8.1 Objectives

The purpose of a surface gas monitoring program is to demonstrate that landfill cover material, capping and/or the gas extraction system are effective in limiting the emission of landfill gas. Monitoring the surface of the landfill is effective in locating any point sources or fissures that may be emitting landfill gas.

3.8.2 Management Strategy

Landfill gas monitoring for methane will be conducted on a quarterly frequency. The metrological conditions necessary for monitoring require calm conditions (wind less than 10 km

per hour) and two days without measurable rainfall. The need for calm weather conditions is fairly obvious, measurements would be biased under windy conditions. The restriction based on precipitation is related to the filling of the pore spaces following rain. Under these conditions the landfill gas would be prevented from exiting at the surface and may be transported horizontally.

The surface testing will be undertaken 5 cm above the ground surface at various points within 5 metres of the site perimeter. This will be repeated on parallel pathways every 25 metres inward from the perimeter till the centre of the site is reached. The threshold concentration for closer investigation and potential action, including extraction, is 1% methane by volume of gas. The surface testing also includes examination of discontinuity in the landfill such as the interface between an original quarry wall and the waste fill.

A thermal conductivity detector or flame ionisation detector are suitable for measuring the methane concentration. These instruments are able to provide a response of less than 500 ppm methane.

3.8.3 Task and Actions

The performance goal of ensuring that landfill gas migrating from the site is detected will be met by the procedures outlined above. However, there are two differences between the program of work identified for the Austral Landfill and the benchmark techniques established by the EPA. These differences relate to the frequency of testing and the threshold level for corrective actions. The differences are shown below:

Action	Benchmark Technique	LEMP
Frequency for testing surface gas emissions	Monthly	Quarterly
Methane threshold for action	500 ppm (0.05 %)	1 % (10 000 ppm)

The benchmark technique identifies a need to conduct surface monitoring on a monthly frequency. However, on the basis that the Austral Landfill will operate as a Solid Waste Class 2 Landfill, with restrictions on accepting waste with high compositions of biodegradable components and will be lined, it is reasonable to reduce the frequency of monitoring and test the surface for methane on a quarterly frequency.

The benchmark threshold concentration requires an investigation is 500 ppm. This level is very low on the basis that it is difficult to measure by conventional techniques. Additionally, 1 percent methane is considered to be completely safe, and there are no OH&S concerns in an atmosphere consisting of 1 percent methane (20 percent LEL).

3.8.4 Performance Indicators & Responsible Party

The results from the surface gas monitoring program will provide the key indicator for determining if the landfill gas is being emitted to the environment.

The Landfill Manager will be responsible for selecting an appropriately qualified scientist to conduct the quarterly monitoring and to interpret the results for incorporation into the annual report.

3.8.5 Monitoring, Frequency and Timing

The frequency and timing for surface gas emission monitoring are:

ACTION	TIMING
Surface gas emission monitoring	Quarterly
Annual Report	Annually

3.8.6 Review/Auditing and Reporting

The Landfill Manger will be responsible for organising the sampling and determining the course of action necessary on the basis of test results as interpreted by an appropriately qualified landfill specialist.

The Landfill Manager, as part of the annual audit, is to ensure that the sampling has been conducted and reported.

3.8.7 Corrective Actions

Corrective actions may take the form of providing a thicker cover or changing the material used as cover, such as use of materials with greater cohesive properties. If these measures are not successful in limiting gaseous emissions, engineering solutions will be assessed.

3.9 GAS ACCUMULATION MONITORING

3.9.1 Objectives

Monitoring for methane in buildings is intended to protect human health. Methane which is both an asphyxiant and explosive can accumulate in buildings, particularly if they were constructed over landfilled materials.

3.9.2 Management Strategy

The bench mark technique identified in the landfill guidelines requires monthly testing of the structures. However, the proposed management strategy to be employed at the landfill recommends quarterly testing in conjunction with surface gas monitoring. The reduced sampling frequency has been justified on the basis that there are reduced risks due to the low biodegradability of the waste, containment within the landfill due to geological barriers and distances (over 100 m) between the landfilled materials and the nearest occupied structure.

The methane measurements in excess of 1% methane require further assessment and greater testing frequencies. If high methane measurements are replicated, it will be necessary to conduct daily testing until the buildings are adequately ventilated to reduce the risk of explosion.

3.9.3 Task and Actions

The performance goal of ensuring that landfill gas is detected in structures can be met by the procedures outlined above. For the reasons outlined in Section 3.8, the frequency of testing has been reduced to quarterly rather than monthly.

3.9.4 Performance Indicators & Responsible Party

The results from the gas accumulation monitoring form the key indicators for determining if the landfill gas is collecting in on site structures.

The Landfill Manager will be responsible for selecting an appropriately qualified scientist to conduct the quarterly monitoring and to interpret the results for the incorporation into the annual report.

3.9.5 Monitoring, Frequency and Timing

The frequency and timing for gas accumulation monitoring are:

ACTION	TIMING
Gas accumulation monitoring	Quarterly
Annual Report	Annually

3.9.6 Review/Auditing and Reporting

The Landfill Manger will be responsible for organising the sampling and determining the course of action necessary on the basis of test results as interpreted by an appropriately qualified landfill specialist.

The Landfill Manager, as part of the annual audit, is to ensure that the sampling has been conducted and reported.

3.9.7 Corrective Actions

Should the monitoring program demonstrate that corrective actions are necessary these may take the form of improving the ventilation within the buildings and continuous methane measurements.

3.10 REMEDIATION OF UNCONTROLLED LANDFILL GAS EMISSION

3.10.1 Objectives

Landfill gas emissions have the potential to cause explosions and add to the greenhouse gas effect. In order that these effects would be controlled, the EPA established monitoring thresholds that, if exceeded, require further ameliorative actions. The EPA thresholds are:

- methane at concentrations greater than 1.25 % at the surface, in sub-surface wells or in on-site structures;
- a one hour oxidised nitrogen (NO_x) average level above 320 $\mu g/m^3$ from electricity generating equipment; and
- non methane organic compounds (NMOC) destruction efficiency in the gas combustion equipment lower than 98 %.

3.10.2 Management Strategy

Of the goals developed by the EPA, the 1.25 % methane level is the only action level appropriate for a Solid Waste Class 2 landfill when it is completed in competent rock or lined. Should this threshold be exceeded, Austral will notify the EPA in writing and provide an assessment report within 14 days.

3.10.3 Task and Actions

The types of waste accepted at the landfill will limit the production of landfill gas, the liner and surrounding geological strata will limit the migration of gas and the surface monitoring program will detect any changes in gas production over time.

3.10.4 Performance Indicators & Responsible Party

The requirement to remediate landfill gas emissions will be determined on the basis of monitoring results exceeding threshold values.

The Landfill Manager will be responsible for contacting the EPA if the gas measurements exceed threshold values.

3.10.5 Frequency/Monitoring

Assessment of the need to remediate landfill gas emissions will be based on the surface and structure monitoring data. The frequency and timing for this gas emission monitoring are:

ACTION	TIMING
Surface gas emission monitoring	Quarterly
Annual Report	Annually

3.10.6 Review/Auditing and Reporting

The Landfill Manger will be responsible for organising the sampling and determining the course of action necessary on the basis of test results as interpreted by an appropriately qualified landfill specialist.

The Landfill Manager, as part of the annual audit, is to ensure that the sampling has been conducted and reported.

4.1 ASSURANCE OF QUALITY

4.1.1 Objectives

Quality Assurance for a solid waste landfill is needed to ensure that the completed components meet project design criteria, plans and specification. This will involve monitoring and documenting the quality of materials, the methods used and the manner in which the materials are to be placed. Through construction quality assurance (CQA) landfill operators are able to detect variations from design and provide corrective action, prior to failure in any system.

4.1.2 Management Strategy

Austral has not fully implemented a formal quality assurance program based on international accreditation systems. However, it will ensure that site construction and testing is carried out to a high standard. This will be achieved by the following actions:

- giving preference to firms that are accredited under AS 3 900, ISO 9 000 or ISO 14 000;
- using standard specification in contracts with construction activities;
- employing third party consultants to test and document site activities;
- ensuring that when testing is necessary only standard test procedures (*ie* Australian Standard, British Standard, American Society for Testing and Materials, etc.) are employed; and
- effective record management system which ensures activities are appropriately documented.

4.1.3 Environmental Outcomes

The proposed operation of the Austral Landfill as outlined in this Draft LEMP is viewed as sufficient to prevent the landfill from having deleterious effects on the surrounding environment.

4.2 SCREENING WASTES

4.2.1 Objectives

Landfills should have procedures in place to ensure that they receive only those wastes that the landfill has been designed to receive.

4.2.2 Management Strategy

The Austral Landfill will operate to a level based on NSW Solid Waste Classification 2. Operation at this level requires the exclusion of rapidly biodegradable wastes, liquid wastes and hazardous wastes for disposal. Through a well defined management system these unacceptable materials will be excluded.

The following provisions will be put in place to prevent the disposal of unacceptable wastes:

- Signage - there will be signs at the gate house which clearly identify the types of wastes accepted and not accepted by this waste management centre.
- Education - commercial waste hauling companies will be provided with brochures that explain the types of wastes accepted at the landfill. It is intended that these companies will forward this information to their clients (i.e. the waste generators). This exercise will be conducted on an annual frequency.
- Training - the gatehouse and tipping supervisors will be trained in how to identify liquid, hazardous and sludge wastes. This training will be documented and retained by the Manager.
- Sludges or contaminated soils without proper documentation will not be accepted.
- Inspection (gatehouse) - the gatehouse supervisor will use an elevated mirror at the weighbridge to visually inspect all open loads. Liquid, sludges and hazardous wastes will be rejected.
- Inspection (tip face) - the tipping supervisor, a full-time person in the pit without primary equipment responsibilities, will monitor the wastes as the trucks unload. If a load looks suspect, it will be dumped separately and individually inspected. The distance between the active face of the landfill and the gatehouse will permit the tipping supervisor to notify the weighbridge operator to intercept and detain trucks which dispose of unacceptable wastes. Liquids, illegal sludges and hazardous materials will be segregated at the face and the material will be placed back in the truck from which it came.
- Exclusion - reasonable measures, including questioning the transporter and where considered necessary, the generator, will be employed to exclude excavated soil or natural soil like material that is suspected to be contaminated.

On a monthly frequency, if there has been an incident, a report which outlines a summary of the waste screening incidents will be prepared and submitted to the EPA. A compilation of these incidents forms part of the annual report to the EPA.

The goal of the waste screening program is 100 percent exclusion of rapidly biodegradable wastes. However, it is recognised that commercial wastes received at Solid Waste Class 2 Landfills can contain minute amounts of rapidly biodegradable materials. These materials may include office lunch wastes or kitchen wastes inadvertently disposed to bins serviced by commercial front end-loaders.

4.2.3 Task and Actions

The proposed management strategy for the screening waste fully conforms to the environmental goals in the Landfill Guidelines.

4.2.4 Performance Indicators & Responsible Party

The effectiveness of the screening program can be assessed by:

- the number of incidents whereby hazardous or highly biodegradable wastes are discovered in the pit;

- an increase in odour complaints (reflecting acceptance of highly biodegradable wastes and putrefaction);
- visual observations and assessments by experienced solid wastes professionals; such as the on-site management, experienced EPA officers and some solid waste consultants.

The Operations Manager will be responsible for assessing waste disposed to the landfill and the management of any unapproved wastes discovered on the premises.

The Landfill Manager will be responsible for arranging and documenting training staff in the identification and management of wastes. During the annual audit the Landfill Manager will be responsible for assessing the overall effectiveness of the waste exclusion program.

4.2.5 Frequency/Monitoring

The frequency and timing for waste screening procedures will be:

ACTION	TIMING
Screening waste at weighbridge	Continuous
Refusing entry to vehicles with unacceptable waste	Each incident as discovered
Screening waste at the active face	Continuous
Assessment of the screening program's effectiveness	Annually
Monitoring of the odours on site	Continuous

4.2.6 Review/Auditing and Reporting

The incident report and complaints register will be maintained at the Site and Operations Manager's Office. These records will be audited in the annual site audit by the Landfill Manager.

4.2.7 Corrective Actions

Exclusion of offenders is the primary corrective action to prevent recurrence of illegal disposal. Any person or company that do not follow the directions contained in the signs that identify acceptable and non-acceptable waste materials may be prohibited from future entry to the landfill.

If the assessment policy identifies that the program needs to be augmented to improve performance, the Landfill Manager will modify the program. Any modifications will be based on the types of unacceptable materials received, but will likely include:

- greater training of staff;
- increased stringency in the screening procedure;
- increasing the effort made to educate the waste generators and haulers; and
- hire waste management professionals to assess options.

4.3 MEASUREMENT OF QUANTITIES OF WASTE RECEIVED

4.3.1 Objectives

It will be critical to monitor the consumption of air space during site operations. This data will be necessary to update and calibrate models related to filling and waste management at individual landfills and on a regional basis. Updating these models may generate a more accurate estimate of projected landfill life expectancy which would be useful for planning purposes. These measurements are necessary to provide the necessary data to prepare accurate reports necessary for completing payment requirements, as required under Section 72 of the Waste Minimisation and Management Act.

4.3.2 Management Strategy

The landfill will have two NATA accredited weighbridges, one for incoming waste vehicles and the other for truck tare weights upon exiting. These weighbridges will be calibrated on an annual frequency and will provide the landfill with the capability to record the mass of wastes deposited. The weighbridges will be connected to a computer operating system which will record the mass, type and hauler for all waste loads upon entry.

A range of product codes will be developed for various waste types and these will be reproduced on the weighbridge dockets. The nomenclature used will be based on the National Waste Classification System.

A report of wastes received will be prepared and sent to the EPA on a monthly frequency and a summary of the wastes accepted will be included in the annual report.

4.3.3 Task and Actions

The proposed management strategy for the recording of waste will conform to the environmental goals in the Landfill Guidelines.

4.3.4 Performance Indicators & Responsible Party

The mass reported to the EPA on a monthly frequency will be the performance indicator for measuring waste. The Operations Manager will be responsible for supervising the collection of this information from the weighbridge.

4.3.5 Frequency/Monitoring

The measuring of wastes to be received at the landfill will be performed whenever wastes are received.

4.3.6 Review /Auditing and Reporting

The Landfill Manager will review the records which are reported to the EPA on a monthly frequency.

4.3.7 Corrective Actions

It is anticipated that during normal functioning of the weighbridges there will be no need for corrective actions to be taken. The weighbridges will be serviced under contract from the manufacturer and will be certified by a NATA accredited technician on an annual frequency.

4.4 RECORDING OF THE QUANTITIES, TYPES AND SOURCES OF WASTES RECEIVED

4.4.1 Objectives

As discussed in Section 4.3.1 one of the objectives associated with measuring and reporting of waste is to provide waste planners with accurate information regarding waste disposal rates and capacities.

4.4.2 Management Strategy

Austral will undertake volumetric surveys to measure the consumption of air space throughout the life of the landfill. The results of the survey will be reported to the EPA bi-annually. Monthly Section 72 Contribution reports will be submitted to the EPA with a claim for rebates of the materials which have approved Rebate Identification Numbers.

4.4.3 Task and Actions

The proposed reporting procedures to be adopted at the landfill will be in compliance with the requirements identified in the Regulation.

4.4.4 Performance Indicators & Responsible Party

The masses reported in the Section 72 Contribution reports and the volumes reported within 30 days of the survey will be the performance indicators for recording waste. The Landfill Manager will be responsible for reporting this information to the EPA.

4.4.5 Frequency/Monitoring

The proposed frequency and timing for reporting waste masses and volumes accepted are:

ACTION	TIMING
Measurement of waste at weighbridge	Continuous
Reporting the mass of waste to the EPA as part of the Section 72 Contribution report	Monthly
Report results from the volumetric survey	Bi-annually
Summary report of wastes received	Annually

4.4.6 Review /Auditing and Reporting

The data will be reviewed prior to reporting at the frequency as indicated above.

4.4.7 Corrective Actions

The Waste Minimisation and Management Regulations have provisions for punitive actions and penalty payments associated with poor reporting. There may be unusual circumstances that prevent reporting according to the schedule listed above. On these occasions, the corrective action would be to inform the EPA, to ensure that it is aware of the circumstances and prevent the levying of any punitive measures.

4.5 COMPACTION OF WASTES

4.5.1 Objectives

The objective of compacting wastes is to ensure that landfill space is conserved as a resource and the area of land which is rendered unhealthy building land through landfilling activities is minimised.

4.5.2 Management Strategy

Optimal compaction of waste will be undertaken to ensure that the existing landfill space is optimised. The degree of compaction of the deposited material will play an important role in conserving air space, generating increased revenues and minimising subsequent settlements.

All deposited refuse is contained in the working area and the face kept to a maximum of 50 metres in length.

The NSW EPA established a compaction goal of 850 kg/m^3 for large landfills. The landfill will aim to achieve this compaction level through the use of appropriate equipment and good operating practices.

Equipment to be used will include a compactor, dozer and loader. Other ancillary equipment will include a grader, water cart, fuel truck and tip truck. It is envisaged that a prime mover with trailer will be used for transporting waste from the transfer station to the working area of the landfill.

Whenever practical, the compaction equipment will be operated by pushing and rolling in towards the landfill face, rather than pushing down the face. Pushing down the face will tend to spread the refuse away from the face resulting in less compaction.

Settlement or subsidence of the finished landform as a result of surcharge loading within the fill itself may result in the landform taking on a significantly different topographical appearance. Settlement is the result of primary consolidation due to compaction and surcharges, as well as secondary consolidation (creep) and the decomposition of refuse.

The design of the finished landfill surface will incorporate these forms of settlement. Based on our previous experience, overfilling by approximately 15 % will be required to compensate for consolidation and to achieve the designed finish surface levels. Typically the majority of the settlement will occur in the first three or four years following the completion of the individual cells.

Routine settlement monitoring will be included to allow better determination of the volume of overfilling required for the site.

Surveys (see Section 4.4) can be utilised to determine the volume of the refuse. Regular surveys incorporating specific layer markers will permit incremental refuse densities to be determined (based upon, and comparison between, current and previous surveys).

4.5.3 Task and Actions

The proposed management strategy for waste compaction will conform to the EPA's compaction requirements.

4.5.4 Performance Indicators & Responsible Party

The waste mass accepted and the volumetric surveys will provide the information necessary to calculate the compliance with the EPA's compaction goal of 850 kg/m^3.

4.5.5 Frequency/Monitoring

The frequency and timing for reporting waste masses and volumes accepted are:

ACTION	TIMING
Measurement of waste at weighbridge	Continuous
Reporting the mass of waste to the EPA as part of the Section 72 Contribution report	Monthly
Report results from the volumetric survey	Bi-annually
Summary report of wastes received	Annually

4.5.6 Review /Auditing and Reporting

The data will be reviewed prior to reporting at the frequency as indicated above.

4.5.7 Corrective Actions

Considering the proposed type of waste to be accepted and the intended site operations at the landfill, it is likely that the compaction goal of 850 kg/m^3 would be achieved. However, in the event that this goal is not met, Austral will discuss the appropriateness of this goal with the EPA.

4.6 RECYCLING

4.6.1 Objectives

In order to maximise air space and promote land conservation, recyclable materials will be separated from incoming loads to the greatest extent feasible.

4.6.2 Management Strategy

In order to meet this recycling objective, a waste recycling depot will be developed as a resident drop-off facility. Separate storage for quantities of materials such as glass, metal, plastics, batteries, waste oil and paper will be provided. Stockpiled materials will be removed

for processing by contractors when the bins or vessels approach capacity. It is intended that access and use of the recycling facilities will be provided without cost to residents. The transfer station will be is used for stockpiling larger items of recyclable materials such as white goods.

4.6.3 Task and Actions

The recycling initiatives to be adopted at the landfill will meet all regulatory requirements and environmental goals.

4.6.4 Performance Indicators & Responsible Party

The mass of recyclable materials will be incorporated into the Section 72 Contribution report. This report will serve as a relative measure for the amount of materials recycled over time.

The Operations Manager will be responsible for:

- maintaining the recyclable area in a clean and tidy manner;
- organising the removal of recycled products; and
- providing the Landfill Manager with the mass so that it may be reported on a monthly frequency.

4.6.5 Frequency/Monitoring

The frequency and timing for reporting are:

	TIMING
Reporting the recyclables to the EPA as part of the Section 72 Contribution report	Monthly
Summary report of recyclables received	Annually

4.6.6 Review /Auditing and Reporting

The data will be reviewed prior to reporting at the frequency as indicated above.

4.6.7 Corrective Actions

Recycling is driven by market processes that are independent of NSW regulatory requirements and the Landfill Guidelines. The amount of recycling will be a function of the public's interest and the viability of the recycling industry. As such, it is not possible to design any effective corrective actions for recycling.

4.7 FILLING PLAN/CONTOURS

4.7.1 Objectives

Developing and implementing a strategy for completing a landfill will ensure that it is filled to design specifications. This action enables greater surety with respect to the integrity of a landfill.

4.7.2 Management Strategy

The overall proposed landfill area covers some 25 hectares. The surface area of the existing quarry void is some 6.5 hectares.

Waste material will be placed using the area fill method of landfill. Area fill involves progressively filling the site in layers in the base of the quarry. The site has been divided into two cells (14.3 Ha and 10.9 Ha each). Filling will generally take place from west to east with the final cap being placed progressively as final levels are achieved.

The conceptual design identifies cells that are filled in approximately 1.8 m lifts of compacted waste, with 0.15 m of cover material applied daily. Where a lift of material will not be progressed within a one month period, a 0.3 m thick interim cover layer of shale or other suitable material will be applied compacted at optimum moisture content, to create a low-permeability barrier. This interim cover will largely prevent infiltration of surface water and will be graded at a slope of 1:50, to a dirty water collection pond for appropriate management.

When active landfilling is recommenced over a cell previously capped with intermediate cover to stimulate clean stormwater runoff, cover material in excess of 0.15 m is recovered for reuse elsewhere or would, at least, be ripped to ensure that the moisture levels in the site are able to develop consistently without perched leachate levels developing.

Figures 4 and 5 provide a conceptual plan of the progressive filling within the landfill, while Figure 8 provides schematic sections of filling in progress. Figure 6 shows the anticipated final contours.

The volume of available airspace has been assessed as 6 842 000 m^3 using the ENTEC Environmental and Mining modelling program. The 6 842 000 m^3 total airspace comprises 3 703 000 m^3 of overburden to be excavated for brickmaking and cover purposes and 3 139 000 m^3 of existing airspace and overtopping potential. It has been assumed in the calculations of the cumulative volume of fill, that the proportion of cover (including final capping and soil) is approximately 19.0%.

An ISG (Integrated Survey Grid) grid was laid out across the site by a registered surveyor. This grid will permit the identification of burial locations, for any wastes which require this level of documentation.

4.7.3 Task and Actions

The filling plan, design contours and grid will provide the necessary information required by the benchmark technique identified in the Landfill Guidelines.

4.7.4 Performance Indicators & Responsible Party

The survey details will provide indicators of the rate with which the landfill is filled. The Operations Manager will be responsible for determining the layout of the landfill and reconciling any differences between the conceptual design and actual filling practice.

4.7.5 Frequency/Monitoring

The proposed frequency and timing for filling plan indicators are:

	TIMING
Reporting the survey to the EPA	Bi-annually
Review of contours	Continuous
Site survey	As needed (approx. bi-annually)

4.7.6 Review /Auditing and Reporting

The rate of fill will be reviewed by the end of each calendar year and will form part of the annual report.

4.7.7 Corrective Actions

The Operations Manager will be responsible for filling the landfill following a systematic plan and will be required to review the ongoing development of the landfill and determine any necessary modifications on a daily basis.

4.8 SITE CAPPING AND REVEGETATION

4.8.1 Objectives

The objectives of site capping and revegetation are:

- Generate a final rehabilitated landform which is consistent with the closure plan and the surrounding development;
- Minimise the infiltration of rain; and
- Control landfill gas emissions.

4.8.2 Management Strategy

General Site Rehabilitation

Landfill rehabilitation should aim to create a surface which can be reused for an appropriate land use and allow operators to minimise the future impact of the landfill on the environment.

Rehabilitated landfill surfaces will be properly designed and constructed to reduce surface water infiltration by increasing runoff and evapotranspiration from the rehabilitated surface. Runoff will be encouraged by including a low permeability layer within the final core sequence and by forming a moderately sloping topography on the rehabilitated surface, thereby providing a surface water drainage route. Rehabilitation, however, must allow for vigorous vegetative growth in the long term and must contain landfill gas.

It is proposed that as an integral part of the overall post closure development, the final landfill surface will be landscaped and developed for a use compatible with the objectives of the Prospect Corridor. Final landforms have been reproduced on Figure 6.

The highest finished surface level adopted for this rehabilitation strategy is RL 85 m AHD. However, the final surface profile will be discussed and agreed with regulatory authorities when the filling of the landfill is nearing completion. The proposed maximum height of the finished

landfill surface is 85 m AHD. This is approximately 20 m higher than the level of the quarry rim and results in a minimum gradient of 1 : 20.

It is proposed to rehabilitate the various areas of the site to different levels. Where grassland or vegetated areas are to be disturbed or overburden stockpiles removed, areas will be reshaped appropriately and then sown with a cover of perennial grass. Rehabilitation will take place progressively until the final surface level has been completed. The landfill area will be reshaped to the final landform and landscaped in accordance with Figure 6. The final form and landscaping will be subject to a landscaping study to be carried out by an landscape architect in conjunction with relevant regulatory authorities. Any vegetated or cleared areas which are not affected by the depot operations will be left untouched.

Areas containing site facilities associated with the depot will be left as hardstand if possible or, if not, then reshaped and vegetated with a perennial grass. All remaining buildings and plant will be removed prior to disposal of the site.

A progressive rehabilitation program for disturbed areas will be undertaken at the site. As each nominal cell is completed, rehabilitation works will commence on that cell.

Effective drainage along with the placement of the low permeability layer will be included as part of the rehabilitation plan to prevent drainage to the landfill mass which will otherwise emerge as leachate.

Rehabilitation of the final capped area will begin within 30 days of the completion of tipping and intensive revegetation will continue for between 12 and 18 months (to be determined in detailed design). All bare ground will be revegetated with a minimum of grass cover to prevent erosion and with more intensive plantings of trees and shrubs following in stages.

Capping

The capping goal will be met at the landfill by provision of a low permeability final capping layer and progressive revegetation of finished surfaces. It is presently proposed that a final capping layer at least 2.2 m thick, including compacted impervious material ($k = 1 \times 10^{-8}$m/s) approximately 900 mm thick (sealing layer), is used to minimise rainfall infiltration into the landfill mass. As mentioned previously, the top of the landfill will also have a minimum slope of approximately 5% to promote surface runoff away from the landfill mass.

Final landscaping fill, comprising 1.0 m of topsoil will be placed on top of the sealing layer. The final landscaping fill required is necessary to promote revegetation and moisture storage over the landfill surface and with the final capping sequence, will minimise rainfall infiltration to the landfill mass. The final capping layer will include mulch and compost on top of the soil to promote vegetation growth and to minimise odours from any fugitive gas emissions. It is particularly important that a thickness of 1 000 mm soil is used to generate the necessary texture and depth, to resist erosion of surface soils immediately after planting.

The final cover will also provide a biologically and mineralogically active filter for suppression of odours. It should also allow for vehicular access even during periods of extreme wet weather.

Revegetation

Successful revegetation of lands, a principal stabilisation technique, requires:

- availability of acceptable soil materials;

- correct site preparation;
- selection of the most suitable establishment technique;
- application of sufficient water for germination and to sustain plant growth, if rainfall is insufficient; and
- an adequate maintenance program.

Correct site preparation is essential to encourage both plant establishment and subsequent persistence of adequate ground cover. Where possible, local topsoil should be used.

Revegetation with plants can be considered as temporary or permanent. Temporary revegetation is usually undertaken with annual species because they can result in a very fast growing and highly effective ground cover; nevertheless, annual species die within one season, often providing minimal or no residual surface protection after about 6 or 8 months. Permanent revegetation is usually undertaken with an annual species combined with perennial species which, generally, are slower to germinate and protect the ground surface but are much more likely to last several years.

There are three broad options for revegetation of recently landfilled premises. In ascending order of cost they are:

- use exotic grasses only;
- use exotic grasses, native trees and native shrubs; or
- exclusive use of native grasses, trees and shrubs.

In order to develop a workable solution that permits flexibility (*ie* the need to revegetate an area outside of the germination period for a native plant) and considering the low plant maintenance requirements often found in commercial and industrial areas, it is considered that the second option provides the greatest level of flexibility.

The immediate stabilisation of disturbed areas will be carried out using an annual species, such as Japanese Millet (*Echinochloa frumentacea).* Regal ryegrass may also be used. Revegetation will also include the use of exotic species, in particular, pasture grasses.

Rehabilitation will include the revegetation of the site with species of *Pultenaea microphylla.* This shall occur through the collection of seed from existing species on-site prior to their removal, and subsequent germination and sowing of the seedlings.

The final selection of grass and shrub species will be discussed with the DWLC at the time when revegetation is to commence.

Establishment of plant cover is subject to weather conditions and it is important to schedule revegetation works, where possible, to occur in the most favourable growing seasons, notably, autumn and spring. Accordingly, disturbed lands will be progressively rehabilitated throughout these favourable times and not more than 4 weeks from conclusion of land disturbance activities so that:

- minimal lands are exposed to the forces of soil erosion at any one time; and
- rehabilitation measures are progressively installed throughout the development phase.

As the physical and chemical characteristics of many subsoil materials inhibit the establishment of plants, respreading of topsoil over the disturbed area will be undertaken. Every effort will be

made to ensure that subsoil material is not incorporated into the topsoil. Generally, sowing will be undertaken by direct drilling or sod seeding to a depth of about 10 to 15 mm.

Where the erosion hazard is particularly high (eg. areas of concentrated water flow), grasses will be established by laying couch or kikuyu turf, particularly where immediate vegetative cover is required for stabilisation or aesthetic reasons.

Where turf is used, it can be:

- be placed on a bed of a minimum depth of 75 mm of fertilised topsoil;
- be laid parallel to the contour on sites with steep slope gradients and normal direction of flow in waterways;
- where necessary, include a light polypropylene, UV stabilised mesh with about 20 mm openings in areas of very high water velocity;
- be rolled or tamped immediately as it is laid;
- where necessary, be pegged to the soil at 1 to 2 m centres, eg. with 4 mm (No. 8 gauge) wire approximately 200 mm in length; and
- be watered immediately to enhance establishment, and then, regularly for the first 7 days or as required to effect establishment.

In some situations, straw-mulching or hydromulching may be employed, particularly on very small areas or lands which are inaccessible to conventional implements. It is understood that ground preparation is still important for these areas. Cultivation on steep ground may be achieved by shallow ripping with a dozer. Where possible, the surface will be harrowed immediately after the seed and fertiliser have been applied. Where native species are included in the seed mix, the harrowing will be undertaken first. Sand will be added to the seed mix to assist in achieving an even spread. Areas not satisfactorily revegetated will be investigated to determine the reason for failure. Appropriate remedial action will be taken, including replacing any lost topsoil and resowing of affected areas.

4.8.3 Task and Actions

The proposed strategies outlined for capping and revegetation are considered to be sufficient to reduce infiltration and produce an adequate base to support revegetation.

4.8.4 Performance Indicators & Responsible Party

The results of the soil testing will drive the revegetation program for the landfilled surface. The Landfill Manager will be responsible for organising these tests and providing these along with the revegetation plan to the DLWC for its comments.

4.8.5 Frequency/Monitoring

The testing of soil properties should be conducted within one week of placing the final topsoil layer. This schedule will provide sufficient time so that re-seeding operations occur within 30 days.

4.8.6 Review /Auditing and Reporting

The capping and revegetation plan contained in this Draft LEMP will be reviewed by soil scientists within the DLWC during site closure preparation activities.

4.9 LANDFILL CLOSURE AND POST CLOSURE MONITORING AND MAINTENANCE

4.9.1 Objectives

Following closure of a landfill, the only activity which terminates is the receiving of wastes and tipping fees. The landfill will continue to store waste which may take over twenty years to stabilise. Therefore, it will be necessary to monitor for environmental emissions and the conditions of the surface, due to differential settlement, during this time.

4.9.2 Management Strategy

Austral will continue monitoring, and performing post closure maintenance of completed areas, until such time that there is scientific evidence that the landfill wastes have stabilised and do not have the potential to pollute. The Certificate of Completion will take the form of a report that summarises:

- hydrological monitoring data;
- leachate monitoring data;
- landfill gas monitoring data;
- surface monitoring data;
- water and sediment control evaluation report;
- physical inspection reports;
- revegetation analysis report;
- defined future use analysis; and
- environmental regulation compliance statement.

The conclusions in all these reports and evaluations must support a statement to the regulators that the landfill no longer poses an environmental threat.

4.9.3 Task and Actions

The proposed arrangements for closure at the site will meet all environmental goals. A detailed site closure program will be prepared nearer the time of site closure. The plan will be based on the schedule (adopted from O'Leary et al, 1995) as shown below:

Site Closure Checklist

Pre-planning:

- Identify final site topographic plan;

- Prepare site drainage plan;
- Specify source of cover material;
- Prepare vegetative cover and landscaping plan;
- Identify closing sequence for phased operations of on-site structures; and
- Specify engineering procedures for the development of on-site structures.

Three months before closure:

- Review closure plan for completeness;
- Schedule closing date;
- Prepare final time-table for closure procedures;
- Notify Fairfield City Council and EPA; and
- Notify site users by letter if they are municipalities or contract haulers; by published announcement if private dumping is allowed.

At closure:

- Erect fences or appropriate structures to limit access;
- Post signs indicating site closure and alternative disposal sites;
- Collect any litter or debris and place in final cell for covering; and
- Place cover over any exposed waste.

Three months after closure:

- Complete required drainage control features or structures;
- Complete as required gas collection or venting system, leachate containment facilities, and gas or groundwater monitoring devices;
- Install settlement plates or other devices for detecting subsidence;
- Place required thickness of earth cover over landfill; and
- Establish vegetative cover.

4.9.4 Performance Indicators/Responsible Party

Performance indicators include the notification of Fairfield City Council and the EPA that the site is closed and submitting a formal closure plan.

The Landfill Manager will be responsible for ensuring that the closure plan is prepared and official notification is provided to the relevant regulatory authorities.

5.1 SECURITY OF SITE

5.1.1 Objectives

The primary environmental objective of site security is to prevent unauthorised entry to the site in order to minimise waste dumping, fires and vandalism of pollution control devices, as well as loss of amenity. Several other objectives also exist and include the following:

- Recording of wastes received;
- Preventing degradation of local amenity; and
- Adequate staffing and training.

5.1.2 Management Strategy

Access to the site will be controlled by fencing and gates of two metre high chain wire construction. Additional chain wire fencing will be constructed around the perimeter of the waste management centre/landfill area. Internal access gates will be constructed where necessary to restrict private vehicular access to the landfill and cover material excavation area(s).

Regular inspections of the fence line will be undertaken to ensure site security is maintained. Detailed records on monitoring results, any non-compliance's and any other relevant information will be kept on site for reference by the Site and Operations Manager, as required.

The gates will be locked outside of operating hours. A certified key list will be maintained with each key holder identified.

The weighbridge operator will screen site visitors at the front gate during operating hours. All visitors will be required to "sign-in" utilising a Visitors Register. The details recorded in the Visitor Register include: time, name, organisation, car details and person to be visited. A visitor identification badge will be provided for the duration of the visit. These procedures ensure that the number of persons and their location at the site may be identified in the event of an emergency.

An automatic alarm system will be connected to the office complex, weighbridge building, and other structures which may be erected on site. Forced entry or power failure to these structures will set off an alarm. Once the alarm has been activated the Operations manager or his delegate will be notified.

A security firm will be contracted to inspect the premises each night. This will include a visit to all buildings, the weighbridge, the recycling area, the tip face and the transfer station. A report will be issued by the security service, outlining any findings from its inspections.

5.1.3 Task and Actions

The environmental goals for site security will be met through the use the 2.0 m man-proof fence around the site, the gate security system, automatic alarms and security contractor.

5.1.4 Performance Indicators and Responsible Party

Performance indicators for site security include:

- the number of reports detailing damage or vandalism;
- the number of incidents reported by the security contractor; and
- the number of alarms set-off.

The Weighbridge Operator will be responsible for ensuring that the access gates are locked at the close of business each day. The Operations Manager will be responsible for regular maintenance, perimeter inspections and response to emergency or alarm situations after hours.

5.1.5 Frequency/Monitoring

The frequency and timing for site security measures will be:

ACTION	TIMING
Gates Locked with Certified Key List	Daily
Gate Control	Continuous
Perimeter Inspection	Monthly
Visitor Log	Each visitor's visit
Alarm System	Continuous
Security Patrol	Twice nightly

5.1.6 Review/Auditing and Reporting

The following reports will be prepared covering site security:

1. A monthly report will be prepared upon inspection of the security facilities on site, which will be filed for future reference.
2. The security contractor will provide report summaries of its findings.
3. A report will be prepared upon inspection of the fences at the site, which will be filed by the Operations Manager for future reference.

The records will be reviewed as part of an annual site Audit by the Landfill Manager.

5.1.7 Corrective Actions

Specific responses to be undertaken will be subject to the nature of the breach in site security. Evidence of unauthorised disposal of wastes will require the following actions:

- segregation of the wastes from approved wastes;
- notification of the EPA that illegal dumping has breached site security; and
- providing EPA with assistance in disposing of this material in an approved location.

Site security breaches which result in damage to property will be handled by the Landfill Manager working with the property insurance company for the landfill. This will require evaluation of the nature of the problem, its source and actions to prevent recurrence.

5.2 LITTER CONTROL

5.2.1 Objectives

The primary objective is to prevent the degradation of local amenity due to windblown litter in the vicinity of the landfill. This goal is best achieved by addressing the following:

- Covering wastes; and
- Adequate staffing and training.

5.2.2 Management Strategy

Litter control will be maintained through the minimisation of the active cell area, use of the systematic cellular tipping program and rapid cover placement over the refuse. A temporary litter fence will also be in place around the perimeter of the active cell. Additionally, the chain wire perimeter boundary fence will also act as a litter fence.

One of the benchmark techniques from the *Solid Waste Guidelines* (EPA, 1996) is the retrieval of litter on a daily basis. Due to the nature of waste to be accepted at the landfill, litter retrieval is not normally required on a daily frequency. A weekly litter patrol will be established to collect any windblown litter from along the fence lines, as well as along Wallgrove Road in the vicinity of the landfill. This frequency may be increased under unusual or windy conditions, which lead to greater litter nuisance.

Warning signs will be located on the entry/exit gates advising transport operators and the public that they can be fined for any litter on public roads resulting from their improper transportation of waste.

Rather than follow the benchmark techniques identified in the guidelines, litter is controlled through operating in a deep landfill, monitoring the litter and removing litter on a as-needed or weekly frequency.

5.2.3 Task and Actions

The environmental goals for litter control will be met through the design of the waste tipping and covering system, the fencing system and the litter patrols.

5.2.4 Performance Indicators/Responsible Party

Performance indicators will include monitoring of the site boundary fences to identify the build up of litter materials and complaints caused by litter effecting local amenity. The Operations Manager will be responsible for ensuring that these events are documented.

