ORIGIN ENERGY RESOURCES LIMITED

Environmental Impact Report

For The Production and Processing of Petroleum Products and Associated Activities at the

Katnook and Ladbroke Grove Gas Plants

Otway Basin - South Australia

September 2002

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1 Introduction

1.1 Gas Production Activities

Origin Energy Resources Limited (OERL) operates two adjacent gas production facilities in the south east of South Australia, the Katnook and Ladbroke Grove Gas Plants (Appendix A). The land area occupied by the two adjacent plants comprises a total of approximately 6ha of freehold land in Section 336, Hundred of Monbulla, South East South Australia (approximately 3 hectares per Gas Plant) the nearest regional centre is Penola (figure 1).

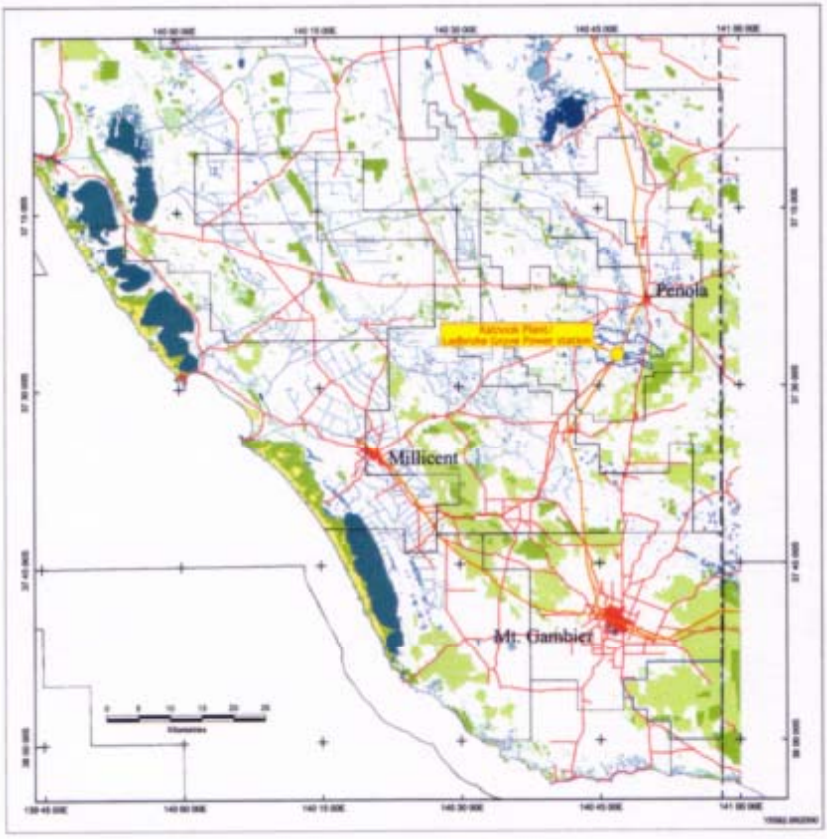


Figure 1 Location Map of the Katnook and Ladbroke Grove Gas Processing Plants

The Katnook gas plant has been in operation since February 1991 and currently sells gas to Origin Energy Retail Ltd who on-sell the gas to customers in the region. The Ladbroke Grove gas plant has been in operation since January 2000 and the gas is sold to Origin Energy Power Ltd (an independent electrical power generator) to provide fuel for the power turbines. OERL, as operator on behalf of the PL 62 and PPL 168 Joint Venture has a commitment to ensure supply to the points of sale (the outlet of the respective gas plants).

Field production

Condensate produced with the gas is recovered for sale to Mobil's Port Stanvac refinery. The condensate is trucked at regular intervals to the Pt Stanvac refinery.

The petroleum products are produced from five separate reservoirs (gas fields) within the onshore Otway Basin. Wells producing from the Redman, Katnook, Haselgrove and Haselgrove South fields are processed through the Katnook gas plant while the Ladbroke Grove gas plant processes gas from the Ladbroke Grove field. A gas gathering system (underground steel pipelines) collects gas from producing fields for processing in the Gas Plants (Figure 2).

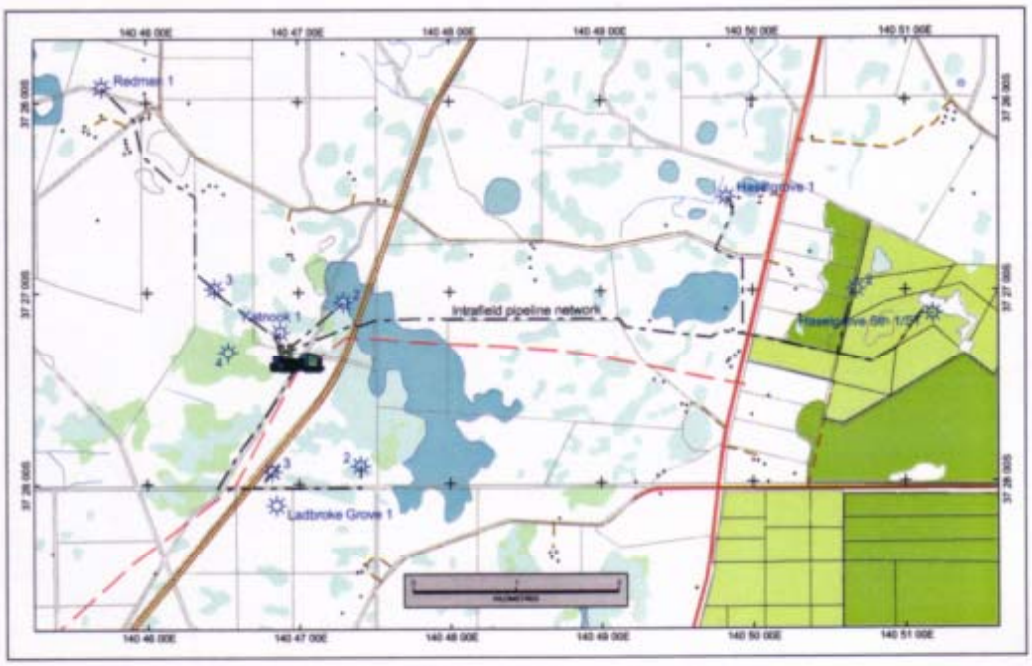


Figure 2 **Well locations and intra-fields pipeline network.**

Currently the Katnook plant processes hydrocarbons from six (6) wells and the Ladbroke Grove Plant processes hydrocarbons from two (2) wells.

Production Process

Katnook gas plant achieves sales gas specification by separating water through an inlet separator then processing the gas through a low temperature separation unit. Produced water is removed by boiling off through a glycol recovery unit.

Ladbroke Grove gas only requires free water removal and heating as it is supplies gas directly to the turbines in the adjacent electricity plant.

The process includes

- removal of produced formation water by separation
- hydrocarbon and water dew point control through a low temperature separator
- hydrates control using injected glycol,
- glycol recovery via a boiler/still column (glycol recovery unit)
- gas heating using a direct fired water bath heater and gas/liquid heat exchanger
- removal of condensate to storage via separation

During the process small quantities of gas are regularly vented to air as part of the routine plant operation. In addition, depressurisation and other maintenance activities that vent gas are conducted on an as-required basis.

See Katnook Process Schematic and Ladbroke Grove Process Schematic (Appendix B).

Both the Katnook and Ladbroke Grove Gas Plants produce limited quantities of wastes associated with gas and condensate production and these are disposed of in accordance with EPA regulations.

The produced formation water (Ladbroke Grove Gas) is disposed of by evaporation from two lined ponds. This process may be supplemented during periods of low evaporation and/or high rainfall by trucking excess water for disposal to an Environmental protection Authority (EPA) approved facility.

Key activities in the processing and production of gas and petroleum liquids by Origin Energy Resources Limited in PPL 62 and PPL 168 are as follow:

- Monitoring of cased and suspended or completed wells
- Monitoring of casing integrity and fluid levels in suspended and completed wells
- Monitoring and maintenance of wellhead integrity on completed wells
- Monitoring and maintenance of flowlines, petroleum collection facilities
- Monitoring of the environment peripheral to producing wells, flowlines and the gas plants
- Monitoring of petroleum and associated liquids from producing wells
- Processing of petroleum to required specifications
- Maintenance of processing plant to ensure supply and compliance obligations
- Monitoring of corrosion in all susceptible fittings, flanges and piping
- Safe and environmentally acceptable disposal of produced formation water
- Management of wastes
- Road related activities for delivery of goods required at the gas plants and operations activities
- The maintenance and eventual restoration of areas affected by bunding, surface facilities, access tracks, well sites and flow lines
- Prevention of fires via elimination of sources of ignition, fuel and possible methods of propagation both within and peripheral to the facilities
- Maintain a clean and safe work environment in accordance with workplace health and safety objectives
- Conduct all operations in a manner to minimise visual, audible and vehicle impact on the landowners and stock in underlying and contiguous properties.

1.2 Definitions

Pipeline and petroleum as defined by the *Petroleum Act 2000*.	Pipeline means "a pipe or system of pipes for conveying petroleum or another regulated substance from place to place and includes – tanks, vessels, machinery and equipment necessary for, or associated with, its operation; a part of a pipeline Within the Operator's documentation in relation to the Katnook and Ladbroke Grove plants *pipeline* is synonymous with flowline, gathering system and metering run.
Petroleum	"a naturally occurring substance consisting of a hydrocarbon or mixture of hydrocarbons in gaseous, liquid or solid state…"
Hazard	"The potential to cause harm…"
Risk means	"The combination of the chance that a specified undesired event will occur and the severity of the consequences of the event"
Hydrate (as defined by Beggs)	"Gas hydrates are crystalline compounds, formed by the chemical combination of natural gas and water under pressure at temperatures considerably above the freezing point of water"
Line Pack (as defined by the Company)	Increasing the volume of gas available for sales in a gas pipeline by increasing the pressure above the normal offtake pressure but to less than the maximum line pressure
Workover (as defined by the Company)	an intervention carried out on a well utilising a "Workover" rig - the purpose of the intervention is most often to repair damaged or worn out downhole equipment but can also be associated with remedial treatment of reservoirs in the well (acidising, fracture stimulation, or re-perforation), and / or re-completing or reconfiguring the well to produce from new or bypassed zones.

2 Scope of the EIR

Origin Energy Resources Limited has defined commitments under the Petroleum Act to achieve an acceptable level of environmental management while undertaking regulated activities. Activities conducted by OERL as operator (and on behalf of the joint venture) in the course of producing and processing petroleum within Petroleum Production Licence (PPL) 62 and PPL 168 have the potential to cause adverse impacts to the environment.

The potential hazards to the environment posed by these activities have been identified by an audit conducted in 1996 and a Fit for Purpose Report conducted in early 2001, in addition to ongoing assessment of the site by field personnel and management. The assessment of those hazards is outlined in this EIR. The subsequent Statement of Environmental Objectives (SEO) for Production and Processing of Petroleum and Associated Activities derived from this EIR lists environmental objectives and assessment criteria by which to determine success at meeting these objectives. Operational aspects and hazard assessment have been reviewed under *Regulation 30* and the fit-for-purpose assessment of the Katnook and Ladbroke Grove gas plants.

This EIR covers the following areas

- The production facilities within the fenced area encompassing the Katnook and Ladbroke Grove gas plants to the point of sale at the respective meter stations at the outlet to the Katnook and Ladbroke Grove Gas Plants.
- The gathering systems connecting the producing wells to the Katnook and Ladbroke Grove gas plants
- The fenced well yards at each of the producing wells, totalling eight wells in all.
- The trucking of product and waste from the gas plant.