Daily covering of waste will limit the volume of loose surface waste build up at the landfill. The Operations Manager will be responsible for ensuring that the cover is sufficient to prevent wind blown litter being carried outside the site boundaries.

5.2.5 Frequency/Monitoring

The frequency and timing for litter control measures will be:

ACTION	TIMING
Minimisation of active face size	Continuous
Cover and compaction	Continuous
Litter Patrol	Weekly
Litter Fences	When necessary

5.2.6 Review/Auditing and Reporting

A report is prepared upon completion of the litter patrol and is filed for future reference.

These records form part of an annual site Audit by the Landfill Manager.

5.3 CLEANING OF VEHICLES

5.3.1 Objectives

The primary objective for cleaning of vehicles is to prevent the degradation of local amenity resulting from the off-site deposition of mud and waste materials from vehicles leaving the site. Dirty vehicles that truck waste onto the roadway may effect the quality of stormwater run-off and local amenity.

5.3.2 Management Strategy

To maintain clean road conditions around the waste management facility, a permanent wheel washing facility will be installed to remove soils from the vehicles before they leave the site (Figure 3).

Upon completion of tipping, each truck which is leaving the site will travel along the access road to the truck washdown area. The wheels and chassis of the vehicles will be washed down using a high pressure low volume water hose. Wash down water from the wheel washing facilities will be pumped out and discharged to a dedicated pond, as necessary.

A coarse mesh basket in the collection pit will collect any large refuse, which will then be disposed of in a waste receptacle adjacent to the washdown area.

5.3.3 Task and Actions

The intended arrangements will be aimed at controlling vehicle cleanliness at the site to meet environmental goals.

5.3.4 Performance Indicators/Responsible Party

Performance indicators will include the number of incidents reported in the complaints register, by clients and residents that may be affected by the spread of litter from transportation vehicles leaving the landfill site.

The Weighbridge Operator will be responsible for the visual monitoring of vehicles.

5.3.5 Frequency/Monitoring

Monitoring to take place will include a visual check of the vehicles leaving the site to ensure that no excess waste is attached to the vehicles. During wet weather, the Operations Manager will review the need for the mandatory use of the truck wash by all commercial waste vehicles.

5.3.6 Review/Auditing and Reporting

The Operations Manager will be responsible for determining if weather conditions warrant greater use of the truck washing facilities. The Landfill Manger will be responsible for determining the course of action necessary to resolve any complaints listed in the Complaint Register.

5.3.7 Corrective Actions

If vehicles are identified leaving the site with the potential to decrease the amenity of the surrounding area, the Weighbridge Operator will record the vehicle details. These details will be given to the Operations Manager who has responsibly for notifying the driver of his/her unsatisfactory conduct. If a similar incident is repeated, the driver may be prohibited from using the landfill.

If there is a notation in the Complaints Register from an independent road user, the Landfill Manager is to determine appropriate corrective action on a case-by-case basis.

5.4 COVERING OF WASTES

5.4.1 Objectives

The primary environmental objective of the covering of waste is to prevent the degradation of local amenity. This is achieved by:

- limiting run-on and infiltration of water;
- controlling and minimising risk of fire;
- minimising emission of landfill gas;
- suppressing site odour;
- reducing fly propagation and rodent attraction; and
- decreasing litter generation.

5.4.2 Management Strategy

Amount of Cover Material

The management strategy adopted during tipping operations includes the continuous application of at least 15 cm of daily cover over the active face of the landfill. This cover has the net effect of controlling:

- odours;

- fires;
- infiltration by rain; and
- vector (rodents, flies and bird) populations.

All landfills are required to use a significant quantity of material for site operations, such as cover (daily, intermediate and final), interior haul roads, hard stand areas, batters and soft spots in the fill. It is therefore seen as desirable to accurately quantify these uses to ensure that the Section 72 Contributions will be paid on waste only, and not the material used for site engineering purposes.

Section 72 Contribution

It is important to provide a reasonable estimate of the cover material requirements for the landfill which will form the basis of exemptions and rebate projections under the *Waste Minimisation and Management Regulation (WMMR)*, 1996. Section 21 (1) specifies waste activities that are exempt from the Section 72 Contributions. This exemption includes a 10 % reduction in the amount of the contribution that would otherwise be paid on clean fill.

Additionally, Section 22 of WMMR identify the rebate conditions for Section 72 Contributions. The materials suitable for rebate include any waste accepted at the landfill and subsequently recycled or reprocessed; clean fill used for site operations as identified in the LEMP, and other wastes (*ie* construction or demolition wastes) used for approved operational purposes as identified in the LEMP.

For the purpose of claiming the rebate of the Section 72 Contributions it is assumed that at least some percentage of the material accepted at the landfill is necessary for optimum cover. Therefore, approximately 20 % is a reasonable cover material estimate for the purposes of the Section 72 Contribution. Actual cover practice at the landfill may usually exceed this percentage.

On site engineering works for landfills include internal roads, building embankments and drainage structures (Parametrix, 1987). From a waste minimisation point of view, it is advantageous to utilise demolition and construction materials for on-site engineering purposes rather than importing materials.

Temporary roads construction activities provide an opportunity for reuse of materials which were disposed in landfills (O'Leary, 1995). Coarse aggregate demolition materials may be used as road base; crushed materials can be spread as surface aggregates.

MONTHLY MATERIAL USAGE	PERCENTAGE REBATE
Daily Cover	17 %
Roads	3 % (on an average basis)
Engineering structures	0 to 6 %.

Based on the foregoing, it is apparent that cover material and materials used for on-site engineering purposes, comprise a significant contribution to the materials accepted at non-putrescible landfills.

Once the Landfill Manager has gathered quantitative data on waste received, the Landfill Manager will present an application for other engineering works to be considered as an approved Section 72 Rebate. These measurements will include surveyors volume calculations, photographic records and mass measurements from weighbridge records.

Source of Cover and Engineering Material

There will be two primary sources of cover material available for the landfill. The first material for cover, in terms of preference, is the quarry overburden that would be stockpiled on inactive cells and would be the most readily available source. A stockpile of at least 1 000 tonnes ($\cong$ 625 m^3) of excavated material (not topsoil) will be maintained on-site for use as emergency cover throughout the operational life of the depot. A second source of cover/engineering material will be demolition/construction and excavation materials brought to the depot as waste. As a general rule, these materials would be expected to comprise approximately 30 percent of the waste stream. These wastes will be admitted for a reduced charge (which does not include the Section 72 Contribution required by the *Waste Minimisation and Management Act*, 1995 for disposal of waste), when required, to encourage their disposal at the depot.

It will be advantageous to utilise demolition and construction materials for daily cover and on-site engineering purposes (roads, batters and acoustic mounds). The environmental advantage for using demolition and mixed excavation materials to meet the cover and engineering requirements for the landfill include:

- maximising the landfill resource and extending the life of the landfill by not accepting unnecessary clean fill;
- protecting clean fill resources which have beneficial uses outside of landfill; and
- reducing the quantity of wastes received thereby promoting the state government's 60% reduction target for solid waste landfills.

These materials will be accepted as cover material throughout the life of the landfill.

Special Covering Requirements

Special waste is acceptable non-hazardous waste. It includes Solid Waste as identified in Table 5 of NSW EPA '*Environmental Guidelines: Assessment, Classification and Management of Non-Liquid Wastes*' (1997). Odorous wastes are often liquid and/or highly biodegradable materials. These materials will not be accepted at the landfill.

Grid points to identify the burial location of special wastes will be kept on a log to be retained by the Landfill Manager.

5.4.3 Task and Actions

The procedures to be put in place will be sufficient to meet the environmental goals for the covering of waste.

5.4.4 Performance Indicators/Responsible Party

Daily cover controls wind blown litter, pest species and landfill odours. For this reason, client identification of wind blown litter, vermin and landfill odours in the complaints registrar form the performance indicators for adequate cover material. The Landfill Manager will be responsible for ensuring that all complaints are actioned as soon as practical.

The Operations Manager will be responsible for determining which materials are to be used as cover material. The Machine Operator (Supervisor) will make this determination when the Operations Manager is not available.

The Operations Manager is responsible for ensuring that there is sufficient cover material available, that effective daily covering of material occurs and to maintain a minimum working face.

Section 72 Contribution rebate request forms will be completed by the Landfill Manager.

5.4.5 Frequency/Monitoring

The frequency and timing for daily cover measures will be:

ACTION	TIMING
Selection of Cover Material	Daily
Application of Cover Material	Continuous
Proper Burial of Asbestos Wastes	Each shipment of Asbestos
Completion of Section 72 Contribution Rebate Form	Monthly (3 months following use of cover)

5.4.6 Review/Auditing and Reporting

Information regarding the volume of material used will be recorded on the daily activities register. These reports will be filed and maintained by the Operations Manager.

The records will be kept on site and reviewed as part of an annual Audit by the Landfill Manager.

5.4.7 Corrective Actions

If there is evidence of litter or odour nuisance due to insufficient cover being placed on the daily working face, a thicker daily cover should be utilised. If the material being used as cover is determined to be inappropriate for use as cover material, an alternative material will be located and used.

5.5 DUST CONTROLS

5.5.1 Objectives

The primary environmental objective of dust controls at the landfill facility will be to prevent the degradation of local amenity. Dust controls will be necessary to minimise pollutants

leaving the site as airborne dust and reduce stormwater sediment load, thereby protecting local amenity.

Minimising the generation of dust will include the use of:

- sealed or gravel roads where possible; and
- water spraying on unsealed roads.

5.5.2 Management Strategy

Dust control measures at the site will consist of minimising exposure of the surface cover to wind. A grass cover will be present over much of the site. Areas not suitably grassed, will be irrigated to prevent dust from posing a problem at the site. Irrigation of these areas with leachate pumped from the dam will provide a use for the leachate and helps to control dust problems. Water stored in the stormwater sediment ponds is also available for use as irrigation water.

The haul road from the Transfer Station to the active tipping face will be regularly sprayed with water from a water cart throughout the daily operating period, to control the generation of dust from this source. The frequency of spraying will be increased during windy periods. Water from the dirty water collection pond or stormwater sediment ponds will also be available for this purpose subject to the quality of the water being acceptable.

All other unsealed roads and haul routes for cover material on the site will be similarly sprayed with water to minimise dust problems.

Minimisation of traffic into the tipping area will also help to reduce dust problems. Small vehicles will be prohibited from going down the haul road to the tip face. Additionally, the access road to the Transfer Station which will be used by the small vehicles will be sealed to minimise dust generation.

Dust from the landfill will be monitored at the dust deposition gauges at the boundary of the landfill on a monthly frequency in accordance with AS 3580.10.1-1991 (*Methods for sampling and analysis of ambient air - Determination of particulates - Deposited Matter - Gravimetric Method*).

5.5.3 Task and Actions

The procedures to be put in place will be sufficient to meet the environmental goals for the covering of waste.

5.5.4 Performance Indicators/Responsible Party

The performance indicators include:

- the number of complaints by affected clients, visitors and nearby residents regarding dust; and
- the dust monitoring results over the maximum dust deposition threshold for total solids.

The responsible party for maintaining minimal dust impact as the working face progresses and ensuring that the roadways are properly watered, will be the Operations Manager.

The Landfill Manager will be responsible for organising monthly dust monitoring and preparation of the annual report.

5.5.5 Frequency/Monitoring

The frequency and timing for dust control measures will be:

ACTION	TIMING
Evaluation of dust from waste activity and directing the water truck	Continuous
Dust monitoring to AS 3580.10.1-1991	Monthly
Reporting to EPA and Council	Annual

5.5.6 Review/Auditing and Reporting

A complaints register will be available for recording complaints from clients or residents. These records will be reviewed in the annual audit by the Landfill Manager.

The landfill will issue annual reports in tabular and graphical format to the EPA and Fairfield Council.

5.5.7 Corrective Actions

If dust becomes problematic, water trucks will be utilised more frequently to wet down affected areas. Revegetation of exposed areas will also reduce dust levels.

Should dust result in loss of local amenity, it would be necessary to determine the dust emission from each point source, in order to formulate a plan to control dust emissions and reduce the impact on the local amenity.

5.6 PEST, VERMIN AND NOXIOUS WEED CONTROL

5.6.1 Objectives

The primary environmental goal is to prevent the degradation of local amenity from pests, vermin and noxious weeds. These controls will be best conducted by:

- compacting and covering waste, keeping exposed volumes to a minimum;
- adequate drainage of the site, to prevent ponds of water forming; and
- implement a plan to manage pests, vermin and declared noxious weeds.

5.6.2 Management Strategy

Animal and plant pest species are not expected to form a significant issue at the proposed landfill. However, these species have the potential to cause nuisance on any landfill site. Pest, vermin and noxious weeds will be controlled through good compaction of all waste and prompt, thorough and effective covering of the landfill area.

Feral animals are often present around landfills, as a result of the easy access for animals to sources of food and the various habitats suitable for breeding and population increase.

The operational procedures at the site will be designed to minimise potential problems associated with feral animals (cats, dogs and rodents), seagulls, flies and other pathogen vectors. This will be achieved by rapid placement of daily cover over the active cell area, together with the continued compaction of the waste, to maximise the density of the fill.

It is noted that putrescible wastes have the highest potential to rapidly attract pest species. Since these wastes will not be accepted at the landfill, there is little incentive for feral animal encroachment. However, if vermin problems at the landfill are identified, a local exterminating firm will be contracted to control pest populations.

Noxious weed growth is generally not a significant problem around landfill sites during the life of a landfill. The revegetation techniques to be employed for the site rehabilitation plan as outlined in Section 4.11, should correct any long term problems related to the expansion of weed species. However, should noxious species be found at the site, the NSW National Parks and Wildlife Service and DLWC will be contacted for expert advice, on approved eradication procedures. These recommendations will be acted upon as appropriate.

5.6.3 Task and Actions

The procedures to be put in place will be sufficient to meet the environmental goals for the pest control at a solid waste landfill.

5.6.4 Performance Indicators/Responsible Party

Performance indicators for pest species include an increase in the number of flies, cockroaches, rodents, feral animals (cats & dogs) and nuisance weeds.

5.6.5 Frequency/Monitoring

The frequency and timing for pest control measures will be:

ACTION	TIMING
Note observations in Site Log	When pest species seem to be increasing
Setting of rodent and fly traps	Monthly, when alternative cover materials are investigated

5.6.6 Review/Auditing and Reporting

Monthly reports will be kept on site. These reports will be used to identify when the population of pests appear to be increasing. All of these records will be reviewed by the Landfill Manager as part of an annual site Audit.

5.6.7 Corrective Actions

If pests are identified, a commercial pest control contractor will be contracted and the appropriate actions taken.

5.7 ODOUR CONTROLS

5.7.1 Objectives

The primary environmental objective regarding odour control is the protection of local amenity, by minimising odours in accordance with the *Clean Air Act,* 1961 and ambient air quality criteria set by NSW EPA. The following measures will ensure that odours will be minimised:

- good housekeeping steps such as good compaction and continuous cover to prevent the production of odours; and
- accepting only non putrescible waste that is not highly biodegradable.

5.7.2 Management Strategy

Landfill odours may potentially become a nuisance to the local community and result in a loss of amenity, which can result in intervention of the landfill operating procedures by regulatory bodies. An integral part of maintaining an amicable relationship with residents neighbouring the landfill site, is to eliminate or minimise the emissions of gases and odours from the site.

Odours from landfill sites generally result from ketones, esters, mercaptans (thiols) and hydrogen sulphide (H_S) generated during the decomposition of long chain fatty acids. The extent to which these gases emerge will be limited on this site because of the limited volume of biodegradable material and because it is mainly in the form of moderately degradable waste.

Control of odours at the site, during the landfilling process, will be achieved by the maintenance of the seals comprised of a suitable material over the completed cells and by incorporating compacted material in interim cover to stimulate biofiltration of gases. Ongoing maintenance will be undertaken to ensure that gas seepage from cracks that may develop in the cover material, are minimised.

Leachate sumps and the leachate pond will be routinely checked for odour emissions. Leachate in the pond can readily be pumped as irrigation water across the open grassed areas before odour becomes a potential problem. Any leachate sumps developed at the site will be adequately sealed to prevent odour emission from these areas.

As the landfill facility has no sensitive surrounding land uses, the risk of odours emanating from site activities and effecting local amenity is minimal. A vegetation buffer between the working face and the access road will assist in minimising these impacts.

5.7.3 Task and Actions

The environmental benchmark techniques from the *Solid Waste Guidelines* (1996), indicate that odour dispersion modelling is a suitable technique for the management of odours. Due to the location and type of wastes accepted at the landfill, odour is not expected to be an issue and on this basis modelling is not required.

5.7.4 Performance Indicators/Responsible Party

Performance indicators are best illustrated by the complaints register which is kept for clients and nearby residents, who may be affected by odour.

The responsible party for initially prohibiting highly biodegradable waste from entry to the landfill premises will be the Weighbridge Operator. The Operations Manager will be responsible for daily covering of waste and monitoring the complaints register.

All employees will be trained to immediately report any complaints from clients, site visitors, neighbouring property owners or the surrounding community to the Landfill Manager. A copy of the formal complaints and follow-up form, will be held in the Operations Manager's Office.

5.7.5 Frequency/Monitoring

The frequency and timing for odour control measures will be as follows:

ACTION	TIMING
Screening waste at weighbridge	Continuous
Act on Complaint	At time of complaint
Monitoring of the odours on site	Continuous

5.7.6 Review/Auditing and Reporting

The complaints register will be kept at the Operations Manager's Office. These records will be audited in the annual site audit by the Landfill Manager.

5.7.7 Corrective Actions

If odour presents an ongoing nuisance, temporary gas extraction wells may be installed to permit flaring of the gases. Flaring of the gases extracted from the landfill would destroy the odorous traces associated with the landfill gases. All complaints regarding odours will be acted on immediately and steps taken to prevent recurrence. The ameliorative actions which will receive consideration include:

- increasing the thickness of the cover or using other more cohesive materials; and
- chemical treatment of the waste (application of lime).

Investigations will be conducted until the nuisance is under control.

5.8 NOISE CONTROLS

5.8.1 Objectives

The principal objective related to noise control at the landfill is to ensure that:

- noise from any single source does not intrude generally above the prevailing background noise level; and
- the background noise level does not exceed the level appropriate for the particular locality and land-use.

The EPA generally accept that the following levels are acceptable:

- Noise emanating from the site must not exceed a $L_{A,10T}$ sound pressure level of 50 dB (A) (daytime) or 40 dB (A) night time when measure or computed at any point within one metre of residential boundary or other noise sensitive area, such as schools, hospitals etc.
- Noise emanating from the site must not exceed a $L_{A,10T}$ sound pressure of 70 dB (A) when measured or computed at any point within one metre of any site boundary.

5.8.2 Management Strategy

Noise associated with landfill development generally comes from two sources. These include the equipment operating on the site and from garbage vehicles entering and leaving the site. It is expected that much of the noise generated at the landfill will be associated with the hauling of wastes into the pit. The separation of vehicles by purpose will reduce the potential for conflict and assist in minimising major noise sources where vehicles might interact.

The existing quarry access road will be utilised for access to the waste disposal area by authorised vehicles. Small private and commercial vehicles transporting waste material to the site will deposit their loads at the Waste Transfer Station.

Noise associated with the landfill equipment at the landfill is expected to be considerably attenuated by carefully planned landfill and extraction activities as well as natural features. As the landfilling and emplacement activities will occur below surface level in the disused Void 1 and proposed extension area, noise sources will for the most part be contained within the pit area.

5.8.3 Task and Actions

The procedures to be implemented will be sufficient to meet the environmental goals for noise control.

5.8.4 Performance Indicators/Responsible Party

Performance indicators include the number of complaints reported by neighbouring properties and clients concerning noise issues. The Operations Manager will be responsible to ensure that noise on site is minimised.

All employees will be trained to immediately report any complaints from clients, site visitors, neighbouring property owners or the surrounding community to the Landfill Manager. The Landfill Manager will be responsible for determining which measures need to be taken to control noise.

5.8.5 Frequency/Monitoring

The frequency and timing for noise control measures will be:

ACTION	TIMING
Act on Complaint	At time of complaint

5.8.6 Review/Auditing and Reporting

A complaints register will be kept on site at all times. Any additional machinery brought on to site will be recorded in the daily activities register. These records will be reviewed as part of an annual site Audit.

5.8.7 Corrective Actions

If noise is identified as being a problem on site, several management strategies may be employed. The first action taken to describe noise nuisance will include quantitative measurements. A suitably qualified consultant will be employed to monitor the noise upon serious complaint. The levels of noise measures will be compared to EPA criteria.

Solutions aimed at attenuating any noise nuisance may include measures such as the use of residential grade exhaust silencers and acoustic engine enclosures. These measures could be introduced to ensure the noise levels from the landfill operations, remain within EPA noise guidelines.

5.9 FIRE FIGHTING CAPACITY AND EMERGENCY RESPONSE

5.9.1 Objectives

The primary environmental objective is to ensure that there is adequate fire fighting capacity at any part of the landfill site.

The benchmark techniques for fire fighting capacity from the EPA's Solid Waste Guidelines (1996) include:

- *The procedure to follow, persons responsible, and equipment to be used in the event of a fire. This includes how on-site resources and external resources (Bush Fire Brigade etc.) and how resources will operate on a 24-hour-a-day basis.*
- *The maintenance schedule for all fire-fighting equipment and facilities. This should at a minimum include all equipment and facilities being visually checked on a weekly basis and test operated on a three-monthly basis*
- *Details of all the fire-fighting equipment that will be installed at the flammable store and at-site buildings.*
- *How all fire-fighting equipment will be clearly marked and signposted with access ensured at all times.*
- *How appropriate fire breaks are to be constructed and maintained around all filled areas, stockpiles or combustible gas extraction equipment and site buildings.*
- *Landfill staff training in landfill fire-fighting techniques.*

5.9.2 Management Strategy

Fire fighting and other emergency response will be maintained through capability operational controls, staff training and equipment maintenance.

Operational Measures

Compaction of the refuse to minimise air voids and recycling of leachate will reduce potential fire hazards at the landfill. In addition, rapid cover placement practices, minimises potential oxygenation of the fill.

The operational procedures to be adopted at the landfill, incorporating the systematic cellular tipping routine, rapid cover placement and compaction of the refuse, all synergistically combine to help ensure that the fire hazards are reduced. If a fire were to break out or if there was a burning load delivered, the first fire control action would be to place an additional load of cover material to extinguish the flames. The on-site water truck and other water trucks from nearby Austral operations would be available to assist in extinguishing the fire or to wet the surface where the fire is located.

All flammable and combustible liquids stored on site shall be maintained in accordance with the storage and handling requirements of Australian Standard 1940.

The lighting of fires will be banned at the site. Fire ban warning signs will be installed around the facility to ensure that no fires are lit. A detailed safety plan outlining fire fighting procedures, the location and access routes to water storages, and the location of fire fighting equipment will be prepared.

Any stored water in the leachate/dirty water collection pond or sedimentation ponds will be available for extinguishing fires, that may occur in the deposited waste material within the landfill area. Elsewhere, a reticulated water supply will provide sufficient fire protection to the Transfer Station and all other site buildings.

The chipped and unchipped wood waste, the chipped and unchipped greenwaste and the tyre stockpiles, will have a 10 metre fire break between rows. Additionally, the chipped green waste will be watered, which assists in controlling spontaneous generation of fires.

Other considerations with respect to fire safety include, the selection of machinery operated at the site and the maintenance of the current open space buffer zones. Machinery operated at the site will largely be diesel driven, to minimise the ignition potential of any gases at the site, while buffer zones to the site boundaries will be maintained to provide additional fire safety.

All vehicle and equipment maintenance will be conducted outside the landfill area including welding or hot processes. Where it is unavoidable that such processes are undertaken, within the landfill, special precautions will be taken to remove any potential for fire generation.

Staff Training

All permanent staff will be trained to use the fire extinguishers to fight on-site fires.

Fire Fighting Equipment

A water truck, used for wetting the roads, will be available for use in an emergency.

The following fire extinguishers will be available:

- portable nine kilogram, dry powder extinguishers in the office buildings;
- portable nine litre stored pressure water extinguishers in the office and amenities buildings; and
- 2 kg capacity fire extinguishers in all trucks and landfill machinery (*ie* compactors & graders).

All installed portable extinguishers will be maintained in accordance with Australian Standard 1851.1. The maintenance of fire extinguishers will include quarterly inspections by a private contractor, to ensure that all equipment and facilities are visually checked for damage and test operated on a quarterly frequency.

Hazardous Waste

All waste that enters the site will be screened and will follow specific controls before acceptance. The Weighbridge Operator, Machine Operators and Operations Manager will be trained in the identification of hazardous waste and its typical containers. However, there remains the possibility that prohibited waste materials may enter the site.

In the event that hazardous waste is identified at the weighbridge, that vehicle will be refused site entry. The EPA's Regional Office will be notified and the waste transporter identified.

Should hazardous waste be found in the working face, the material will be immediately segregated from all other wastes and made secure. The EPA Regional Office will be notified when there is a hazard to the safe operation of the landfill. This will be documented in writing as part of the annual report. The material may not be handled until an appropriately qualified consultant or the EPA, assess the dangers and determine a safe means to deal with the waste.

5.9.3 Task and Actions

The procedures to be put in place will be sufficient to meet the environmental goals for fire fighting capacity and emergency procedures at the landfill.

5.9.4 Performance Indicators/Responsible Party

Performance indicators for fire fighting capacity include the documentation of the quarterly inspection of fire extinguishers and an incident report submitted to the EPA and Fairfield City Council.

The Operations Manager will be the responsible party for the landfill covering operations, equipment maintenance, ensuring that the extinguishers are inspected and implementation of effective action in the landfill, should a fire occur. The Landfill Manager will be responsible for completing an incident report that notifies EPA and Fairfield City Council that a fire has occurred.

The Landfill Manager will also be responsible for organising training and maintaining training records for all employees.

The Administrative Assistant will be responsible for notifying the Fire Brigade, if a fire occurs anywhere on the premises.

5.9.5 Frequency/Monitoring

The frequency and timing for fire fighting capacity measures will be:

ACTION	TIMING
Cover Material	Continuous
Equipment Maintenance	Dependent on item, schedule in shop
Training	Annually
Extinguisher Inspection	Quarterly
Incident Reporting	Whenever a fire is identified

5.9.6 Review/Auditing and Reporting

All records relating to the maintenance of equipment and incident reports will be kept at the site. The results of any staff training conducted will also be recorded and kept. These records and the incident will be subject to an annual audit, conducted by the Landfill Manager.

5.9.7 Corrective Actions

The following procedures will be employed by all staff during a fire or other emergency:

1. Ensure that personnel are safe and take whatever actions are necessary to protect human health.
2. Identify nature of fire or event. Administer first aid if required.
3. Radio incident details to the Administrative Assistant.
4. Administrative Assistant to contact (in this order)
   - fire brigade;
   - other emergency services (ie ambulance) by dialling 000;
   - the Operations Manager;
   - the Landfill Manager.
5. Clean up any residue
6. Landfill Manager to contact EPA and Fairfield City Council once the incident is under control.

Other corrective actions include:

- If equipment is noted to be in need of repairs, maintenance should occur immediately; and
- All new personnel should be trained as soon as possible .

5.10 STAFFING AND TRAINING

5.10.1 Objectives

The primary environmental objective of the staffing and training benchmark, is to ensure an adequate level of staffing and training is conducted for environmentally responsible and safe management of the landfill.

Landfill operators are also to provide adequate staff to ensure that during operating hours all continuous tasks (including waste reception and security, compaction and covering) are completed in compliance with this Draft LEMP.

Staff training ensures that:

- all operators of compaction or earthworks equipment are skilled at undertaking all tasks required of them;
- all those who operate gas testing, water sampling or water testing apparatus are familiar with required testing and sample retention protocols, to a standard approved by the EPA; and
- all those who are to inspect or direct the placement of incoming wastes are capable of accurate data recording, and skilled at identifying wastes that are unacceptable.

5.10.2 Management Strategy

The landfill will be staffed by an adequate number of personnel at all times to ensure the managed operation of the facility. In order to ensure that operators possess suitable skills for operating heavy equipment, they are selected on the basis of necessary qualifications.

A full-time weighbridge operator will be present during operating hours. The weighbridge operator and machine operators will be instructed on how to identify liquid, hazardous and sludge wastes. This training will be documented and retained by the Landfill Manager.

All staff will be trained in the content of the LEMP as part of initial site induction. The sections that deal with safety and emergency procedures will form the core of this training. Initial training will include the identification and location of first aid and fire equipment. Routine training will be conducted on an annual frequency.

5.10.3 Performance Indicators/Responsible Party

There are no specific performance indicators for training. The Landfill Manager will be responsible for:

- initial selection of operators/contractors;
- ensuring that initial training/induction has been completed;
- filing of all training records and selection of all consultants and sub contractors.

The Landfill Manager may delegate these responsibilities, as necessary.

5.10.4 Frequency/Monitoring

The frequency and timing for fire fighting capacity measures will be:

ACTION	TIMING
Induction Training	Soon after appointment
Review	Annually
Safety Training	Annually
Contractor/Consultant Review	Each contract and then annually

5.10.5 Review/Auditing and Reporting

Reports of all training undertaken by the landfill staff as well as a copy of personnel files will be kept on file and reviewed as part of an annual site Audit.

5.10.6 Corrective Actions

Should a staff member not possess the correct training, arrangements will be made to train the staff member in the appropriate manner. The staff member will not be permitted to operate equipment or conduct inspections until proper training has been documented.

6.1 REPORTING

Austral will issue a number of reports to relevant authorities in conformance with any Waste Disposal and Pollution Control Licences. The purpose of these reports will be to keep the responsible authorities informed of on-site conditions relative to consumption of air space, waste disposal tonnages, environmental performance and unusual incidents.

6.1.1 INCIDENT REPORTS

All incidents will be reported to the EPA Pollution Line ((02)-9325-5555) as soon as it is safe to do so. A written report will follow the verbal notification within 14 days. The written report will clearly describe the event, identify the source and state the corrective actions, to minimise damage and prevent recurrence. A copy of this report will also be submitted to Council. Incidents shall include the following:

- attempts to dispose of hazardous wastes;
- fires;
- leachate escape; and
- any other event which may result in adverse environmental consequences.

6.2 MONTHLY REPORTS

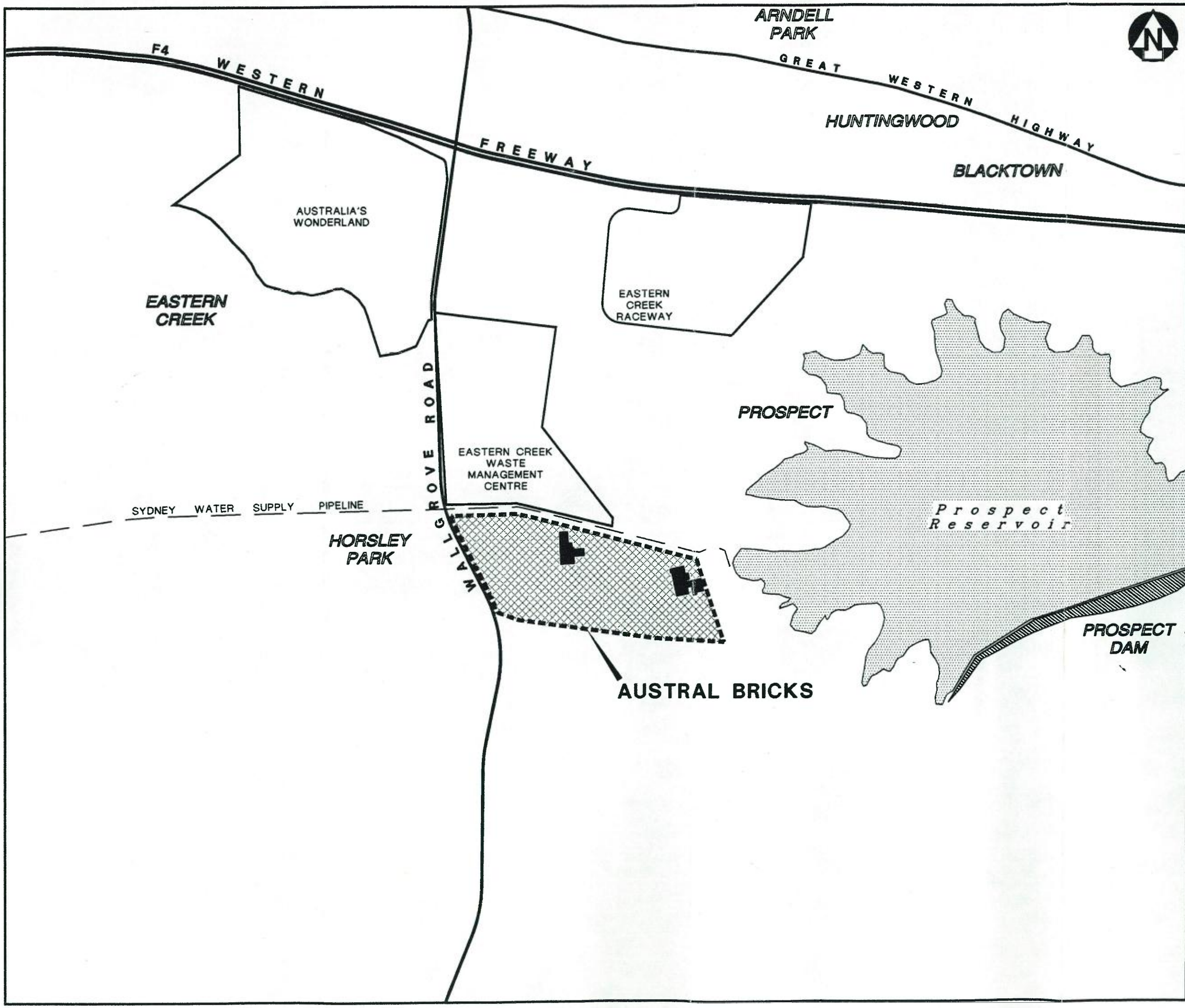
On a monthly frequency, Austral will report the total tonnage received for disposal and recycling. The monthly report will be useful for monitoring general trends in disposal mass and to enable payment of the Section 72 Contribution.

6.3 ANNUAL REPORTS

The annual site activity report/review, will be provided to the EPA and Fairfield City Council. This report will identify:

- significant changes in site operations and the LEMP;
- summarise wastes received for disposal;
- summarise recycling and composting activities;
- report on the semi-annual Registered Surveyors' report which will be used to project capacity of remaining air space;
- report on groundwater monitoring activities in tabular and graphical format, noting any statistical changes in groundwater conditions;
- report on surface water monitoring activity in tabular and graphical format, summarising results and indicate conformance with the Pollution Control License;
- report on leachate monitoring activities, noting trends in indicator parameters;
- summarise gas monitoring activities and any remedial actions; and
- summarise incident reports.