The following environmental features have been identified as those that could be affected by a reasonably foreseeable hazardous event

- Water/Groundwater
- Soil
- Air
- Flora and fauna
- Cultural Values
- Amenity and Land Use
- Personnel & Third Parties
- Public Safety & Risk

Exclusions

This document does not cover the independent activities of:

(i) Origin Energy Power (OEP) which operates gas turbines adjacent to the Katnook and Ladbroke Grove Gas Plants,

(ii) Epic Energy which operates a transmission pipeline system that takes gas from the Katnook Gas Plant

(iii) Origin Energy Retail Ltd who distribute the gas, and

(iv) A mercaptan injection facility that is located within the Epic compound, and operated by Epic on behalf of Origin Energy Asset Management (OEAM).

(v) Drilling operations resulting in casing, well completion and installation of the wellhead from which the gas supply is drawn are covered by separate EIR and SEO for Drilling and Well Operations.

3 Regulatory System

The plant operates under the *Petroleum Act 2000* and the *Environment Protection Act 1993*, Licence 12559 (Appendix C), and has recently undergone a Fitness-for-Purpose assessment[1].

Part 12, Environment Protection, Division 1 – Objects, section 95, of the *Petroleum Act 2000* (the Act) has a number of objectives:

- ensure that regulated activities that have (actually or potentially) adverse effects on the environment are properly managed to reduce environmental damage as far as reasonably practicable; and
- eliminate as far as reasonably practicable risk of significant long term environmental damage; and
- ensure that land adversely affected by regulated activities is properly rehabilitated.

In order to achieve the above objectives the Act prescribes that an Environmental Impact Report (EIR) be prepared in accordance with *Regulations, being* Part 3, 10. Part 12 of the Act and EPA licence#12559 constitute the legislative basis for the environmental objectives associated with production and processing of petroleum. In addition, OERL has further corporate objectives for responsible operation of the gas plants.

Activities that qualify as Prescribed Activities of Environmental Significance under Schedule 1 of the *Environment Protection Act 1993* are conducted at the site. These activities are defined under Schedule 1, Part A, 1. (5), *Petroleum Production, Storage or Processing Works or Facilities* (b) with a total petroleum production rate exceeding 20 tonnes per hour and 3.(4) *Activities Producing Listed Wastes***.** The Licence #12559 applies to activities conducted in Section 336 (Argyle Road), Hundred of Monbulla, South Australia.

OERL holds licence MG/8343201, MG/8343204 and MG/8854301 issued under the Dangerous Substances Act 1979, to keep dangerous substances, as defined by the Act, on site.

Pressure vessels and safety relief valves are registered with DAIS Workplace Services.

4 Environmental Features in the Region

4.1 Biological

The Katnook & Ladbroke Grove gas plants and gathering systems are situated on land that has previously been cleared and grazed by sheep farming. Right of access to this land has been agreed through lease or access agreements with the local landholders. The gas plant was constructed in 1990 after obtaining all of the necessary regulatory approvals. This included a Declaration of Environmental Factors that was reviewed by the Department of Environment and Planning approved by Department of Mines and Energy of South Australia on 1 August 1990. Since that time the plant has been in continuous operation and there has been no change to the areal extent of the gas plant (that is surrounded by man-proof fence) nor the general process activity conducted at the site.

In this review of the gas plant in relation to the environmental features of the region we have drawn upon some twelve years of operating experience at the site, internal Origin expertise and third party sources of information such as,

- Biodiversity Plan for the South East of South Australia (by Croft et al., 1999)
- Environmental Protection & Biodiversity Conservation Act (EPBC Act) online database
- Bureau of Meteorology website data statistics
- Consultation with various State Government regulatory bodies and
- Anecdotal evidence from local persons

"Since European settlement, about 87% of the original native vegetation [in the south east of South Australia] has been cleared primarily for agriculture…" (Croft *et al*., 1999, p.6). The clearing "…has resulted in the direct loss of [fauna] habitat, and fragmentation of the remaining vegetation…" (Croft *et al*., 1999, p.135). As a result of this various fauna in the region is listed as rare or threatened under relevant legislation. The native vegetation remaining tends to be "…concentrated in areas less suited to agriculture either on deep sands, saline soils or sheet limestone" (Croft *et al*., 1999, p.6).

The land systems peripheral to the Katnook and Ladbroke Grove gas production facilities are dominantly cleared grazing paddocks with scattered gum trees, including. Messmate (*Eucalyptus obliqua*) and Brown stringy bark (*E. baxteri*), Pinkgum (*E. fasciculosa*) and River Red Gum (*E. camaldulensis*).

Clearing of natural vegetation and conversion of the land to agriculture can potentially leave the land susceptible to weed growth. Earthworks and other land disturbance such as clearing may provide a suitable environment for establishment and growth of weeds unless preventative measures are taken. In particular, Bridal Creeper, *Mysiphyllum asparagoides* prevents regeneration and smothers and replaces native vegetation such as low shrubs (Croft *et al*., 1999). Bridal Creeper is dispersed by birds (Croft *et al*., 1999) and can therefore spread and proliferate without control. Similarly, Boneseed (*Chrysanthemoides monilifera*) is spread by birds and is difficult to eradicate once it becomes established (Croft *et al*., 1999). *Phalaris aquatica,* a perennial tussock grass rapidly colonises disturbed ground in grassy woodlands (Croft *et al*., 1999). Approvals by, inter alia, appropriate regulatory bodies are required before any earthworks can be conducted outside existing approved areas of the gas plant and gathering system. Compliance with operational procedures including Origin's environmental systems is required prior to undertaking any earthworks within the perimeter of the gas plant and gathering system.

Introduction of weeds to the region is also possible through vehicle movements. In general local small traffic is unlikely to have access to regions infected by noxious weeds. Vehicles from more distant locations have increased risk of contamination by weeds. However, as travelling is predominantly on sealed roads the opportunity to attract and retain seeds and vegetable matter is minimised.

The Biodiversity Plan for the South East of south Australia (Croft *et al*., 1999) should be referred to for a description of the various flora and fauns species under threat in the region and lists relevant weed species. The EPBC Act online database indicates threatened species in the area as tabulated below

Threatened Species:

Species & Status	**Comment**	**Likelihood of Occurrence**
Southern Bell Frog: Vulnerable	Occurs in ephemeral wetlands. Found across much of south east SA	Known to occur locally
Red-tailed black cockatoo (south east sub-species): Endangered	Occurs in red gum woodlands and old growth forests. Very rare in south east SA	Known to occur locally
Swift Parrot: endangered	Migratory species. Prefers box woodlands. Very mobile species	Very unlikely to occur in the area
Regent Honeyeater: endangered	Nomadic species. Prefers ironbark woodlands. Mobile species	Very unlikely to occur in the area

Species Covered by Migratory Provisions and Marine Provisions:

Red-tailed black cockatoo (south east sub-species)	Occurs in red gum woodlands and old growth forests. Very rare in south east SA	Known to occur locally
White-bellied Sea-Eagle	Occurs near large inland water bodies. Mobile species	May fly over the area, but unlikely to occur within the area
White-throated Needletail	Aerial species. Very mobile	May fly over the area, but unlikely to occur within the area
Satin Flycatcher	Generally occurs within forested areas	Very unlikely to occur in the area
Regent Honeyeater: endangered	Nomadic species. Prefers ironbark woodlands. Mobile species	Very unlikely to occur in the area
Latham's Snipe	Nomadic species favouring sheltered wetlands	Known to occur locally
Painted Snipe	Nomadic species favouring sheltered wetlands	Known to occur locally
Magpie Goose	Unusual species in southern Australia; favours large water bodies	May overfly the area
Swift Parrot	Migratory species. Prefers box woodlands. Very mobile species	Very unlikely to occur in the area

Of the identified species, most are either unlikely to occur in the area or are mobile (bird) species that are not expected to be impacted by the plant which is located amongst cleared and grazed farming pasture. It is noted that there is no attendance by waterbirds within the plant area and this is presumably due to the abundance of 'natural' water lagoons and alternate sites across the greater region. However, the Southern Bell frog is indicated to "occur in ephemeral wetlands" and "found across much of south east of SA". As indicated on the map below, the Reedy Lagoon which is ephemeral is located approximately 3 km to the east of the gas plant and across the other side of the raised north south road (Argyle Road)and a north south trending railway line. As far as we have been able to ascertain there is no evidence of the Southern Bell frog in the Reedy Lagoon. However, refer to section 4.2 below for discussion on the potential impact of the gas plant operations on the Reedy Lagoon.

4.2 Physical Environment

South-eastern South Australia is dominated by largely flat terrain with systems of parallel dune ridges (Laut *et al.*, 1977) that generally "…lack natural surface drainage and within them extensive swamps and lake systems have formed…" (Laut *et al.*, 1977, p.6). Artificial drainage systems now prevalent in the region have " …effectively drained interdunal swamps" (Croft *et al.*, 1999, p.6). The gas plant incorporates two waste water evaporation ponds and chemical storage areas. Each of these ponds and storage areas are constructed with bunding and operated in accordance with procedures to manage physical and operating risks to the environment (refer to section 8.1 and 8.4 in particular).

Although the regional area is generally very flat, the gas plant is sited on a locally elevated position that according to the recollection of local persons, has only once been threatened by regional or local flooding once, being the year 1991. According to the Bureau of Meteorology statistics, the highest recorded monthly rainfall for the area (Penola) was in the year of 1964. Rainfall of August 1991

represents a 97th percentile event. The highest annual rainfall recorded for the region was in 1863 with annual rainfall in 1991 representing a 62nd percentile.

With the generally flat local terrain the bunded areas within the plant incorporate a number of controls to prevent breach of containment either by over fill or by rising flood waters, namely

- Lined bund walls are constructed above the level of the surrounding land
- Intra day monitoring of levels (site is manned 24 hours a day)
- Pond freeboard limits are maintained
- Two evaporation ponds are available for service
- Offsite disposal via trucking is available as required
- As a last resort the production system can be shut down

An investigation was conducted as to the potential impact of flooding and stormwater runoff on the gas plant containment facilities and the risk to the surrounding environment and particularly the Reedy Lagoon. This incorporated statistical data available from the Bureau of Meteorology web site and anecdotal evidence from local landholders.

Given the low level of contaminants in the pond water which is generally less than 20 ppm total petroleum hydrocarbon and nil heavy metals in combination with the control system that are in place, the chance of a spill and its dispersion due to a flood event is assessed as low risk to the environment.

Anecdotal evidence:

In the 12 years of plant operation, there has never been rainfall event sufficient to cause free-flowing flood water across the plant site, although in winter of 1991 approximately 1 inch (25 mm) of standing water was present in large patches across the plant 'floor' however the plant area was not engulfed. Note that the bund walls for the evaporation ponds and chemical storage areas are constructed to a height of approximately 500 - 600 mm and 1435 mm respectively, above average ground level at the perimeter of the plant.

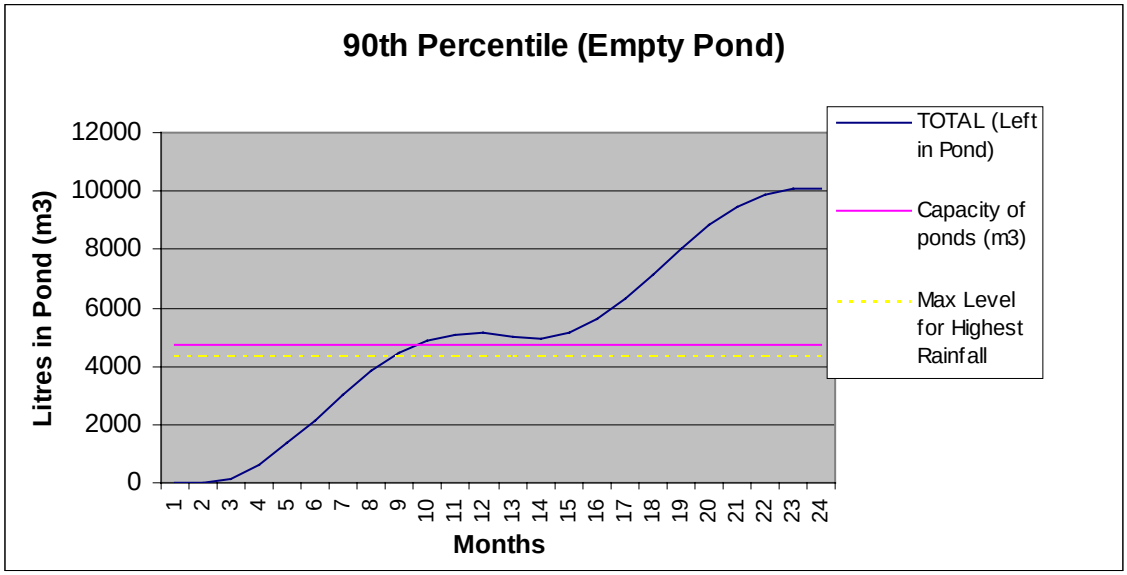
Local landholder accounts indicate that the flood of 1991 resulted in the highest flood levels in recent memory for the region which is supported by the Bureau of Meteorology statistics indicating a 97th percentile monthly rainfall event.

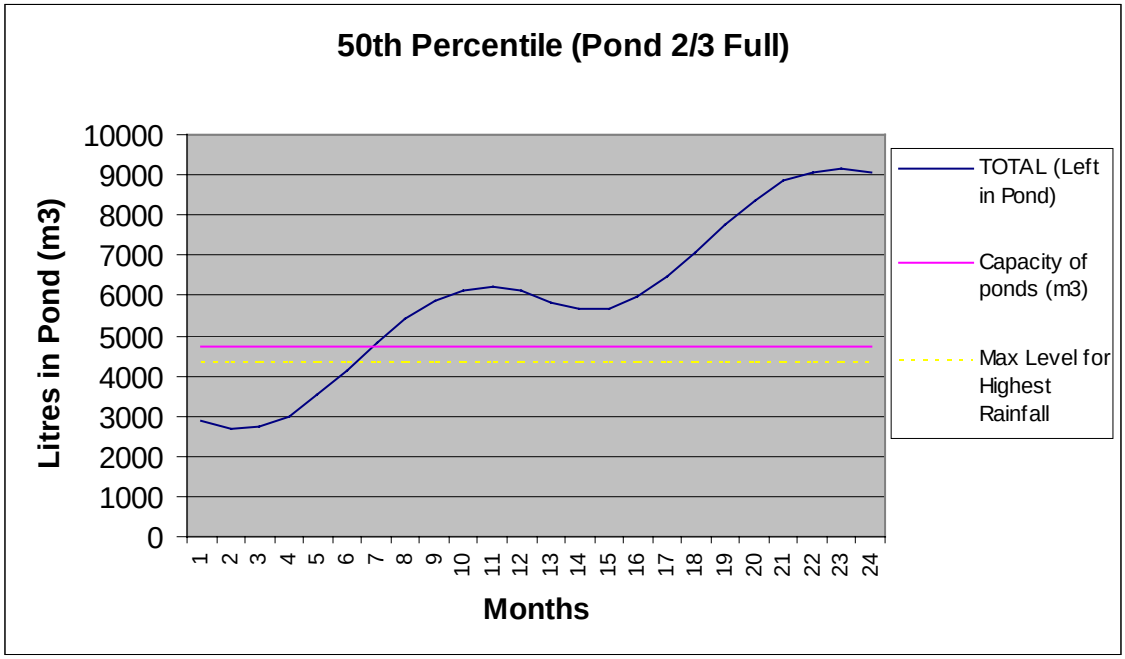
The general direction of movement of surface water in the area has been observed to be from east to west. This is in line with the regional drainage system that has been constructed in the area that moves water from east to west. Surface water build-up and directional water flow is also affected by elevated structures. Argyle Road and the elevated train line both lie to the east of the gas plant between the plant and Reedy Lagoon. Both of these features form a barrier to any water flow through the local area. As such, if there was a breach of containment from the gas plant site, both the direction of water dispersion and the impediments created by the road and the train line form an isolating barrier between the gas plant site and the Reedy Lagoon.

Statistical evidence:

The Bureau of Meteorology has rainfall statistics available for the last 39 years from Penola which is about 10 km to the north of the Katnook gas plant. An analysis of the rainfall statistics of the area was conducted to determine that on the basis of a 90th percentile rainfall event and after allowing for the further addition of produced water, there is 5 months of pond capacity available during normal operations, before either trucking or production shut down would have to occur.

Assuming both ponds were 2/3rd full at the end of April (coming out of the summer period) this indicates pond capacity will 'survive' until the end of September under a continuous 90th percentile rainfall event (see graph below).





Two aquifer systems, "the Gambier Limestone and the Dilwyn Formation, dominate the groundwater hydrology of the region (Tyler *et al.*, 1983). "The Gambier Limestone generally forms a 20 metre thick unconfined aquifer…" (Boral, 1996, p.8). Water quality in the aquifer as determined by a total dissolved solids (TDS) of <500 mg/L (Boral, 1996) is 'good' according to Australian Drinking Water

Guidelines (ANZECC, 1996). The aquifer is recharged directly by infiltration of rainfall through the soil during winter (Tyler *et al.*, 1983). Surface recharge of the aquifer indicates that the aquifer is potentially vulnerable to contamination (Tyler *et al.*, 1983).

"The Dilwyn Formation forms a 20 - 100 metres thick confined aquifer…" (Boral, 1996, p.8). Water quality in the aquifer as determined by a TDS of 600 – 1000 mg/L (Boral, 1996) is classified as fair to poor according to Australian Drinking Water Guidelines (ANZECC, 1996). This aquifer is used to supply most of the town and city water supplies in the Southeast and is used for irrigation, watering stock and industrial purposes (Boral, 1996).

Crossflow between different aquifers could have an adverse impact on both the water quality and the aquifer pressures in the Gambier Limestone and the Dilwyn Formations. Water quality impacts could arise from contamination of near surface aquifers with water from deeper aquifers that typically contain saline formation water and would have an adverse impact on both urban and agricultural uses of the water in the region. Economic loss to the agricultural community in particularly may occur is such an instance.

Soil types in the region vary according to location in terms of land forms (Laut *et al.*, 1977). The predominant soil type near the Katnook and Ladbroke Grove facilities is distinguished by its dark grey to black appearance (Tyler *et al.*, 1983). These soils "…generally have a high content of clay and are alkaline…" (Tyler *et al.*, 1983, p.41) and "before the widespread construction of surface drains …[the soils]…were subject to annual flooding…" (Tyler, *et al.*, 1983, p.41-42). The quality of soil could be adversely affected by activities which contaminate the soil with heavy metals, hydrocarbon or which degrade the soil structure.

4.3 Land Use and Cultural Values

The predominant land use in the region is grazing on privately owned land. Land holdings in the region are relatively small are generally cleared. Transformation of the land through agricultural activities has increased the susceptibility of the region to visual and audible environmental impacts. Pine plantation activities occur in the eastern most portions of the OERL areas of operation with some pipelines passing through privately owned pine plantation. The gas plants were constructed on grazing land that was previously cleared of native vegetation. The gas plants and most of the gas well are situated adjacent to land that is predominantly used for grazing sheep.

The site was evaluated for Aboriginal and European heritage at the time of construction and the immediate area was determined to be devoid of items of Aboriginal or European cultural significance.

5 Stakeholders

Land holdings in the region are relatively small. Shallow aquifers are utilised for stock and soil and water quality must be maintained. Fire has the potential to impact immediate landowners and the broader rural and urban community.

The Wattle Range Shire maintains the local roads used by road tankers and periodically by work-over rigs and other vehicles accessing the gas plants and surrounding wells.

Land utilised for petroleum production operations includes:

- Gas plants - A segment of is occupied by the gas plants in PPL 62 (approximately 2.6ha each for the Katnook and Ladbroke Grove Gas plants)
- Wellheads of producing and suspended wells

- Buried flowlines and pipelines cross freehold land, road and a railway line and do not impact on surface use of the land

These facilities are likely to remain for the life of the gas fields and require mutually acceptable access agreements with the affected stakeholders, these are in place, and compensation is paid annually.

The primary stakeholders involved with the Katnook and Ladbroke Grove plants are–

Landowners –Landowners peripheral to the gas plant and wells share local and main roads and the activity is located on or near their land.

Wattle Range Shire – provides infrastructure and roads that are shared with the broader community.

The following landowners have operating equipment on their properties (Table 1). As such, they represent key stakeholders in the overall Katnook/Ladbroke Grove operation.

Table 1 List of owners of relevant land

Well/Flowline	Landholder
Katnook 3 and 4 wells, Redman and Ladbroke Grove Flowlines Katnook Gas Plant/Ladbroke Grove Power Station	G & M Koch
Katnook 1 and 2 wells, Ladbroke Grove 1 and 2 and Flowlines	Alby McIntyre
Haselgrove Flowline	George Dean
Haselgrove Flowline	Peter Copping
Haselgrove 1 and Flowline	Peter Rymill
Haselgrove 2, Haselgrove South 1, Haselgrove South 2 and Flowline	Dennis Page
Haselgrove and Ladbroke Grove Flowline	Ruth Warren
Redman 1 well and Flowline	Jim Kidman
Redman Flowline	Ian Leask
Redman Flowline	Duan Butler
Redman Flowline	George Butler
Redman Flowline	Mark Thorn
Ladbroke Grove 1 well	RK Paltridge

Consultation with the local stakeholders including landholders and the Wattle Range Shire Council occurred April 3, 2002 and with government agency stakeholders on April 11, 2002.

Approximately 12 landholders were invited of whom 4 attended and one apology was received. Representatives, including the Mayor, from the Wattle Shire Council also attended.

The matters in Table 2 have been raised in relation to the Katnook & Ladbroke Grove Gas Plant Operations by the local landholders.

Table 2 Landholder & Wattle Range Shire matters raised in relation to the Katnook & Ladbroke Grove Gas Plant Operations

General Landowner & Council Issues	OERL Response
Notification of Hazards:- To inform the landowners of operational issues that may be misconstrued as hazards. Possibly be more proactive with information, rather than reactive	OERL acknowledges this as an appropriate and constructive suggestion.
Road Condition: - Shoulder of road littered with tree lopping debris from mobilisation of power station equipment. Debris prohibits the slashing of road shoulders. Vehicles on road causing dust problem for landholders on access roads	• Origin Generation have indicated that no trees were pruned however a clean up program will be considered. • Reminders have been circulated regarding Origin's policies in relation to driving and procedures to minimise vehicle disruption at site.
Origin Personnel and Contractor Driving Habits:- Landowners are uneasy about the speed that personnel and contractors travel the road at. Landowners unable to graze stock on road easement through fear of stock losses, also landowners concerned about road safety.	Katnook gas plant (and power station) personnel have been reminded of our obligation to minimise disturbance to landowners that may be created by vehicle traffic. Contractors should also be informed of the landowner concern and requested to abide by appropriate speed limits. It is noted that livestock is now grazing the verge areas of Argyle Road. • Road speed signage • Road surfacing } Issues were raised and referred to the relevant Shire Council for consideration.

Consultation with Government and regulatory agency stakeholders was held with local agencies invited to the meeting of 3 April 2002 and Adelaide based agencies invited to a meeting on 11 April 2002 as indicated in Table 3.