Figures



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CAD FILE NO: G.040
DATE: 20/11/97

DESIGNED: CB
DRAWN: HC
CHECKED: SKT
APPROVED: CB
STATUS: FINAL

LEGEND

- TRANSMISSION LINE
- WATER BODY
- ROADS
- SITE BOUNDARY

0 200 400 600 800 1000
metres

CLIENT
AUSTRAL BRICK COMPANY PTY LTD

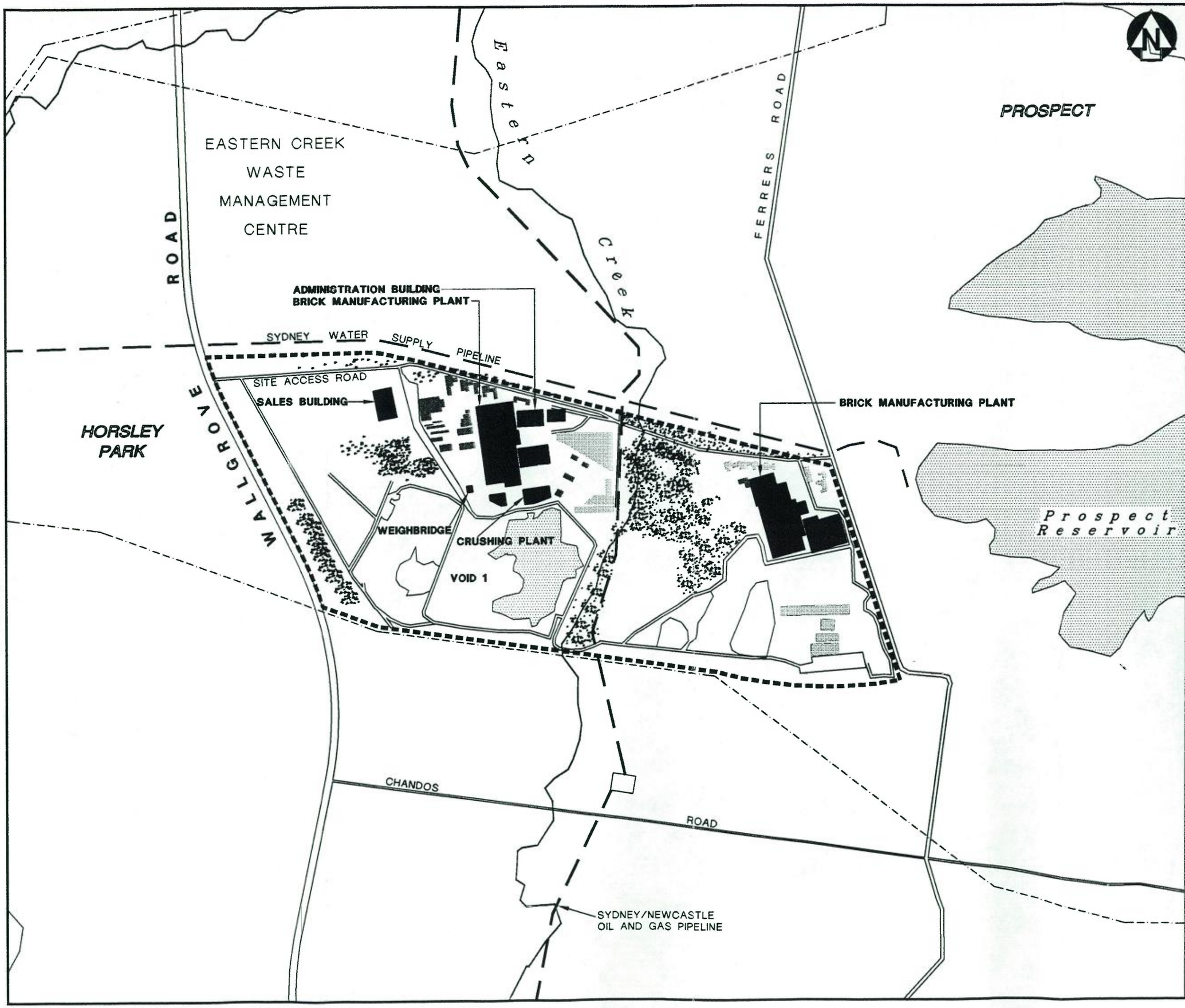
PROJECT
AUSTRAL BRICK SOLID WASTE LANDFILL EIS

TITLE
SITE LOCATION

FIGURE
1

A3

Woodward-Clyde



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CAD FILE NO:	G.041	APPROVED:	CB
DATE:	20/11/97	STATUS:	FINAL

LEGEND

- TRANSMISSION LINE
- CREEKS
- WATER BODY
- ROADS
- SITE BOUNDARY
- PIPELINE
- VEGETATION
- CLAY/SHALE STOCKPILE AREAS
- BRICK STOCKPILE AREAS

0 200 400 600
metres

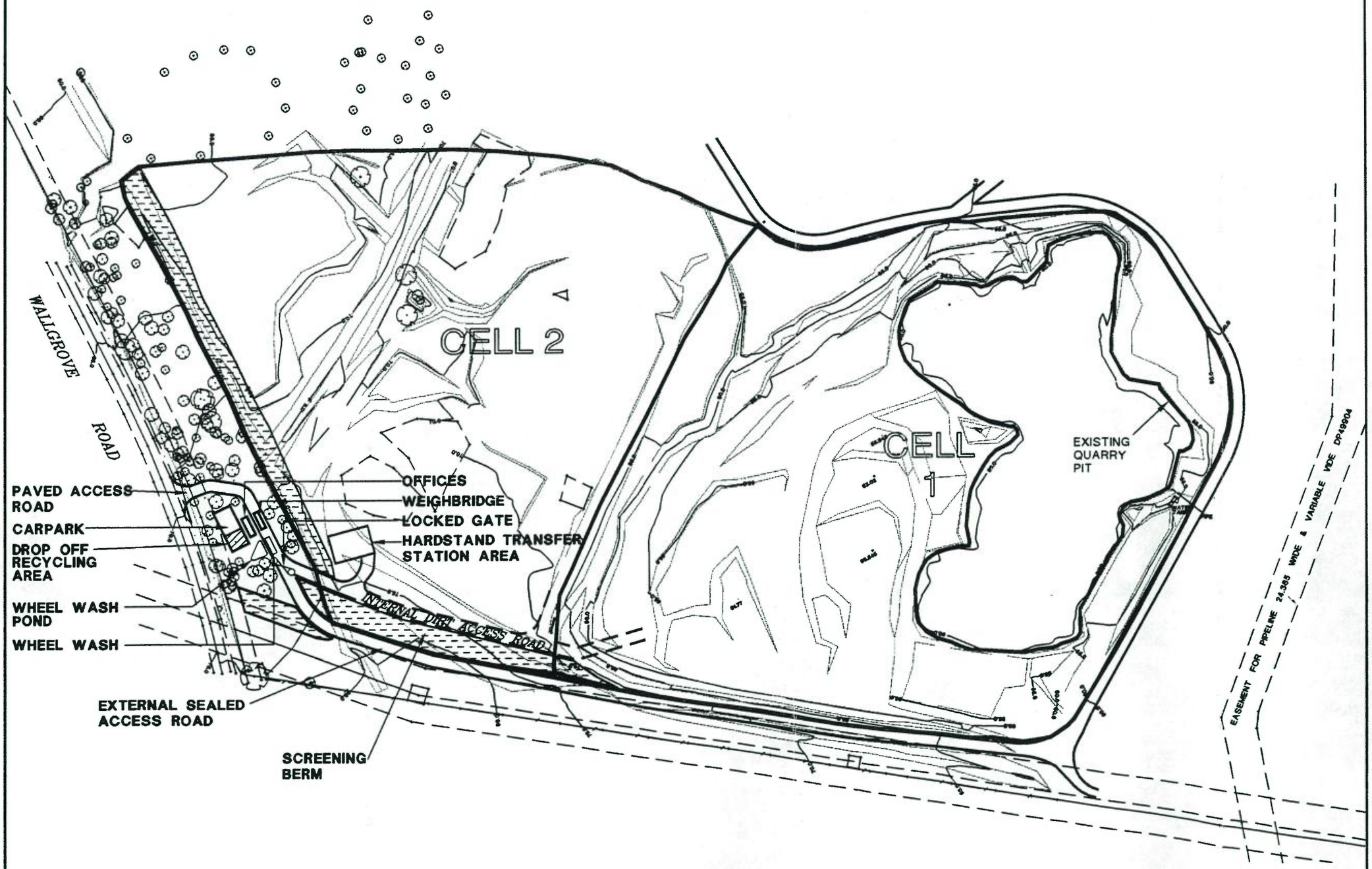
CLIENT
AUSTRAL BRICK COMPANY PTY LTD

PROJECT
AUSTRAL BRICK SOLID WASTE LANDFILL EIS

TITLE
AUSTRAL BRICKS PREMISES

FIGURE
2
A3

Woodward-Clyde



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CAD FILE NO: G.012
APPROVED: CB
DATE: 20/11/97
STATUS: FINAL
SOURCE:
WILLIAM L. BACKHOUSE Pty. Limited

LEGEND

SCREENING BERM

0 20 40 60 80 100
metres

CLIENT
AUSTRAL BRICK COMPANY PTY LTD

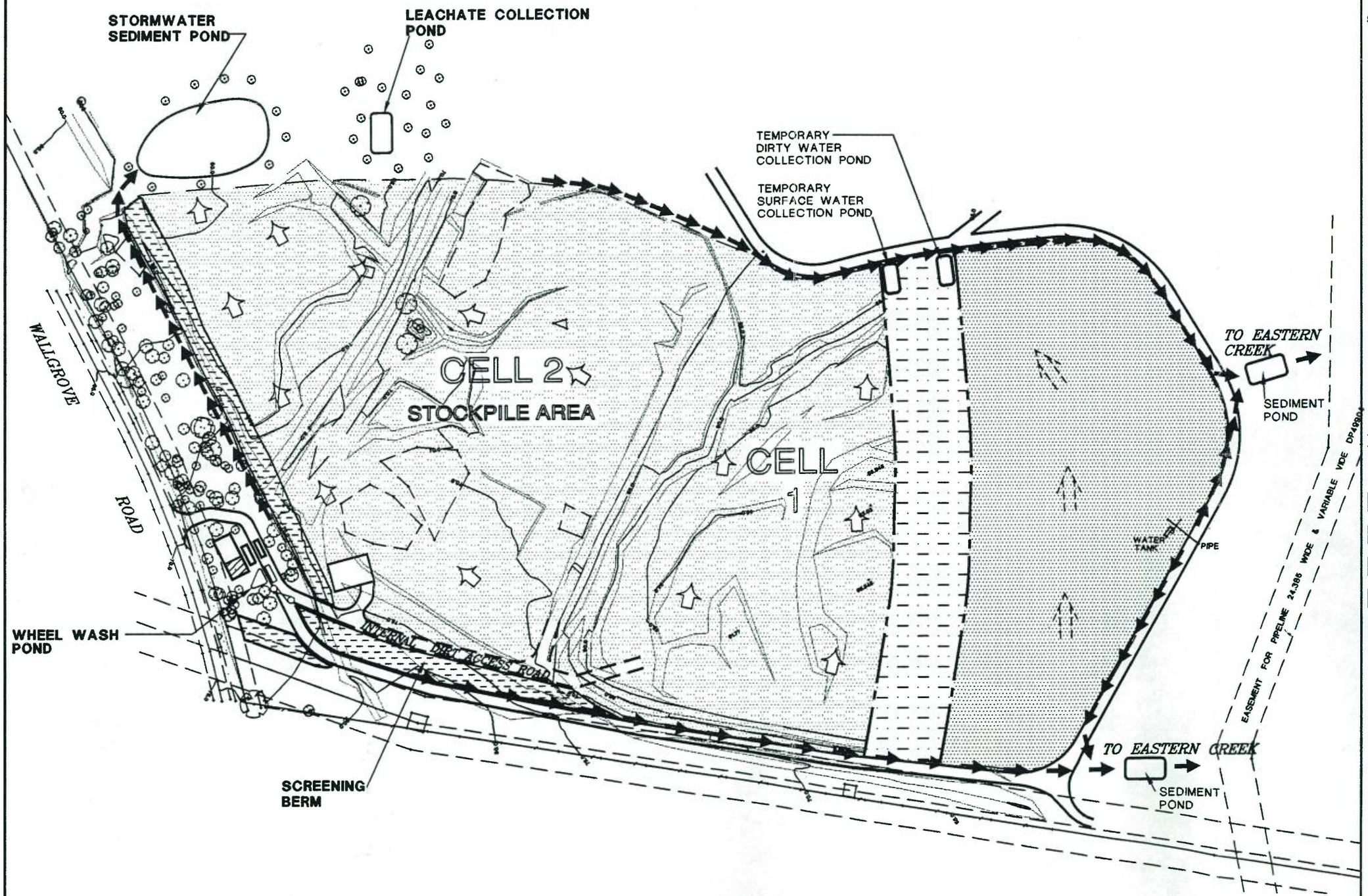
PROJECT
AUSTRAL BRICK SOLID WASTE LANDFILL EIS

TITLE
PROPOSED SITE LAYOUT

FIGURE
3

A3

Woodward-Clyde



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DATE:	20/11/97	STATUS:	FINAL

SOURCE:
WILLIAM L. BACKHOUSE Pty. Limited

LEGEND

- SURFACE WATER DIVERSION DRAIN
- DIRTY WATER FLOW PATH
- SURFACE WATER FLOW PATH
- ACTIVE LANDFILL AREA
- LANDFILL BASE PREPARATION AREA
- EXTRACTION AREA
- SCREENING BERM

0 20 40 60 80 100
metres

CLIENT
AUSTRAL BRICK COMPANY PTY LTD

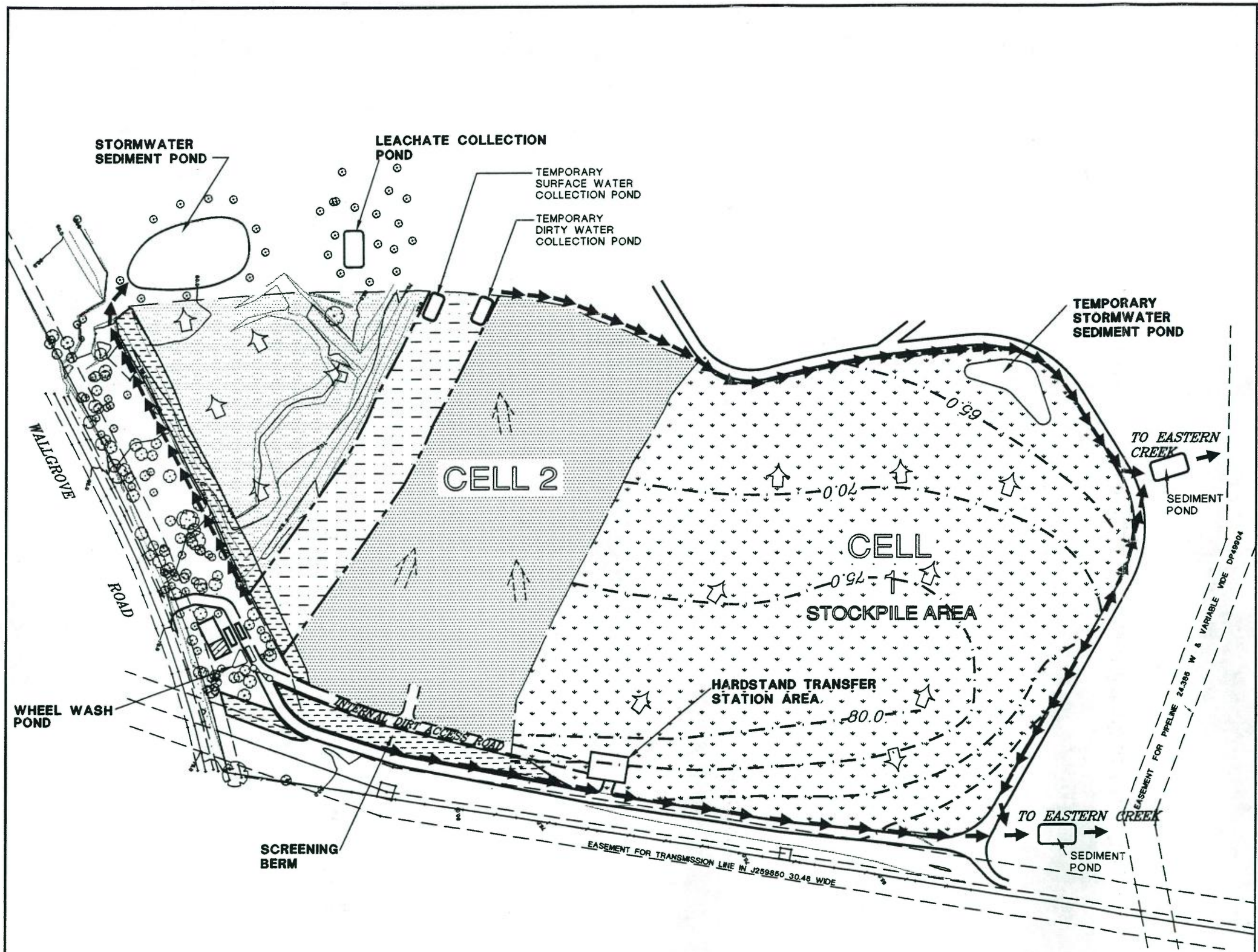
PROJECT
AUSTRAL BRICK SOLID WASTE LANDFILL EIS

TITLE
WATER MANAGEMENT - CELL 1 ACTIVE

FIGURE
4

A3

Woodward-Clyde



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CHECKED: SLT
CAD FILE NO: G.045
APPROVED: CB
DATE: 20/11/97
STATUS: FINAL
SOURCE:
WILLIAM L. BACKHOUSE Pty. Limited

LEGEND

- SURFACE WATER DIVERSION DRAIN
- DIRTY WATER FLOW PATH
- SURFACE WATER FLOW PATH
- ACTIVE LANDFILL AREA
- LANDFILL BASE PREPARATION AREA
- EXTRACTION AREA
- SCREENING BERM
- FINISHED SURFACE
- 80.0 FINISHED SURFACE LEVEL CONTOURS

0 20 40 60 80 100
metres

CLIENT
AUSTRAL BRICK COMPANY PTY LTD

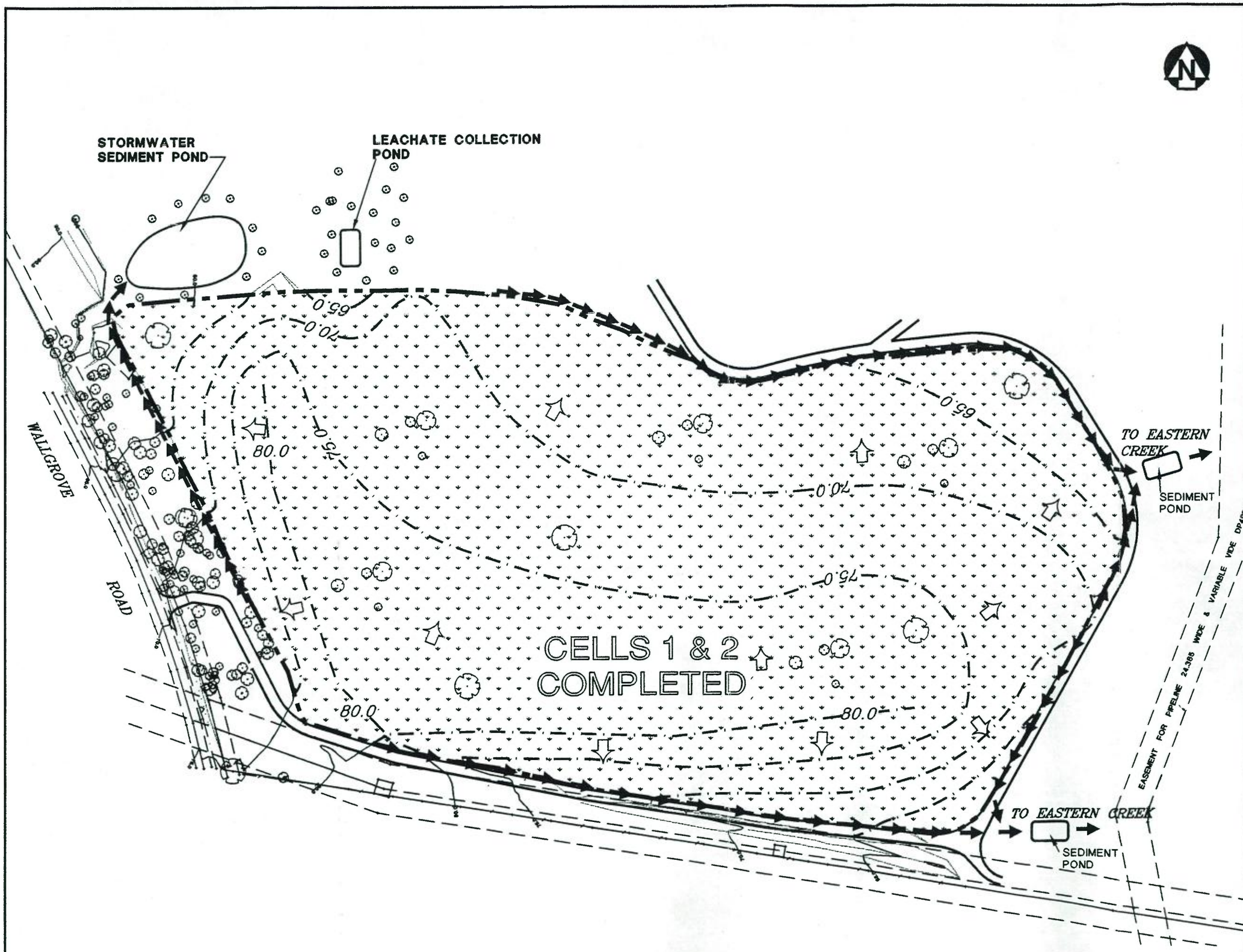
PROJECT
AUSTRAL BRICK SOLID WASTE LANDFILL EIS

TITLE
WATER MANAGEMENT CELL 2 - ACTIVE CELL 1 - COMPLETED

FIGURE
5

A3

Woodward-Clyde



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CHECKED: SKT
CAD FILE NO: G.043
APPROVED: CB
DATE: 20/11/97
STATUS: FINAL
SOURCE:
WILLIAM L. BACKHOUSE Pty. Limited

LEGEND

- SURFACE WATER DIVERSION DRAIN
- SURFACE WATER FLOW PATH
- REVEGETATED FINISHED SURFACE LEVEL

0 20 40 60 80 100
metres

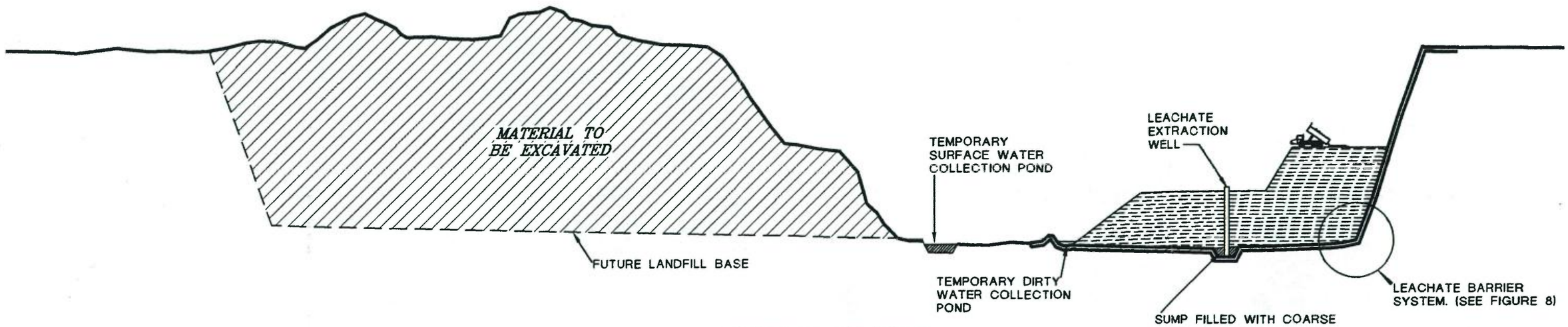
CLIENT
AUSTRAL BRICK COMPANY PTY LTD

PROJECT
AUSTRAL BRICK SOLID WASTE LANDFILL EIS

TITLE
WATER MANAGEMENT CELL 1 AND CELL 2 COMPLETED

FIGURE
6
A3

Woodward-Clyde



DURING FILLING
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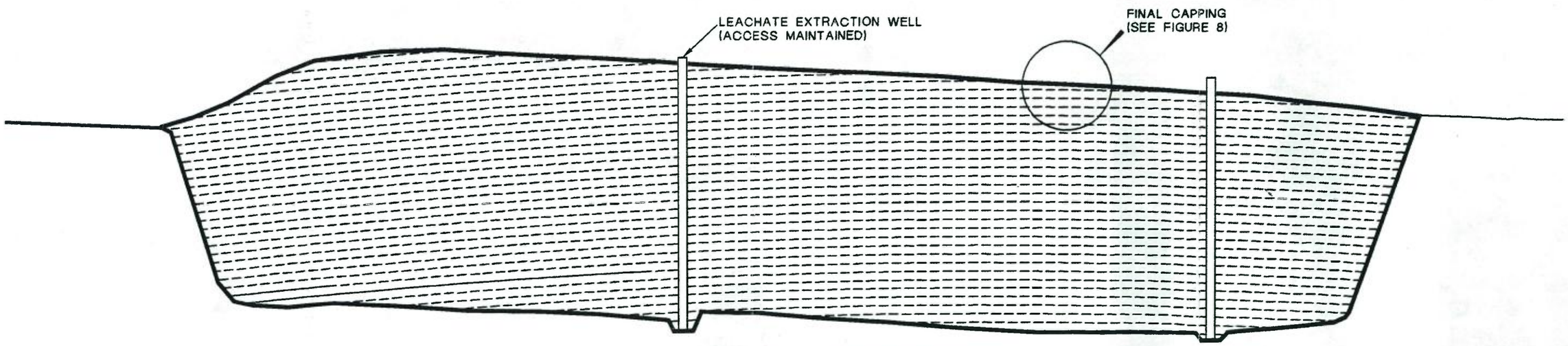

FILLING COMPLETED
NOT TO SCALE

Woodward-Clyde

CLIENT
AUSTRAL BRICK COMPANY PTY LTD

PROJECT
AUSTRAL BRICK SOLID WASTE LANDFILL EIS

REVISION: A
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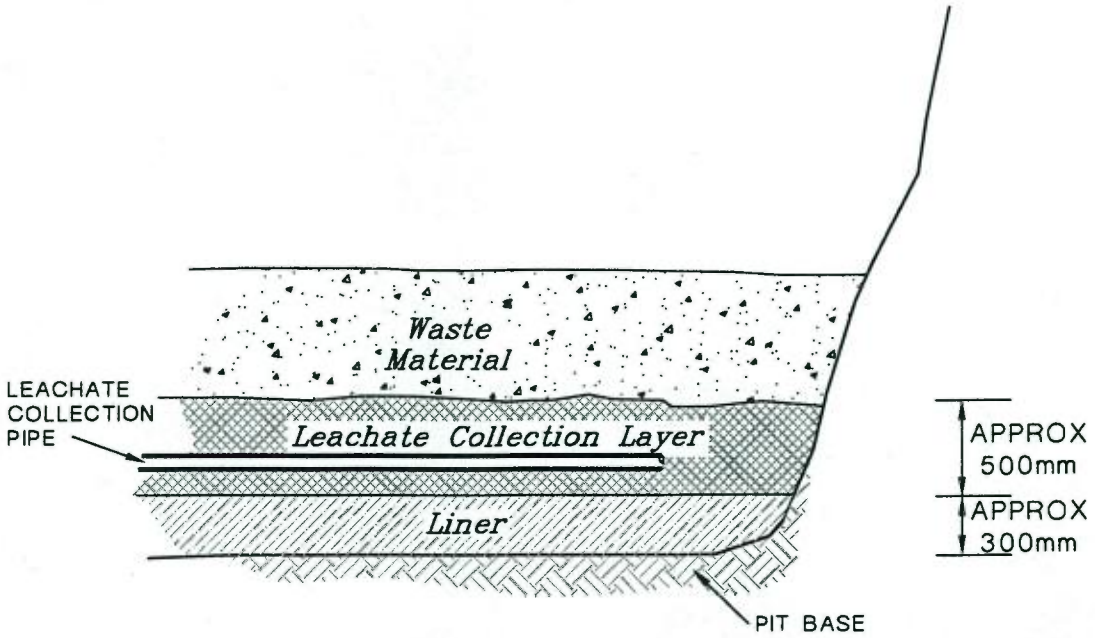
DRAWN: HC
DRAWING No: A8601191/0170
CHECKED: SKT
CAD FILE NO: G.044
APPROVED: CB
DATE: 20/4/97
STATUS: FINAL

TITLE
SCHEMATIC LANDFILL CROSS SECTION SHOWING LEACHATE COLLECTION

FIGURE
7

A3



LINER DETAIL SYSTEM
DETAIL 1
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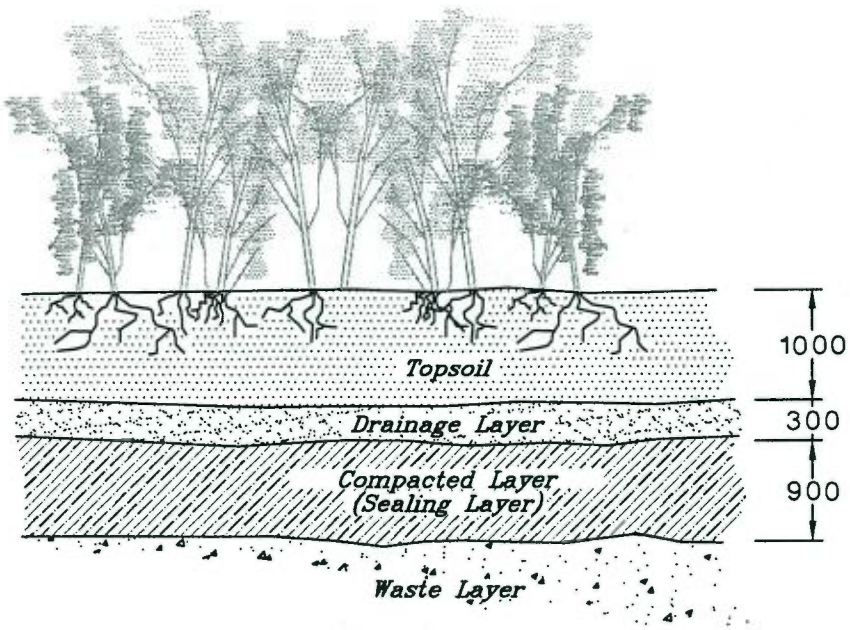
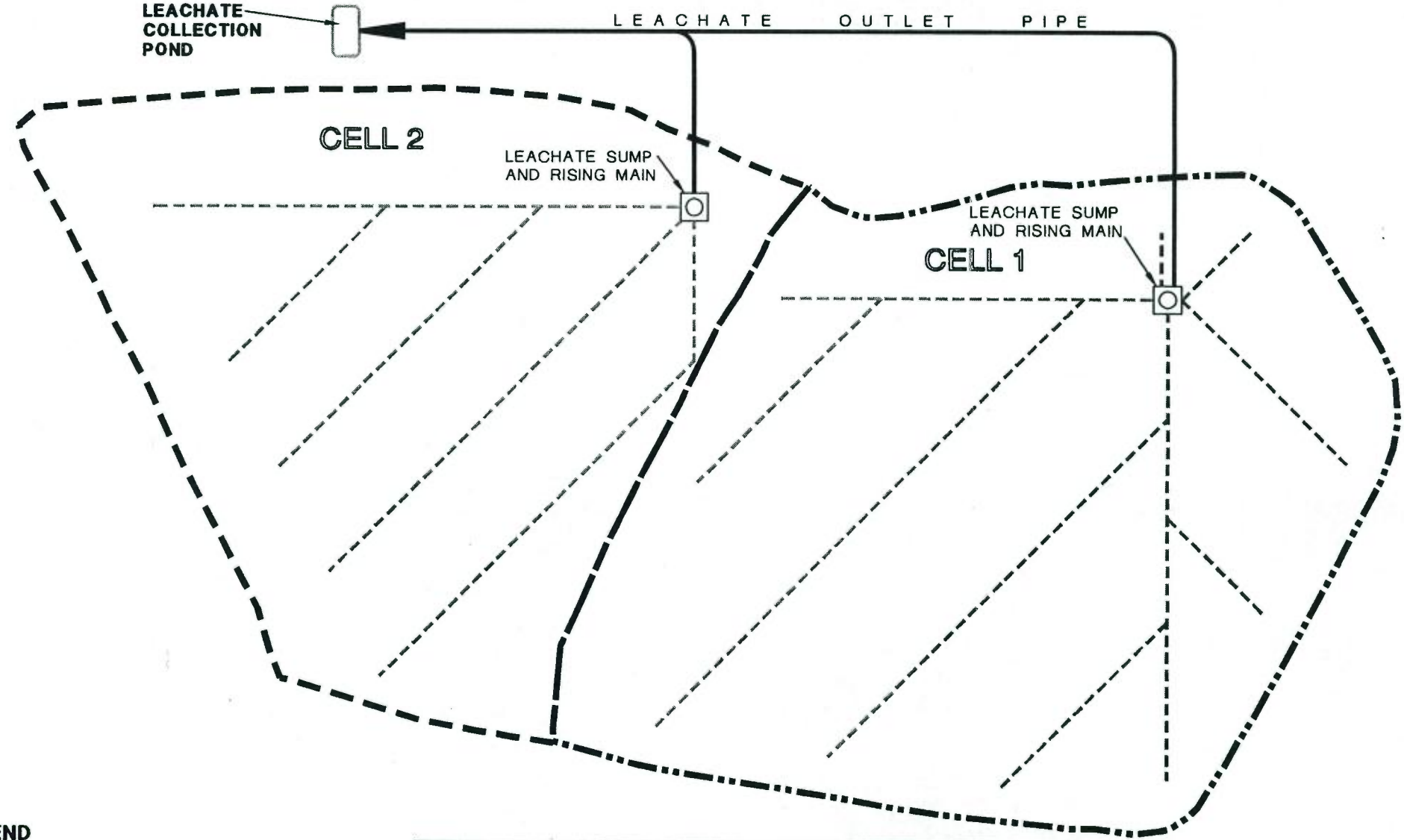


FINAL CAPPING
DETAIL 2
NOT TO SCALE

Woodward-Clyde	CLIENT: AUSTRAL BRICK COMPANY PTY LTD PROJECT: AUSTRAL BRICK SOLID WASTE LANDFILL EIS	REVISION: B SCALE: N.T.S. DRAWING No: A8601191/0170 CAD FILE NO: G.011 DATE: 20/11/97	DESIGNED: ST DRAWN: HC CHECKED: SKT APPROVED: CB STATUS: FINAL	TITLE: SCHEMATIC LINER DETAILS 1 AND 2 FIGURE: 8

A4



LEGEND

- LEACHATE COLLECTION PIPE
- CELL 1 BOUNDARY
- CELL 2 BOUNDARY

0 20 40 60 80 100

metres

Woodward-Clyde

CLIENT
AUSTRAL BRICK COMPANY PTY LTD

PROJECT
AUSTRAL BRICK SOLID WASTE LANDFILL EIS

REVISION: B	DESIGNED: ST
SCALE: AS SHOWN	DRAWN: HC
DRAWING No: A8601191/0170	CHECKED: SLT
CAD FILE NO: G.008	APPROVED: CB
DATE: 20/11/97	STATUS: FINAL

TITLE
SCHEMATIC OF LEACHATE COLLECTION SYSTEM LAYOUT

FIGURE
9 A4

Appendix C

Director-General's Requirements

New South Wales Government
Department of Urban Affairs and Planning

Mr Michael England
Principal Environmental Planner
AGC Woodward-Clyde Pty Ltd
Level 6, 486-494 Pacific Highway
ST LEONARDS NSW 2065

Contact: Miranda Yue

Our Reference: P97/00278 Pt 1

Your Reference:

30 SEP 1997

Dear Mr England,

Proposed Inert Waste Landfill, Horsley Park, Fairfield

Thank you for your letter of 6 August seeking consultation with the Director-General for the preparation of an environmental impact statement (EIS) for the proposed inert waste landfill. I refer also to your subsequent letter of 20 August 1997 which forwarded the Planning Focus Report and the notes of Planning Focus Meeting held on 14 August 1997, and your letter of 19 September 1997. According to the correspondence, it is understood that the proposal is comprised of continuation of quarrying and landfilling.

Under clause 52 of the Environmental Planning and Assessment Regulation 1994 (the Regulation), the Director-General requires that the key issues outlined below be specifically addressed in the EIS.

Key Issues

- the consistency with the objectives and any relevant provisions of Sydney Regional Environmental Plan No. 9 - Extractive Industry (No. 2), in particular clause 8;
- the consistency of the proposed development with the objectives and the relevant provisions of the Sydney Regional Environmental Plan No. 20 - Hawkesbury Nepean River and the relationship with the Draft Sydney Regional Environmental Plan No. 20 - Hawkesbury Nepean River 1996;
- demonstration, through the rehabilitation plan, that the land will be suitable for the proposed use within the objectives of the regional open space zone, 6(c) Recreation - Corridor under Fairfield Local Environmental Plan 1994;
- the traffic impact on Wallgrove Road;
- the impacts on Eastern Creek; and
- assessment of the likelihood of the area supporting any threatened species, populations or ecological communities, or their habitats, including:
  - * a description of the area, including details of the types and condition of the habitat(s) in, and adjacent to, the land to be affected by the proposal
  - * a list of those threatened species, populations or ecological communities known to occur in the same or similar habitats in the region, and

Governor Macquarie Tower
1 Farrer Place, Sydney 2000
Box 3927 GPO, Sydney 2001

Telephone: (02) 9391 2000
Facsimile: (02) 9391 2111

* an assessment of the likelihood of those species, populations or ecological communities identified above occurring within the area given the habitat requirements of the species, populations or ecological communities and the habitats present within the area

The Environmental Planning and Assessment Act, 1979 requires the submission of a Species Impact Statement (SIS) if the proposal is likely to have a significant effect on threatened species, populations or ecological communities, or their habitats. If the appraisal referred to above indicates that threatened species, populations or ecological communities, or their habitats are present and are likely to be affected by the proposal, it is recommended that the proponent evaluate the significance of the impacts by applying the 8 part test in section 5A of the Act. If this is done, the 8 part test should be included as an Appendix to the EIS. The consent authority will also apply the 8 part test and may request an SIS if one has not already been submitted. The decision to prepare an SIS should not be made without first undertaking the 8 part test.

The EIS should also include the results of consultation with relevant public authorities and organisations, including the Sydney Region West Branch of the Department, Fairfield City Council, Blacktown City Council, the Hawkesbury Nepean Catchment Management Trust and Pacific Power.

Attached please find two sets of EIS Guidelines: *Landfilling* and *Extractive Industries - Quarries*. These guidelines contain the type of information most likely to be relevant to your proposal. Not all matters raised therein may be appropriate for consideration in the EIS, equally, they are not exhaustive.

Requirements for the form and content of the EIS, together with requirements for public exhibition are outlined in Attachment No. 1.

Should you have any further enquiries please do not hesitate to contact Miranda Yue on phone (02) 9391-2201.

Yours sincerely,

J Broadbough

for David Mutton
Acting Manager
Major Assessments and Hazards Branch
As Delegate for the Director-General

DEPARTMENT OF URBAN AFFAIRS AND PLANNING

Attachment No. 1

STATUTORY REQUIREMENTS FOR THE PREPARATION OF AN ENVIRONMENTAL IMPACT STATEMENT UNDER PART 4 OF THE ENVIRONMENTAL PLANNING AND ASSESSMENT ACT 1979

In accordance with the *Environmental Planning and Assessment Act 1979* (the Act), an environmental impact statement (EIS) must meet the following requirements.

Content of EIS

Pursuant to Schedule 2 and clause 51 of the *Environmental Planning and Assessment Regulation 1994* (the Regulation), an EIS must include:

1. A summary of the environmental impact statement.
2. A statement of the objectives of the development or activity.
3. An analysis of any feasible alternatives to the carrying out of the development or activity, having regard to its objectives, including:
   (a) the consequences of not carrying out the development or activity; and
   (b) the reasons justifying the carrying out of the development or activity.
4. An analysis of the development or activity, including:
   (a) a full description of the development or activity; and
   (b) a general description of the environment likely to be affected by the development or activity, together with a detailed description of those aspects of the environment that are likely to be significantly affected; and
   (c) the likely impact on the environment of the development or activity, having regard to:
      (i) the nature and extent of the development or activity; and
      (ii) the nature and extent of any building or work associated with the development or activity; and
      (iii) the way in which any such building or work is to be designed, constructed and operated; and
      (iv) any rehabilitation measures to be undertaken in connection with the development or activity; and
   (d) a full description of the measures proposed to mitigate any adverse effects of the development or activity on the environment.
5. The reasons justifying the carrying out of the development or activity in the manner proposed, having regard to biophysical, economic and social considerations and the principles of ecologically sustainable development.
6. A compilation, (in a single section of the environmental impact statement) of the measures referred to in item 4(d).
7. A list of any approvals that must be obtained under any other Act or law before the development or activity may lawfully be carried out.
8. For the purposes of Schedule 2, the principles of **ecologically sustainable development** are as follows:
   (a) The precautionary principle - namely, that if there are threats of serious or irreversible environmental damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation.
   (b) Inter-generational equity - namely, that the present generation should ensure that the health, diversity and productivity of the environment is maintained or enhanced for the benefit of future generations.
   (c) Conservation of biological diversity and ecological integrity.
   (d) Improved valuation and pricing of environmental resources.

Note

The matters to be included in item (4)(c) might include such of the following as are relevant to the development or activity:

(a) the likelihood of soil contamination arising from the development or activity;
(b) the impact of the development or activity on flora and fauna;

(c) the likelihood of air, noise or water pollution arising from the development or activity;
(d) the impact of the development or activity on the health of people in the neighbourhood of the development or activity;
(e) any hazards arising from the development or activity;
(f) the impact of the development or activity on traffic in the neighbourhood of the development or activity;
(g) the effect of the development or activity on local climate;
(h) the social and economic impact of the development or activity;
(i) the visual impact of the development or activity on the scenic quality of land in the neighbourhood of the development or activity;
(j) the effect of the development or activity on soil erosion and the silting up of rivers or lakes;
(k) the effect of the development or activity on the cultural and heritage significance of the land.

An environmental impact statement referred to in Section 77(3)(d) of the Act shall be prepared in written form and shall be accompanied by a copy of Form 2 of the Regulation signed by the person who has prepared it.

Procedures for public exhibition of the EIS are set down in clauses 55 to 57 of the Regulation.

Attention is also drawn to clause 115 of the Regulation regarding false or misleading statements in EISs.

Note

Should the development application to which the EIS relates not be exhibited within 2 years from the date of issue of the Director-General's requirements, under clause 52(5) of the Regulation the proponent is required to reconsult with the Director-General.