Table 3 Government Agency matters raised in relation to the Katnook & Ladbroke Grove Gas Plant Operations

Government Agency	Representative	Presence at Meeting on 3 April 2002
CFS	Phillip McDonough	Attended
Department of Environment & Heritage	Brenton Grear	Did not attend
Department of Water Resources	Gary Mavrinac	Apology
Department of Water Resources	Lud Schmidt	Did not attend.
EPA	Carl Smith	Attended
EPA	Uma Preston	Did not attend
Forestry SA	D Stevens	Attended
Forestry SA	Denis Page	Attended
Lower SE Soil Conservation Board	Beverly Hebbermen	Did not attend
PIRSA	Angela Crimes	Attended
PIRSA	Michael Malavazos	Attended
SE Catchment Water Management Board	Lindsay Fulloon	Did not attend
SE Catchment Water Management Board	Hugh Hoptin	Did not attend
SE Water Conservation & Drainage Board	Evan Pettingill	Did not attend

Government Agency	Representative	Presence at Meeting on 11 April 2002
Dpt Water, Land & Biodiversity Conservation.	Glen Scholz	Attended
Dpt Water, Land & Biodiversity Conservation.	Stephen Howlz	Attended
Planning SA	Lee Webb	Attended
DEH, NPWSA (Reserve Planning)	Carla O'Neill	Attended
DEH, NPWSA (Reserve Planning)	Brian Moore	Attended
PIRSA	Angela Crimes	Attended
EPA	Uma Preston	Attended
PIRSA	Michael Malavazos	Attended

Agency	Issues	OERL Response
1. EPA	Need to better recognise the potential risk to groundwater resources in the area caused by their activities, particularly due to spillages and leakages.	The Katnook/Ladbroke Grove EIR and SEO have been developed specifically to identify potentially hazardous events and their risk and possible environmental consequences.
2. EPA	Spill responses need to be as quick and thorough as possible.	OERL has emergency response procedures in place which are to be regularly reviewed and maintained. These will be reviewed on an ongoing basis
3. EPA	Spill responses include appropriate treatment of contaminated soils and assessment of residual site contamination which needs to be done in accordance with the NEPM (Assessment of Site Contamination) by an appropriately	OERL to review response procedures and rehabilitation activities and update as necessary

Agency	Issues	OERL Response
	qualified/experienced environmental consultant.	
4. EPA	Contaminated soils must be treated as scheduled waste in terms of any disposal and transport options.	OERL to review response procedures and rehabilitation activities. OERL to ensure any contaminated soil is rehabilitated or removed to an appropriately approved disposed site as necessary.
5. EPA	The SEO should reflect the requirements of the NEPM for site contamination and the SA EPA's requirements for transport and treatment of contaminated soils.	The objectives of the SEO are to avoid or manage any spill that may cause soil contamination. OERL to review response procedures and rehabilitation activities against NEPM
6. EPA	Performance measures/Assessment Criteria that Origin Energy should be using in relation to assessing their management of this risk should relate to both the speed and effectiveness of any spill response (as well as prevention measures offcourse).	Origin's performance objective is 'absolute' in terms of avoiding or appropriately managing any Environmental hazard irrespective of timing. OERL will review its Emergency Response Plan and appropriate environmental procedures to consider "speed".
7. Forestry SA	Fire Fighting Capability and Bush Fire Plans:- Buffer zone around well site installations. Is it adequate in forestry areas?	OERL has reviewed the well site installations and confirms the 'buffer zone' is in accordance with prior agreements with Forestry.
8. Forestry SA	Security:- Third party interference	All sites are surrounded by manproof fencing which is kept locked. Signage is also erected at all sites
9. Forestry SA	Chloride Levels in Drilling Reserve Pits:-	This matter will be passed on to the Origin drilling contractor that operates on OERL's behalf under the separate SEO under the Regulations.
10. Forestry SA	Depth of Pipeline:- Concern regarding the pipeline coverage in forestry areas, which will have heavy equipment traversing them when harvesting timber.	OERL has resurveyed all pipelines within the forestry areas and confirms that pipes within the forestry area are buried deeper than the agreed 1.5 m and more than twice the depth required under AS2885.1-1997
11. Dpt WLBC	Further research on the local flora, fauna and ecosystems is required providing an informed assessment of the potential impacts on local environment.	To be further considered in conjunction with WLBC.
12. Dpt WLBC	Provide a quantative assessment of the ability of the evaporation ponds to contain water during extended and extreme rainfall events.	Operating procedures and hazard management systems are in place, as discussed in the EIR and FFP assessment, however OERL will further review the matters as raised.
13. Dpt WLBC	Provide information on the flood hydrology and security of the evaporation ponds against the impact of extreme runoff events.	Plant location and design as well as hazard management systems considered in the original siting of the plant. This issue is discussed in the EIR and FFP assessment, however OERL will review the matter as raised.

5.1 Public Health and Safety Risks

The risks posed to public health & safety by the Katnook & Ladbroke grove operations is limited by the following:

- Facilities are isolated from the public
- Landholders (Table 3) are remote from the facilities
- Facilities are constructed and maintained to the appropriate Standards (see Appendix [A])
- Very low use of local roads by 3rd parties
- Appropriate systems and in procedures in place to manage identified risks

Further details on the risks posed are detailed in the Fitness for Purpose Assessment referenced in Section 7.1.

6 Corporate Commitment – OERL Environment Policy

The Katnook and Ladbroke Grove Gas Plants are managed jointly by Origin Energy Resources Ltd and Oil Company of Australia Ltd. Both organisations are part of the Origin Energy Group and work under the Origin Energy Health Safety and Environment Management System and are committed to meeting the environmental performance commitments set out in the Origin Energy HS&E Policy. As such the gas plants are operated according to Origin Energy's *Health, Safety and Environment* Policy along with relevant statutory requirements, and industry practice standards.

Origin energy

Policy

Health, Safety & Environment

We at Origin Energy are committed to

- Eliminating or managing hazards and practices in our business that could cause accident, injury or illness to people, damage to property or unacceptable impacts on the environment.
- Assisting all employees to meet their health, safety and environmental obligations.
- Conducting all activities mindful that the decisions we make should recognise both short and long term economic, environmental and community considerations.

We will demonstrate this commitment by

- Integrating Health, Safety and Environment (HSE) management into the planning and operation of all Origin Energy businesses. Accountability for implementing this policy will be clearly defined and the principles by which we operate will be effectively communicated.
- Providing systems for identifying, classifying, assessing, controlling and reviewing HSE risks in all areas. Formal, documented processes for controlling the risks and effectively managing incidents will be established and communicated.
- Ensuring adequate resources, with appropriate training and qualifications, are provided to manage, maintain and implement HSE systems and controls. Systems for work procedures will be developed, implemented, maintained and reviewed regularly for appropriateness.
- Ensuring communication channels are available to provide staff with relevant information on HSE issues. Employee committees or other appropriate mechanisms will ensure involvement of all personnel is possible.
- Measuring, monitoring and reviewing HSE performance as part of our management reviews, with records maintained and results reported to senior management, relevant authorities and other stakeholders.
- Ensuring procedures for the purchase or supply of goods or services include HSE requirements consistent with these management principles. Contractors must comply with our HSE standards and requirements.
- Ensuring that, in the event of a work related injury or illness, we support the full recovery of injured employees through prompt treatment and active rehabilitation programs. In the event of an environmental incident, we will take those steps necessary to minimise the impact of any such incident. We will ensure that the opportunity is taken to learn from any incident and improve our health, safety and environmental capabilities.
- Taking all viable opportunities to reduce waste and greenhouse gas emissions, conserve energy and recycle materials.

Grant King
Managing Director
May 2000

Review date May 2002

Health Safety and Environment • Management System • HSE ms

The Origin Energy HSE Management System (see Section 6.1) has been recently developed to ensure that the Policy commitments can be met. The System defines a set of HSE Standards by which implementation of the Policy can be measured. A set of Codes of Practice provides guidance to each Origin Energy Business Unit on how each Standard may be met. These Codes of Practice address legislative requirements, the relevant Australian Standards and industry standards and guidelines.

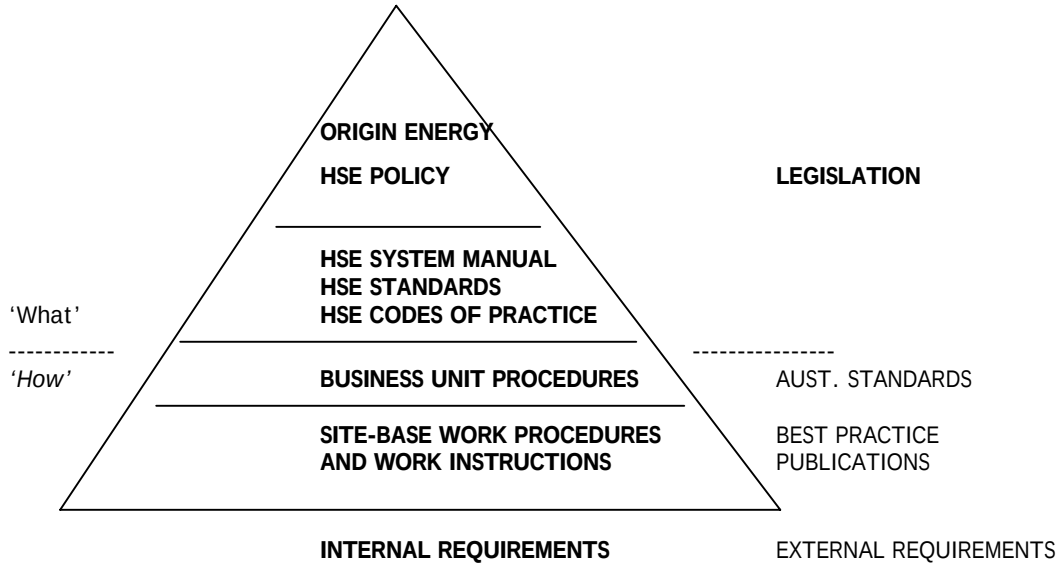
Origin Energy Resources Ltd and Oil Company of Australia Ltd are continually improving the procedures and work practices that apply to the Katnook and Ladbroke Grove Gas Plants to guide all staff towards meeting their statutory and Corporate safety and environment obligations.

Key environmental aspects of site management flowing from the HSE Management System are:

- Education of staff and contractors in environmental awareness and job competence
- Identifying environmental risks in planning and design, management and operational decisions and activities
- Auditing and reporting of environmental performance
- Continual monitoring and review of all environmental aspects of the operation
- Induction
- Training

6.1 Management System and Responsibility

Origin Energy has a structured Managements System as conceptualised in the diagram below. The Management System contains a subset of manuals, standards, codes of practice which are implemented through business unit and site based procedures and work instructions.



Responsibility for ensuring the functioning of the management systems needed to achieve the objectives of the Environment Management plan rests with the relevant managers and supervisors in accordance with their line and function responsibilities.

The personnel are responsible for the operation of the Katnook and Ladbroke Grove Gas Plants are outline in Table 4.

Table 1 Personnel responsible for Katnook and Ladbroke Grove Gas Plants Operations

NAME	TITLE
John Rodda	Manager, Exploration and Production (CB&SA)
Geoff Mathews	Manager – Engineering
Ken Horton	Origin/OCA Manager - Operations
Ian Cook	Origin/OCA Manager –HSE & Native Title
Dusan Pribilovic	Operations Superintendent – Otway Basin
Russell Campbell	Field Supervisor
Don Stephens	Senior Operator

6.2 Training, Awareness and Competence

Staff environmental training is conducted at all levels in the OERL/OCA organization. The purpose of the training is to make employees aware of:

- The importance of compliance with environmental laws and regulations, Origin HSE Management System, the environmental policy, procedures and with the requirements of the site environmental management manual contained within this document
- The significant environmental impacts, actual or potential, of their work activities and environmental benefits of improved personal performance
- Their roles and responsibilities in achieving conformance with the environmental policy and procedures and with the requirements of the environmental management plan including emergency preparedness and response requirements
- The potential consequences of departure from specified operating procedures
- The training is in the form of interactive, structured lecture/seminar sessions conducted both in the field and office. Training sessions are documented for content and attendance. The level of information disseminated will be dependent on the target audience i.e. managers, supervisors, field or plant personnel.
- Katnook/Ladbroke Grove personnel will undergo routine HS&E refresher training during 2001/2002, and will also undertake specific environmental training activities as specific issues are identified.

6.3 Emergency Procedures

Origin Energy Resources Limited has developed an Emergency Response Plan (ERP) specific to the requirements of the Katnook and Ladbroke Grove operations. Key aspects of the ERP include the Emergency Organisation Structure, Specific Emergency Actions and Emergency Contacts. This ERP is linked to the Origin Energy Group Crisis Management Plan.

Both the Katnook and Ladbroke Gas Plants incorporate automatic Emergency Shutdown (ESD) capability. An ESD of the plants, involves automatic isolation of the facility from sources of hydrocarbon (at both the plant inlet and outlet) and depressurising the plant to atmosphere via remote vents, so that the plant is left in a safe condition. These capabilities include ESD switches, fusible loops (for fire) and pressure relief valves. There is also the opportunity for operator intervention.

6.4 Environmental & Safety Audits

Environmental & Safety audits are undertaken based upon:

- Site performance (ie number of environmental incidents)
- Management system requirements
- At senior management request
- As required to conform with legislation and the relevant SEO under the *Petroleum Act 2000*

Two environmental audits were completed in the last 12 months, December 2000 and January 2001. A number of activities have commenced as a result of these audits. A fitness-for-purpose assessment has been conducted under Regulation 30, *Petroleum Regulations 2000.*

6.5 Reports

Origin Energy Resources Ltd (OERL) Provides activity reports to a range of Authorities and Associations.

6.5.1 Environment Protection Authority (EPA)

OERL provides the EPA with data of environmental significance in accordance with licence conditions.

6.5.2 Department of Primary Industry & Resources SA (PIRSA)

OERL reports to PIRSA as per the requirements of the *Petroleum Act 2000*.

6.5.3 National Pollutant Inventory (NPI)

OERL reports estimated emissions of National Pollutant Inventory (NPI) listed substances for its exploration and production activities to the N P I annually as required by the National Environmental Protection Measure.

6.5.4 Australian Petroleum Production and Exploration Association (APPEA)

OERL provides Australian Petroleum Production and Exploration Association (APPEA) with data on greenhouse gas emissions and eligible environmental incidents (as specified by APPEA reporting guidelines).

7 Hazard Assessment

The documents listed in Part 10 References, were used to provide information for the development of this document. Specifically, the *Guidelines for Fire and Explosion Management* was used in understanding the consequences of fire and explosion. Various sections of the *E&P Forum QRA Datasheet Directory* (1996) were also used in compiling this report and although the focus of *The E&P Forum QRA Datasheet Directory* is on Offshore activities, it can also be used to gain an understanding of related onshore operations. In particular the below sections were used to understand each of these aspects

- *Vulnerability of Plant/Structure*
- *Vulnerability of humans*
- *Human Factors in the Determination of Event Outcomes*
- *ESD and Blowdown Systems*
- *Human Factors in Calculation of Loss of Containment Frequencies*
- *Mechanical Lifting Failures – dropped objects*
- *Storage Tank Incidents*
- *Riser and Pipeline Leaks*
- *Process Release and Ignition*

Unless otherwise stated, predictions and consequences referred to in this document have been arrived at through search of company records, personal experience and involvement in related incidents and through anecdotal evidence from conversations with operators and truck drivers.

7.1 Limitation of information and lack of knowledge or uncertainty

The information in this document is based on data contained within the Fitness For Purpose Assessment (FFPA) (prepared by Hepburn). There is a high level of certainty on the frequency of events and the effectiveness of the current controls. This is a reasonable statement as the Plants have been in operation for (in total) 10 years and there is a reasonable record of events that have occurred during that time. Additionally several of the operators have been working at the Plant since day one and consequently have a good oral history of the operation.

However because of the lack of actual events there is a medium level of certainty in the description of the consequences should an event occur. There is a significant reliance on theoretical data and company experience in other operational areas to determine the consequences of a specific hazardous event.

7.2 Hazards

The FFPA conducted in April 2001 identified a number of hazards associated with the Operations. These hazards were referenced in the course of preparing this Environmental Impact Report (EIR). The following table (Table 5) correlates the findings of this EIR with the FFPA.

Table 2 Correlation of findings of this EIR with the FFPA

Environmental Impact Report	Fit for Purpose Assessment Hazard References K & L (see note)
Normal Operations	K2, K3, K9, K16, K17, K18, K21, K22, K25, K28, K29, K30, K31, K37, K38, L1, L3, L9, L10, L17, L22, L23, L25, L26
Corrosion in Wellhead, Vessels and Pipelines	K7, K8, K15, K22, L5
Condensate & Chemical Handling and Storage	K2, K4, K12, K13, K14, K23, K32, K33, K34, L6, L7, L11, L12
Hydrate/Emulsion formation	K19, K20, K23 L20
Contain Produced Water – Evaporation ponds	L24
Presence of low level mercury contaminated sludge (Katnook Plant only)	K35, K36
Vehicle accident	K24 L15, L16
Third party interference	L19
Gas wells – Casing and/or cement failure	K5
Introduction of weeds	-
Waste generation	-
Cultural sites	-

Note: K refers to Katnook hazard & L refers to Ladbroke Grove hazard

There are a number of storage areas within the operational area that contribute significantly to the risks associated with the operation. These storages are listed in Table 6.

Table 3 Storage of hydrocarbon and water in the study area

Name	Type	Volume or quantity
Contained Hydrocarbon & chemicals	hydrocarbon liquid (no diesel) in bulk storage > 200L	consists of 3 x 90,000L condensate tanks (bunded)
	minor storage < 200L	2 x 25L engine oil
	chemical bulk storage > 200L	1 x 20,000L glycol tank (bunded) 2 x 20,000L methanol tank (bunded) 4 x 5500L glycol tanks at individual wells (bunded)
	minor storage < 200L stored in bunded chemical storage area	12 x 200L drums glycol 3-4 x 200L drums corrosion inhibitor – (Champion IZB172 & IZB282)
	Gas (and associated liquids)	gas In pipelines (under pressure not exceeding 14,000 KPa) There is approximately 2.9km of 168mm pipeline at Ladbroke Grove gathering system There is approximately 7km of 4" pipeline in the Katnook gathering system
	Well bore and reservoir	volume unknown
	Pressure vessels	minor volume
Contained water	produced water	two evaporation ponds, containing >6,000,000L

7.3 Risk Assessment Methodology

In order to determine the level of risk associated with various hazards, and their potential consequences, both the likelihood (Table 7) and severity of hazards (Table 8), and their associated consequences have to be considered. Categories of likelihood and severity have been determined using subjective estimates of whether or not a particular event or outcome will occur. The Katnook Ladbroke Grove operation is an existing operation and there is a reasonable understanding of the hazards and the effectiveness of existing management measures.

Table 4 Assessment of likelihood

Likelihood of occurrence	Qualitative description of exposure
Virtually certain	Includes continuous emission
Likely	Likely to occur during operation lifetime
Unlikely	Not likely during operation lifetime
Rare	Has occurred a few times
Virtually impossible	Has almost never occurred but conceivably could

Table 5 Assessment of Severity

Severity	Qualitative description of consequences
Negligible	Possible impacts but without consequence
Minor	Some limited consequence but no significant changes
Major	Significant changes
Severe	Substantial and significant changes
Disastrous	Extreme changes

Note: based on Stoklosa (1999) and AS/NZS 4360

It is generally accepted that the severity and likelihood of consequence together define the risk associated with a hazard (Table 9). However the severity of the consequence is dependent to a large degree on the vector of transmission and the receptor and its condition. The risk(s) associated with the likelihood and severity of a consequence in the hazard consequence section in Section 8 – Hazard has been derived from Table 9 below.

Table 6 Risk Matrix

			Likelihood of Consequences				
			1	**2**	**3**	**4**	**5**
			Virtually Impossible	Rare	Unlikely	Likely	Virtually certain
Severity of consequence	**E**	Negligible effects	Low	Low	Low	Low	Low
	D	Minor effect	Low	Low	Medium	Medium	Medium
	C	Major effects	Medium	Medium	Medium	Medium	High
	B	Severe effects	Medium	Medium	Medium	High	High
	A	Disastrous effect	Medium	Medium	High	High	High

(Source: Stoklosa 1999)

8 HAZARDS

8.1 Contained produced water - evaporation ponds

Threats

The issue is the loss of pond containment integrity which can be brought about in varying degrees by:

- operator error or high rainfall
- high water level in the pond combined with strong winds
- deterioration in quality of impervious liner that lines the inside of the pond
- liquid transfer between pond and removal of surface residue

Frequency

Rare

Basis of prediction

- There has been no overflow event recorded for the evaporation ponds, due either to overfilling or from wind action
- Analysis of water samples from monitoring bores (positioned external to the pond walls) over a number of years has not indicated any sign of pond water, this provides some indication that water has not leaked through the impermeable liner.
- No incidents recorded of loss of water during transfer between ponds
- Spills and leaks during removal of surface residue from the pond surface are minimised through operation being conducted using set procedures backed up by the experienced site Operators
- Equipment failure during removal of surface residue has not, historically, been a problem
- Research of available records indicates no incidents or complaints from surrounding land users in relation to the containment of produced water

Current Controls

Leak controls

- Evaporation ponds are lined with impervious liner to prevent leakage. Threats to the integrity of the liners are negligible because of their location
- A secondary line of defence is that the ponds (one pond only) are clay lined under the liner
- Monitoring bores, positioned strategically around the site, to an approximate depth of 3 meters, are in place to detect leaks (subsurface) from the evaporation ponds
- Integrity checks of evaporation ponds (liner, walls) via visual observations
- Monitoring the produced water quality in the evaporation pond for comparison with water (if any) in monitoring bore
- Monitoring for fluids from beneath the basal liner of the evaporation pond on an intermittent basis utilising a purpose built sub-liner drain system

Overflow control

- Water levels of evaporation ponds are monitored as a part of daily operations, to ensure that at least 0.5 meter freeboard is maintained
- During periods of high rainfall or low evaporation, freeboard of evaporation ponds is maintained by trucking excess water away
- Evaporation pond walls are approximately 500mm above grade and at a low angle of recline on the storage side thus mitigating any ‘splash’ event potentially caused by strong wind

Transfer of water & removal of surface residue

- Programme of regular maintenance of all pumps, piping, valves and other equipment used for transferring water between ponds and in removing

residual condensate from evaporation pond surface. Procedures for removing surface residue in place and staff have been appropriately instructed

Consequences The consequences of loss of water from evaporation ponds may lead to potential impacts on surface water, soil, subsurface water, flora and land use. The loss would be in a northerly and westerly direction, therefore any impact would be restricted to that area

Water

- Overfill of pond could result in an overflow that results in migration of water to the external environment adjacent to the northern/eastern Plant area. However because of the rate of production of water it is not expected that a significant volume of water would be involved
- Over splash could lead to localised minor deposition of water to the immediate environment. Over-splash would require a combination of events for it to occur, high water level in the pond and strong winds. Any over-splash would be confined within the immediate area of the pond and would continue until the pond level was lowered and/or conditions ceased. This unlikely event could occur during periods of high rainfall and/or high water production.
- Leak in the impervious liner that lines the inside of the pond could result in migration of water to the subsurface environment
- Spill and leaks during transfer between pond and removal of surface residue would be little significance as they can be quickly cleaned up.