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Appendix D

Statutory Authority Requirements

FILE NOTE

AUSTRAL BRICK SOLID WASTE LANDFILL EIS, HORSLEY PARK

Planning Focus meeting

14 August 1997, 10.30 am

Meeting was attended by:

Kerry Brew - Department of Urban Affairs and Planning
Gilbert de Chalain - Fairfield City Council
Glenn Apps - Fairfield City Council
Perry Bezzina - Blacktown City Council
Tracy Chalk - Blacktown City Council
Gareth Ponton - Blacktown City Council
Peter Watson - Environment Protection Authority
Alan Ferguson - Department of Mineral Resources
Alan Pendleton - Western Sydney Waste Board
Paul Williamson - Western Sydney Waste Board
Tim Sheridan - Sydney Water
Marina Hatzakis - Sydney Water
Graham Richards - Roads and Traffic Authority
Tony Bles - Southern Western Sydney Public Health Unit
Alex Payne - Austral
Peter Mahony - Austral
Cathy Ingles - Austral
Grant Ackers - Austral
Michael England - Woodward-Clyde
Catherine Brady - Woodward-Clyde
Sarah Townsend - Woodward-Clyde

Record of discussions follows:

Austral Brick Company Environmental Impact Statement-concerns and issues raised during Planning Focus Meeting

Department of Urban Affairs and Planning:

- Consider context of site.
- Land is located in Prospect Corridor and DUAP is the acquisition authority for corridor lands.
- Need to consider the impact of the proposal on the water quality of Eastern Creek.
- Need to retain vegetation along Eastern Creek.
- On completion of landfilling activities, the final landform should be stable, attractive and enable the growth of vegetation.
- The EIS should justify the need for the proposed landfill.

Fairfield City Council:

- Need to address odour control and means of dealing with odour emissions in EIS.
- Strategies to monitor and manage landfill gas should be addressed in the EIS.
- Longterm stockpiles should be stabilised with vegetation. Would help reduce the visual impact.
- Diversion of surface water from fill areas and other surface water management strategies should be addressed in the EIS.
- The impact of the proposal on the rural residential interface should be assessed.
- The final landform should be detailed in the EIS. It should reflect the surrounding topography.
- Assess the cumulative impact of the proposal.
- Detail means of ensuring the landfill only receives the waste it is licenced to receive. How will the proponent deal with unacceptable waste?
- Indicated that the local community objected to the overall timeframe of landfilling at the nearby PGH site. Timeframe on this site will be longer.
- Consider implications of potential rezoning of land parcel on western side of Wallgrove Rd for industrial purposes.

Blacktown City Council:

- A Landfill Environmental Management Plan (LEMP) is a critical component of the project.
- The LEMP and EIS should detail the timing of activities and the agencies responsible for undertaking specific activities.
- The anticipated duration of landfilling should be detailed in the EIS.
- Environmental controls relating to water and air quality etc should be included in the EIS.
- Examine impact on regional water and air quality.

Environment Protection Authority:

- Solid waste guidelines apply to the proposal.
- A draft LEMP must be prepared as part of the EIS.
- Any new waste management technologies would be reviewed by the EPA.
- No problem with using cells to compartmentalise waste as long as environmental monitoring is undertaken.

Department of Mineral Resources:

- The site is located in a regionally significant area.
- Marketing of bricks is currently based on the colour of brick preferred by consumers. This could change in the future. There is a need to determine whether Void 1 contains resources which are suitable for brick manufacturing operations. Concerned that the proposed landfill does not sterilise a future resource.
- Exploration drilling should be conducted prior to extending Void 1.
- Provide details of what resources are there, what can be extracted and justification for any sterilisation of future resources.

Western Sydney Waste Board:

- Waste Minimisation and Management Act states that efforts should be made to reduce the consumption of resources and the disposal of waste to landfills.

- There are number of landfills in this region.
- Class 2 landfills should be in the business of waste management.
- A draft LEMP must be prepared as part of the EIS.
- Materials in the waste stream are potential resources.
- New waste management strategies aim to divert 60% of waste from landfill. Also aim to reduce the quantity and promote the reuse of waste. This would result in the landfill having a longer lifetime.
- Class 2 landfills contain waste which degrades slowly. May be 150 years or more. need to examine the ecologically sustainable issue.
- Examine the Waste Minimisation and Management Act 1995 as it relates to management of waste.
- Waste Boards set the policy for the region while the EPA ensures appropriate environmental controls.
- The Draft Regional Waste Plan for the Sydney Region states that the materials now in the waste stream are a valuable resource that should be used to gain higher value. For instance demolition and commercial material should be resourced so it can be reused rather than just placed in a landfill.
- Need to look at reuse of waste.

Sydney Water:

- No impact on Sydney Water Supply Pipeline is anticipated.
- Environmental control measures should be adopted to ensure there is no impact on Prospect Reservoir or on groundwater quality.

Roads and Traffic Authority:

- The likely traffic movements generated by the proposed development should be addressed in the EIS.
- The necessity of making improvements to existing road and intersection conditions (in terms of traffic and pedestrian safety and efficiency) in the immediate vicinity of the development should be addressed in the EIS.
- Need to examine options for entrance and sight distances on Wallgrove Rd.
- The form of intersection should be discussed - will it be signal or sign controlled?

- A traffic management plan should be developed particularly if there will be truck movements in the period from 10 pm and 6 am. Where possible residential areas should be avoided, particularly during this time period.
- The proposed access driveway treatment and on-site parking layout for staff, visitor and heavy vehicles should be addressed.
- The EIS should justify the need for a separate access road to the landfill.
- The Orbital road is not likely to be constructed as soon as previously proposed but has not been abandoned.

Southern Western Sydney Public Health Unit:

- The proposed landfill should not affect the provision of water for drinking purposes.
- The disposal on site, project generated sewage should be addressed.
- Health and safety issues relating to the construction and operation of the proposed landfill should be addressed.

Note

A copy of the file note was sent out to the authorities who attended the planning focus meeting in order to provide them with an opportunity to confirm their comments and concerns. The letters received in response to the file note have been attached along with the letters received from authorities who were unable to attend the Planning Focus Meeting.

Hawkesbury Nepean
CATCHMENT MANAGEMENT TRUST

29th August 1997

Woodward-Clyde Pty Ltd
Level 6
486-494 Pacific Highway
ST LEONARDS 2065

Contact: Tony Towers
Our Ref: LM/FA/EIS hors-aust-q
Your Ref: A8601191

Dear Ms Townsend,

Proposed waste landfill - Austral Brickworks site, Horsley Park, Fairfield.

Thank you for your invitation to the Planning Focus Meeting on 14th August 1997. Although the Trust representative was unable to attend, we do have an interest in the proposal. The Trust recommends that the following issues be assessed in the forthcoming EIS.

1. The project should satisfy the Trust's policy on water quality and quantity:
   - *Any water flow or changes in flow from the area should not alter the downstream natural hydrology (frequency or peaks) for all events up to the one in two year storm event (30 minute event), and should not alter the downstream peak levels for events up to the 1 in 100 year event.*
   - *Surface run-off should not compromise the: ANZECC Guidelines standard for healthy rivers - aquatic ecosystems, water supply for livestock, fish etc for human consumption; and NHMRC Guidelines for recreational water quality - visual amenity and secondary contact recreation.*
   - *Groundwater should be protected from the impacts of any contaminated surface waters and/or leachate.*

   In this location the Trust is particularly concerned with the present and potential impact on Eastern Creek.
2. Establish in terms of ESD principles: the need for, and appropriateness of, using such a site for landfill and consistency with an overall strategy for the use of former quarries in the area; ways in which the sources of fill can be guaranteed and the filling closely monitored to prohibit other than approved fill. Identification of proposed final uses.
3. Construction of a final landform that will be geomorphologically stable in the long term.
4. The Trust supports the preparation of a Landfill Environment Management Plan in the form of an EMS in accordance with ISO 14000, aimed at ensuring that the site is managed effectively, that impacts upon the environment are minimised and that there are effective monitoring and reporting mechanisms in place. The Plan would incorporate:
   - The Environmental Management and Rehabilitation Plan required by the Extractive Industries/Quarries Practice Guideline (July 1994) prepared by the DUAP. It needs to specifically identify who is responsible for implementation of each action and the timeframe; document reporting mechanisms including the management routine for

Hawkesbury-Nepean Catchment Management Trust, 68 Mileham St, (PO Box 556), Windsor NSW 2756
Tel: (045) 77 4243 Fax: (045) 77 4236

after hours activation of alarms; an incident management system; management and monitoring; on-site materials management; day to day operating procedures; erosion and sediment controls; emergency/contingency plans; water cycle, drainage, erosion and sediment control; air quality; rehabilitation/regeneration.

- Water quality management that will achieve the Trust's policy, including: the flow regime of receiving waters; likely impact of the proposal; the means of collection and disposal of surface water run-off; the management of waste waters, oils and grease; control of drainage, both quantity and quality; appropriate leachate control measures and any likely infiltration into the ground water and effects on water bores.
- Vegetation management including, but not limited to: important vegetation communities; revegetation of disturbed areas.
- The environmental management plans should indicate a requirement for preparation of working documents for works supervisors on the ground, specifying required outcomes and best practice to achieve the outcomes in relation to the issues set out in this letter.

5. Provision for an environmental impact prediction verification report. The Trust considers that this is particularly useful as it establishes a process for determining whether the predictions made for a proposal are valid; provides for reporting at several stages; gives the opportunity, depending upon the outcomes of the report, for the permitting and regulatory authorities to require amendments to the operations; and produces a document that can be made available to the public.

6. Fauna and flora should be adequately protected. Any significant effect on threatened species, populations or communities is to be assessed in terms of the Threatened Species Conservation Act.

7. Air quality will be maintained. The EIS will indicate measures for dust suppression from activities, haulage vehicles and waste disposal.

8. The consistency of the proposal with the:
   - *Environmental Guidelines: Solid Waste Landfills,* NSW E.P.A. 1996; and
   - *EIS Practice Guideline: Landfilling,* NSW DUAP 1996

The EIS should also address the provisions of Sydney Regional Environmental Plan No 20 Hawkesbury-Nepean River and the draft amendments to the Plan, in particular the consistency of the proposal with the Plan's aims, objectives and criteria.

Should you wish to discuss any matter raised in this letter, please contact the Trust's staff.

Yours sincerely,

Clarison

for Malcolm Hughes

Director, Planning & Assessment Program

cc. Erich Weller **Chairperson**
Michael Druce **Catchment Co-ordinator**
South Creek Catchment Management Committee

File:
Date: 21/08/97

Western Sydney Waste Board
Managing resources for our future

Mr Michael England
Principle, Environmental Planning
AGC Woodward Clyde Pty Ltd
486-494 Pacific Highway
ST LEONARDS NSW 2065

RE: PROPOSED EIS - AUSTRAL BRICKWORKS

Dear Michael,

Thank you for your time and effort at the workshop last week. I write to formalise my statements on the day and to express a desire to continue working with you and your clients on their proposals.

It seems that the proponents of the activity need to consider more fully their responsibilities under the Waste Minimisation & Management Act 1995. Particularly the need to work to achieve the diversion of 60% of wastes from landfill and the management of resources recovered from waste streams.

As you are aware, the Draft Regional Waste Plan proposes that future landfill standards should be improved and that the Plan states that landfilling as we know it is considered unsustainable in regard to the principles of ecologically sustainable development. On both these accounts the Boards desires are to see in future plans attempts to move away from seeing landfilling as an easy option for waste generators, that is as an easy disposal option. The Waste Minimisation & Management Act, 1995 states that it also is meant to impact on resource consumption and as such the Boards directions support the intent of the legislation.

In developing the Draft Regional Waste Plan the Board has reviewed many activities and developments from around the world. At this time, it is clear many alternatives, both economically and environmentally sound, exist to achieve the desired outcomes of the WM&M Act, 1995. It is also clear that there is a need by proponents of new developments to become familiar with these and the new regime of management principles the WM&M Act, 1995 and the Western Sydney Draft Regional Waste Plan sets in place.

As we are moving through these new issues, we would welcome further discussions with yourself and your clients in regard to their proposals.

Yours sincerely,

P. Williamson

Paul Williamson
Manager, Waste Strategies

pw2108L1

Suite 203, 30 Campbell Street, PO Box 1101 Blacktown NSW 2148
Ph: 02. 9676 6299 Fax: 02. 9676 6363 Email: wswmb@region.net.au
Bankstown • Baulkham Hills • Blacktown • Hawkesbury • Holroyd • Fairfield • Liverpool • Parramatta • Penrith

LAND & WATER CONSERVATION

Contact: Greg Daley
Phone: (02) 9895 7361
Fax: (02) 9895 7501
e-mail:
gdaley@dlwc.nsw.gov.au

Our Ref: EISEXT04
[G:\GDALEY\EISEXT04.DOC]

Ms Sarah Townsend
AGC Woodward-Clyde Pty Ltd
Level 6
486-494 Pacific Highway
St Leonards NSW 2065

DATE RECEIVED 18/8/97 FAX MAIL COURIER
PROJECT No. ..... FILE No. .....
DOCUMENT No. .....
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Attention: Ms Sarah Townsend

13 August, 1997

Dear Madam

Re: Environment Impact Statement for Proposed Inert Waste Landfill, Horseley Park

Thank you for your enquiry regarding the issues that the Department of Land & Water Conservation (DLWC) would like to be addressed in the Environmental Impact Statement (EIS) for the proposal for landfilling and site rehabilitation at the Austral Brick Company site at Horseley Park. Thank you also for the invitation to the Planning Focus Meeting, I would have liked to have attended and I hope that you will keep me in mind for future meetings.

The 1:25,000 topographic map, Prospect 9030-N, indicates that the upper reaches of Eastern Creek are located on the subject site. This office is concerned with potential impacts to the area's water resources, ie. aquatic and riparian issues, from the proposal. Generally you will need to provide information on the existing environment of the site, the likely impacts resulting from the proposal and mitigative measures that the proponent must undertake to ameliorate any environmental impacts.

In terms of the aquatic and riparian habitat there are a number of factors that the EIS will need to consider:

Environmental Legislation

The EIS will have to address the *Rivers and Foreshores Improvement Act 1948* in relation to the proposed development. If any works occur in the bed of any watercourse, or within 40 meters of the high bank of any watercourse (including depositing fill within the channel), the proponent will need to apply to the DLWC for a permit under Part 3A of the Act.

Surface Water Quality and Supply

Potentially all development within a catchment will impact upon its waterways. Where developments are adjacent to a watercourse safeguards must be incorporated to prevent contaminated runoff (including excessive sediment) from discharging directly into the watercourse, during and after construction. The proponent must prove that the proposal will not affect the availability of a reliable water supply, impact on other water users, cause the

deterioration of water quality within the catchment (eg. change in temperature, turbidity, salinity or input of pollutants such as suspended solids, organic material, nutrients, pesticides and trace metals) or change the streamflow regime (eg. volume, reliability, variability, quantity, quality, timing, duration).

Groundwater Quality and Supply

The development must not adversely affect either existing or potential groundwater users, groundwater levels, adjacent ecosystems dependant on groundwater (eg. wetlands), or the interaction between groundwater and surface water. Other impacts that the proponent must guard against includes the possible rise of groundwater levels due to vegetation clearance, the creation of waterlogging problems through rising water tables, an increase in salinity (where the groundwater is saline such as occurs in the vicinity of this proposal), or the potential for seepage of pollutants into the groundwater system (including chemicals, petroleum products, nutrients, heavy metals, bacteria).

To assess the impact of the proposal on groundwater resources the proponent may wish to initiate a monitoring programme to identify unexpected impacts.

Riverine Corridor

The proponent must consider the potential for the proposed development to adversely impact on the riverine corridor, the adequacy of erosion controls and revegetation proposals (the use of indigenous species is encouraged), the possibility of changes to the stream geometry through excavation, obstruction or cuttings within and/or near the waterway, and the likelihood of increased runoff (through removal of vegetation, urbanisation, etc.).

DLWC recommends that a vegetated buffer strip of at least 40 metres be retained or restored along waterways. The width of the buffer strip will vary according to local site conditions, with more sensitive areas requiring a wider strip. Such a buffer helps to maintain streams in a sustainable manner by reducing levels of erosion and sedimentation, enhancing habitat values and generally mitigating stream degradation.

The EIS must also assess the impact on existing vegetation and fauna, and the likelihood of rare and endangered species occurring on-site and/or being affected by the proposal.

Instream Environments

Aquatic environments provide valuable habitat for flora and fauna particularly breeding and nursery areas, which may be affected if the proposed development results in changes in the frequency, depth, extent or volume of flow in the waterway. The proponent must ensure that the instream environment will not be impacted by the discharge of harmful pollutants (eg. chemicals, nutrients, heavy metals and bacteria) into the waterway, seepage of pollutants to an adjacent aquifer, the introduction or proliferation of exotic plant and animal species and the physical disturbance to the waterway (including clearing of aquatic vegetation).

The EIS will need to determine if any wetlands occur on-site, and the likely impacts on them by the development if they exist.

DLWC would prefer that the proponent assist in the preservation and rehabilitation of the natural character and functions of the on-site stream. To this end the proponent may wish to consider the introduction of a weed management programme for the long term removal of weed species. Furthermore the introduction of an Erosion and Sediment Control Plan, which would include the implementation of sediment management and controls during the construction and operational phases of the proposal, and stormwater and water quality control measures to be implemented (eg. detention basins, wetlands, etc), would enhance an EIS.

If a development proposal is likely to cause any impact on water resources, compensatory works may be considered as a condition of development consent. Compensatory works may include rehabilitation of natural habitats, re-establishment of vegetation buffer zones adjacent to streams and wetlands, restoration of wetland areas, maintenance of aquatic and wetland habitats by ensuring adequate streamflows, stabilisation of all disturbed areas, and provision of retention basins to minimise downstream impacts.

If you have any further queries with regard to the above, please contact Greg Daley on (02) 9895-7361.

Yours faithfully,

Greg Daley
Environmental/Ecological Impact Assessment, Sydney/South Coast Region

INERT WASTE LANDFILL, HORSLEY PARK - EIS.

The RTA, through the Sydney Region Development Advisory Committee, may be asked to comment on this development and the RTA would like to see an E.I.S. give consideration to :-

(i) the preparation of a traffic impact report outlining the likely traffic movements generated by the proposed development;

(ii) the need (if any) for improvements to existing road and intersection conditions (in terms of traffic and pedestrian safety and efficiency) in the immediate vicinity of the development to accommodate the additional traffic generated by the development. Items including vehicle turning movements (and possible delay or queuing), improved pedestrian facilities, pavement condition, street lighting, street signs and parking restrictions could be addressed. This is particularly relevant to access to Wallgrove Road, if being considered;

(iii) development of a transport management plan identifying truck routes to be used (particularly if work is to be undertaken between 10pm and 6am). Where possible, residential areas should be avoided, particularly during these hours, and

(iv) the proposed access driveway treatment and onsite parking layout for staff, visitors and heavy vehicles.

G. Richards.

Graham Richards
Land Use Transport Manager
Roads and Traffic Authority
14th August 1997.

Phone - 9831 0988
Fax - 9831 0155

Woodward-Clyde

Engineering & sciences applied to the natural & built environment

18 November 1997
Project No. A8601191

Pacific Power
Crn Park and Elizabeth Streets
SYDNEY NSW 2001

Dear Sir/Madam,

Subject: Environmental Impact Statement for Proposed Solid Waste Landfill, Horsley Park

AGC Woodward-Clyde Pty Limited has been commissioned by Austral Brick Company Pty Ltd to prepare a landfill concept design and an Environmental Impact Statement (EIS) for a solid waste landfill at their Horsley Park brickworks site. The EIS will be placed on exhibition in the week ending the 28 November, 1997.

Austral proposes to continue quarrying activities in Void 1 which would result in the westward extension of the void towards Wallgrove Road. As quarrying activities proceed the void would be rehabilitated through landfilling. The three key elements of the proposed works include:

- Any suitable clay/shale extracted would be used by Austral in their brick manufacturing operations. Existing brick making operations, together with all other ancillary activities, would continue at the site.
- Excavation and retention in stockpiles of overburden of up to around 3.7 million m^3 for use as landfill cover material and for site rehabilitation.
- Landfilling of some 300 000 tonnes per annum of Class 2 Solid Waste (inert waste and all solid wastes with the exception of putrescible wastes) and rehabilitating the landfill area.

Excavation, extraction and landfilling activities would be staged to enable progressive rehabilitation of Void 1 and its extension and the return of this portion of the site to a landform compatible with the pre-existing Cumberland Plain topography. Land uses which could be accommodated on site following site rehabilitation would be compatible with the objectives of the Draft Regional Environment Plan for Western Sydney open Space Corridor currently being prepared by DUAP.

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AGC Woodward-Clyde Pty Ltd (ACN 000-691-690)
Level 6, 486 - 494 Pacific Highway, St Leonards NSW 2065 Australia
Tel +61 (2) 9934 6700 · Fax +61 (2) 9934 6710

If you would like to review the EIS or discuss the proposal please contact Fairfield City Council or Catherine Brady of this office on 9934 6700.

Yours sincerely,
AGC WOODWARD-CLYDE PTY LIMITED

S Townsend

Sarah Townsend
Project Environmental Scientist

Catherine Brady
Senior Environmental Planner

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Appendix E
Hydrogeological Investigations

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Appendix E Hydrogeological Investigations

Figures

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Appendices

E1.1 GENERAL

The Austral Bricks Company (Austral) is planning to re-develop its existing clay quarry at Horsley Park as a solid waste landfill, whilst continuing clay extraction on other sections of the property. The proposed development is a designated development under the Environmental Planning and Assessment Act and, therefore, it requires the submission of an Environmental Impact Assessment in support of the proposal. AGC Woodward-Clyde Pty. Ltd. (Woodward-Clyde) has been retained by Austral to co-ordinate the several studies required for the preparation of the EIS document. The following report describes the hydrogeological investigations carried out at the site to gather initial groundwater data.

E1.2 SCOPE OF WORKS

The scope of works for the hydrogeological study was as follows:

- determine the depth of groundwater under the site;
- determine the quality of groundwater under the site;
- determine the hydraulic conductivity of the rockmass underlying the site;
- determine the hydraulic conductivity of the surface clay material and its suitability as an engineered liner.

E1.3 PROGRAMME OF WORKS

In order to evaluate the hydrogeological conditions of the rockmass underlying the quarry area, a groundwater investigation programme was carried out based on:

- the drilling and construction of three groundwater monitoring wells around the periphery of the void;
- the hydraulic testing of the monitoring wells in order to determine the hydraulic conductivity of the rock mass tapped by the wells;
- the collection of groundwater samples from the monitoring wells for the analysis of a number of parameters and analytes; and
- the collection of surface clay samples by Woodward-Clyde and subsequent permeability testing by a NATA registered laboratory.

E1.4 RESULTS OF INVESTIGATIONS

E1.4.1 Geology

The study area is situated near the central portion of the Sydney Basin, which is a broad geological province formed essentially by Permian and Triassic sedimentation. The general stratigraphic succession at this location comprises the Triassic Hawkesbury Sandstone, overlain by the Wianamatta Group, also of Triassic age. The Wianamatta Group comprises, in ascending order, the Ashfield Shale, the Minchinbury Sandstone and the Bringelly Shale, with the latter forming the ground surface across the relatively flat terrain in the region.

The Wianamatta Group sediments were deposited in the variable energy environments of an alluvial plain during a single regressive episode. As a consequence, lateral and vertical facies variability is a characteristic of this group.

The Bringelly Shale, the uppermost member of the Wianamatta Group, comprises, in decreasing abundance, claystone (often carbonaceous), siltstone, laminite, tuff and coal (Herbert, 1975). The Bringelly Shale is also considered to be more plastic than the Ashfield Shale, and it displays greater lithological variation than the underlying formations. Weathering of the Bringelly Shale produces grey and red silty clays, with abundant siderite nodules.

E1.4.2 Site Geology

Based on investigation drilling and observation of the existing quarry faces, the site geology reflects the general nature of the Bringelly Shale, as described in the previous section. From the ground surface down, the stratigraphy at the site is described as:

- topsoil, comprising silty clay with high organic content, including vegetation, rootlets and other organic components. The topsoil is typically between 0.0m and 0.2m thick.
- residual soil, comprising dark grey to grey and mottled red-grey clay, of generally low to medium plasticity, which is derived from insitu weathering of the Bringelly Shale, and that typically becomes harder with depth and progresses through extremely weathered to distinctly weathered and fresh shale, and
- various layers of claystone, siltstone and sandstone. However, the predominant lithology comprises a light grey claystone with occasional carbonaceous claystone layers.

At borehole locations MWAUS1 and MWAUS3, fill material was encountered to depths of 1.2m and 5.5m below the ground surface, respectively. The fill typically comprised clay and shale with some sand, gravel, plastic, brick fragments and occasional organic matter. The fill was assessed to be moderately to well compacted, and is probably re-worked site soils.

No major structural features were observed within the site. Moderately to widely spaced sub-vertical joint planes were evident on remnant sandstone and siltstone faces along the eastern boundary of the study area. The bedding planes within the shale formation visible in the quarry faces indicated near horizontal structure, with a slight overall dip (in the order of 1° or less) towards the north-east.

E1.4.3 Hydrogeology

The previous section described the general geological setting of the Horsley Park area. As mentioned, the quarry has been excavated into material belonging to the Bringelly Shale formation. Due to the depositional environment in which the sediments of the Wianamatta Group were laid, the Bringelly Shale is made of an alternation of different lithologies. These range from massive sandstones to finely laminated shales, with each different material usually having limited thickness, generally not more than four or five metres.

The Wianamatta Group, to which the Bringelly Shale belongs, has not been affected by severe tectonic disturbances. As a result, the majority of structural defects is represented by fractures and joints, generally tight and infilled by secondary depositional products. Characteristically, most fractures and joints do not cross the lithological boundaries, i.e., a fracture in a sandstone horizon, for instance, would not continue into the underlying, or overlying, laminite horizon.

Major faults are rare and are mostly found against the uplifted blocks surrounding the Sydney Basin.

The individual lithological units of the Bringelly Shale do not have a primary hydraulic conductivity, due to their degree of cementation and weathering, that tends to produce clayey products. The formation's hydrogeological parameters depend entirely upon fractures, joints and interbed partings. To the extent that these defects are interconnected, they provide secondary hydraulic conductivity and groundwater storage. In these circumstances, the rockmass will occasionally behave as an aquifer, delivering useful, albeit small, quantities of water. (See definition of aquifer in the Glossary). However, throughout the Sydney Basin, the Bringelly Shale displays a characteristically low hydraulic conductivity that results in negligible groundwater yields to bores drilled into this formation.

E1.4.4 Monitoring Wells

The layout of the groundwater monitoring network was selected as an array surrounding the existing quarry void. This array was intended to provide sufficient areal coverage to determine hydraulic gradients and the possible interaction between the groundwater and the water-filled void.

The position of wells MWAUS-1, MWAUS-2 and MWAUS-3 is shown on Figure 6.1 of the accompanying EIS, and their geological and construction logs are presented in the attached figures. The monitoring wells were installed by Intertech Drilling Services Pty Ltd under the direct supervision of Woodward-Clyde. Drilling was carried by a combination of air drilling methods, rotary air or down the hole hammer, as required by the ground conditions.

Table E1 below presents a summary of some statistics of the monitoring wells.

Table E1

MONITORING WELLS STATISTICS

Item		MWAUS-1	MWAUS-2	MWAUS-3
Easting		286868.10	286800.31	287336.93
Northing		1255834.32	1255418.05	1255744.42
Quarry Depth	mAHD	~45	~45	~45
Surface level at wellhead	mAHD	69.41	73.64	59.31
Drilled Depth	m b s.	32.2	35.0	21.1
Well Base	mAHD	37.21	38.64	38.21
Screened Interval	m.b.s.	18.8-30.7	21.6-33.5	10.7-19.6
Screened Interval	mAHD	50.61-38.71	52.04-40.14	48.61-39.71
Datum	m a.s.	0.81	0.80	0.82
Datum	mAHD	70.22	74.44	60.13
Static Water Level (26.8.97)	m.b.d.	13.80	31.30	8.03
Static Water Level (26.8.97)	mAHD	56.42	43.14	52.10

mAHD = metres above Australian Height Datum

m b.s. = metres below surface

m a.s. = metres above surface

m b.d. = metres below datum

E1.4.5 Groundwater Levels

The elevation of the static water levels measured at the monitoring wells some weeks after drilling was completed is shown in Table E1 above. No definite conclusion can be drawn from the available levels, because large differences in elevation are evident, considered to be a reflection of the variations in hydraulic conductivity of the rockmass at the three monitoring wells. The more permeable rockmass around MWAUS -1 displays the most rapid water level recovery and the highest elevation of the water level. The least permeable rockmass encountered around MWAUS -2 displays the lowest water level, as discussed below.

Well MWAUS-2 has not yet fully recovered to the expected regional level and its water level is still considerably lower than the pond's level, located at around RL 51m. In undisturbed circumstances, the water level in the well would be expected to be above the pond's level, as are the other two wells. At the measured rate of recovery, it is expected that the water level in MWAUS -2 will take up two months to reach an elevation comparable with the other bores.

The present indications suggest that a groundwater gradient exists inward from the area surrounding the pond. This local effect is superimposed on to a regional water table which follows the slope towards Eastern Creek. Longer monitoring records will confirm this preliminary assessment.

E1.4.6 Hydraulic Conductivity

The hydraulic conductivity is a hydrogeological parameter related to the ease with which groundwater flows through a rockmass under certain conditions. It is measured by performing a variety of tests in specifically constructed wells.

The Bringelly Shale is known throughout the Sydney Basin to have low hydraulic conductivity, a fact that normally precludes the possibility of carrying out long duration pumping tests. Instead, short duration rising head, or recovery, type hydraulic tests are more commonly carried out on the wells. These tests consist in the removal from the well of a known volume of water and in the measurements of the rate of the water level recovery. The recovery tests provide a value of the hydraulic conductivity of the rockmass immediately surrounding the well.

The plots of the hydraulic tests performed in the monitoring wells are presented in the attached figures. Table E2 below shows a summary of the results.

Table E2

HYDRAULIC CONDUCTIVITY, K, SUMMARY

Well	Date	Interval tested m AHD	K m/sec	Type of test
MWAUS-1	12.8.97	51.91-37.21	3.1×10^{-6}	Recovery
MWAUS-2	26.8.97	31.3-35.0	1.8×10^{-8}**	Recovery
MWAUS-3	11.8.97	50.11-3.21	1.9×10^{-8}	Recovery

** Preliminary value, as this well is recovering at a very slow rate.

The hydraulic conductivity values measured at the Austral Bricks quarry are low and indicate that the movement of groundwater in and around the quarry is limited. The groundwater is under semiconfined to confined conditions under the clay surface layers derived from the weathering of the Bringelly Shale formation units. Under these conditions, recharge to the rockmass aquifer is poor, as the chemistry of the groundwater show.

E1.4.7 Surface Water / Groundwater Quality

Water samples were collected from the three monitoring wells, from the pond and from Eastern Creek and submitted to Australian Laboratory Services Pty Ltd. (ALS) for analysis of a range of parameters and constituents. The analytical range was based on the list of groundwater indicator parameters required under the NSW EPA's "Environmental Guidelines: Solid Waste Landfills", 1996, but expanded to include additional analytes.

ALS performed all analytical work. The AOX scan was however performed by Levay and Co.-Environmental Services in Adelaide. Levay is the only laboratory in Australia capable of performing the AOX analyses. These analyses were performed as required by the NSW EPA guidelines as an indicator analyte for organic compounds containing halogens. These groups of compounds include volatile aliphatic Halogenated compounds (solvents) and organochlorine pesticides.

A duplicate sample (GWDUP-01) and a field blank sample were collected at MWAUS-3 for QA/QC purposes. The laboratory QA/QC data are presented in the original laboratory report in Appendix E3. The analyses fall within the acceptable analytical error limits.

Groundwater sampling was carried out under the Woodward-Clyde QA/QC protocols, which are based on the US EPA and NSWEPA requirements.

Table E3 presents the field measurements and laboratory results.

The groundwater is typical of the groundwater in the Bringelly Shale formation in the western Sydney area. The Bringelly Shale was deposited in a near-marine and lacustrine environment and the water entrapped in the sediments was saline. Due to the low permeability of the sediments, flushing of the connate waters by recharge waters since deposition has occurred only in part and, preferentially, along more permeable conduits associated with structural defects and weaknesses. As a result, the salinity of the groundwater in this formation is variable and unevenly distributed.

These conditions have been encountered at the Austral Bricks site. The groundwater has a composition similar to seawater, with the higher salinity found where the rockmass permeability is lowest. The Piper plot in the attached figures shows that the groundwater has a composition similar to sea water. The diagnostic plots of the groundwater analyses in the upper diamond of the trilinear diagram fall in the same area as that of sea water. Interestingly, the diagnostic plot of MWAUS1, the well with the relatively higher hydraulic conductivity, plots more closely to the surface water samples, indicating some hydraulic connection with the pond water, although the sulphate concentration is higher in the surface water and the chloride concentration is higher in the groundwater.

The concentrations of metals and other constituents are generally low and within background levels for the western Sydney area. Traces of heavier fractions hydrocarbons have been recorded in the wells, but not in the creek and pond water. The concentration of TPH in the wells is low and it is possible that it derives from the carbonaceous component of the Bringelly Shale, as experienced at other sites in the western Sydney area.

The Absorbable Organic Halogens (AOX) test is carried out as an inexpensive and preliminary indicator of organic contamination. The presence of hydrocarbon-bound chlorine or bromide is required to give a positive result. The analytical results from the bores indicate generally low AOX values. The presence of colloidal material or particulate in the sample may produce erroneous readings.

In consideration of the type of activities carried out at and around the site, of the low rockmass hydraulic conductivity, of the depth of the bores and of the low AOX levels (80-88 µg/L) in the creek and pond waters, it is most probable that the groundwater values encountered are background values applicable to the area. In addition, the upgradient (MWAUS-1) and the downgradient (MWAUS-3) wells have similar AOX concentration, which further excludes the quarry void as the possible source of the AOX.

Table E3

GROUNDWATER FIELD AND LABORATORY RESULTS

Analysis	Units	LOR	MWAUS - 1	MWAUS - 2	MWAUS - 3
Field					
pH			7.84	7.01	6.8
Electrical Conductivity	µS/cm		11050	17090	15650
Dissolved Oxygen	mg/L		4.05	2.05	4.8
Dissolved Oxygen	%		43.3	21.3	50
Redox Potential	mV		334	0	290
Laboratory					
Total Dissolved Solids	mg/L	1	6560	10300	9970
Calcium	mg/L	1	71	140	104
Magnesium	mg/L	1	186	73	430
Sodium	mg/L	1	212	3900	3130
Potassium	mg/L	1	25	44	17
Bicarbonate as $CaCO_3$	mg/L	1	1320	346	824
Sulphate	mg/L	1	55	12	404
Chloride	mg/L	1	2980	6290	5400
Iron	mg/L	0.1	<0.1	<1.0	0.4
Arsenic	mg/L	0.01	<0.01	0.01	<00.1
Copper	mg/L	0.001	0.008	0.004	0.010
Manganese	mg/L	0.001	0.013	0.192	0.485
Lead	mg/L	0.001	<0.001	<0.001	0.019
Zinc	mg/L	0.001	0.026	0.027	0.059
Mercury	mg/L	0.0001	<0.0001	<0.0001	<0.0001
Fluoride	mg/L	0.1	0.2	<0.1	0.3
Ammonia as N	mg/L	0.01	1.98	8.59	0.83
Nitrate as N	mg/L	0.01	0.04	0.06	0.04
Nitrite and Nitrate as N	mg/L	0.01	0.05		0.04
Total Kjeldhal Nitrogen as N	mg/L	0.1	2.5	9.8	1.1
Total Nitrogen as N	mg/L	0.1	2.6		1.1
Phosphorus as P -Total	mg/L	0.01	0.05	0.43	0.19
Total Organic Carbon	mg/L	1	14	22	12
Phenols	mg/L	0.2	<0.2	<0.2	<0.2
Total Petroleum Hydrocarbons					
C6-C9 Fraction	µg/L	20	<20	<20	<20
C10-C14 Fraction	µg/L	50	<50	<50	<50
C15-C28 Fraction	µg/L	100	200	<100	748
C29-C36 Fraction	µg/L	50	<50	<50	76
Halogenated Organics (AOX)	µg/L		235	180	265

E1.4.8 Surface Water Quality

Two surface water samples were collected from the central flooded pit and from Eastern Creek, half way through its length within the property. The sampling sites are shown in the Figure 6.1 of the accompanying EIS and are summarised in the following Table E4. In addition, the surface water results have been plotted in the Piper plot in the attached figures, as discussed earlier. The diagnostic points of the creek and pond waters fall close to the MWAUS1 position, indicating a similar anionic and cationic composition, although the surface waters have a higher proportion of sulphate and a lower proportion of chloride.

It is considered that some mutual exchange relationship exists between the pond's water and the groundwater, whereby the incident rainfall is blended with groundwater influent into the pond. The same relationship cannot be clearly established with the Eastern Creek's water as, on present data, it appears that the creek is a loosing stream to groundwater, and the rate of such recharge is expected to be low.

E1.4.9 Surface Clays Permeability Tests

As part of this investigations, two samples of surface clay materials were collected and submitted to Australian Soil Testing Pty. Ltd. for laboratory permeability testing. The results of the tests are presented in the Appendix. The tests returned values of permeability (k) of $2.4x10^{-8}$cm/sec ($2.4x10^{-10}$m/sec) and $2.7x10^{-8}$cm/sec ($2.7x10^{-10}$m/sec) respectively. These values are effectively typical of impermeable materials and show the suitability of materials for use as a liner, as they fall within the range of values recommended by the NSWEPA for this purpose.

Table E4

SURFACE WATER FIELD AND LABORATORY RESULTS

Analysis	Units	LOR	CREEK 01	PIT 01
Field				
pH			7.45	8.03
Electrical Conductivity	µS/cm		1045	1208
Dissolved Oxygen	mg/L		7.5	7.12
Dissolved Oxygen	%		80	75
Redox Potential	mV		140	135
Laboratory				
Total Dissolved Solids	mg/L	1	758	856
Calcium	mg/L	1	12	11
Magnesium	mg/L	1	20	18
Sodium	mg/L	1	214	211
Potassium	mg/L	1	5	5
Bicarbonate as $CaCO_3$	mg/L	1	134	139
Sulphate	mg/L	1	62	61
Chloride	mg/L	1	272	259
Iron	mg/L	0.1	0.2	0.1
Arsenic	mg/L	0.01	<0.01	<0.01
Copper	mg/L	0.001	0.011	0.09
Manganese	mg/L	0.001	0.018	0.058
Lead	mg/L	0.001	<0.001	<0.001
Zinc	mg/L	0.001	0.017	0.035
Mercury	mg/L	0.0001	<0.0001	<0.0001
Fluoride	mg/L	0.1	0.5	0.8
Ammonia as N	mg/L	0.01	<0.01	<0.01
Nitrate as N	mg/L	0.01	0.03	0.18
Nitrite and Nitrate as N	mg/L	0.01	0.03	0.19
Total Kjeldhal Nitrogen as N	mg/L	0.1	0.5	0.65
Total Nitrogen as N	mg/L	0.1	0.5	0.8
Phosphorus as P -Total	mg/L	0.01	0.08	0.09
Total Organic Carbon	mg/L	1	15	18
Phenols	mg/L	0.2	<0.2	<0.2
Total Petroleum Hydrocarbons				
C6-C9 Fraction	µg/L	20	<20	<20
C10-C14 Fraction	µg/L	50	<50	<50
C15-C28 Fraction	µg/L	100	<100	<100
C29-C36 Fraction	µg/L	50	<50	<50
Halogenated Organics (AOX)	µg/L		88	80

E1.5 QA/QC AND DATA VALIDATION

E1.5.1 Quality Assurance

The following measures were utilised to ensure the integrity of the data collected during the study. The techniques used are standard in the Woodward-Clyde's Quality Assurance/Quality Control protocols and included the following:

Well purging and Sample Collection

Sample collection was undertaken by a Woodward-Clyde's scientist with specific training in field investigation techniques after purging the well. Purging consisted in the removal from the well of three bore volumes or until dry, in order to remove stale groundwater.

Control Samples

In order to assess the accuracy and precision of the analytical data obtained several quality control samples were taken. These consisted of a duplicate and a blank sample, submitted to the laboratory as independent samples and analysed for the same range of analytes as the other samples.

Decontamination

All field sampling equipment was decontaminated prior to use and between samples to prevent cross contamination. Decontamination of equipment involved the following process:

- scrub in a solution of Decon 90 (phosphate free detergent) and water,
- rinse in clean potable water, and
- air dry.

Sample Containers

The samples were collected in sample containers appropriate for the specific analyses, which are based on USEPA guidelines.

Sample Tracking and Identification

All samples were identified with a unique sample number. Sampling details were included on the sample label (which was sealed with clear tape) and reproduced in the field logging sheets and chain of custody (COC) records.

Sample Transport

The sample containers were packed on ice from the time of collection and were transported under chain of custody procedures from the site to Woodward-Clyde's Sydney office or directly to the laboratory. The condition of the containers was checked before forwarding the samples to the laboratories, again under chain of custody procedures.

Instrument Calibration

The instruments used to conduct the field investigation (pH/redox potential meter, EC meter and DO meter) were calibrated prior to use according to the manufacturers' recommended procedures. The calibration record is retained in the logbook maintained with each individual instrument.

Laboratory

The collected samples were submitted for analysis to Australian Laboratory Services Pty Ltd (ALS) for all required tests and to Levay and Co. Environmental Services for the AOX analyses. This laboratory is the only laboratory in Australia capable of performing this service, as required by the NSWEPA.

ALS is a NATA registered laboratory and has been audited by Woodward-Clyde chemists for its services, equipment and QA/QC practices.

E1.5.2 Data Validation

As part of the QA sampling requirements, duplicate samples were collected from groundwater monitoring wells. In addition, field blanks were also collected.

The field duplicates, submitted to the laboratory as independent samples, are used to measure the precision of the sampling, sample preparation and analysis process.

Field blanks consisted of purified water used to rinse the sampling equipment after decontamination. The collection of field blanks enables the measurement of incidental or accidental contamination during the sampling, transport, sample preparation and analysis process.

In addition to the field duplicate, the laboratory also carried out organics batch quality control analyses in the form of matrix spike samples. The samples are spiked with a pre-determined concentration of analytes and, then, analysed in the same manner as the original sample. The results are compared to determine the effects of sample matrix on the accuracy and precision of the analyses. Accuracy is assessed by calculation of the relative percent difference (RPD).

The samples reported within the required limits of accuracy and precision as shown in the laboratory reports in the Appendix.

E1.6 CONCLUSIONS

The hydrogeological assessment of the Austral Bricks site has shown that the quarry is located in the Bringelly Shale rockmass, that is characterised by low hydraulic conductivity and semiconfined to confined conditions under the surface clays. These characteristics and the original nature of the sediments are responsible for poor recharge to the rockmass and for the persistence of high salinities around the site and for their uneven distribution.

The overall hydraulic gradient has not been determined with accuracy at this stage as the groundwater levels are still recovering from the drilling and purging and sampling carried out. However, it appears that a regional gradient from west to east towards Eastern Creek exists under the site, following the natural surface topography. Groundwater is located some metres below the creek level, indicating that, potentially, recharge could occur through the creek bed.

Superimposed to the regional gradient, there is a depression in the water table coinciding with the quarry void. The water table depression results in an inward gradient towards the pond, limiting the opportunity for migration of the pond water away from the site. On the basis of the hydrochemical results, it would appear that the groundwater has a significant impact on the composition of the pit's ponded water.

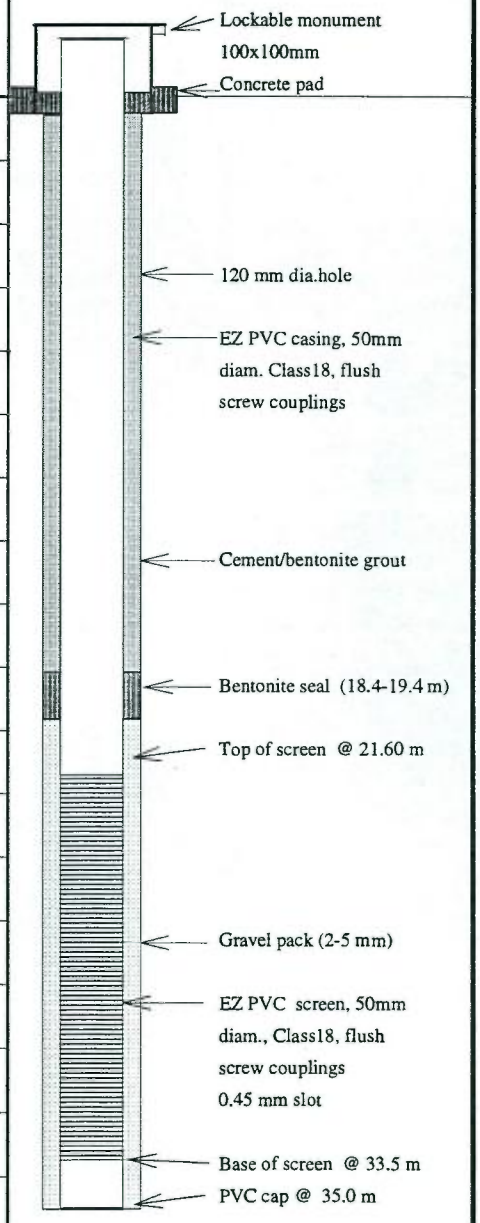
Figures

WOODWARD - CLYDE

PROJECT : Austral Bricks Company		JOB NO:	A8601191 / 150
LOCATION: Horsley Park		DATE STARTED:	7.8.97
SUPERVISOR: Dino Parisotto		DATE COMPLETED:	7.8.97
INSTALLED BY: Intertech Drilling	METHOD: SFA/RAB/Hammer	DIAMETER:	120 mm
RIG: Intertech 650	TOTAL DEPTH : 35.0 m	R.L. GROUND:	73.64 m AHD
DATUM: top of PVC	SWL: 30.18 m (b.d. 11/8/97)	R.L. SWL :	42.26 m AHD

WELL NUMBER: MWAUS-2

Lithological Log	Remarks	Depth (m)
0.0-4.0 m CLAY: light grey with red-brown streaks, low plasticity, silty firm to stiff, slight moisture.	SFA 114 mm diam.	
@ 3-4 m some red-brown iron stone gravel		4
4.0-32.0 m SHALE/SILTSTONE: brown-grey, moderately weathered semi-competent and friable, trace of brown clay and sandy bands.	Blade bit 120 mm diam.	
@ 5-10 m slightly weathered, medium to dark grey, carbonaceous in parts, low-medium hardness, competent.		8
@ 7-10 m trace of fine grained sandstone- lighter grey		
@ 9-32 m predominantly dark grey carbonaceous, moderately hard, fossiliferous, some traces of lamination	Down the hole hammer 120 mm diam.	12
@ 11 m base of weathering, increasing hardness		
@ 12-15 m trace of fine grained sandstone- lighter grey		16
@ 17-24 m slightly lighter grey, less carbonaceous, harder, trace of fine grained sandstone.		20
		24
@ 25-27 m slightly lighter grey, less carbonaceous, harder, trace of fine grained sandstone.		28
		32
@ 33-35 m slightly lighter grey, less carbonaceous, harder, trace of fine grained sandstone.	Groundwater not intersected during drilling	
35.0 m **Bottom of the hole**		36



Prepared by: DP
Checked by: FC

WOODWARD - CLYDE

PROJECT : Austral Bricks Company		JOB NO:	A8601191 / 120
LOCATION: Horsley Park		DATE STARTED:	6.8.97
SUPERVISOR: Dino Parisotto		DATE COMPLETED:	7.8.97
INSTALLED BY: Intertech Drilling	METHOD: SFA/RAB/Hammer	DIAMETER:	120 mm
RIG: Intertech 650	TOTAL DEPTH : 21.0 m	R.L. GROUND:	59.31 m AHD
DATUM: top of PVC	SWL: 7.97 m (b.d. 11/8/97)	R.L. SWL :	52.16 m AHD

WELL NUMBER: MWAUS-3

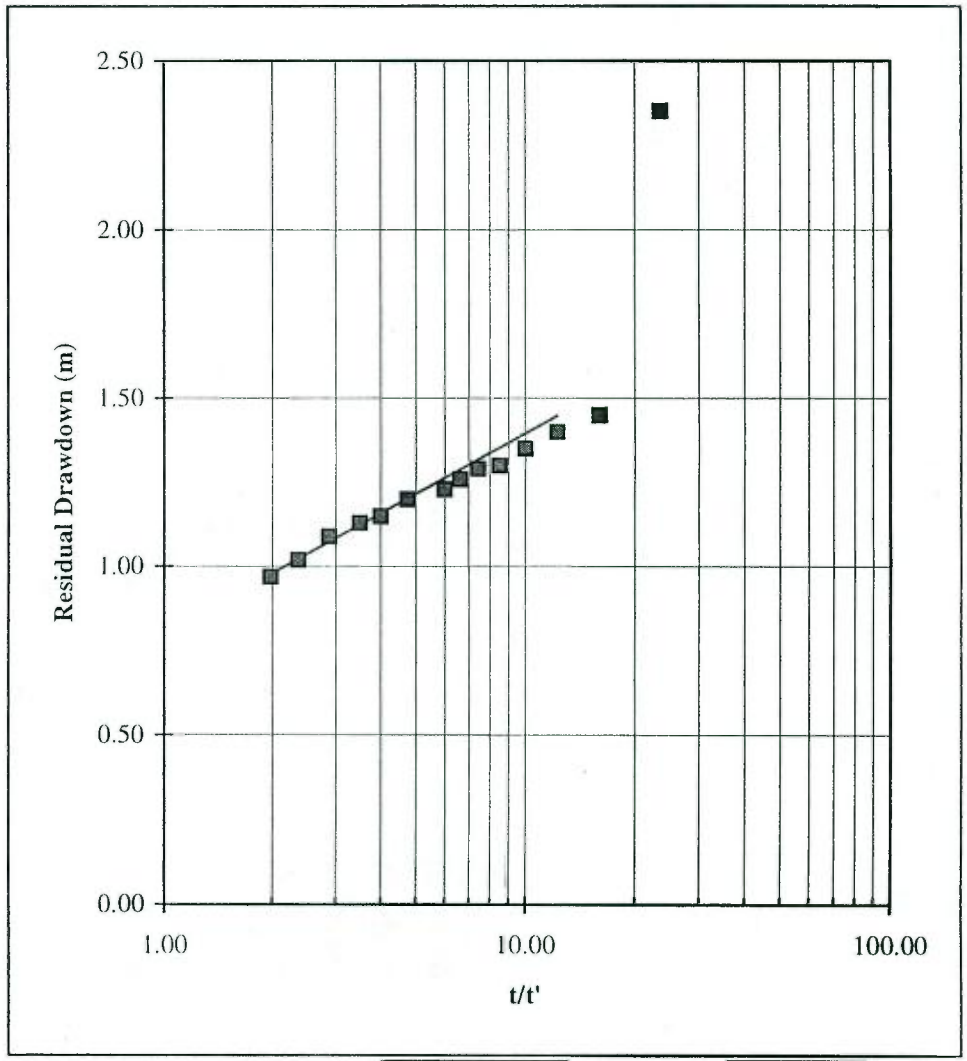
Lithological Log	Remarks	Depth (m)	Bore Construction
0.0-1.5 m FILL: grey-brown, clay and shale, compacted, semi-cohesive, firm to stiff, slight moisture (access road).	SFA 114 mm diam.		Lockable monument 100x100mm; Concrete pad; EZ PVC casing, 50mm diam. Class18, flush screw couplings; 120 mm dia.hole; Cement/bentonite grout; Bentonite seal (8.2-9.2 m); Top of screen @ 10.7 m; EZ PVC screen, 50mm diam., Class18, flush screw couplings 0.45 mm slot; Base of screen @ 19.6 m; PVC cap @ 21.0 m
1.5-5.5 m FILL: mottled light-medium brown and light grey, silty clay with minor fine grained sand, low pasticity, firm, slight moisture		4	
@ 2-5.5 m some plant rootlets, occasional ironstone gravel			
@ 5-5.5 m trace of white brick material, some twigs			
5.5-21.0 m SHALE/SILTSTONE: brown-grey, highly weathered, semi-competent, some brown silty clay, slight moisture.	Blade bit 120 mm diam.	8	
@ 6.5-7 m moderately weathered, grey-brown, partly carbonaceous.			
@ 7-9 m slightly weathered, dark grey, carbonaceous, low hardness, friable, some traces of lamination, competent.			
@ 9 m base of weathering, increasing hardness		12	
@ 9-21 m predominantly dark grey, carbonaceous, moderately hard, fossiliferous, some traces of lamination			
@ 10-11 m some brown-grey claystone, softer		16	
@ 15-21 m slightly harder and lighter grey			
	no groundwater airlifted during drilling	20	
21.0 m Bottom of the hole			

S:\A86001191.150\MWAUS-3.XLS\22/08/97\DP

Prepared by: DP
Checked by: PC

Test Date	12.8.097
Pumping Duration (min)	45.00
Standing Water Level (m)	13.65
Time Pumping Started	10:00 AM
Volume Removed (L)	400.00
Discharge Rate (m3/d)	12.80

Time Since Pumping Started, t (min)	Time Since Pumping Stopped, t' (min)	t/t'	Water Level (m)	Residual Drawdown s' (m)
47.00	2	23.50	16	2.35
48.00	3	16.00	15.1	1.45
49.00	4	12.25	15.05	1.40
50.00	5	10.00	15	1.35
51.00	6	8.50	14.95	1.30
52.00	7	7.43	14.94	1.29
53.00	8	6.63	14.91	1.26
54.00	9	6.00	14.88	1.23
57.00	12	4.75	14.85	1.20
60.00	15	4.00	14.8	1.15
63.00	18	3.50	14.78	1.13
69.00	24	2.88	14.74	1.09
78.00	33	2.36	14.67	1.02
91.00	46	1.98	14.62	0.97



		Transmissivity (m2/d)	3.95	**^S**	0.59
Aquifer section Tested (m)	14.7	**Hydraulic conductivity (m/sec)**	3.11E-06	**Y Intercept**	0.80

Woodward-Clyde

AUSTRAL BRICKS
RECOVERY TEST
WELL: MWAUS -1

PREPARED BY: DP
CHECKED BY:
APPROVED BY:

S:\A8601191\150\RECMW-1.XLS\15/09/97\DP

WOODWARD - CLYDE

PROJECT : Austral Bricks Company		JOB NO:	A8601191 / 150
LOCATION: Horsley Park		DATE STARTED:	5.8.97
SUPERVISOR: Dino Parisotto		DATE COMPLETED:	5.8.97
INSTALLED BY: Intertech Drilling	METHOD: SFA/RAB/Hammer	DIAMETER:	120 mm
RIG: Intertech 650	TOTAL DEPTH : 32.0 m	R.L. GROUND:	69.41 m AHD
DATUM: top of PVC	SWL: 13.60 m (b.d. 11/8/97)	R.L. SWL :	56.62 m AHD

WELL NUMBER: MWAUS-1

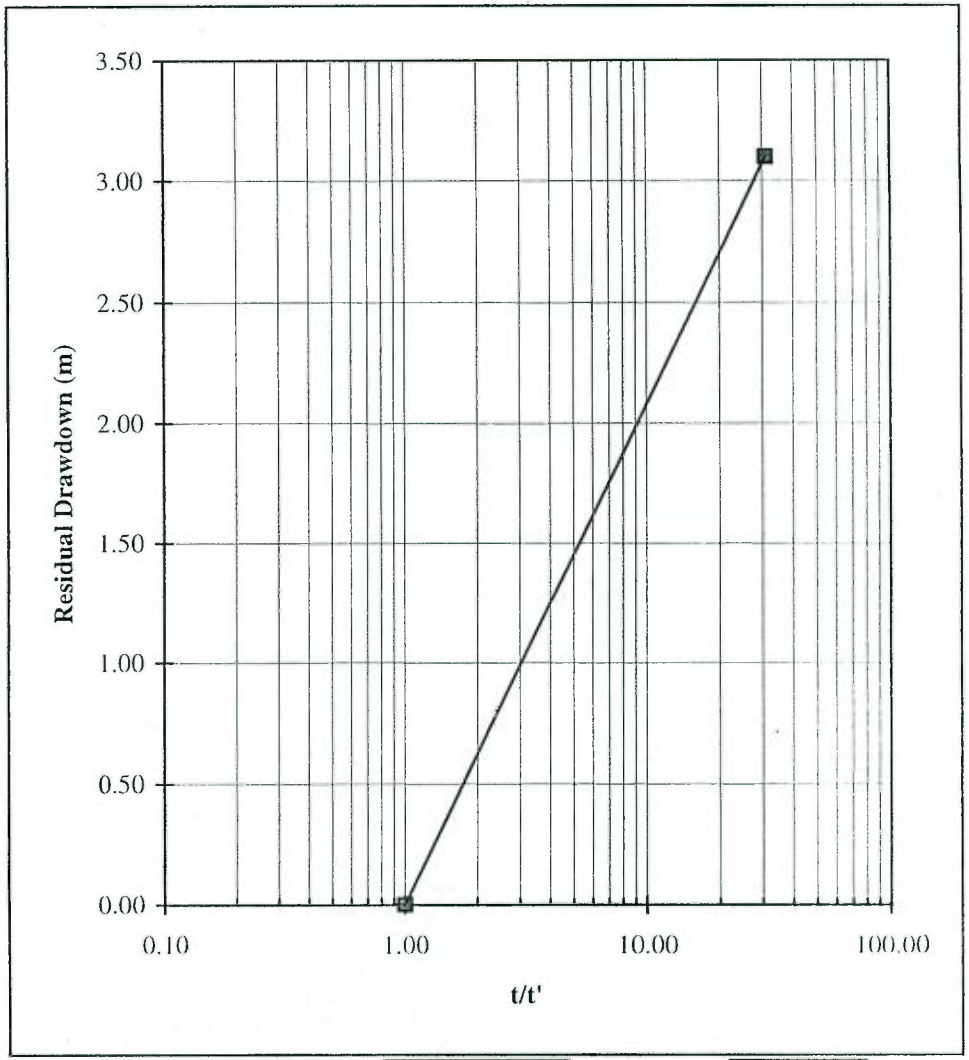
Lithological Log	Remarks	Depth (m)	Bore Construction
0 -1.2 m FILL: brown and brown-red, some iron stone gravel plastic, reworked material, slight moisture.	SFA 114 mm diam.		Lockable monument 100x100mm; Concrete pad
1.2-3.0 m CLAY: light grey with red-brown streaks, silty low plasticity, firm, slight moisture.	Blade bit 120 mm diam.	4	
3.0-32.0 m SHALE/SILTSTONE: brown-grey, moderately weathered semi-competent and friable, trace of brown clay bands.			120 mm dia.hole
@ 4-6 m minor fine grained sandstone, partly ferruginised		8	EZ PVC casing, 50mm diam. Class18, flush screw couplings
@ 4-11 m slightly weathered, medium grey carbonaceous in parts, low-medium hardness, competent.			
@ 6-7 m some brown grey massive claystone, softer			
@ 9-10 m dark grey, carbonaceous			
@ 12 m base of weathering, increasing hardness		12	
@ 14-15 m dark grey, carbonaceous		16	Cement/bentonite grout
	Intersected groundwater (0.1 L/sec) Down the hole hammer 120 mm diam. water injection		Bentonite seal (16.5-17.5 m)
		20	Top of screen @ 18.8 m
@ 22-23 m some brown grey massive claystone, softer			EZ PVC screen, 50mm diam., Class18, flush screw couplings 0.45 mm slot
@ 23-24 m dark grey, carbonaceous		24	
@ 25-32 m dominantly carbonaceous, dark grey, moderately hard, appears massive.			Gravel pack (2-5 mm)
@ 27-28 m some brown grey massive claystone, softer		28	
@ 29-30 m some brown grey massive claystone, softer			Base of screen @ 30.7 m
	Final airlift ~ 0.2 L/sec	32	PVC cap @ 32.2 m
32.0 m Bottom of the hole			

S:\A8601191.150\MWAUS-1\22/08/97\DP

Prepared by: DP
Checked by: FC

Test Date	26.8.97
Pumping Duration (min)	30.00
Standing Water Level (m)	31.30
Time Pumping Started	12:00 AM
Volume Removed (L)	15.50
Discharge Rate (m3/d)	0.0671

Time Since Pumping Started, t (min)	Time Since Pumping Stopped, t' (min)	t/t'	Water Level (m)	Residual Drawdown s' (m)
31.00	1	31.00	34.4	3.10
20160.00	20190	1.00	31.3	0.00



Aquifer section Tested (m) 3.7

Transmissivity (m2/d) 0.005901

Hydraulic conductivity (m/sec) 1.85E-08

^S 2.08

Y Intercept 0.00

Woodward-Clyde

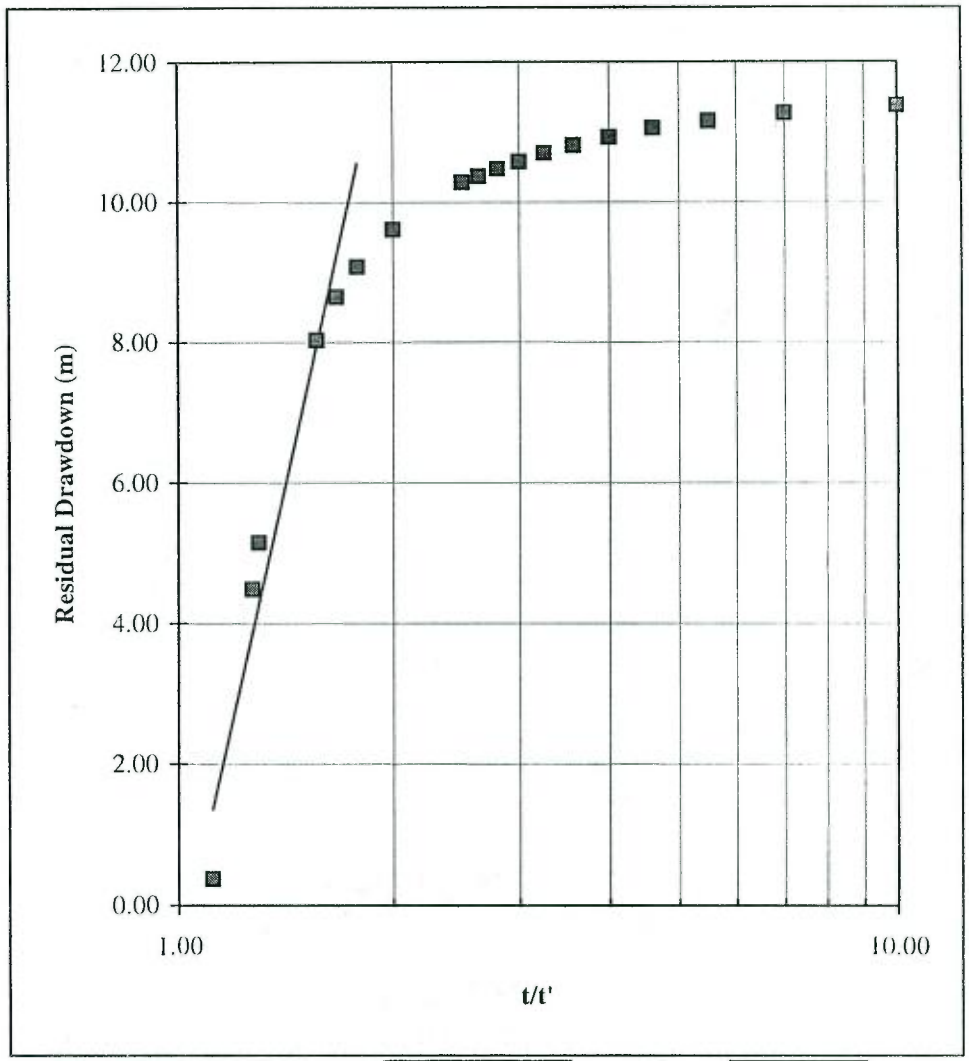
AUSTRAL BRICKS
RECOVERY TEST
WELL : MWAUS-2

PREPARED BY: FC
CHECKED BY: ST
APPROVED BY:

S:A8601191.150\RECMW-2.XLS\ 15/09/97\FC

Test Date	11.8.97
Pumping Duration (min)	18.00
Standing Water Level (m)	7.97
Time Pumping Started	9:45am
Volume Removed (L)	60.00
Discharge Rate (m3/d)	4.80

Time Since Pumping Started, t (min)	Time Since Pumping Stopped, t' (min)	t/t'	Water Level (m)	Residual Drawdown s' (m)
20.00	2	10.00	19.35	11.38
21.00	3	7.00	19.24	11.27
22.00	4	5.50	19.13	11.16
23.00	5	4.60	19.03	11.06
24.00	6	4.00	18.90	10.93
25.00	7	3.57	18.78	10.81
26.00	8	3.25	18.67	10.70
27.00	9	3.00	18.55	10.58
28.00	10	2.80	18.45	10.48
29.00	11	2.64	18.34	10.37
30.00	12	2.50	18.25	10.28
36.00	18	2.00	17.58	9.61
41.00	23	1.78	17.05	9.08
45.00	27	1.67	16.62	8.65
50.00	32	1.56	16.00	8.03
79.00	61	1.30	13.12	5.15
85.00	67	1.27	12.46	4.49
173.00	155	1.12	8.35	0.38



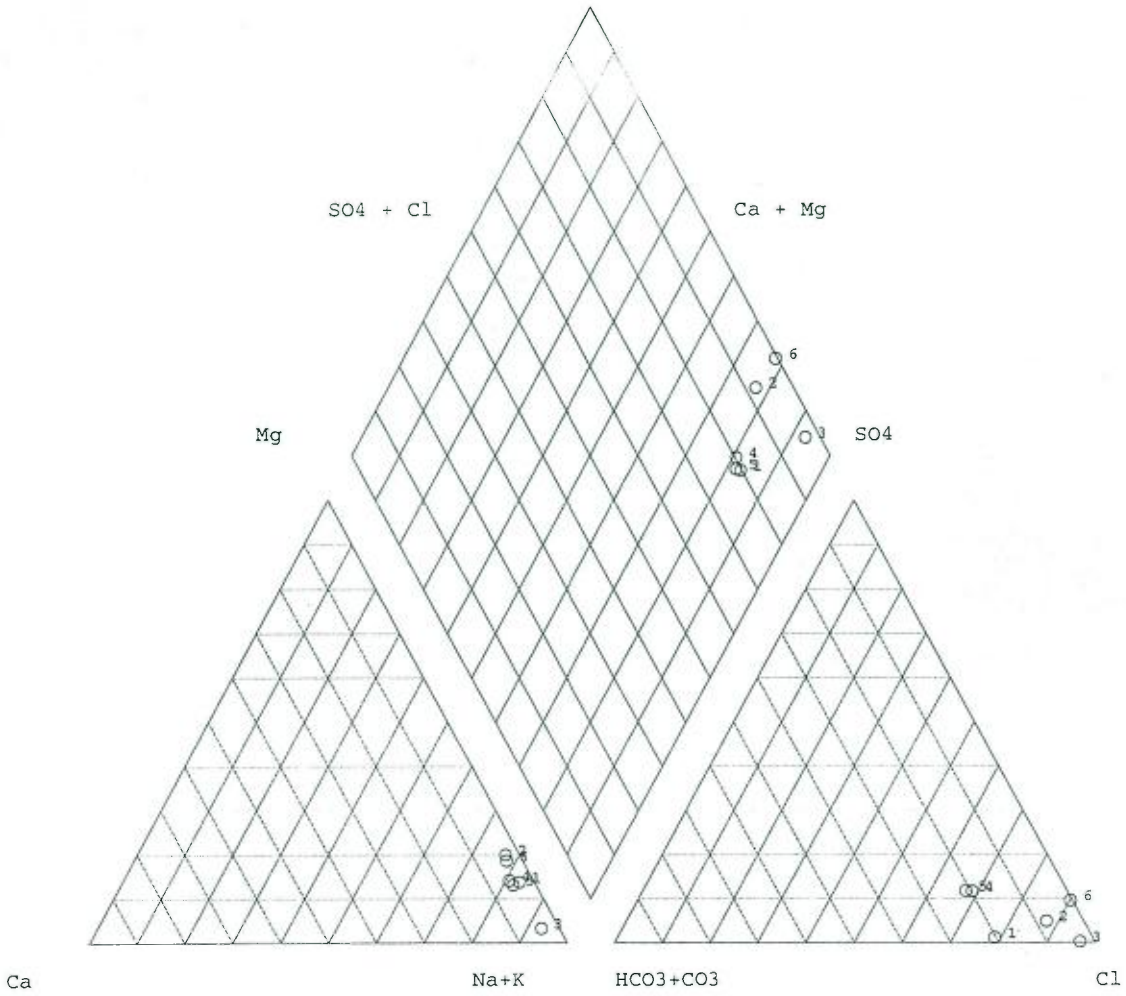
		Transmissivity (m2/d)	0.021	**^S**	45.19
Aquifer section Tested (m)	11.8	**Hydraulic conductivity (m/sec)**	1.91E-08	**Y Intercept**	-0.80

Woodward-Clyde

AUSTRAL BRICKS
RECOVERY TEST
WELL : MWAUS-3

PREPARED BY:DP
CHECKED BY:
APPROVED BY:

S:\A8601191.150\RECMW-3.XLS\15/09/97\DP



Plot No	Sample No	Na+ (mg/L)	K+ (mg/L)	Ca++ (mg/L)	Mg++ (mg/L)	Cl- (mg/L)	HCO3- (mg/L)	CO3-- (mg/L)	SO4-- (mg/L)	TDS (mg/L)
1	MWAUS1	2120	25	71	186	2980	1320		55	6560
2	MWAUS3	3130	17	104	430	5400	824		404	9970
3	MWAUS2	3900	44	140	73	6290	346		12	10300
4	Creek01	214	5	12	20	272	134		62	758
5	Pit01	211	5	11	18	259	139		61	856
6	Sea	10500	390	410	1350	19000	142		2700	34492

Woodward-Clyde

CLIENT
AUSTRAL BRICK COMPANY PTY LTD

PROJECT
AUSTRAL BRICK SOLID REMEDIAL ACTION PLAN EIS

REVISION: **A**
SCALE: **N/A**
DRAWING No: **A8601191/0640**
CAD FILE NO: **G.048**
DATE:

DESIGNED: **ST**
DRAWN: **HC**
CHECKED:
APPROVED:
STATUS: **FINAL**

TITLE
PIPER TRILINEAR PLOT

A4

Appendices

AUSTRALIAN LABORATORY SERVICES P/L
A.C.N. 009 936 029

ANALYTICAL REPORT

CONTACT: MS CATHERINE BRODY
CLIENT: AGC WOODWARD-CLYDE (NSW)
ADDRESS: LEVEL 6, 486-494 PACIFIC H'WAY
ST LEONARDS NSW 2065

LABORATORY: ENV SYDNEY
BATCH NUMBER: ES6842
SUB BATCH: 0
No. OF SAMPLES: 6
DATE RECEIVED: 12/08/97
DATE COMPLETED: 26/08/97

ORDER No.: A861191/130 SAMPLE TYPE: WATER PROJECT:

Method	Analysis description	Units	LOR	AUSTRAL-3 11/08/97	PIT-01 11/08/97	CREEK-01 11/08/97	GWDUP-01 12/08/97
EA-015	Total Dissolved Solids (TDS)	mg/L	1	9970	856	758	10100
-005F	Calcium - Filtered	mg/L	1	104	11	12	107
-010F	Magnesium - Filtered	mg/L	1	430	18	20	418
ED-015F	Sodium - Filtered	mg/L	1	3130	211	214	3230
-020F	Potassium - Filtered	mg/L	1	17	5	5	20
-035	Bicarbonate as CaCO3	mg/L	1	824	139	134	803
ED-040F	Sulphate - Filtered	mg/L	1	404	61	62	387
-045	Chloride	mg/L	1	5400	259	272	5560
-005F	Iron - Filtered	mg/L	0.1	0.4	0.1	0.2	<0.1
-020F	Arsenic - Filtered	mg/L	0.01	<0.01	<0.01	<0.01	<0.01
	Copper - Filtered	mg/L	0.001	0.010	0.009	0.011	0.028
	Manganese - Filtered	mg/L	0.001	0.485	0.058	0.018	0.480
	Lead - Filtered	mg/L	0.001	0.019	<0.001	<0.001	0.033
	Zinc - Filtered	mg/L	0.001	0.059	0.035	0.017	0.079
-035F	Mercury - Filtered	mg/L	0.0001	<0.0001	<0.0001	<0.0001	<0.0001
-040	Fluoride	mg/L	0.1	0.3	0.8	0.5	0.3
EK-055A	Ammonia as N	mg/L	0.01	0.83	<0.01	<0.01	1.03
-058A	Nitrate as N	mg/L	0.01	0.04	0.18	0.03	0.03
-059A	Nitrite and Nitrate as N	mg/L	0.01	0.04	0.19	0.03	0.03
K-061A	Total Kjeldahl Nitrogen as N	mg/L	0.1	1.1	0.6	0.5	1.3
EK-062A	Total Nitrogen as N	mg/L	0.1	1.1	0.8	0.5	1.3
-067A	Phosphorus as P - Total	mg/L	0.01	0.19	0.09	0.08	0.06
-005	Total Organic Carbon	mg/L	1	12	18	15	16
EP-035	Phenols	mg/L	0.2	<0.2	<0.2	<0.2	<0.2
-005	Total Cations	me/L	0.01	177	11.34	11.68	181
-010	Total Anions	me/L	0.01	177	11.41	11.67	181
EZ-015	Actual (Anion / Cation) Difference	me/L	0.01	0.08	0.08	<0.01	0.23
Z-020	Allowed (Anion / Cation) Difference	me/L	0.01	2.85	0.28	0.29	2.91

DATE RECEIVED: ... FAX/MAIL/COURIER
PROJECT No ... FILE No. ...
DOCUMENT No. ...
DISTRIBUTION ... CB

COMMENTS:

This report supersedes any previous preliminary reports of the same batch number.

• This is the Final Report which supersedes any preliminary reports with this batch number.

• Results apply to sample(s) as submitted by client.

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ANALYTICAL REPORT

CONTACT: MS CATHERINE BRODY
CLIENT: AGC WOODWARD-CLYDE (NSW)
ADDRESS: LEVEL 6, 486-494 PACIFIC H'WAY
ST LEONARDS NSW 2065

LABORATORY: ENV SYDNEY
BATCH NUMBER: ES6842
SUB BATCH: 0
No. OF SAMPLES: 6
DATE RECEIVED: 12/08/97
DATE COMPLETED: 26/08/97

ORDER No.: A861191/130 SAMPLE TYPE: WATER PROJECT:

Method	Analysis description		Units	LOR	AUSTRAL-1 12/08/97	BLANK-01 12/08/97
EA-015	Total Dissolved Solids (TDS)		mg/L	1	6560	----
E 005F	Calcium	- Filtered	mg/L	1	71	----
E 010F	Magnesium	- Filtered	mg/L	1	186	----
ED-015F	Sodium	- Filtered	mg/L	1	2120	----
E 020F	Potassium	- Filtered	mg/L	1	25	----
E 035	Bicarbonate as CaCO3		mg/L	1	1320	----
ED-040F	Sulphate	- Filtered	mg/L	1	55	----
ED-045	Chloride		mg/L	1	2980	----
E 005F	Iron	- Filtered	mg/L	0.1	<0.1	<0.1
EG-020F	Arsenic	- Filtered	mg/L	0.01	<0.01	<0.01
	Copper	- Filtered	mg/L	0.001	0.008	0.001
	Manganese	- Filtered	mg/L	0.001	0.013	<0.001
	Lead	- Filtered	mg/L	0.001	<0.001	<0.001
	Zinc	- Filtered	mg/L	0.001	0.026	0.034
E 035F	Mercury	- Filtered	mg/L	0.0001	<0.0001	<0.0001
E 040	Fluoride		mg/L	0.1	0.2	----
EK-055A	Ammonia as N		mg/L	0.01	1.98	----
EK 058A	Nitrate as N		mg/L	0.01	0.04	----
E 059A	Nitrite and Nitrate as N		mg/L	0.01	0.05	----
EK-061A	Total Kjeldahl Nitrogen as N		mg/L	0.1	2.5	----
EK-062A	Total Nitrogen as N		mg/L	0.1	2.6	----
E 067A	Phosphorus as P - Total		mg/L	0.01	0.05	----
E 005	Total Organic Carbon		mg/L	1	14	----
EP-035	Phenols		mg/L	0.2	<0.2	----
E 005	Total Cations		me/L	0.01	112	----
E 010	Total Anions		me/L	0.01	112	----
EZ-015	Actual (Anion / Cation) Difference		me/L	0.01	0.08	----
EZ 020	Allowed (Anion / Cation) Difference		me/L	0.01	1.84	----

COMMENTS:

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ANALYTICAL REPORT

CONTACT: MS CATHERINE BRODY
CLIENT: AGC WOODWARD-CLYDE (NSW)
ADDRESS: LEVEL 6, 486-494 PACIFIC H'WAY
ST LEONARDS NSW 2065

LABORATORY: ENV SYDNEY
BATCH NUMBER: ES6842
SUB BATCH: 0
No. OF SAMPLES: 6
DATE RECEIVED: 12/08/97
DATE COMPLETED: 26/08/97

ORDER No.: A861191/130 SAMPLE TYPE: QUALITY CONTROL PROJECT:

Method	Analysis description	Units	LOR	AUSTRAL-3 %SPK REC 11/08/97	AUSTRAL-1 CHK 12/08/97	BLANK-01 CHK 12/08/97	METHOD BLANK 12/08/97
EA-015	Total Dissolved Solids (TDS)	mg/L	1	----	6730	----	<1
-005F	Calcium - Filtered	mg/L	1	----	72	----	<1
-010F	Magnesium - Filtered	mg/L	1	----	188	----	<1
ED-015F	Sodium - Filtered	mg/L	1	----	2120	----	<1
-020F	Potassium - Filtered	mg/L	1	----	25	----	<1
-035	Bicarbonate as CaCO3	mg/L	1	----	1320	----	----
ED-040F	Sulphate - Filtered	mg/L	1	----	55	----	<1
-045	Chloride	mg/L	1	83.0 %	3020	----	<1
-005F	Iron - Filtered	mg/L	0.1	99.0 %	----	<0.1	<0.1
EG-020F	Arsenic - Filtered	mg/L	0.01	102 %	----	<0.01	<0.01
	Copper - Filtered	mg/L	0.001	94.0 %	----	0.001	<0.001
	Manganese - Filtered	mg/L	0.001	78.0 %	----	<0.001	<0.001
	Lead - Filtered	mg/L	0.001	86.0 %	----	<0.001	<0.001
	Zinc - Filtered	mg/L	0.001	101 %	----	0.033	<0.001
-035F	Mercury - Filtered	mg/L	0.0001	100 %	----	<0.0001	<0.0001
-040	Fluoride	mg/L	0.1	113 %	0.2	----	<0.1
EK-055A	Ammonia as N	mg/L	0.01	80.0 %	1.95	----	<0.01
-058A	Nitrate as N	mg/L	0.01	111 %	0.04	----	<0.01
-059A	Nitrite and Nitrate as N	mg/L	0.01	----	0.05	----	<0.01
EK-061A	Total Kjeldahl Nitrogen as N	mg/L	0.1	111 %	2.8	----	<0.1
EK-062A	Total Nitrogen as N	mg/L	0.1	----	2.9	----	----
-067A	Phosphorus as P - Total	mg/L	0.01	116 %	0.06	----	<0.01
-005	Total Organic Carbon	mg/L	1	----	16	----	<1
EP-035	Phenols	mg/L	0.2	92.0 %	<0.2	----	<0.2
-005	Total Cations	me/L	0.01	----	112	----	----
-010	Total Anions	me/L	0.01	----	113	----	----
EZ-015	Actual (Anion / Cation) Difference	me/L	0.01	----	0.83	----	----
EZ-020	Allowed (Anion / Cation) Difference	me/L	0.01	----	1.85	----	----

COMMENTS:

Results which appear on this report are for laboratory QUALITY CONTROL purposes.