Risk assessment	Severity	Likelihood	Risk
Surface	D	2	**LOW**
Subsurface	C	3	**MEDIUM**

Flora

- The River Red Gums surrounding the Plant area would not be impacted

Risk assessment	Severity	Likelihood	Risk
Trees	D	2	**LOW**

Risk assessment	Severity	Likelihood	Risk
Soil	D	2	**LOW**

Amenity & Land Use

- For any significant impact on stock to occur there would have to be a prolonged exposure of the stock to the water, contaminant levels would have to be higher than those anticipated in an accidental discharge.
- Any impact on stock health or meat quality would depend upon the quantity and quality of water ingested and the criteria under which meat quality is determined.

Risk assessment	Severity	Likelihood	Risk
Stock	D	2	**LOW**

The overall consequence of a loss of produced formation water to the environment is difficult to determine and would depend largely on the quality of the water at the time, volume of water lost, and if any surface water was present.

Basis of Prediction

Soil Impacts

- There may be potential for low-level soil contamination to the extent of the migration of the water. However hydrocarbon over a period of time (6 – 12 months) degrades down to its constituent parts thus further reducing the potential for long term impact
- Once-off minor overflow/spills/leak within the Plant perimeter are not expected to have a significant impact on soil quality (short duration < 1hr)
- Leaks during removal of residue from the pond surface could result in loss of fluid to ground in an area within the vicinity of the evaporation pond (short duration), based on observed actual spills or leaks during pumping of surface residue from pond surface at the Katnook site.
- The impact of slow leaks would be determined by rate and duration and would have to continue for a period of time (> 2-3 months). Such an event could lead to a localised impact on the soil.

Water Impacts

- It would be most likely that an overflow event would occur during a period of extremely high rainfall, the overflow would only be for a short duration. While not ideal, dilution of formation water with stormwater would tend to counteract any potential effect of the formation water on the environment.
- There is potential for groundwater contamination resulting from migration of produced water to near surface aquifers. It could reasonably be expected that the volume of water involved such a leak would be minor, and consequently can reasonably be expected that any contamination would be low level. Duration of such an event would be 'until detected'. Potential for localised subsurface contamination is predicted based on in-house work done on subsurface evaporation pond leakage in a similar environment in another state (not published).

Amenity & Land Use

- For any significant impact on stock to occur there would have to be a prolonged exposure of the stock to the water, contaminant levels would

have to be higher than those anticipated in an accidental discharge.

- Any impact on stock health or meat quality would depend upon the quantity and quality of water ingested and the criteria under which meat quality is determined. The Company has had experience with stock consuming produced water (stock gained access to evaporation ponds) of a similar water quality (or worse) to Katnook at other production sites located interstate. Impact would be minimal.
- It is expected that any overflow would be associated with heavy rainfall leading to a further dilution of the overflow water thus it could be reasonably be assumed there would be a negligible impact on land use or amenity. Duration - would be for the period of the overflow.

Flora

The structure of the river red gum is such that its root system will only extend to the edge of its canopy, roots are the same depth as height. The lined pond only extends to the edge of the canopy

Actions

- To further reduce the risk associated with produced water containment alternative water disposal possibilities are being considered including the construction of an additional evaporation pond.
- Information on the quality of the produced formation water in the evaporation ponds is currently being updated.
- In the event that the full potential of the hazard was realised the following actions would be taken:

Soil

- Should an event occur action taken is to:
  - contain and/or remove ponded fluid &
  - depending on extent of soil penetration and concentration leave or remove
  - develop & implement a rehabilitation Plan
- Determination of level of soil contamination via analysis of soil samples in and around the area of migration would be conducted where the event continued for a period of time that could potentially lead to an adverse impact on the soil quality

Water

- In the event of a subsurface leak from an evaporation pond appropriate consultants would be used to conduct detailed studies and predictions of the impact on the groundwater and would include studies on the migration/migration direction/rate of migration/plume pattern
- Comparative sampling from monitoring boreholes

Amenity & Land Use

- In event of surface migration outside plant area,
  - advise landowner,
  - relocate any stock
  - determine extent of migration and develop and implement rehabilitation Plan

8.2 Corrosion in wellhead, vessels and pipelines

Threats

- Corrosion is brought about by the water & CO_2 produced with the gas forming corrosive carbonic acid
- Corrosion of the external surface of a pipeline can be brought about by coating defects allowing corrosion to occur
- Sulphate reducing bacteria (SRB) which attack (corrode) the inside of the pipe

Frequency: Unlikely – SRB and coating defects

Likely – corrosive carbonic acid

Basis of prediction:

- There have been two corrosion failures of a component at the wellhead in 10 years of operation due to carbonic acid
- Wellheads, pipelines and vessels built in accordance with appropriate American Petroleum Institute (API) and Australian Standards which nominate corrosion protection allowance
- Research of available records indicates that there have been no complaints and apart from the two occurrences as above there have been no incidents of wellhead, vessel or pipeline failure due to corrosion.

Current Controls:

- Corrosion inhibitor injected to counter corrosive liquids (well bore, pipelines, vessels)
- Cathodic protection installed to protect pipelines against external corrosion caused by coating defects (pipelines)
- All wellheads, plant vessels and pipelines are pressure tested prior to installation for any defects and are repaired at the time
- SRB counts taken on a planned basis
- Use of corrosion resistant materials in wellhead and meter run
- Regular inspection and maintenance

Consequences: Failure to implement one or more of the above controls could result in one or more of the following consequences:

- Well-bore equipment failure, leading to loss of available gas
- If wellhead or meter-run failure, reduction in flexibility available gas, leading to a relative impact on security of supply

Rupture - uncontrolled release of hydrocarbon, both gas an liquid, resulting in:

- Potential for injury to *third parties* if in the vicinity (gas, noise)
- Some disruption to *land use* until repaired
- Release of natural gas into the *atmosphere*
- Release of a minor amount of liquid to *soil*
- If ignition source introduced, potential for fire and/or explosion which could also result in starting secondary fires such as grass fires, potential impact on *land use, third parties, flora & fauna*
- Depending on location of rupture, Plant shut down due to loss of pressure, leading to a *security of supply* issue

Duration of consequences is dependent on pipeline or vessel inventory or how soon gas flow could be shut off. *Security of supply* threat would be dependent on location of rupture.

These consequences have been predicted using Company experience relating to failure of equipment due to corrosion in other areas and the local corrosion

event at the Ladbroke Grove wells.

Risk assessment	Severity	Likelihood	Risk
Third parties	C	2	**MEDIUM**
Land	D	2	**LOW**
Air	E	2	**LOW**
Flora Fauna	D	2	**LOW**
Security of supply	C	2	**MEDIUM**

Leak – slow release under pressure

- Local minor impact that can exists in subsurface equipment for some time before detection, usually indicated by dead grass or discolouration or bubbling if water present; on surface equipment usually detected by noise emitted or detected by gas detector
- Usually requires replacement of a fitting or replacement of a section of pipe. It can be done in a controlled manner with minimum disruption, therefore short duration
- Corrosion could also lead to failure of valves and vessels and pipework within the Plants. Such failures would result in a plant shut down for minimum period if spares are on hand. However failure of a pressure vessel would result in a shut down for several weeks until the vessel could be repaired or replaced.

Risk assessment	Severity	Likelihood	Risk
Third parties	D	2	**LOW**
Land	D	2	**LOW**
Air	E	2	**LOW**
Flora Fauna	D	2	**LOW**
Security of supply	D	2	**MEDIUM**

Actions:

- In the event of a failure at the well head, well can be shut in using valves on the well head.
- Safety valves would shut in if there was a pipeline failure
- A failure in the plant would result in a pressure loss with automatic shut down of the plant
- Some critical spares are maintained as well as linepack in the transmission pipeline
- Maintain existing corrosion control regime including corrosion inhibitor injection and cathodic protection
- The Company is continually investigating better techniques for managing corrosion through ongoing review of corrosion inhibitor performance

8.3 Gas wells - casing and/or cement failure

Threats A leak can occur in a gas well because of corrosion of the steel casing within the well, or de-bonding or degradation of cement behind casing which may allow gas or water migration between aquifers

Frequency: Rare

Basis of prediction:

- There are no recorded instances of surface casing failure in Origin Operated wells in the Otway area - this confirms the success of the current controls
- Historically cement bonding investigation has shown there to be good cement bonds in the Otway Basin well bores
- There is significant separation between saline water and fresh water aquifers present in the Otway Basin, and furthermore they are isolated behind 7" casing and cement. Saline aquifers are well below the aquifer used by third parties for fresh water
- Aquifers encountered during drilling are isolated by cementing off

Current Controls:

- Ensure casing strings, setting depths and mechanical properties of casing in wells conform to API Standards/Government Regulations Use stainless or chrome production strings in anticipated corrosive environments
- High-grade monitoring of at risk wells due to high CO2
- Program of monitoring of casing corrosion via calliper surveys
- Monitoring of casing, annulus pressure (leaks would be detected by an increase in annular pressure (tubing 7")) and other pressures in casing strings to identify abnormal pressures indicative of leak and for detection of communication and potential for crossflow
- Initiate remedial action of well casing in the event that leak caused by corrosion
- Predict potential problems and weakness in design via a review of the well program, cement bond logs and procedures (eg. cement returns to surface and casing reciprocated when cementing)
- Well maintenance program to effectively isolate all permeable sands
- There is a double barrier –steel casing and cement sheath to surface to protect aquifers (see Appendix D for Schematic diagram of well)
- Any well with corrosive gas composition is completed with chrome (corrosive resistant) tubing and trim wellhead equipment
- In producing gas to surface via tubing, any leak has two additional steel barriers (7" and 95/8" casing).
- The tubing annular is full of inhibitor fluid
- Cement volume (see casing and cementing report in Appendix D) is calculated with 100% excess on the theoretical
- Failure of cement to reach the surface is treated by adding cement from the surface
- Production casing volume is calculated from calliper logs with a 15% excess. Bore hole rugosity noted on 4 arm calliper logs
- 'Flash' setting not common with modern cement formulations, however if this was to occur the casing would be perforated and the required cement squeezed into place

Consequences: *Water*

- Potential for groundwater pressurisation, this potential is based on theoretical knowledge
- Also potential for localised groundwater salination in vicinity of well bore
- Potential for reduced amenity of aquifer for use as drinking water may impact on *third Parties & Personnel*

Risk assessment	Severity	Likelihood	Risk
Water	C	2	**MEDIUM**

Amenity and Landuse

If the groundwater did become salty there would be a significant degradation in its quality with resultant impact on agricultural use

Risk assessment	Severity	Likelihood	Risk
Land	D	2	**LOW**

Basis of prediction of consequences:

- Ability to predict the consequences of such an event is very limited. If there was an event there may be mixing of water within the well bore but there is no evidence available to give an indication of the rate of migration of formation water from deeper aquifers into a near surface aquifer nor the characteristics of any saline water migration plume or the rate of migration of the plume

Actions:

- Such an event(s) would require 'workover' (re-entry into the well under controlled conditions) of the well to locate and fix the problem. This may include re-cementing the well, or running new casing
- Detailed studies may be needed to define the extent of the migration of any saline water plume

8.4 Condensate & chemical handling and storage

Threats Storage facilities for condensate and chemicals are subject to two significant threats which are corrosion and operator error which could result in a leak or storage overflow or a spill.