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• Results apply to sample(s) as submitted by client.

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ANALYTICAL REPORT

CONTACT: MS CATHERINE BRODY
CLIENT: AGC WOODWARD-CLYDE (NSW)
ADDRESS: LEVEL 6, 486-494 PACIFIC H'WAY
ST LEONARDS NSW 2065

LABORATORY: ENV SYDNEY
BATCH NUMBER: ES6842
SUB BATCH: 1
No. OF SAMPLES: 5
DATE RECEIVED: 12/08/97
DATE COMPLETED: 26/08/97

ORDER No.: A861191/130 SAMPLE TYPE: WATER PROJECT:

Method	Analysis description	Units	LOR	AUSTRAL-3 11/08/97	PIT-01 11/08/97	CREEK-01 11/08/97	GWDUP-01 12/08/97
EP-071-WS	TOTAL PETROLEUM HYDROCARBONS						
	C6 - C9 Fraction	ug/L	20	<20	<20	<20	<20
	C10 - C14 Fraction	ug/L	50	<50	<50	<50	<50
	C15 - C28 Fraction	ug/L	100	748	<100	<100	656
	C29 - C36 Fraction	ug/L	50	76	<50	<50	250
[illegible]080S-WS	VOLATILE TPH/BTEX COMPOUND SURROGATES						
	1.2-Dichloroethane-D4	%	1	100	96	98	97
	Toluene-D8	%	1	103	96	95	93
	4-Bromofluorobenzene	%	1	99	100	101	100

COMMENTS:

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ANALYTICAL REPORT

CONTACT:	MS CATHERINE BRODY	LABORATORY:	ENV SYDNEY
CLIENT:	AGC WOODWARD-CLYDE (NSW)	BATCH NUMBER:	ES6842
ADDRESS:	LEVEL 6, 486-494 PACIFIC H'WAY ST LEONARDS NSW 2065	SUB BATCH:	1
		No. OF SAMPLES:	5
		DATE RECEIVED:	12/08/97
		DATE COMPLETED:	26/08/97

ORDER No.: A861191/130 SAMPLE TYPE: WATER PROJECT:

Method	Analysis description	Units	LOR	AUSTRAL-1 12/08/97
EP-071-WS	TOTAL PETROLEUM HYDROCARBONS			
	C6 - C9 Fraction	ug/L	20	<20
	C10 - C14 Fraction	ug/L	50	<50
	C15 - C28 Fraction	ug/L	100	200
	C29 - C36 Fraction	ug/L	50	<50
-080S-WS	VOLATILE TPH/BTEX COMPOUND SURROGATES			
	1.2-Dichloroethane-D4	%	1	101
	Toluene-D8	%	1	94
	4-Bromofluorobenzene	%	1	102

COMMENTS:

• This is the Final Report which supersedes any preliminary reports with this batch number.

• Results apply to sample(s) as submitted by client.

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ORGANICS QUALITY CONTROL REPORT

BATCH NO : ES6842

DATE BATCH RECEIVED : 12/08/97

CLIENT : AGC Woodward-Clyde

DATE BATCH COMPLETED : 21/08/97

Method Code	Test	Matrix	Method Reference		QC Lot Number	Date Samples Extracted	Date Samples Analysed
			Extraction	Analysis			
EP-071	TPH-Volatile	Water	USEPA 5030 A	USEPA 8260A	NVOCW184	N/A	19/08/97
	-Semivolatile	Water	USEPA 3510B	USEPA 8015A	NTPHW176	13/05/97	13/08/97

DATE RECEIVED 25/8/97 FAX/MAIL/COURIER
PROJECT No ..... FILE No. .....
DOCUMENT No. .....
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BATCH QUALITY CONTROL

ALS EP-071 : Total Petroleum Hydrocarbons by Fractions

QC Lot No. : NVOCW184 ANALYST: R. DAUBNEY
MATRIX: Water

Volatile Components

COMPOUND	Level Of Reporting (LOR)	Blank Conc	Spike Conc	SPIKE RESULTS				CONTROL LIMITS		
				SCS conc	DCS conc	Av. Rec.	RPD	Recovery (%)		RPD
	ug/L	ug/L	ug/L	ug/L	ug/L	%	%	Low	High	%
C6-C9	20	<LOR	200	188	189	94	0	83	113	20
C10	20	<LOR	50	40	37	77	7	74	121	20

COMMENTS :
1) The control limits are based on ALS laboratory statistical data. (Method QWI-ORG/06)
2) * : Recovery or RPD falls outside of the recommended control limits.

BATCH QUALITY CONTROL

ALS EP-071 : Total Petroleum Hydrocarbons by Fractions

MATRIX: Water

ANALYST: PERRY RENNEX

QC LOT No.: NTPHW176

Semivolatile Components

COMPOUND	BATCH ADJ. (MDL)	Blank Conc.	Spike Conc.	Spike Results				Control Limits		
				SCS Conc.	DCS Conc.	Av. Rec.	RPD	Recovery %		RPD
	ug/L	ug/L	ug/L	ug/L	ug/L	%	%	Low	High	%
C11-C14	25	<LOR	327	289	295	89	2	43	121	20
C15-C28	25	<LOR	641	612	617	96	1	55	136	20
C29-C36	25	<LOR	290	289	298	101	3	63	132	20

COMMENTS:

1) The control limits are based on ALS laboratory statistical data (Method QWI-ORG/07).

2) * : Recovery or RPD falls outside the recommended control limit.

3) MDL = Method Detection Limit

4) LOR = Level Of Reporting

[redacted]

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Water Quality, Water Treatment and Environmental Pollution Research Laboratories

ATTN -: CATHERINE BRODY

Job No. L&C-97-125 FROM -: MARC CENTNER (ALS)

26th August, 1997

Australian Laboratory Services Pty. Ltd.,
Attn. Mr. MARC CENTNER,
P.O. Box 83,
Rydalmere. NSW 2116.

Dear Marc,

REPORT

RE: MEASUREMENT OF HALOGENATED ORGANICS

Purchase Order No. 70037
Ref. No. ES6842, Project ID A861191/130

I refer to your request regarding AOX analyses of aqueous samples received on 14th August, 1997.

The results are now attached.

Youre sincerely,

George Levay
Managing Director

Eno.

DATE RECEIVED 26/8/97 FAX/MAIL/COURIER
PROJECT No ..... FILE No. .....
DOCUMENT No. .....
DISTRIBUTION .....

Ian Wark Research Institute
University of South Australia, The Levels SA 5095, Australia
[redacted]
Tel. (08) 8302 3130 Fax. (08) 8302 3549 Email: george.levay@unisa.edu.au

LEVAY AND CO. - ENVIRONMENTAL SERVICES

Water Quality, Water Treatment and Environmental Pollution Research Laboratories

Job No.
L&C-97-125

AUSTRALIAN LABORATORY SERVICES PTY. LTD.
New South Wales

AOX Analyses

Purchase Order. No. 70037
Ref. No. ES6842
Project ID A861191/130

Sample No.	Sample Description	Date	AOX (ppb)
1	Austral - 3	11/08/97	265
2	Pit - 01	"	80
3	Creek - 01	"	88
4	GWDUP - 01	12/08/97	255
5	Austral - 1	"	235

* AOX measured in the supernatant of settled samples

Ian Wark Research Institute, University of South Australia, The Levels SA 5095
Tel: (08) 8302-3130, Fax: (08) 8302-3549, Email: george.levay@unisa.edu.au

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ANALYTICAL REPORT

CONTACT:	MS CATHERINE BRODY	LABORATORY:	ENV SYDNEY
CLIENT:	AGC WOODWARD-CLYDE (NSW)	BATCH NUMBER:	ES7047
ADDRESS:	LEVEL 6, 486-494 PACIFIC H'WAY ST LEONARDS NSW 2065	SUB BATCH:	0
		No. OF SAMPLES:	3
		DATE RECEIVED:	27/08/97
		DATE COMPLETED:	08/09/97

ORDER No.: A861191/130 SAMPLE TYPE: WATER PROJECT: AUSTRAL-HORSLEY PARK

Method	Analysis description		Units	LOR	AUSTRAL-2 26/08/97	BLANK 26/08/97	TRIP 26/08/97
EA-015	Total Dissolved Solids (TDS)		mg/L	1	10300	<1	----
ED-005F	Calcium	- Filtered	mg/L	1	140	<1	----
ED-010F	Magnesium	- Filtered	mg/L	1	73	<1	----
ED-015F	Sodium	- Filtered	mg/L	1	3900	<1	----
ED-020F	Potassium	- Filtered	mg/L	1	44	<1	----
EK-035	Bicarbonate as CaCO3		mg/L	1	346	2	----
EK-040F	Sulphate	- Filtered	mg/L	1	12	<1	----
ED-045	Chloride		mg/L	1	6290	1	----
EG-005F	Iron	- Filtered	mg/L	0.1	<1.0	<0.1	<0.1
EG-020F	Arsenic	- Filtered	mg/L	0.01	0.01	<0.01	<0.01
	Copper	- Filtered	mg/L	0.001	0.004	<0.001	<0.001
	Manganese	- Filtered	mg/L	0.001	0.192	<0.001	<0.001
	Lead	- Filtered	mg/L	0.001	<0.001	<0.001	<0.001
	Zinc	- Filtered	mg/L	0.001	0.027	0.001	<0.001
EG-035F	Mercury	- Filtered	mg/L	0.0001	<0.0001	<0.0001	<0.0001
EK-040	Fluoride		mg/L	0.1	<0.1	<0.1	----
EK-055A	Ammonia as N		mg/L	0.01	8.59	<0.01	----
EK-058A	Nitrate as N		mg/L	0.01	0.06	<0.01	----
EK-061A	Total Kjeldahl Nitrogen as N		mg/L	0.1	9.8	<0.1	----
EK-067A	Phosphorus as P - Total		mg/L	0.01	0.43	<0.01	----
EP-005	Total Organic Carbon		mg/L	1	22	<1	----
EP-035	Phenols		mg/L	0.2	<0.2	<0.2	----
EA-005	Total Cations		me/L	0.01	184	<0.01	----
EA-010	Total Anions		me/L	0.01	185	0.07	----
EA-015	Actual (Anion / Cation) Difference		me/L	0.01	0.84	0.07	----
EA-020	Allowed (Anion / Cation) Difference		me/L	0.01	2.97	0.11	----

COMMENTS:

Iron LOR raised (x10) for Austral-2 due to the high concentration of dissolved salts.

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ANALYTICAL REPORT

CONTACT: MS CATHERINE BRODY
CLIENT: AGC WOODWARD-CLYDE (NSW)
ADDRESS: LEVEL 6, 486-494 PACIFIC H'WAY
ST LEONARDS NSW 2065

LABORATORY: ENV SYDNEY
BATCH NUMBER: ES7047
SUB BATCH: 0
No. OF SAMPLES: 3
DATE RECEIVED: 27/08/97
DATE COMPLETED: 08/09/97

ORDER No.: A861191/130 SAMPLE TYPE: QUALITY CONTROL PROJECT: AUSTRAL-HORSLEY PARK

Method	Analysis description	Units	LOR	AUSTRAL-2 %SPK REC 26/08/97	AUSTRAL-2 MS 26/08/97	AUSTRAL-2 MSD 26/08/97	BLANK CHK 26/08/97
EA-015	Total Dissolved Solids (TDS)	mg/L	1	----	----	----	2
ED-005F	Calcium - Filtered	mg/L	1	----	----	----	<1
[illegible]010F	Magnesium - Filtered	mg/L	1	----	----	----	<1
ED-015F	Sodium - Filtered	mg/L	1	----	----	----	<1
ED-020F	Potassium - Filtered	mg/L	1	----	----	----	<1
[illegible]035	Bicarbonate as CaCO3	mg/L	1	----	----	----	2
[illegible]040F	Sulphate - Filtered	mg/L	1	----	----	----	<1
ED-045	Chloride	mg/L	1	94.0 %	99.0 %	102 %	1
[illegible]005F	Iron - Filtered	mg/L	0.1	89.0 %	89.0 %	85.0 %	<0.1
[illegible]020F	Arsenic - Filtered	mg/L	0.01	113 %	109 %	107 %	<0.01
	Copper - Filtered	mg/L	0.001	98.0 %	96.0 %	88.0 %	<0.001
	Manganese - Filtered	mg/L	0.001	124 %	84.0 %	108 %	<0.001
	Lead - Filtered	mg/L	0.001	92.0 %	90.0 %	84.0 %	<0.001
	Zinc - Filtered	mg/L	0.001	104 %	106 %	94.0 %	0.001
EG-035F	Mercury - Filtered	mg/L	0.0001	101 %	101 %	102 %	<0.0001
[illegible]040	Fluoride	mg/L	0.1	104 %	80.0 %	83.0 %	<0.1
[illegible]055A	Ammonia as N	mg/L	0.01	112 %	105 %	105 %	<0.01
EK-058A	Nitrate as N	mg/L	0.01	107 %	104 %	104 %	<0.01
[illegible]061A	Total Kjeldahl Nitrogen as N	mg/L	0.1	116 %	99.0 %	94.0 %	<0.1
[illegible]067A	Phosphorus as P - Total	mg/L	0.01	104 %	97.0 %	89.0 %	<0.01
EP-005	Total Organic Carbon	mg/L	1	----	----	----	<1
[illegible]035	Phenols	mg/L	0.2	111 %	96.0 %	96.0 %	<0.2
[illegible]005	Total Cations	me/L	0.01	----	----	----	<0.01
EZ-010	Total Anions	me/L	0.01	----	----	----	0.07
EZ-015	Actual (Anion / Cation) Difference	me/L	0.01	----	----	----	0.07
[illegible]020	Allowed (Anion / Cation) Difference	me/L	0.01	----	----	----	0.11

COMMENTS:

Results which appear on this report are for laboratory QUALITY CONTROL purposes.

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ANALYTICAL REPORT

CONTACT: MS CATHERINE BRODY
CLIENT: AGC WOODWARD-CLYDE (NSW)
ADDRESS: LEVEL 6, 486-494 PACIFIC H'WAY
ST LEONARDS NSW 2065

LABORATORY: ENV SYDNEY
BATCH NUMBER: ES7047
SUB BATCH: 0
No. OF SAMPLES: 3
DATE RECEIVED: 27/08/97
DATE COMPLETED: 08/09/97

ORDER No.: A861191/130 SAMPLE TYPE: QUALITY CONTROL PROJECT: AUSTRAL-HORSLEY PARK

Method	Analysis description		Units	LOR	METHOD BLANK 27/08/97
EA-015	Total Dissolved Solids (TDS)		mg/L	1	<1
ED-005F	Calcium	- Filtered	mg/L	1	<1
ED-010F	Magnesium	- Filtered	mg/L	1	<1
ED-015F	Sodium	- Filtered	mg/L	1	<1
ED-020F	Potassium	- Filtered	mg/L	1	<1
ED-035	Bicarbonate as CaCO3		mg/L	1	----
ED-040F	Sulphate	- Filtered	mg/L	1	<1
ED-045	Chloride		mg/L	1	<1
EG-005F	Iron	- Filtered	mg/L	0.1	<0.1
EG-020F	Arsenic	- Filtered	mg/L	0.01	<0.01
	Copper	- Filtered	mg/L	0.001	<0.001
	Manganese	- Filtered	mg/L	0.001	<0.001
	Lead	- Filtered	mg/L	0.001	<0.001
	Zinc	- Filtered	mg/L	0.001	<0.001
EG-035F	Mercury	- Filtered	mg/L	0.0001	<0.0001
ED-040	Fluoride		mg/L	0.1	<0.1
EK-055A	Ammonia as N		mg/L	0.01	<0.01
EK-058A	Nitrate as N		mg/L	0.01	<0.01
EK-061A	Total Kjeldahl Nitrogen as N		mg/L	0.1	<0.1
EK-067A	Phosphorus as P - Total		mg/L	0.01	<0.01
EP-005	Total Organic Carbon		mg/L	1	<1
EP-035	Phenols		mg/L	0.2	<0.2
EC-005	Total Cations		me/L	0.01	----
EC-010	Total Anions		me/L	0.01	----
EC-015	Actual (Anion / Cation) Difference		me/L	0.01	----
EC-020	Allowed (Anion / Cation) Difference		me/L	0.01	----

COMMENTS:

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ANALYTICAL REPORT

CONTACT: MS CATHERINE BRODY
CLIENT: AGC WOODWARD-CLYDE (NSW)
ADDRESS: LEVEL 6, 486-494 PACIFIC H'WAY
ST LEONARDS NSW 2065

LABORATORY: ENV SYDNEY
BATCH NUMBER: ES7047
SUB BATCH: 1
No. OF SAMPLES: 2
DATE RECEIVED: 27/08/97
DATE COMPLETED: 08/09/97

ORDER No.: A861191/130 SAMPLE TYPE: SOIL PROJECT:

Method	Analysis description	Units	LOR	AUSTRAL-2 26/08/97	BLANK 26/08/97
EP-071-WS	TOTAL PETROLEUM HYDROCARBONS				
	C6 - C9 Fraction	ug/L	20	<20	<20
	C10 - C14 Fraction	ug/L	50	<50	<50
	C15 - C28 Fraction	ug/L	100	<100	<100
	C29 - C36 Fraction	ug/L	50	<50	<50
EP-080S-WS	VOLATILE TPH/BTEX COMPOUND SURROGATES				
	1.2-Dichloroethane-D4	%	1	101	97
	Toluene-D8	%	1	91	91
	4-Bromofluorobenzene	%	1	92	89

COMMENTS:

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ANALYTICAL REPORT

CONTACT: MS CATHERINE BRODY
CLIENT: AGC WOODWARD-CLYDE (NSW)
ADDRESS: LEVEL 6, 486-494 PACIFIC H'WAY
ST LEONARDS NSW 2065

LABORATORY: ENV SYDNEY
BATCH NUMBER: ES7047
SUB BATCH: 1
No. OF SAMPLES: 2
DATE RECEIVED: 27/08/97
DATE COMPLETED: 08/09/97

ORDER No.: A861191/130 SAMPLE TYPE: QUALITY CONTROL PROJECT:

Method	Analysis description	Units	LOR	METHOD BLANK 27/08/97
EP-071-WS	TOTAL PETROLEUM HYDROCARBONS			
	C6 - C9 Fraction	ug/L	20	<20
	C10 - C14 Fraction	ug/L	50	<50
	C15 - C28 Fraction	ug/L	100	<100
	C29 - C36 Fraction	ug/L	50	<50
EP080S-WS	VOLATILE TPH/BTEX COMPOUND SURROGATES			
	1.2-Dichloroethane-D4	%	1	101
	Toluene-D8	%	1	103
	4-Bromofluorobenzene	%	1	101

COMMENTS:

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• This is the Final Report which supersedes any preliminary reports with this batch number.

• Results apply to sample(s) as submitted by client.

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LEVAY & CO. - ENVIRONMENTAL SERVICES

Water Quality, Water Treatment and Environmental Pollution Research Laboratories

Job No. L&C-97-146

8th September, 1997

Australian Laboratory Services Pty. Ltd.,
Attn. Mr. MARC CENTNER,
P.O. Box 63,
Rydalmere. NSW 2116.

Dear Marc,

REPORT

RE: MEASUREMENT OF HALOGENATED ORGANICS

Purchase Order No. 70052
Ref. No. ES7047

I refer to your request regarding AOX analyses of aqueous samples received on 29th August, 1997.

The results are now attached.

Yours sincerely,

George Levay
Managing Director

Enc.

Ian Wark Research Institute
University of South Australia, The Levels SA 5095, Australia
Tel. (08) 8302 3130 Fax. (08) 8302 3549 Email: george.levay@unisa.edu.au

LEVAY AND CO. - ENVIRONMENTAL SERVICES

Water Quality, Water Treatment and Environmental Pollution Research Laboratories

Job No.			
L&C-97-146			
	AUSTRALIAN LABORATORY		
	SERVICES PTY. LTD.		
	New South Wales		
Sample	Sample	Date	AOX
No.	Description		(ppb)
	AOX Analyses		
	Purchase Order. No. 70052		
	Ref. No. ES7047		
	Project ID A861191/130		
1	Austral - 2	26/08/97	180
2	Blank	"	38
	*** AOX measured in the supernatant**		
	of settled samples		

Ian Wark Research Institute, University of South Australia, The Levels SA 5095
Tel: (08) 8302-3130, Fax: (08) 8302-3549, Email: george.levay@unisa.edu.au

LAB. NO.	SAMPLE SOURCE	SAMPLE DESCRIPTION	MOISTURE CONTENT (%) 1	DRY DENSITY t/c.m	LIQUID LIMIT 2	PLASTIC INDEX 3	LINEAR SHR'KAGE (%) 4
16382	SS–001	(Cl) SILTY CLAY: brown, medium plasticity, trace of fine sand			39	21	11.5
16383	SS–002	(CH) SILTY CLAY: brown, high plasticity, trace of fine sand			52	32	12.0

NOTES TO TESTING

1. Test method : AS 1289 2.1.1–1992

2. Test Method : AS 1289 3.1.2
   Preparation : natural state with no sieving
   Sample History : natural state as recieved

3. Test Method : AS 1289 3.2.1 ; 3.3.1
   Preparation and sample history as 2.

4. Test Method : AS 1289 3.4.1
   Sample history and preparation as 2.
   Mould Size ; 125mm
   Dry sample state : linear

Job No. : 075–055
Sampled by : Client
Date Tested: 3/9/97

FORM: C01. File: C01 Issue 3: Aug 1995

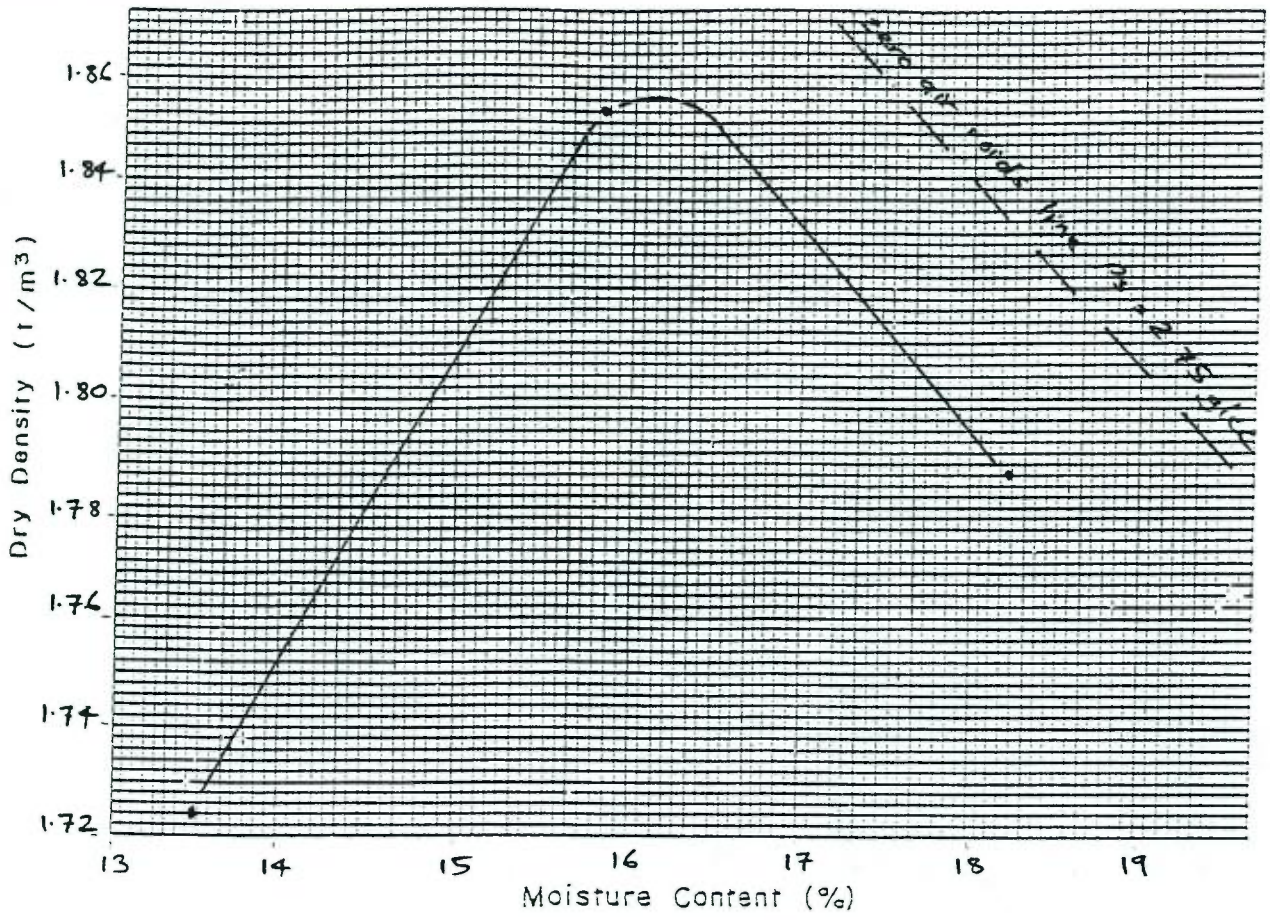
SIGNED BY [signature] DATE 3/9/97

AUST SOIL TESTING P/L. 1ST FLOOR, 338 BOTANY ROAD, ALEXANDRIA 2015

PROJECT:
AGC WOODWARD CLYDE PTY LTD
Project No. A861191/130

SAMPLE CLASSIFICATION TEST DATA

AUSTRALIAN SOIL TESTING
338 BOTANY RD; ALEXANDRIA
NSW 2015. Telephone 9319 2111



SAMPLE NO.	16382/ 16383	
SAMPLE SOURCE:	SS–001/ SS–002 (combined)	
SAMPLE DESCRIPTION :	SILTY CLAY: brown, high plasticity, trace of fine sand	
MAXIMUM DRY DENSITY:	1.85	t/c.m
OPTIMUM MOISTURE CONTENT:	19.0	%
MATERIAL RETAINED ON 19mm Sieve	0	%

COMPACTIVE EFFORT (STANDARD)

No of layers	3	
Blows per layer	25	
Mass of rammer	2.7	kg
Drop of rammer	300	mm

COMMENTS

Tested in accordance with:
AS1289.5.1.1; Standard Laboratory Compaction

SIGNED BY [signature] DATE 3/9/97

AUST. SOIL TESTING P/L, 1ST FLOOR, 338 BOTANY ROAD, ALEXANDRIA 2015

Form E4:File COMPNRPT

PROJECT
AGC WOODWARD CLYDE PTY LTD
Project No. A861191/130

COMPACTION TEST REPORT

AUSTRALIAN SOIL TESTING P/L
338 BOTANY RD, ALEXANDRIA
NSW 2015. Telephone 9319 2111

SAMPLE SOURCE	:	SS−001	
SAMPLE DESCRIPTION	:	SILTY CLAY : brown, high plasticity, trace of fine sand.	
SAMPLE No	:	16382	
INITIAL MOISTURE CONTENT	:	15.1	%
DRY DENSITY	:	1.76	t/c.m.
FINAL MOISTURE CONTENT	:	N/A	%

COEFFICIENT OF PERMEABILITY

	k :	2.4x10^(−8)	cm/sec.
		being the average of 4 tests having a range of 1.2x10^(−8) to 3.2x10^(−8)	cm/sec

DATE TESTED	:	01/09/97
SAMPLED BY	:	Client
COMMENTS	:	Remoulded to 95.0% of MDD at OMC

Tested in accordance with Lambe & Whitman ch 19.

Form C3 File : FHPRPT

PROJECT
AGC WOODWARD CLYDE PTY LTD
JOB No : A861191/130

FALLING HEAD PERMEABILITY TEST REPORT

AUSTRALIAN SOIL TESTING P/L
338 BOTANY RD, ALEXANDRIA
NSW 2015. Telephone 9319 2111.

SAMPLE SOURCE	:	SS−002	
SAMPLE DESCRIPTION	:	SILTY CLAY : brown, high plasticity, trace of fine sand.	
SAMPLE No	:	16383	
INITIAL MOISTURE CONTENT	:	16.9	%
DRY DENSITY	:	1.76	t/c.m.
FINAL MOISTURE CONTENT	:	N/A	%

COEFFICIENT OF PERMEABILITY

k : 2.7x10^(−8) cm/sec.

being the average of 4 tests having a range of 2.1x10^(−8) to 3.4x10^(−8) cm/sec

DATE TESTED	:	01/09/97
SAMPLED BY	:	Client
COMMENTS	:	Remoulded to 95.0% of MDD at OMC

Tested in accordance with Lambe & Whitman ch 19.

Form C3 File : FHPRPT

PROJECT AGC WOODWARD CLYDE PTY LTD JOB No : A861191/130	FALLING HEAD PERMEABILITY TEST REPORT
	AUSTRALIAN SOIL TESTING P/L 338 BOTANY RD, ALEXANDRIA NSW 2015. Telephone 9319 2111.

BATCH QUALITY CONTROL

ALS EP-071 : Total Petroleum Hydrocarbons by Fractions

QC Lot No. : NVOCW189 ANALYST: H.FLAMPOULIDIS
MATRIX: Water

Volatile Components

COMPOUND	Level Of Reporting (LOR)	Blank Conc	Spike Conc	SPIKE RESULTS				CONTROL LIMITS		
				SCS conc	DCS conc	Av. Rec.	RPD	Recovery (%)		RPD
	ug/L	ug/L	ug/L	ug/L	ug/L	%	%	Low	High	%
C6-C9	20	<LOR	200	208	192	100	8	78	118	20
C10	20	<LOR	50	53	48	102	10	67	125	20

COMMENTS :
1) The control limits are based on ALS laboratory statistical data. (Method QWI-ORG/06)
2) * : Recovery or RPD falls outside of the recommended control limits.

BATCH QUALITY CONTROL

ALS EP-071 : Total Petroleum Hydrocarbons by Fractions

MATRIX: Water

ANALYST: SUZY MICHAIL

QC LOT No.: NTPHW181

Semivolatile Components

COMPOUND	BATCH ADJ. (MDL)	Blank Conc.	Spike Conc.	Spike Results				Control Limits		
				SCS Conc.	DCS Conc.	Av. Rec.	RPD	Recovery %		RPD
	ug/L	ug/L	ug/L	ug/L	ug/L	%	%	Low	High	%
C11-C14	25	<LOR	327	259	237	76	9	43	121	20
C15-C28	25	<LOR	641	556	528	85	5	55	136	20
C29-C36	25	<LOR	290	200	222	73	10	63	132	20

COMMENTS:

1) The control limits are based on ALS laboratory statistical data (Method QWI-ORG/07).

2) * : Recovery or RPD falls outside the recommended control limit.

3) MDL = Method Detection Limit

4) LOR = Level Of Reporting

AUSTRALIAN LABORATORY SERVICES P/L
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ORGANICS QUALITY CONTROL REPORT

BATCH NO : ES7047

DATE BATCH RECEIVED : 27/08/97

CLIENT : AGC Woodward-Clyde

DATE BATCH COMPLETED : 08/09/97

Method Code	Test	Matrix	Method Reference		QC Lot Number	Date Samples Extracted	Date Samples Analysed
			Extraction	Analysis			
EP-071	TPH-Volatile	Water	USEPA 5030 A	USEPA 8260A	NVOCW189	N/A	28/08/97
	-Semivolatile	Water	USEPA 3510B	USEPA 8015A	NTPHW181	29/08/97	01/09/97

Appendix F

Ambient Noise Measurements

Figure 9.1.1 Austral 2 Noise, Tuesday 5/8/97

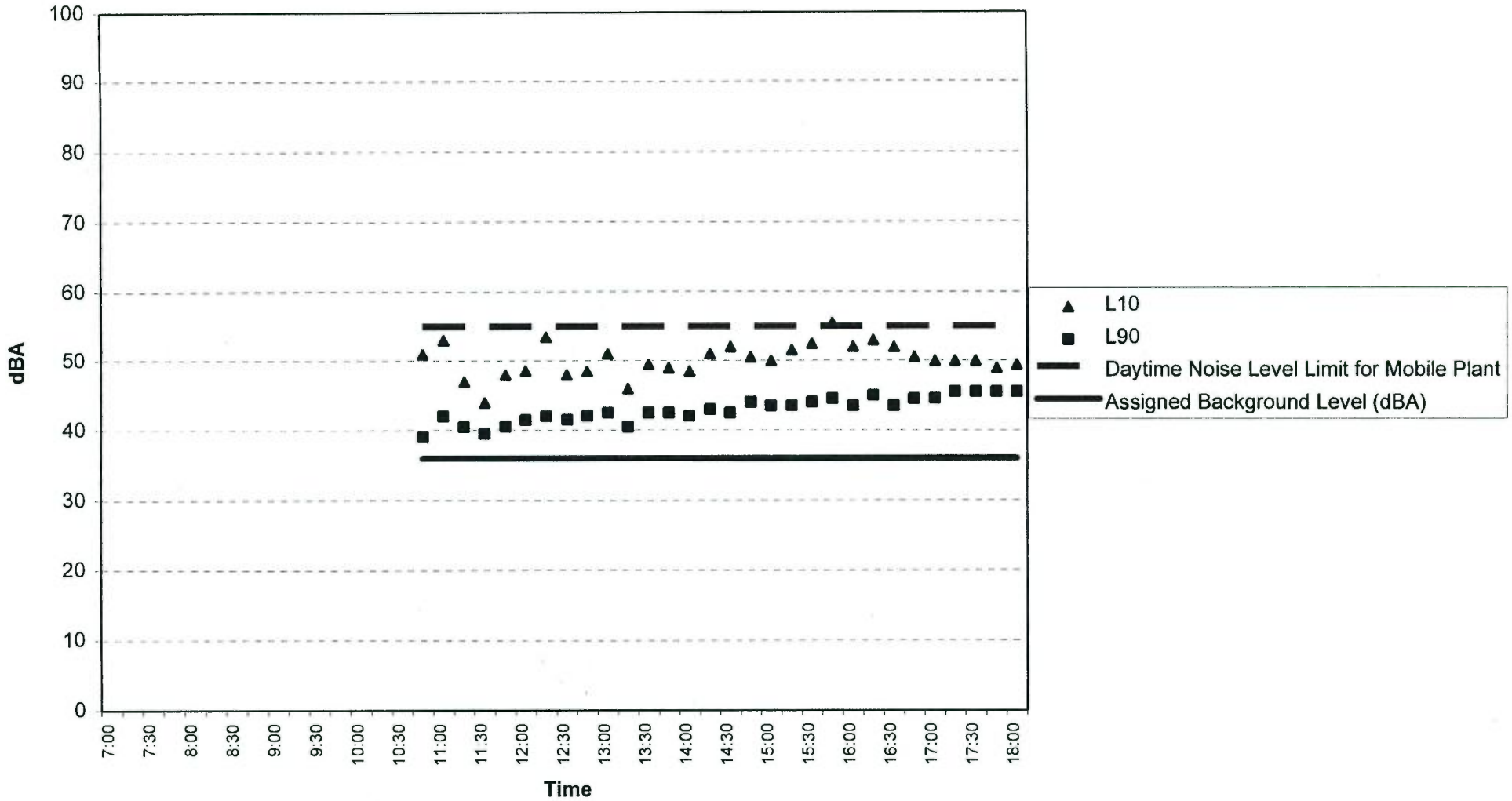

Figure 9.1.2 Austral 2 Noise, Wednesday 6/8/97

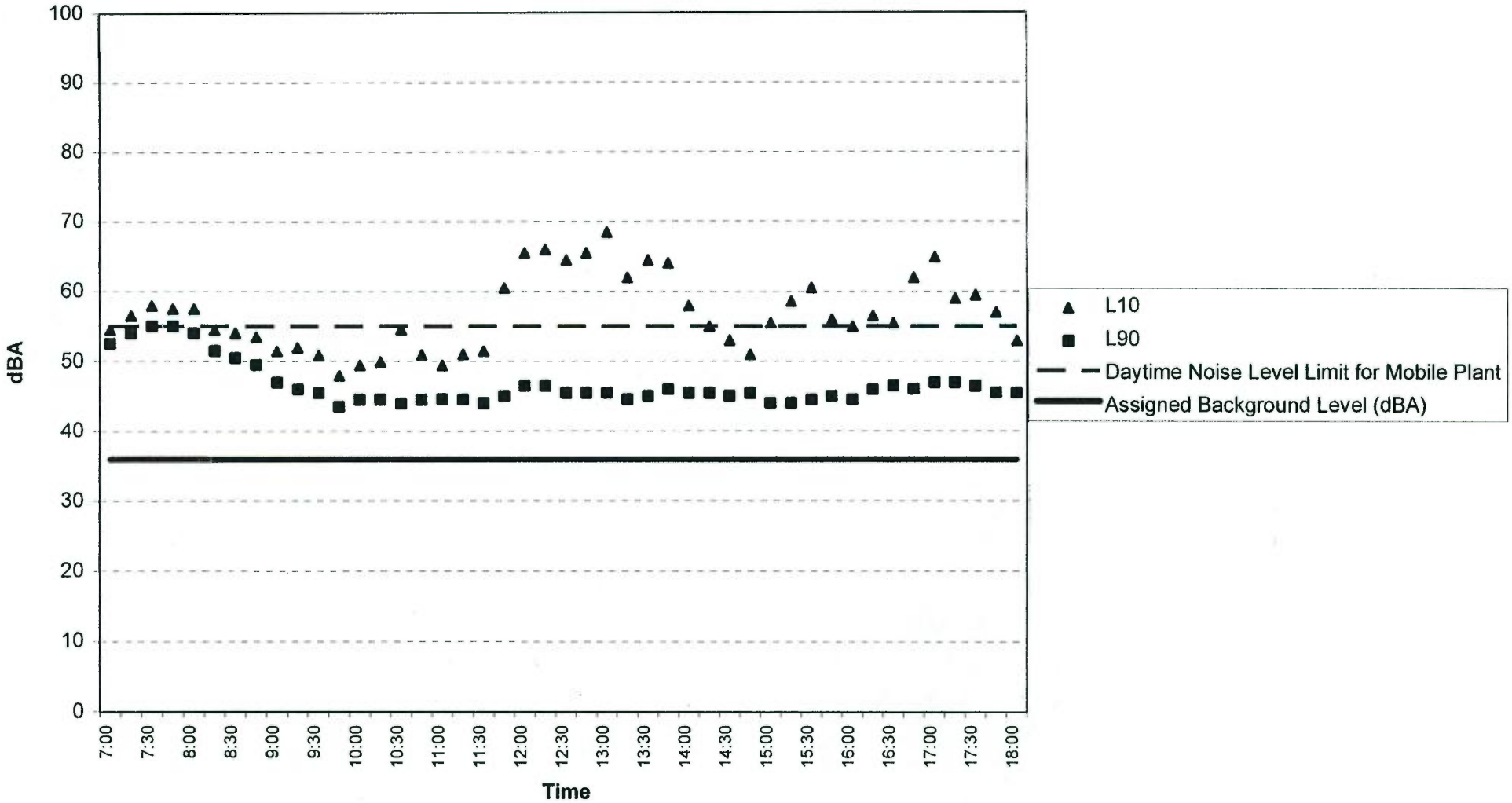

Figure 9.1.3 Austral 2 Noise, Thursday 7/8/97

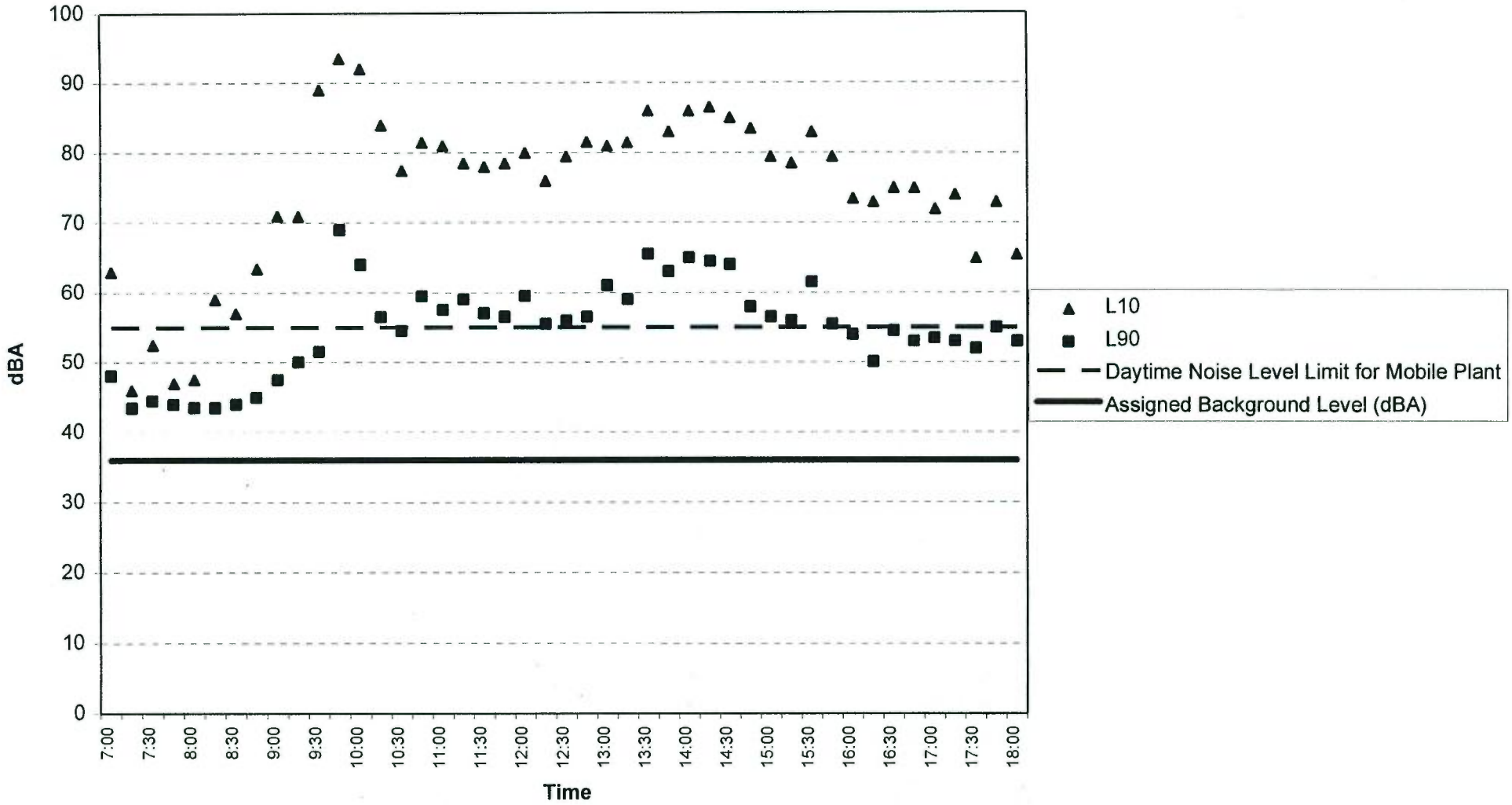

Figure 9.1.4 Austral 2 Noise, Friday 8/8/97

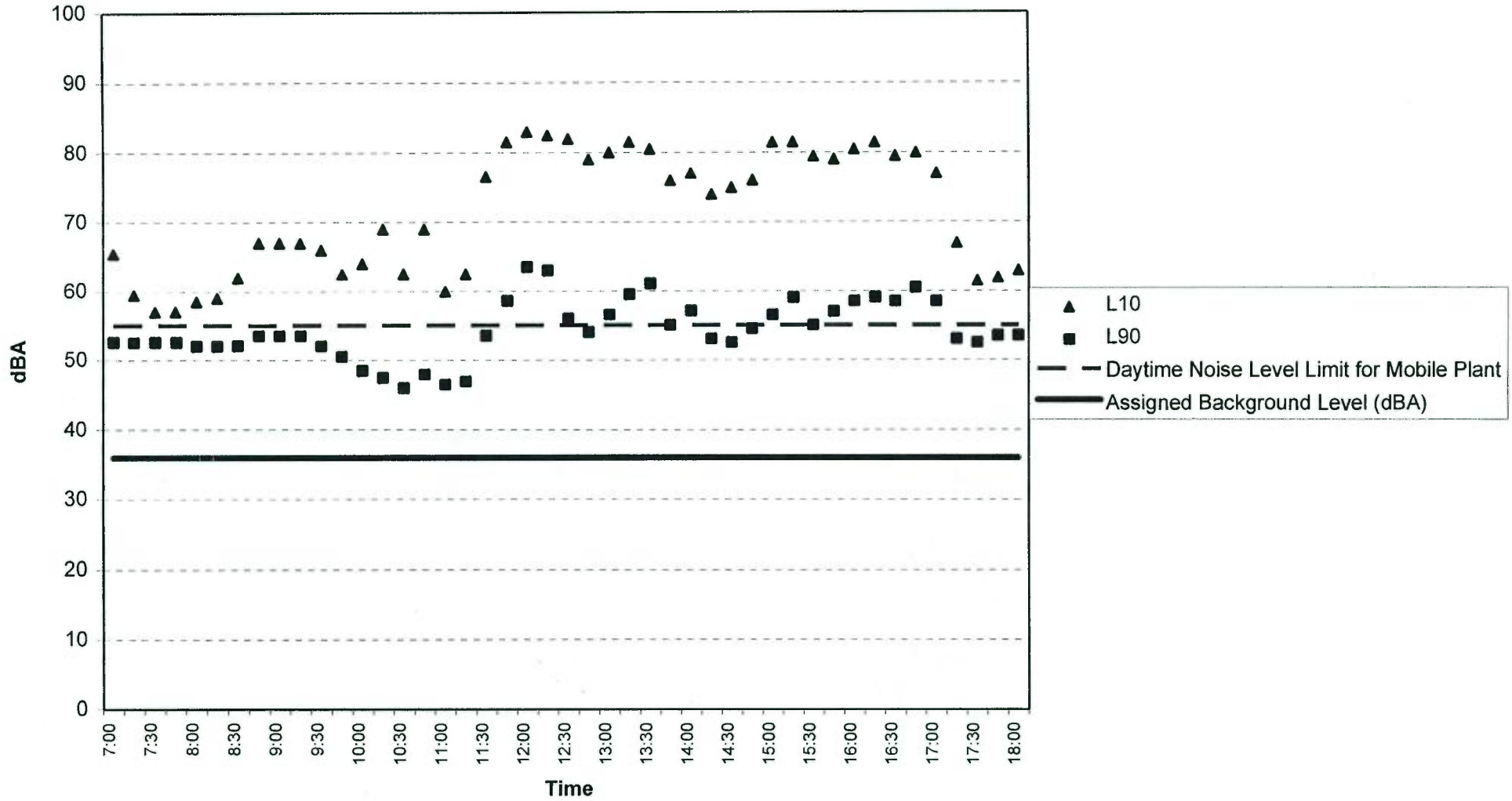

Figure 9.1.5 Austral 2 Noise, Saturday 9/8/97

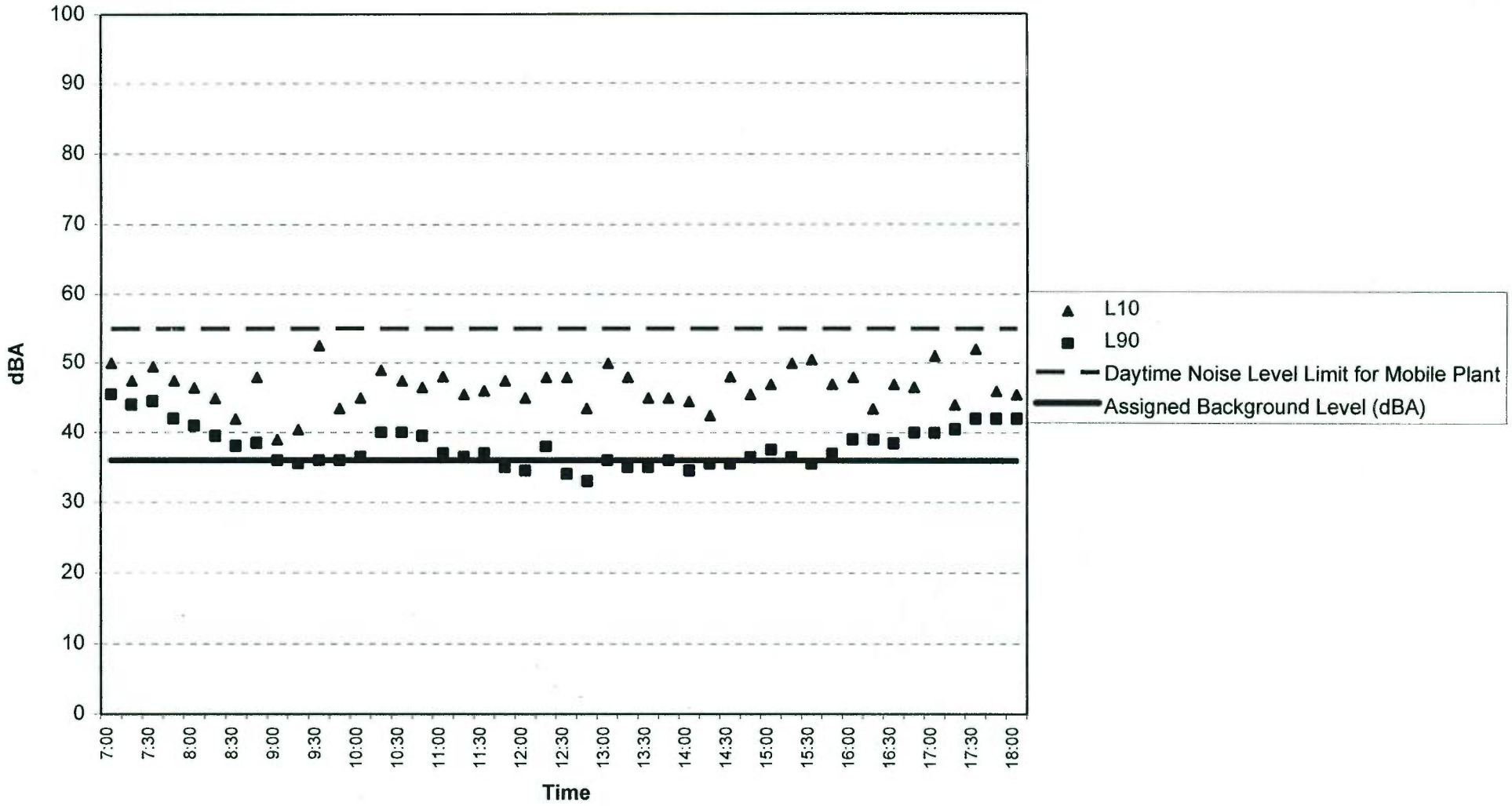

Figure 9.1.6 Austral 2 Noise, Sunday 10/8/97

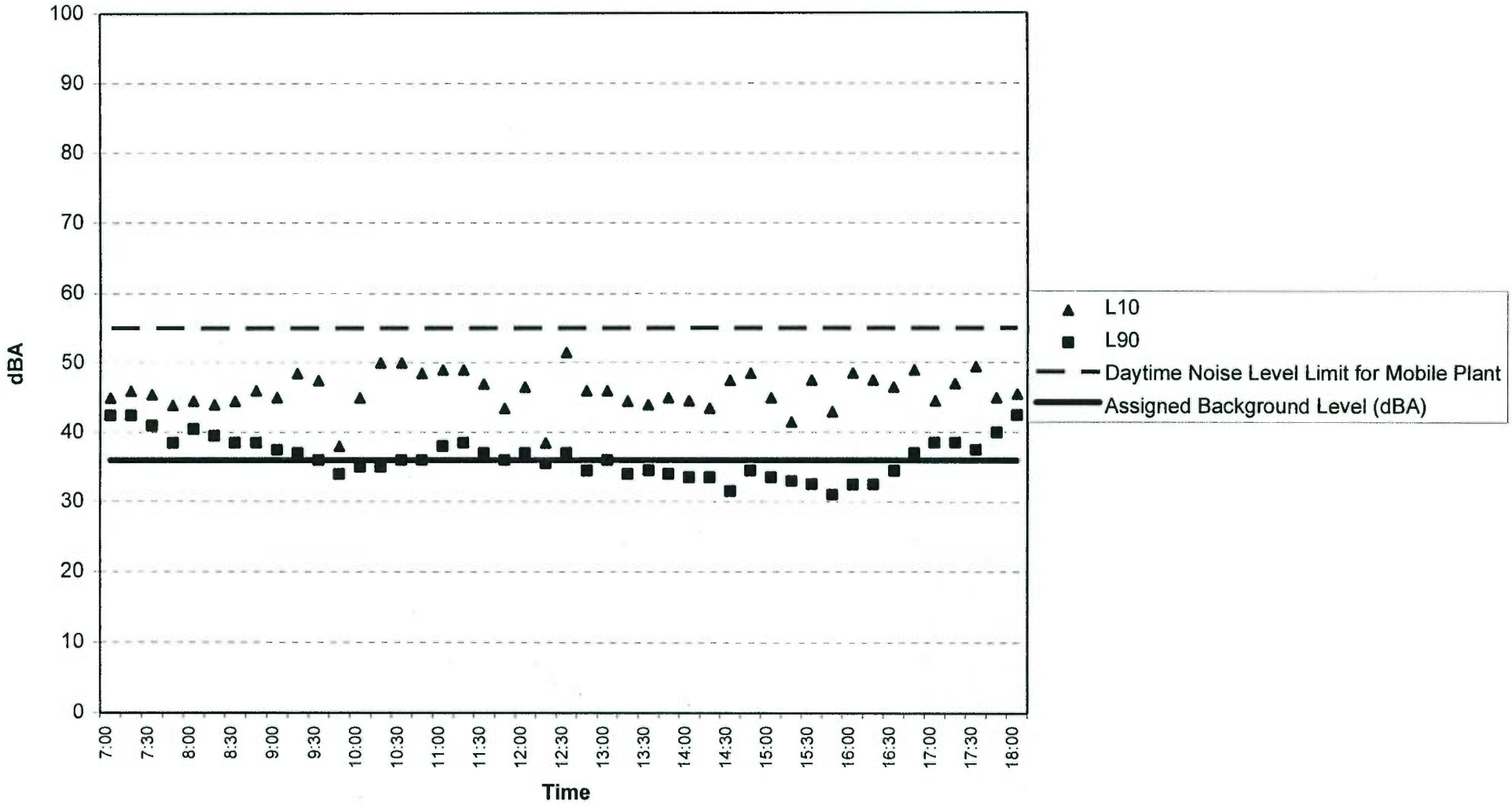

Figure 9.1.7 Austral 2 Noise, Monday 11/8/97

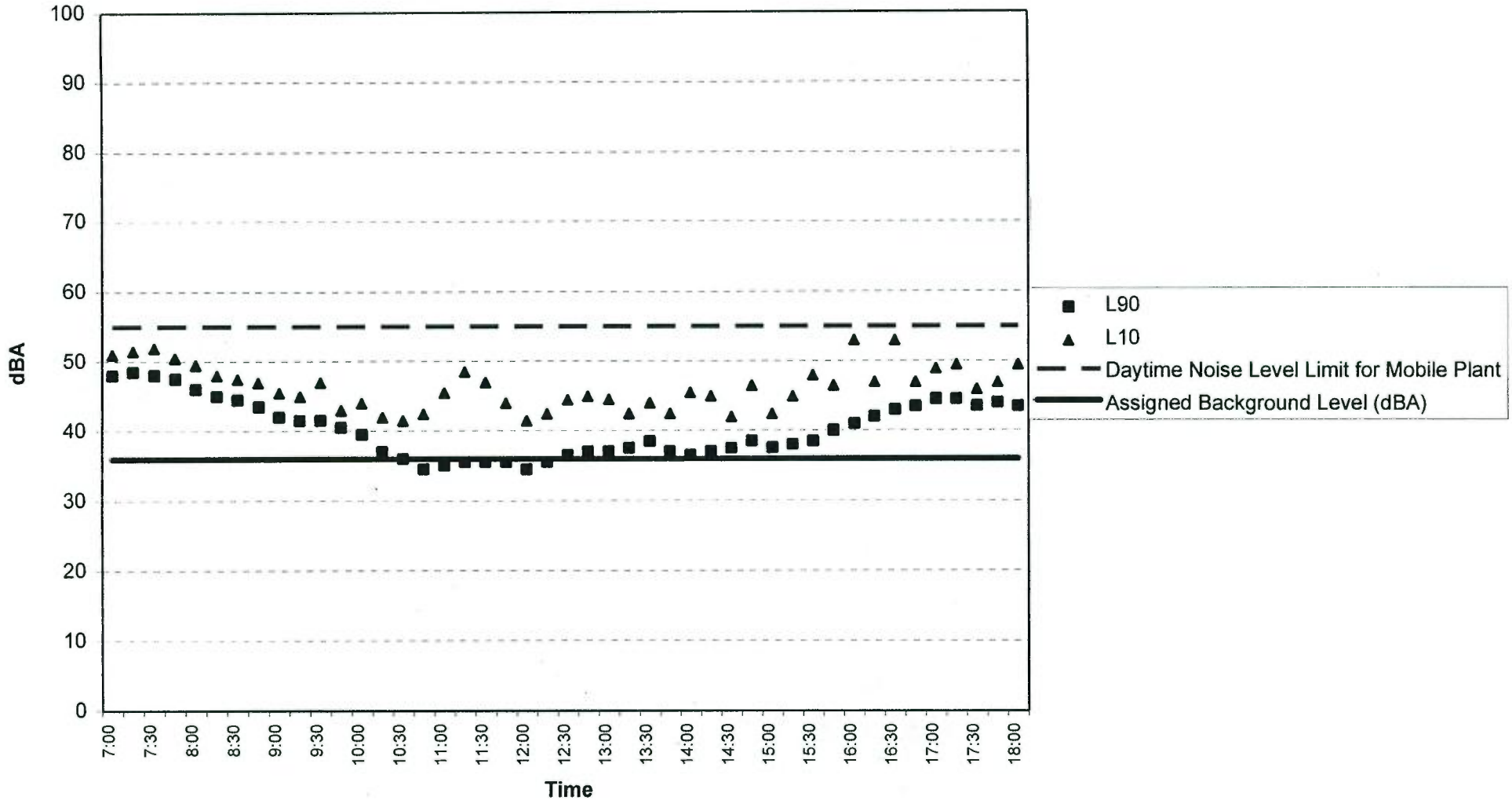

Figure 9.1.8 Austral 2 Noise, Tuesday 12/8/97

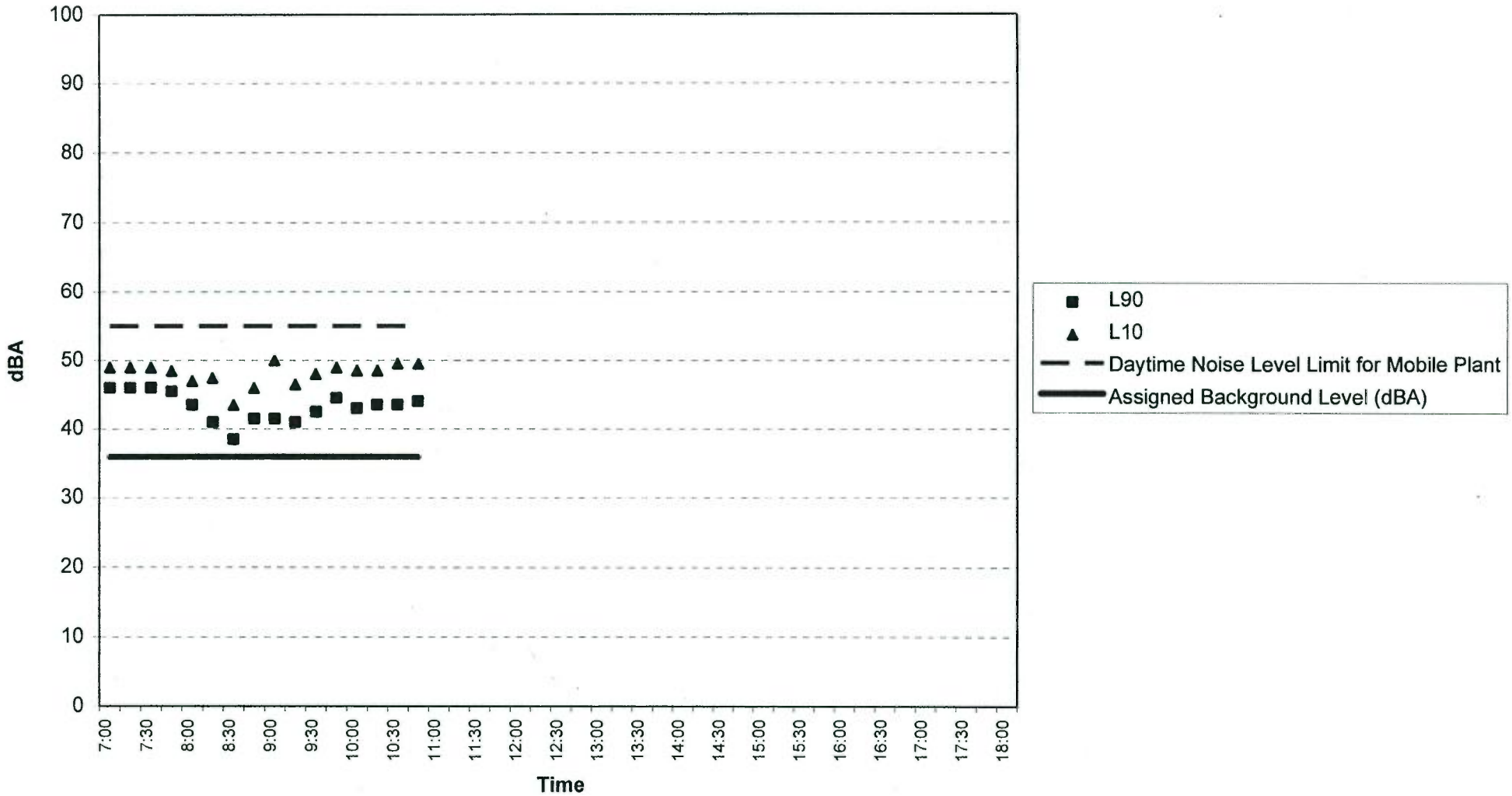

Figure 9.2.1 Austral 3 Noise, Tuesday 5/8/97

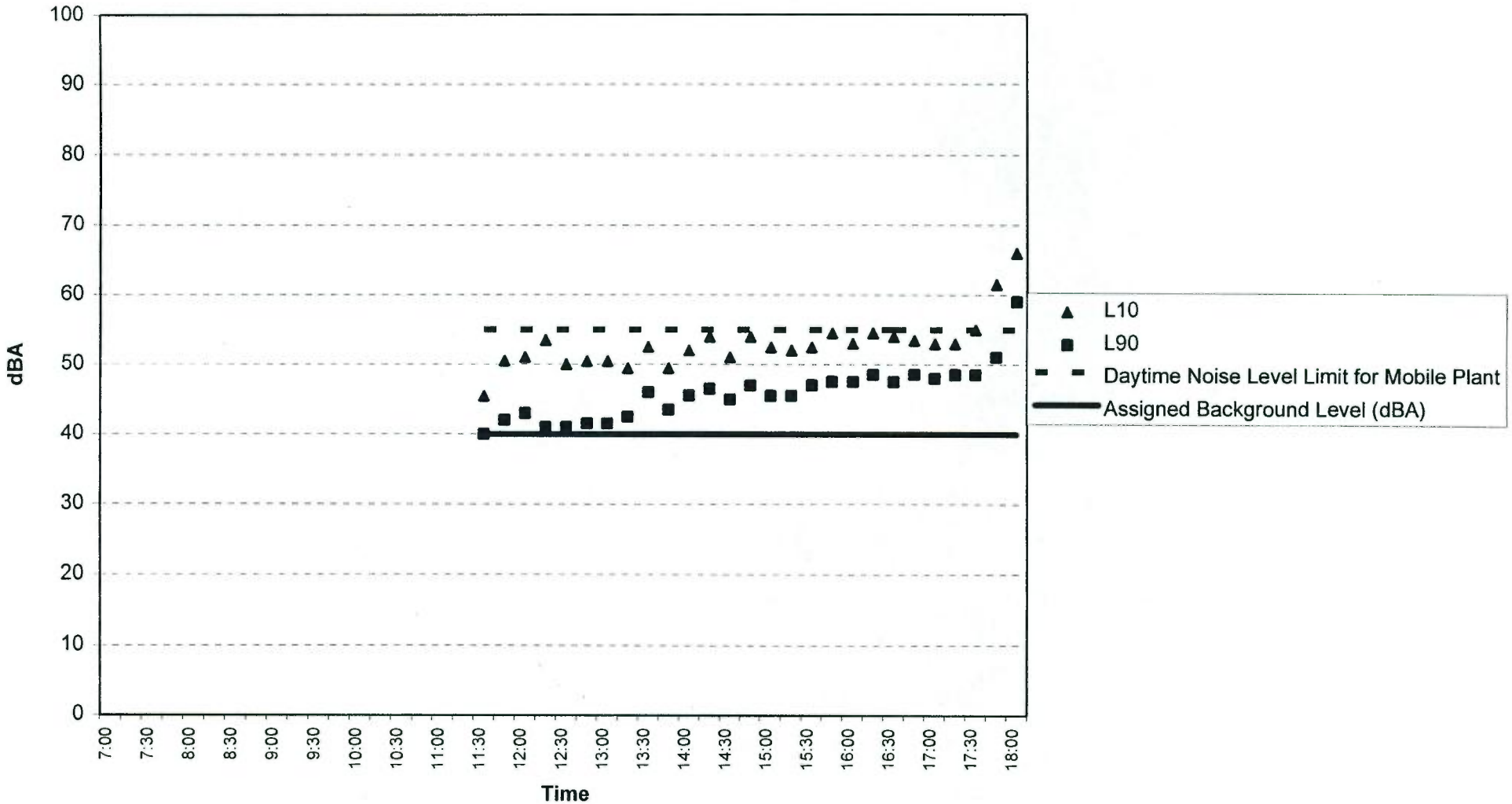

Figure 9.2.2 Austral 3 Noise, Wednesday 6/8/97

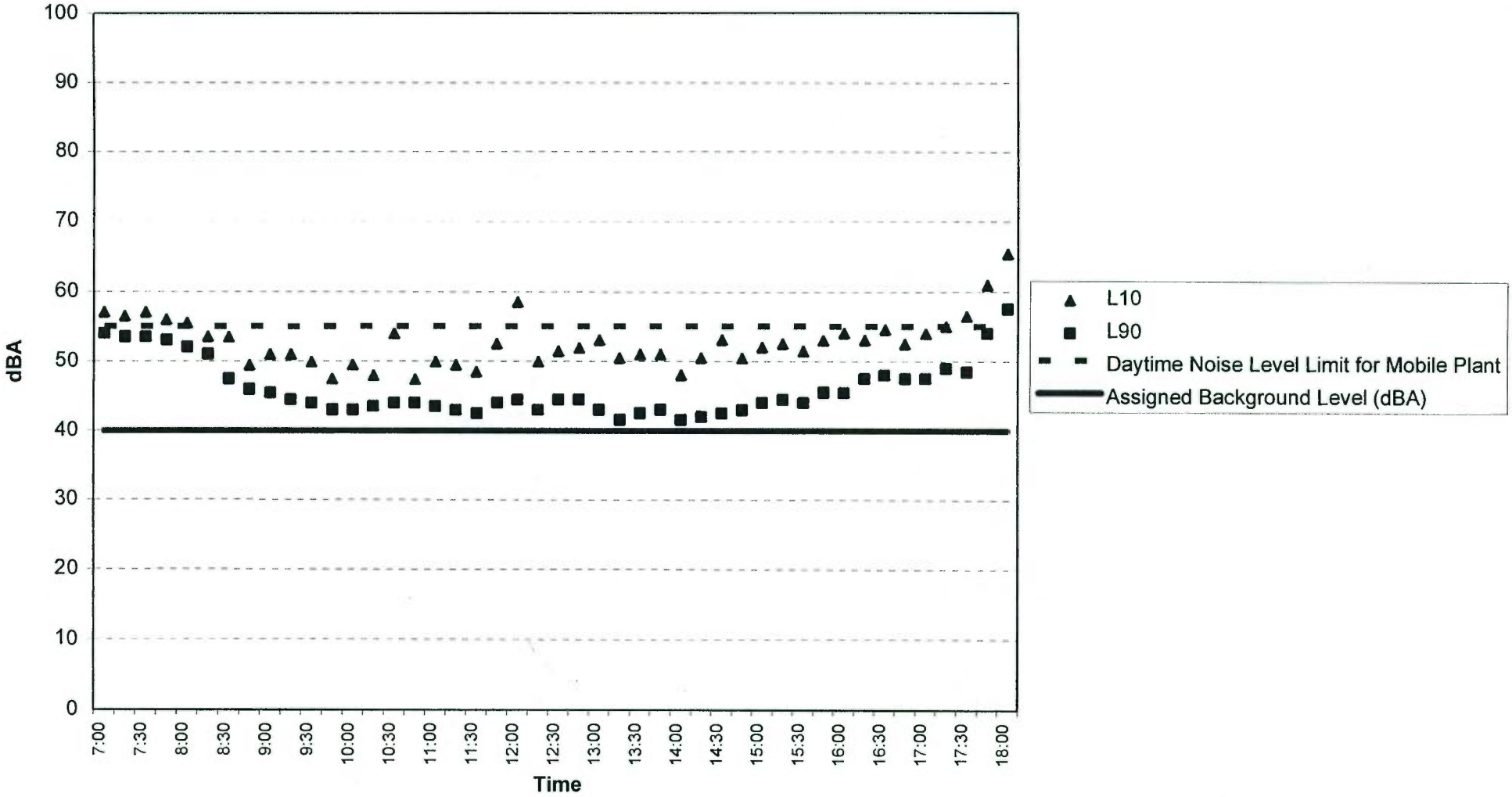

Figure 9.2.3 Austral 3 Noise, Thursday 7/8/97

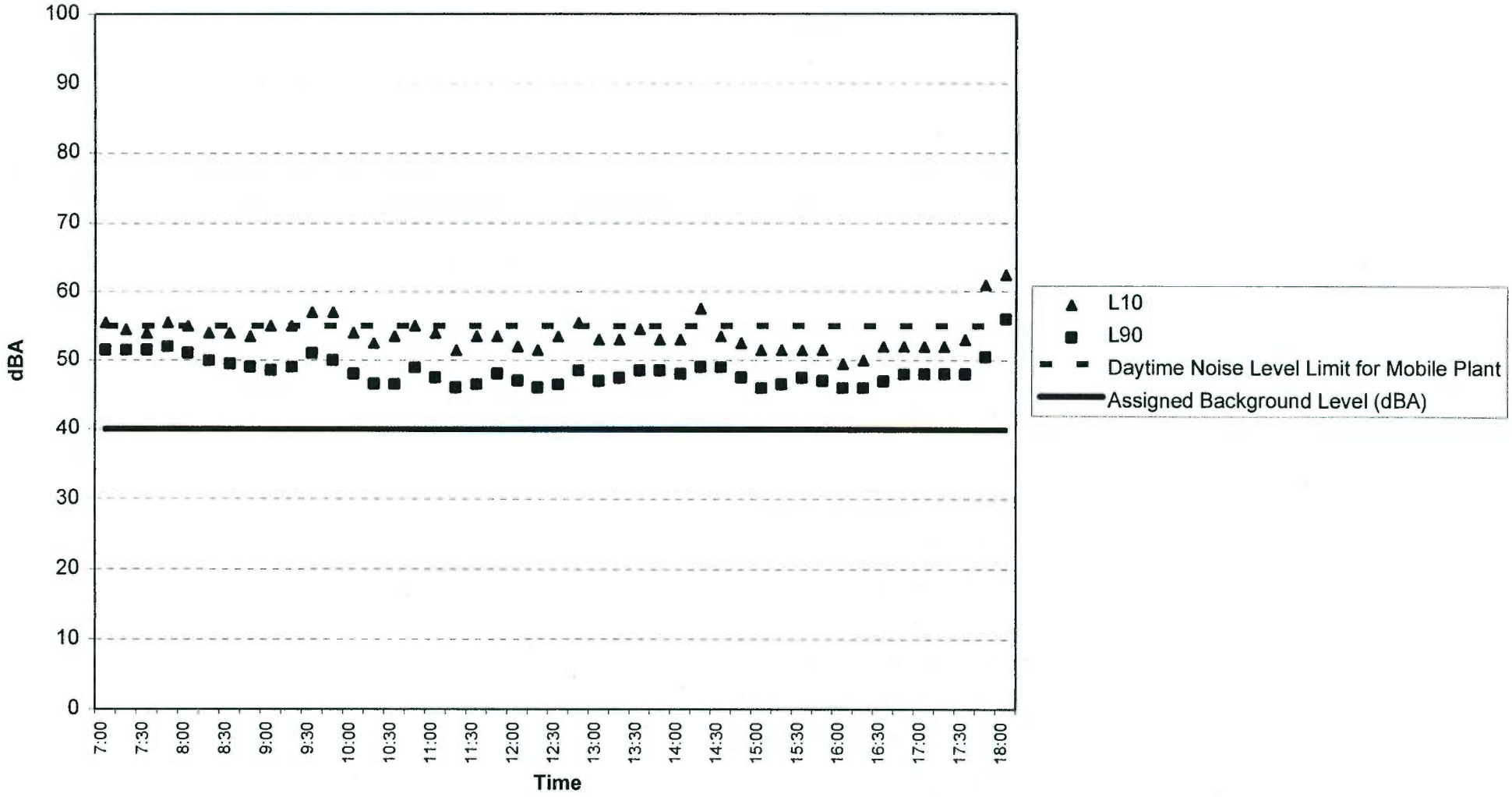

Figure 9.2.4 Austral 3 Noise, Friday 8/8/97