Frequency Low to medium

Basis of prediction

- In the 10 years of operation of the Katnook gas plant there has been no recorded rupture or failure events of storage facilities
- There have been no recorded occurrences of faulty manufacture that has caused breaching of containers or faulty plumbing in relation connections and fittings
- One condensate spill event in early 2001 due to mechanical failure of the loadout pump and to follow the correct procedure
- There have been a number of condensate storage tank overflows which have been contained within the bund
- Otherwise there have only been occasional occurrences of minor drips, leaks, & minor loss of chemical
- Research of available records indicates that there have been no incidents or complaints from surrounding land users regarding any spill events or impact on surrounding land area.

Current controls

General

- Condensate & chemical storage areas are bunded and sufficient to contain a 125% of the volume of the largest tank/drum within the bund
- A Chemical Management Plan for the site is in operation
- Standard Operating Procedures for operations involving condensate and chemical handling are in place
- Personnel are trained in the use of, and dangers associated with, chemicals at the plant including safe handling as indicated in the Chemical Management Plan and MSDS
- Ongoing assessment whereby potential for spills is addressed through engineering modifications and revised procedures (driven by high cost of chemicals)
- Induction and training programme relating to lifting, materials handling techniques Available vehicle mounted lifting equipment

Spills & Leaks

- All spills contained and cleaned up as soon as practicable
- Drip trays are installed under valves and fittings to catch any minor leaks or drips Programme of regular maintenance of all pumps, piping, valves & fittings
- Chemical pumps are usually located on concrete pads or hard stands to contain any leaks or drips and for ease of clean up.
- Appropriate lifting facilities are in place for lifting of chemical drums to minimise the chance of dropping.

Storm water contamination

- Stormwater drainage is designed in the plants to direct it away from areas of potential contamination
- Diversion of stormwater around the plant and control of movement within the plant minimises potential for contamination of stormwater

Personal Protection

- Enforce procedures concerning use of appropriate Personal Protective Equipment (PPE) when handling chemical and condensate

Consequences:

Soil

- An event outside the bunded area would be a localised spill <200lt on the ground, potentially resulting in local soil contamination until cleaned up. Duration of this event would be several hours.
- Consequence of an undetected leak (outside hard stand or concrete pads) could be cumulative over a period of months but would be localised within an area of less than a half a square metre. Depth of penetration would be dependent on soil condition and saturation level of the soil.
- Potential for migration of spill of chemical (<1lt) or product due to routine plant operations through soil very limited. However an unattended leak e.g. 2-3 month may have a cumulative effect directly below the drip point
- Potential for contamination of soil with chemical or hydrocarbon however, duration of the event would be equivalent to the rainfall event. If runoff were sufficient for offsite runoff chemical or product would disperse and dilute
- Potential for minor drips from pumps and dropping and rupturing or splitting of drum, resulting in loss of contents to the ground; duration would be for as long as it takes to clean up (approx. 1 hour)

Risk assessment	Severity	Likelihood	Risk
Soil	D	4	**MEDIUM**

Water

- With watertable at several metres below surface, time to migrate to water table would be considerable, especially without a significant rainfall event. However there is potential for this to happen if spill is not cleaned up.
- Significant loss of product could lead to the spread of product along main water channels, however the likelihood of the sequence of events occurring, overflow of bund for at least 48 hours, rainfall of sufficient quantity to allow flow to Plant boundary is very remote

Risk assessment	Severity	Likelihood	Risk
Water - surface	D	2	**LOW**
Water - subsurface	C	2	**MEDIUM**

Stormwater contamination

- While heavy rain is common, controls in place minimise the exposure to spilt chemical or hydrocarbon
- Rainfall of at least 100mm is required before runoff occurs, generally water tends to pool on site, however stormwater flow through plant may become contaminated and extend beyond the perimeter of the plant. Dilution by the heavy rainfall would significantly mitigate the consequences. Duration of the consequence would be for the water flow period along with any immediate clean up that may be needed, could be as long as several days. An unlikely event.

Risk assessment	Severity	Likelihood	Risk
Water - surface	D	2	**LOW**

Amenity & Landuse

- If spill event migrated outside plant or well yard in significant quantity and concentration, stock would have to be relocated from the immediate area, however stocking rates are not high thus reducing the level of any potential impact
- It is expected that there would be little impact on the stock in the surrounding paddocks. There may be a chance that the stock could drink the fluid, but would be unlikely. If it was sufficiently dilute such that the stock did drink it is unlikely that it would have any adverse impact.

Risk assessment	Severity	Likelihood	Risk
Landuse & amenity	D	2	**LOW**

Personnel & Third Parties

- Incorrect lifting techniques could lead to injury and accidents, a safety concern that could have long terms impacts on a person injured, and could also lead to a spill
- A secondary consequence from an overflow, spill or leak could be a fire if an ignition source was introduced. There have been no fires at the site as a consequence of overflow, spills or leaks. Duration would be till fuel source expended or fire extinguished.

Risk assessment	Severity	Likelihood	Risk
Personnel & 3rd parties	D	2	**LOW**

Basis of prediction of consequences:

General

- All major storage is bunded and is capable of containing the contents of the largest tank. The likelihood of more than one tank losing all its product is extremely remote
- Potential volume of product spilt or leaked in minor storage would be <200lt, clean up would be almost immediate.
- The outlined consequences in relation to stock is based on experience of similar circumstances at other Company production sites
- Based on operators experience at Katnook site and chemical injection at other producing sites
- Chemical and condensate are flammable so there is the potential for fire if the product was able to be ignited
- No site records indicating any incidents during manual lifting. There are suitable mechanical aids on site to assist with the lifting or moving of this type of equipment and material. Historically the Company has some evidence of dropped drums that have split and lost part of the contents (at other sites). There is a wealth of data in the public domain on injuries and accidents caused by incorrect lifting techniques

Soil

- The Company experience is that any migration of product through soil is dependent upon the soil characteristics and the volume of spill and the viscosity of the fluid. Katnook soil has a significant clay content thus would have a tendency to impede any downward migration. Surface within the Plant area has generally been compacted thus further reducing the chance of the migration of the product through the soil
- Experience with the recent spill that occurred at the Katnook condensate loadout bay
- Company has done extensive work on remediation of hydrocarbon contaminated soil at other interstate sites
- Experience at other sites where spills have occurred and have been followed by a significant rainfall event before clean up.
- Any impact is governed by the concentration of the hydrocarbon/chemical in the water. In these circumstances the concentration would be very low due to the quantity of product available

Water

- No data available on rates of migration through the modified Katnook soil profile

Amenity & Land Use

- No local case history of incidents however incidents in other states indicate that migration to surface waterways is the biggest problem if migration path is available

Personnel & Third Parties

- Condensate and chemical are flammable and could ignite if ignition source introduced

Actions: General actions in the event of a an overflow, spill or leak of hydrocarbon or chemicals

- Fix leaks
- Contain and clean up spill – to environmental drum
- Review tank management procedures and review engineering design
- Review maintenance procedures
- Ensure continuation or review of correct lifting techniques (if dropped drum the source)
- Ensure immediate cleanup if spill of drum contents occurs
- Advise appropriate authorities of the incident

Soil

- In the event of a spill in loadout bay
  - Pump out load out area
  - Remove soil if contaminated
  - Rehabilitate site

Water

- In the event of a spill block migration to waterways, then clean up
- Investigate/sample external water channels and/or pools of water to determine if any level of contamination
- Seek independent advice as required after an event where stormwater has become contaminated

Amenity & Land Use

- Remove stock from area after consulting with landholder

Personnel & Third Parties

- Prevent access to site and introduction of ignition sources

8.5 Vehicle accident

Threats Vehicle Accidents may occur due to Driver/vehicle condition, road conditions, collision with or avoiding stock/wildlife

Frequency: Rare

Basis of prediction:

- There are no recorded incidences involving OERL condensate/chemical tanker on local roads and highways on SA roads
- There is no record of operators vehicles being involved in accidents however, when on public roads subject to the same degree or risk as the travelling public
- No record of condensate/water tanker rolling over (1 condensate loadout tanker a day on average)
- Stock is fenced in, low wildlife (threats to trucks and vehicles) population

Current Controls:

- Appropriately Licensed drivers and registered trucks and tanks provided by transport company
- Tanker Contractor (condensate) has to comply with Australian Dangerous Goods (ADG) Code Version 6
- Active programme of company driver education relating to use of rural sealed and unsealed roads and timetable to avoid periods of increased risk to third parties
- Notify landowners of likely periods during which vehicle activity may be elevated
- Induction programme for tanker drivers and traffic policy to control speed on the unsealed roads immediate to the plants
- Minimise risk to roving livestock of vehicle movements on secondary roads via driver induction and road safety programme
- Vehicles stay on designated tracks
- Chemical delivery to wells is as follows:
  - Chemical – Glycol, 1000L per week during winter to Haselgrove and Redmond wells
  - Corrosion inhibitor – approximately 200L every 6 months Ladbroke Grove wells
  - Methanol used on as required basis during winter

Consequences: *Soil*

- In the event of a condensate tanker incident loss of product to roadside soil may occur. If left unattended condensate would degrade over an approximate 6 month period, however there may be residual contamination of heavy ends if not cleaned up
- In the event of a tanker incident carrying formation water, would disperse to the local road side and soak in, leaving a possible low residual of hydrocarbon in the first 25mm of soil (concentration probably within acceptable SA limits) for contaminated soil (short duration as clean up would be required)

Risk assessment	Severity	Likelihood	Risk
Soil	D	2	**MEDIUM**

Flora & Fauna

- Condensate tanker incident - potential for physical injury or loss of flora and fauna in the event of loss of full tanker load of condensate, significantly less if only one compartment. Extent of spill would be confined to immediate area. If ignition source introduced potential for fire and explosion which could lead to secondary fires in adjacent bushland. Tanker fire would last until fuel expended or extinguished. Bush fire may take longer to contain if dry fuel available

Risk assessment	Severity	Likelihood	Risk
Flora & Fauna	D	2	**LOW**

Personnel & Third Parties

- Potential for serious injury or death to drivers or passengers in vehicles involved
- Spill of hydrocarbon/chemical at roadside due to tanker role over may cause hazardous road conditions and would pose a threat to third parties
- Potential for physical injury or loss of life if ignition source then potential for local fire which could spread if suitable fuel (dead grass, etc) along roadside
- Damage to third party vehicles

Risk assessment	Severity	Likelihood	Risk
Personnel & 3rd Parties	C	2	**MEDIUM**

Water

- If tanker contents entered a watercourse there would be contamination of the water, level of contamination would depend on the volume. Such a consequence would be difficult to clean up and would take several days depending on volume and velocity of water flow.
- If chemical load was lost while transporting chemical to a well site, whilst the volumes transported at any one time are small, the impact would depend on the local conditions. If there was water lying around there would be potential for local impact and spill may prove difficult to clean up. If dry clean up would be easier.
- Glycol and Methanol are miscible with water, so spill into a water area will immediately dilute. Methanol will also evaporate.
- Corrosion inhibitor will dilute with water

Risk assessment	Severity	Likelihood	Risk
Water – surface/subsurface	D	3	**LOW**

Amenity & Land Use

- Physical injury or loss of stock if accident involved collision with livestock or wildlife, and some minor disruption to landuse.
- If a condensate tanker involved, potential for further impact if ignition source introduced

Risk assessment	Severity	Likelihood	Risk
Amenity & land use	D	2	**LOW**

Basis of prediction of consequences:

- The Company could find little data on tanker accidents, and has had to rely the record of its current contractor. However the scenario mapped out above appears to be a potential likely outcome.
- Vehicle accident outcomes are generally well known

Actions:

- Vehicle accidents on public roads would be subject to police investigation, implement any action arising
- In the event of a transport incident
  - Police and emergency services would take control of the situation, company would assist where able
  - Review trucking company operating procedures
  - Adequacy of response

8.6 Hydrate/Emulsion formation

Threats

Hydrates usually occur during time of cold weather and are pressure and temperature related. Emulsion formation is an ongoing problem at the facility

Frequency:

- Hydrates - likely during colder months
- Formation of Emulsions – continuous

Basis of prediction:

- Operator reports
- Operator downtime reports
- Historical data & observation

Current Controls:

- Chemical emulsion breakers are used as the primary control
- Separation vessels provide a secondary control, any carryover flows on to evaporation ponds
- Hydrates inhibitor (methanol) injected to prevent hydrate formation
- Operator maintenance and surveillance to ensure continuous hydrates inhibition.