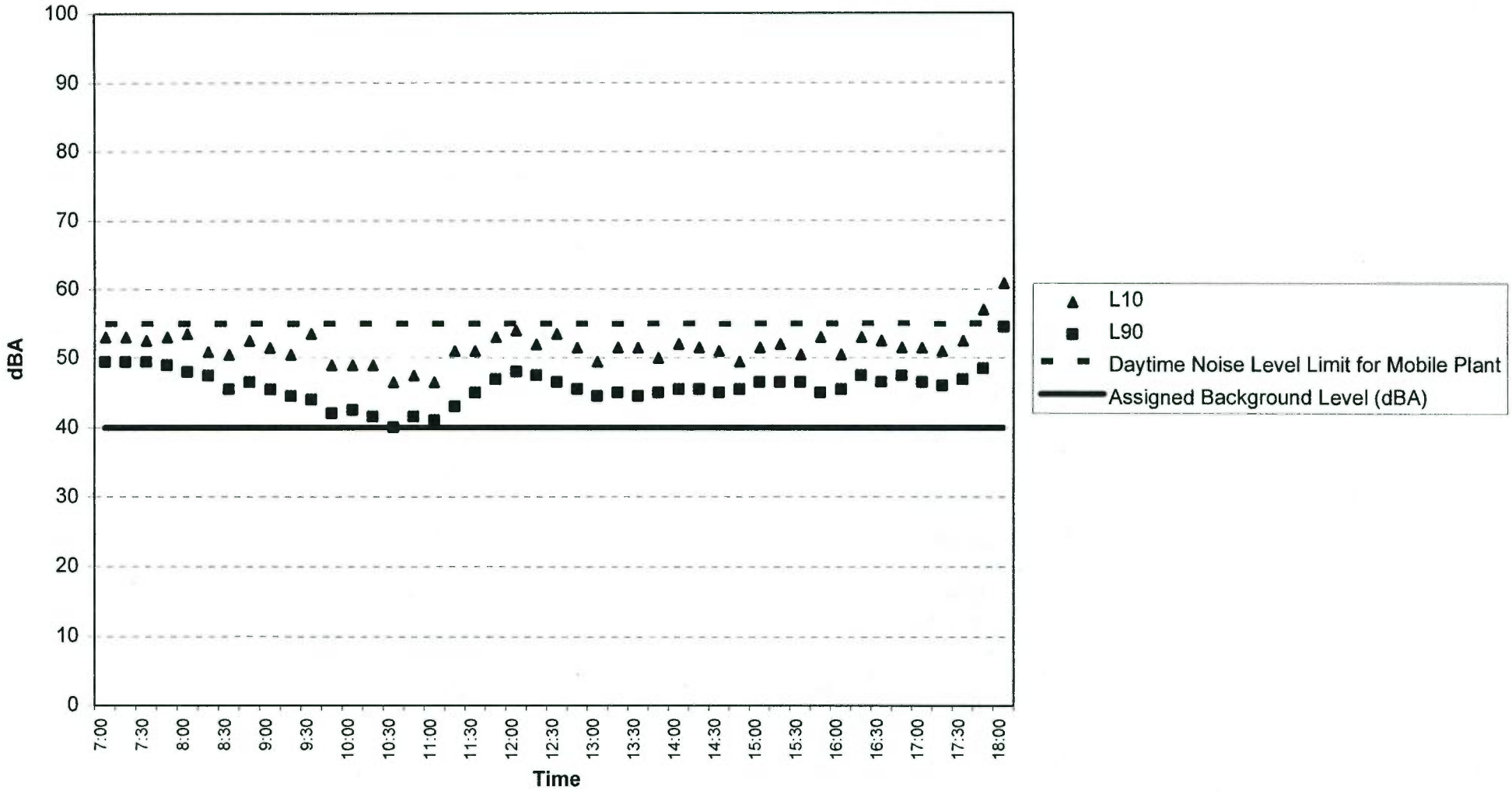

Figure 9.2.5 Austral 3 Noise, Saturday 9/8/97

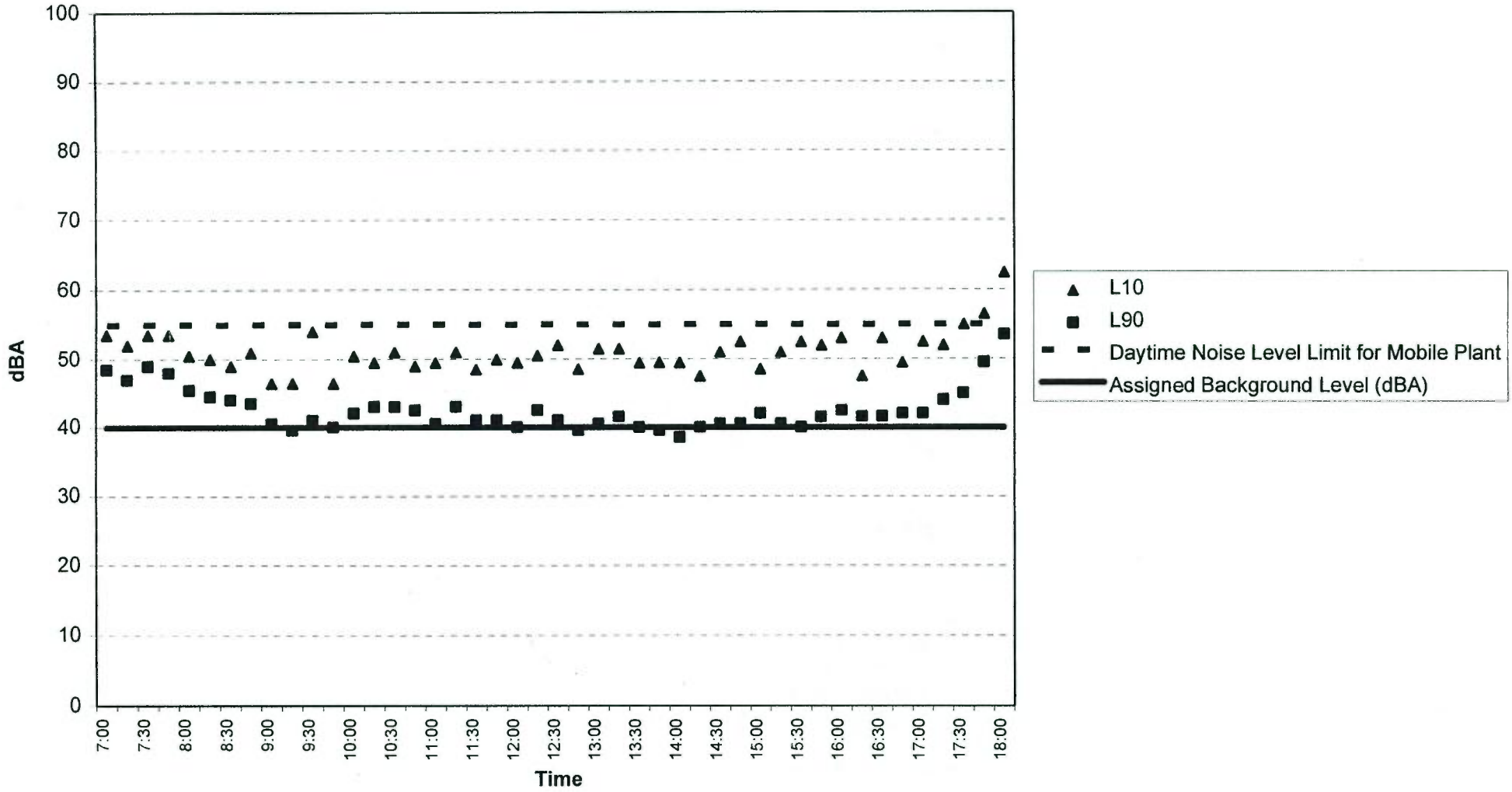

Figure 9.2.6 Austral 3 Noise, Sunday 10/8/97

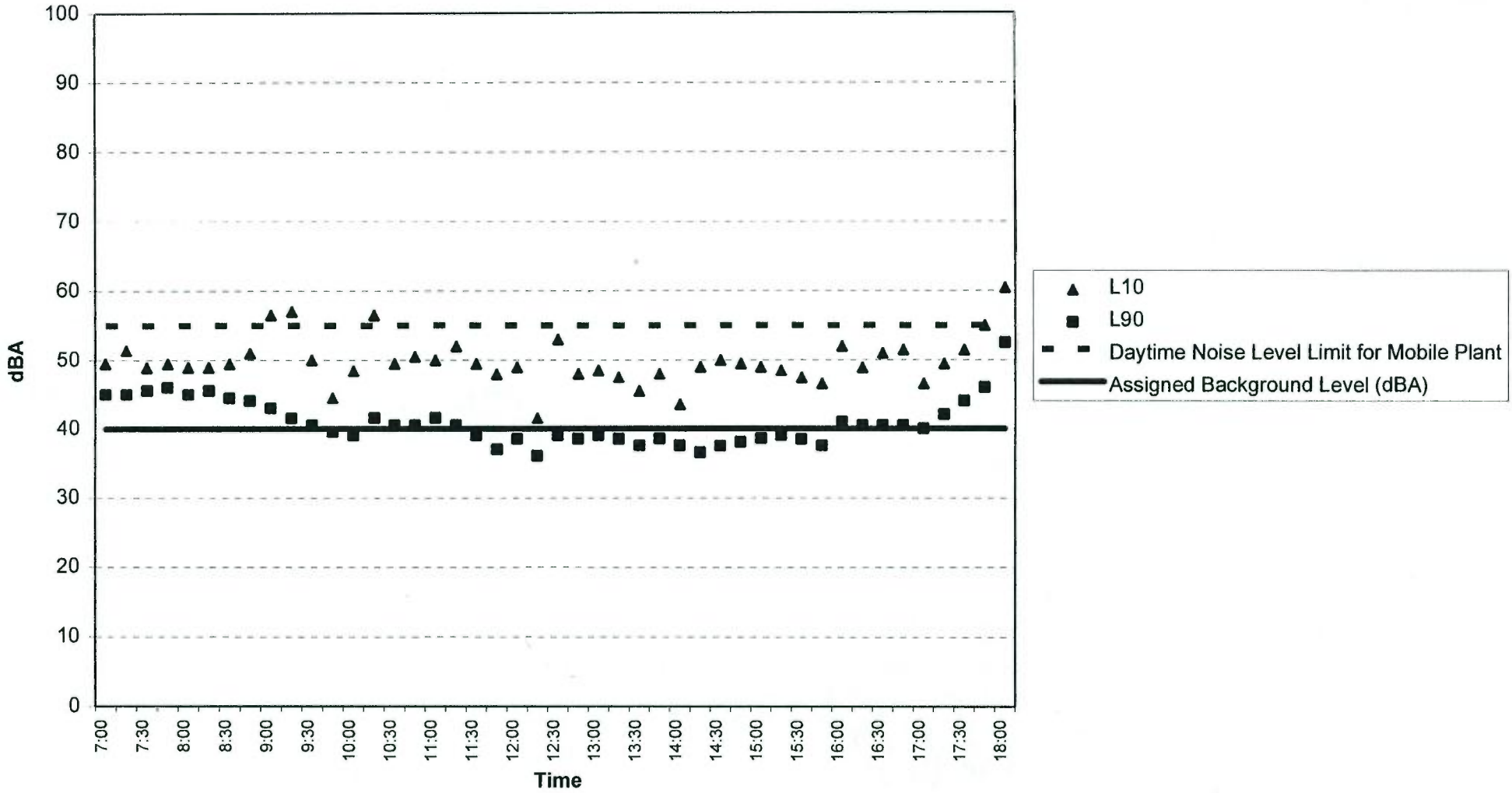

Figure 9.2.7 Austral 3 Noise, Maonday 11/8/97

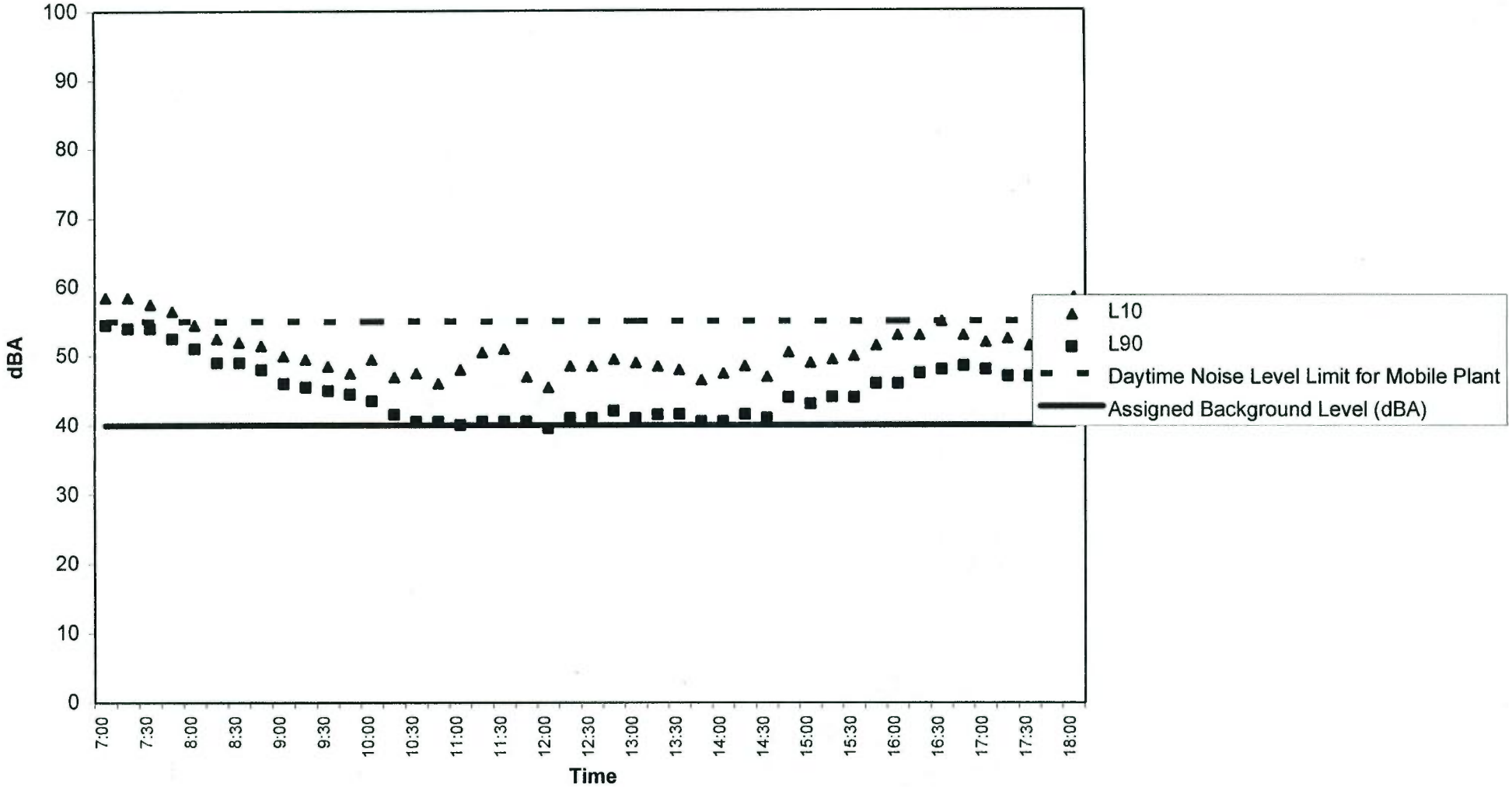

Figure 9.2.8 Austral 3 Noise, Tuesday 12/8/97

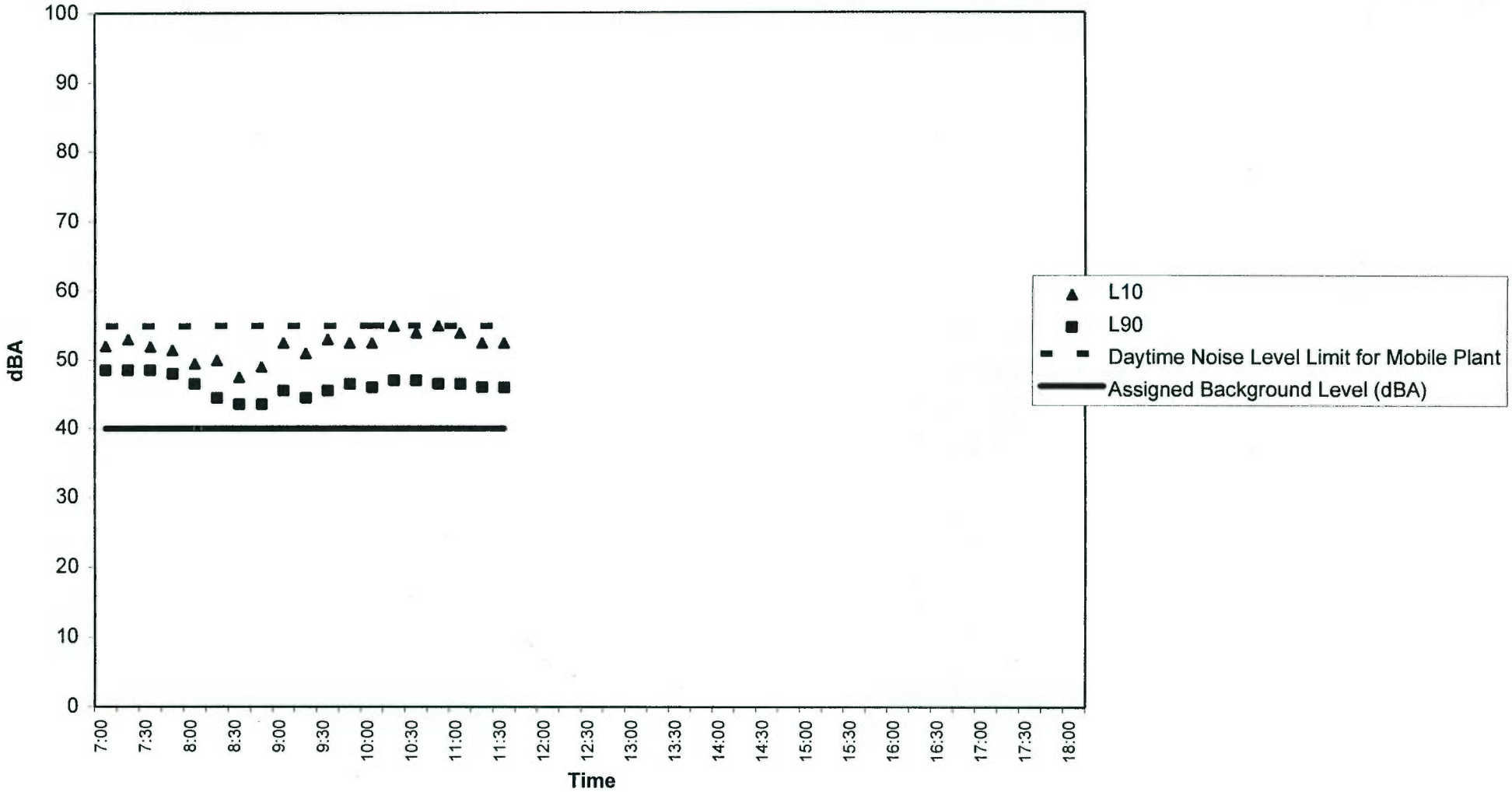

Figure 9.3.1 Austral 4 Noise, Tuesday 5/8/97

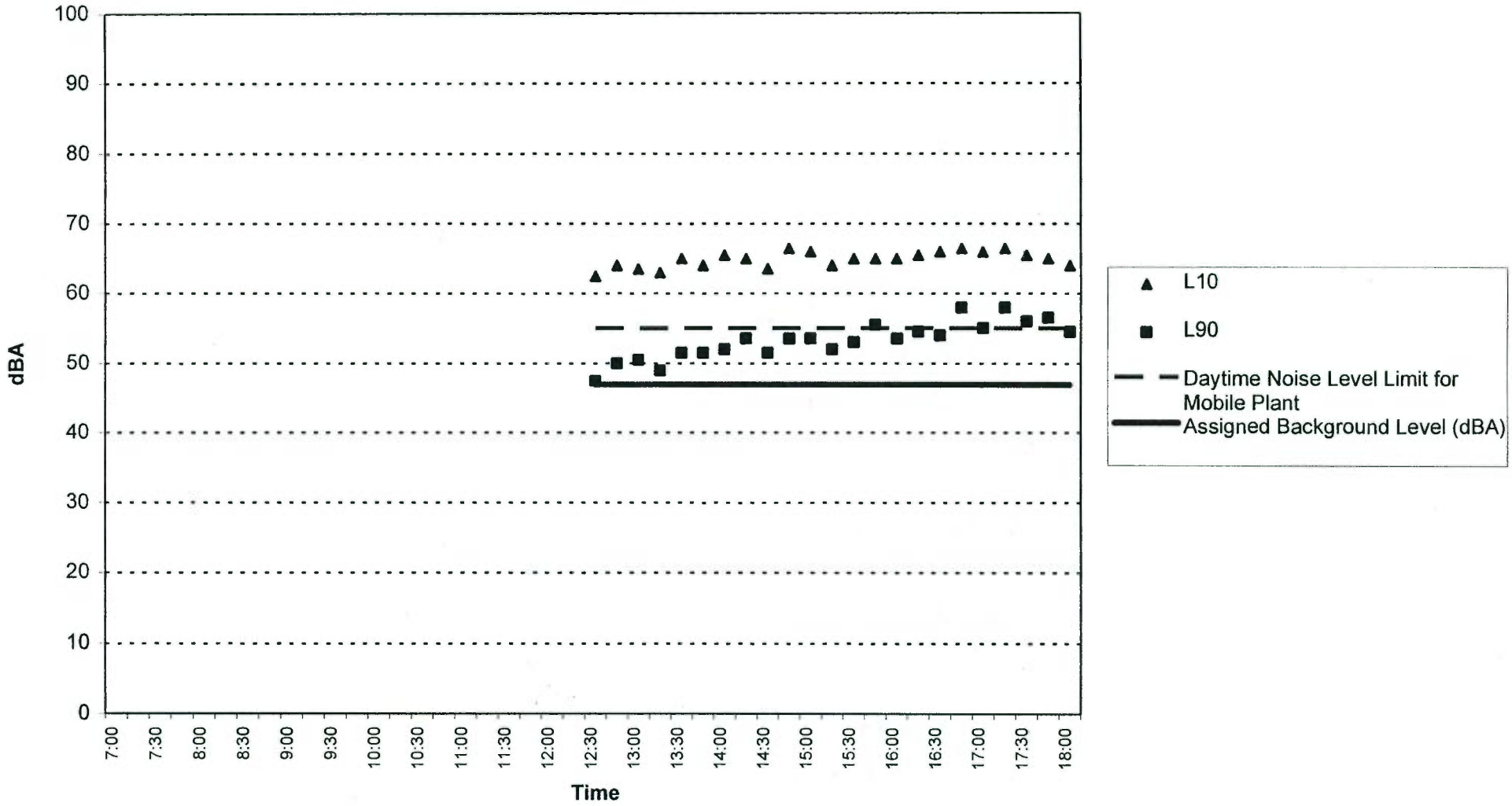

Figure 9.3.2 Austral 4 Noise, Wednesday 6/8/97

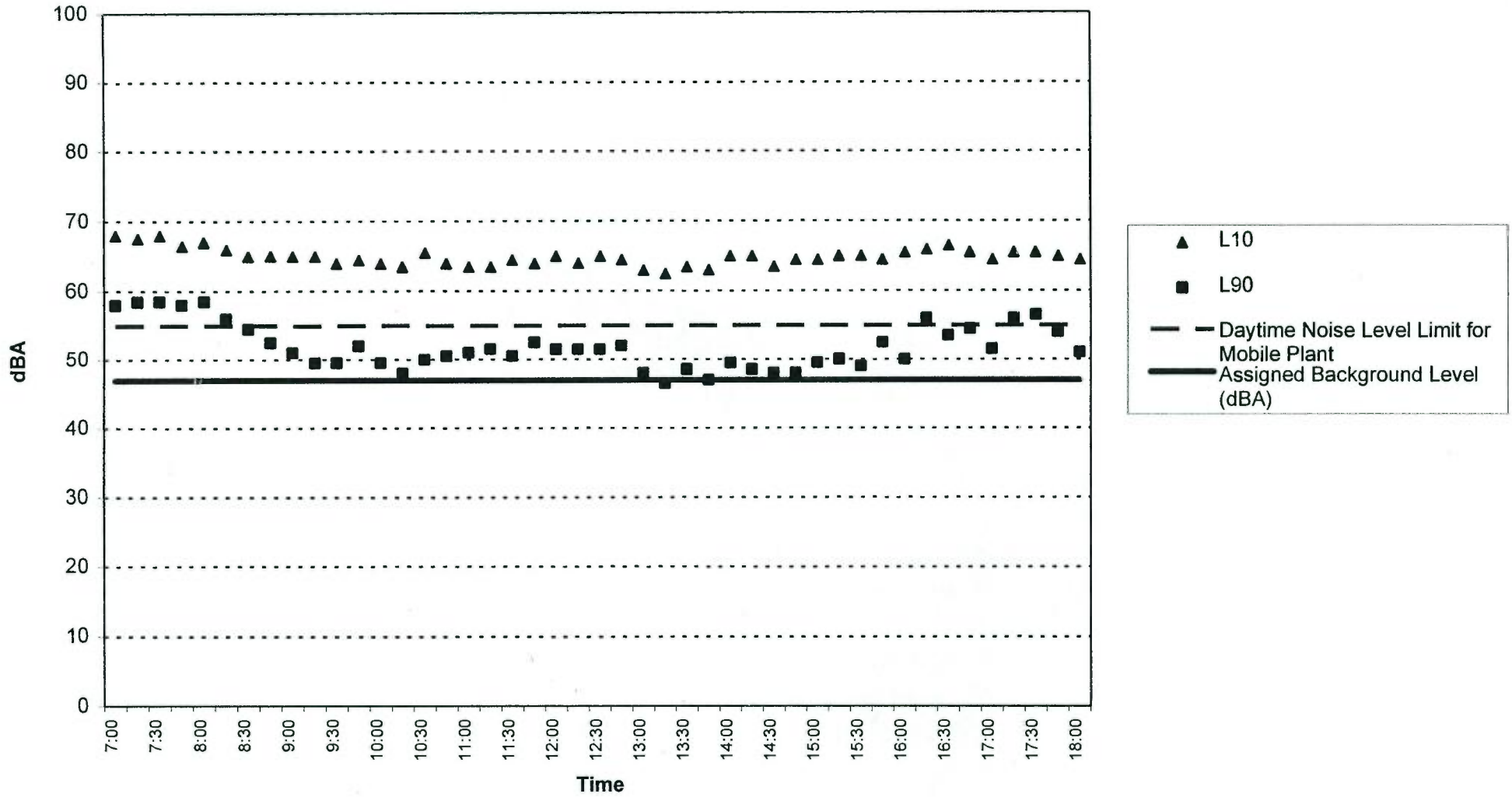

Figure 9.3.3 Austral 4 Noise, Thursday 7/8/97

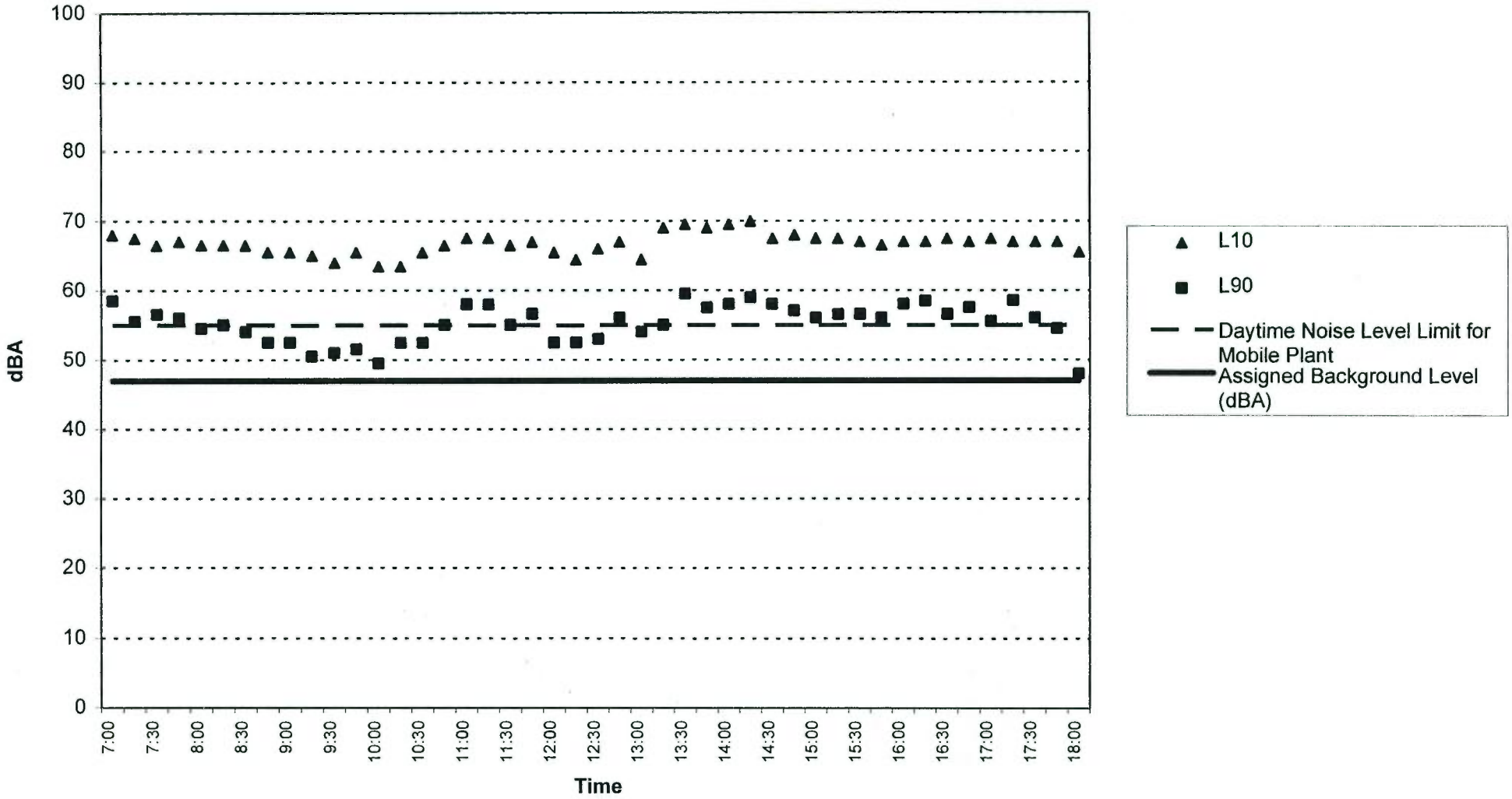

Figure 9.3.4 Austral 4 Noise, Friday 8/8/97

Figure 9.3.5 Austral 4 Noise, Saturday 9/8/97

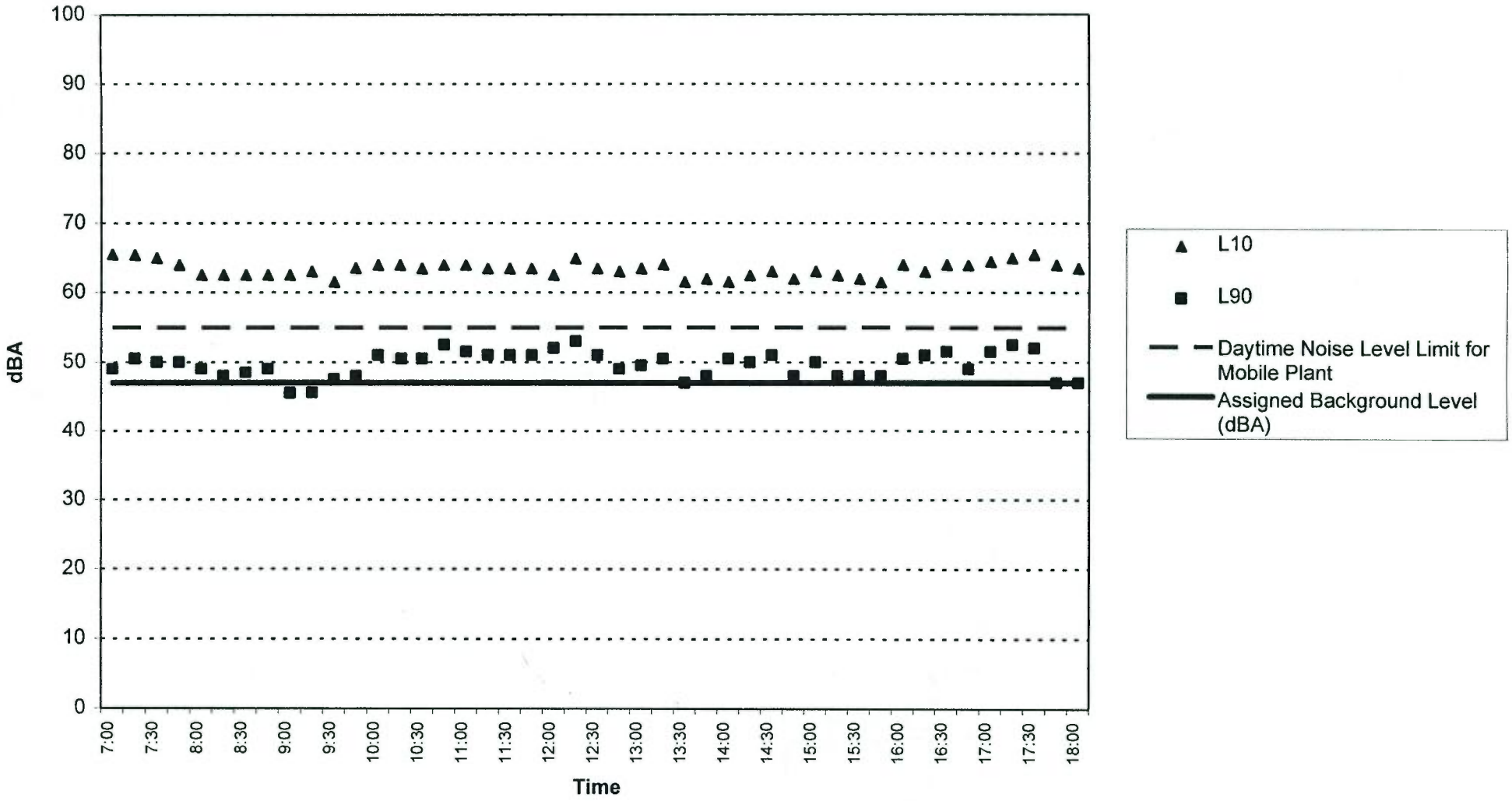

Figure 9.3.6 Austral 4 Noise, Sunday 10/8/97

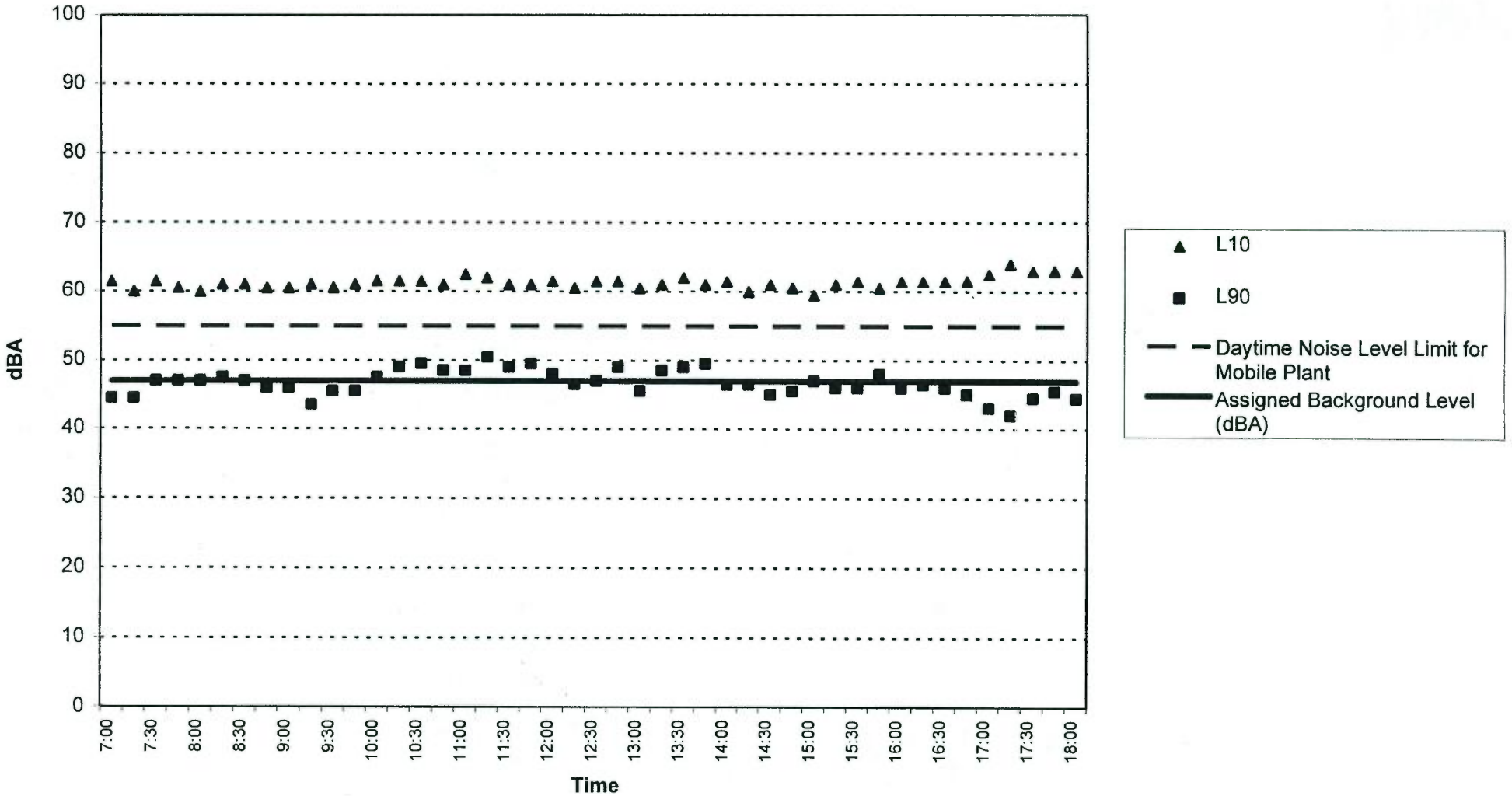

Figure 9.3.7 Austral 4 Noise, Monday 11/8/97

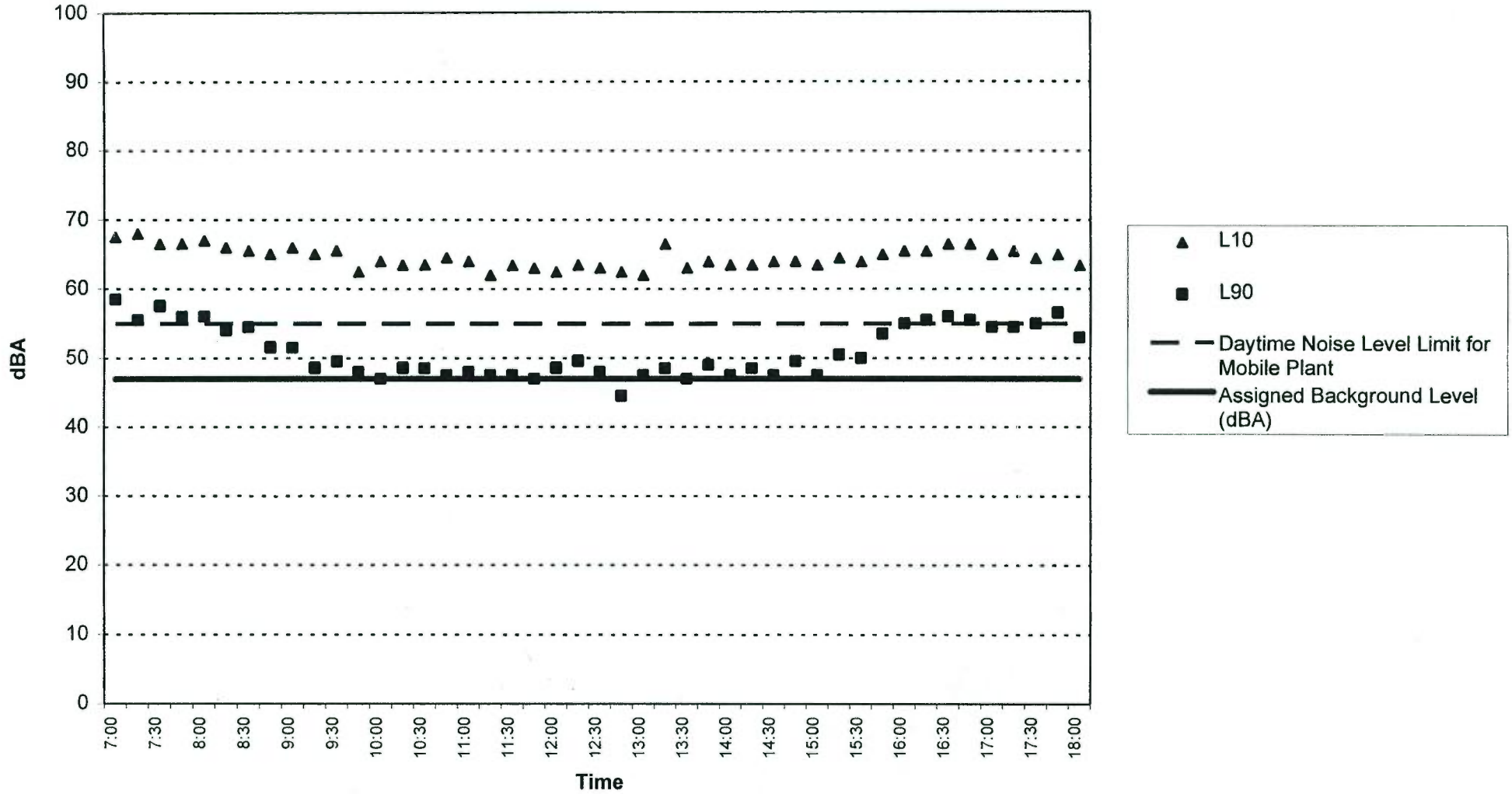

Figure 9.3.8 Austral 4 Noise, Tuesday 12/8/97