Consequences:

Security of Supply

- Hydrates blockage in the plant causing shutdown to clear the blockage, short (<2hr) duration
- Emulsion causes blockage of filter coalescer causing a Ladbroke Grove plant shutdown
- Hydrate blockage could also lead to component failure at wellhead – valves pipework, but this is unlikely
- Excessive carryover of emulsion to the pond causes emulsion management problems and can result in a plant shutdown to remedy the problem

Risk assessment	Severity	Likelihood	Risk
Security of supply	D	4	**MEDIUM**

Amenity & Land Use

- Flowlines that have hydrates blockages cause pressure build up, leading to relief valve release and consequent venting of gas, (short duration)

Risk assessment	Severity	Likelihood	Risk
Amenity & land use	E	4	**LOW**

Personnel & Third Parties

- Limited potential for carryover of emulsion to the sale gas pipeline
- Cleaning of pond represents a hazardous activity for the operators

Risk assessment	Severity	Likelihood	Risk
Personnel & 3rd parties	D	3	**MEDIUM**

Basis of prediction of consequences:

Security of Supply /Amenity & Land Use/ Personnel & Third Parties

- Operating knowledge of equipment and causes of plant shut downs
- Operating practice
- Practical experience during winter months
- Reports of trace liquids in pipeline vessels

Actions:

There have been no occurrences of a failure to meet the Katnook Gas plant supply obligations

- Inject methanol into the pipeline if hydrates occur
- Maintenance/operating practices and equipment design to minimise hydrates formation, thus minimising venting to atmosphere
- Continuous monitoring of equipment to ensure emulsions are controlled
- Assessment of process changes that may improve emulsions management
- Hydrates are an issue during colder months, improvements are being investigated for implementation before winter 2002
- Maintenance/operating practices and equipment design to minimise hydrates formation

8.7 Third party interference

Threats

If third party interference were to occur it is most likely to be from activities being carried out over pipelines without locating the pipeline along pipeline easements or the illegal access to well yards and into the Gas Plant itself. There is a remote possibility that stock could enter a wellyard or plant if gates were left unlocked and open

Frequency:

Unlikely to occur in relation to pipelines

Illegal access to well yards and Gas Plant is rare

Basis of prediction:

- All pipelines are constructed (and buried) in accordance with industry guidelines and approved design parameters. All wellyards and the gas plants are manproof fenced with lockable gates
- Historical data, depth of burial of pipelines - at road and rail crossings, through cultivation and forestry areas. Landholder are kept informed about pipelines
- Katnook plant access is via a main gate to office
- There are no records of unauthorised persons conducting activity within operated area
- Area is reasonably remote

Current Controls:

- Communication with those most likely (landholders, forestry) to come in contact with the pipelines
- Pipelines and flowlines buried >780mm code requirement in areas where potential damage is most likely
- Ensure fences and warning signs are in good condition and replace damaged signs and fencing immediately
- Sign-in/induction

- Restricted entry sign posting
- The sites are securely fenced with a man proof and stock proof fence with regular monitoring and maintenance as required to ensure fences remain in good repair

Consequences: *Personnel & Third Parties*

- 150mm diameter pipeline failure (wall penetration) would either be a hole or full bore failure and would result in gas escape, however
- For pipeline of less than 300mm diameter it is not considered realistic for a full bore failure to occur (AS2885-1997 and McDonough (1999)); gathering systems in the Katnook/Ladbroke Grove fields <300mm
- If ignition source and major leak, potential for explosion and fireball, followed by depressurisation and automatic closure of safety valves
- If ignition source and minor leak, jet flare, may be long lasting if small leak
- No ignition and major leak, rapid depressurisation closure of safety valves and termination of supply
- No ignition and minor leak such that pressure loss not detectable, situation could be sustained until over the ground inspection occurred
- Potential for injury or interference to operators and third parties, because of the actions of third parties interfering with equipment (valves, meters, chokes, pumps, chemicals) in well yards and Plant areas
- Potential for injury to anyone in near vicinity if major event
- Duration of consequences would be dependent on the event type eg.
  - Interference with chemical injection unit – short terms (<2hrs)
  - Introduction of an ignition source may ignite hydrocarbon (several minute to several hours)

Risk assessment	Severity	Likelihood	Risk
Personnel & 3rd parties	C	3	**MEDIUM**

Air

- No ignition, release of pipeline volume to atmosphere (methane)
- If ignited gas would burn to form CO_2, resulting in less greenhouse gas emission

Risk assessment	Severity	Likelihood	Risk
Personnel & 3rd parties	E	2	**LOW**

Security of Supply

- Impact on gas supply would depend on the particular flowline that was ruptured or wellhead or piece of equipment that was interfered with
- Duration and consequences range from 2 days to 1 week depending upon weather conditions and availability of contractors

Risk assessment	Severity	Likelihood	Risk
Personnel & 3rd parties	D	2	**LOW**

Amenity & Land Use

- Some disruption if landholder utilizing area along pipeline easement, however an easement is taken out and compensation agreed with the landholder for precisely this reason. If ignition and explosion, potential for pastures or pine plantation to burn. Impact would be loss of trees and some pasture, loss may either be permanent (Trees) or till re-shoot (grass)

Risk assessment	Severity	Likelihood	Risk
Personnel & 3rd parties	D	2	**LOW**

Basis of prediction of consequences: As there have be no instances of third party interference with pipelines or equipment it is difficult to define what the outcomes might be. Unskilled persons interfering with operational equipment could cause an environmental or safety event as outlined in the consequences above

Actions: *Personnel & Third Parties*

- If a major event notify emergency services and ensure gas supply is shut down to the effected area. Contact relevant landholders
- In the event of third party damage to pipeline
  - Investigate cause and repair the pipe
  - Assess and implement any recommendations
- Within the wellyard or plant an assessment would have to be made as to the actual extent of the damage and appropriate action taken.
- Make arrangements to re-establish gas supply
- Action in the event of repeated unauthorised entry would be to review site security and procedures and implement any recommendations

8.8 Presence of low level mercury contaminated sludge within pressure vessels

(Katnook Plant only)

Threat Very low (micro milligram) levels of mercury are produced with the gas from the Katnook gas wells; it contaminates sludges that becomes entrained in the filters in the glycol system. Cleaning of the associated vessels and changing of filters can result in spilling of sludge on the ground and also present a health hazard if not managed. The quantity of sludge is small

Frequency: Continuous

Basis of prediction:

- The sludge builds up over a period of months resulting in decreased performance of the filters. Filters are changed about 4-6 times per year
- Some vessels cleaned once a year, during which time there is the potential for a small amount of sludge to be spilt

Current Controls:

- Vessels located on hard stand areas covered with crusher dust/gravel
- Immediate clean up of any dropped sludge
- Contaminated equipment is disposed of via an EPA approved facility as appropriate

- Work carried out under a permit issued under the OCA/OERL Permit to Work System, which requires a risk assessment to be done before any work involving the sludge is carried out. Operators required to wear the appropriate protective equipment and only done in dry weather
- Operating Procedures in place and Material Safety Data Sheets

Consequences: As a consequence of the presence of the sludge there could be consequences for the local soil and personnel during cleaning and filter change

Soil

- Low level of consequence as the area is "hard stand" and any spill is easily cleaned up and there is minimal surface penetration
- There is the potential for a gradual build-up of a low level mercury contamination in the localised area

Risk assessment	Severity	Likelihood	Risk
Soil	D	4	**MEDIUM**

Water

- Water sampling shows minor traces of mercury in the pond 1 water

Risk assessment	Severity	Likelihood	Risk
Water	D	4	**MEDIUM**

Personnel & Third Parties

- There is a health hazard present during cleaning or filter change operations that could be realised if the Work Permit instructions are not follow.

Risk assessment	Severity	Likelihood	Risk
Personnel & 3rd parties	C	3	**MEDIUM**

Basis of prediction of consequences: The consequences have been predicted on the basis of observation at the site and the known health hazards associated with mercury

Actions: *General*

- Further work needs to be done on the source of mercury levels contained within the process stream and source of sludge
- Improve vessel cleaning and filter changing procedures to reduce the likelihood of spill and operator exposure

Soil

- Investigate methods for rehabilitating soil with low levels of mercury contamination

Personnel & Third Parties

- Monitor implementation of procedures and Permit to Work System and conduct health surveillance for mercury

8.9 Introduction of Weeds

Threat From a petroleum operations perspective, weeds may be introduced into an area by vehicles, equipment, and personnel who have come from an area that has the particular sort of weed. Seeds would usually found in vehicle radiators, up under the body, inside the cab, and mud on the vehicle; and in the socks and boots of personnel

Frequency: Very rare

Basis of prediction:

- The most likely vectors of transmission available, for the type of operation, include vehicle or boots/socks of workers. Studies and experience in the company's Queensland operations show that this is the most likely mode of transmission. In the 10 years of operation there have been no instances of weeds being introduced to the Katnook site from external areas.

Current Controls:

- Company vehicles coming from interstate (from a known declared weed area) wash down at a certified washdown site before leaving. Interstate vehicles (drivers) are asked to confirm status of vehicle if vehicle has travelled from a known weed area.
- Site vehicles stay on existing tracks which confines any potential weed seed deposit to the track
- Personnel are encouraged to be on the lookout for any 'different' plants that may come up at the site. Declared weed (previously known as noxious) education is part of the current induction program
- Liaison with the landowner(s) to determine the appropriate and mutually acceptable method of eradication should declared weeds be detected and then instigate a remediation programme to eradicate or control
- In the event of an outbreak seek the assistance from the appropriate Government Agency to control it

Consequences: *Flora & Fauna*

- Worst case consequence would be to choke out native vegetation, however there is limited native vegetation and the adjacent grazing land at the Plant is well grassed and would prove a difficult environment for an imported weed to gain a hold. There is limited opportunity for weeds to grow within the gas plant areas, some potential in well yards and along pipeline easement

Risk assessment	Severity	Likelihood	Risk
Personnel & 3rd parties	D	2	**LOW**

Amenity & Land Use

- Can impact on land use through overtaking pasture grasses, however to arrive at this consequence there would need to be an unlikely sequence of events to occur – reasonable deposit of seed, the right soil type, appropriate climatic conditions, non detection, failure of mitigation measures
- If a weed infestation went undetected then it would be reasonable to assume that that there would be an ongoing incremental spread of the weed. However it could generally be accepted that unusual weed would be detected within weeks of sprouting and would be eradicated

Risk assessment	Severity	Likelihood	Risk
Amenity & land use	D	2	**LOW**

Basis of prediction of consequences:

- It is generally accepted that the consequence of any weed infestation is the degradation of the immediate environment through 'choking out' of the exiting grasses, or depending on the type of weed, vegetation. The adjacent land is not overgrazed and therefore limits the opportunities for any seed to strike.

Actions:

- If the above consequences were realised there would need to be a review of the effectiveness of existing weed management procedures, including vehicle washdown, and implement an eradication programme.
- There would also be a need to notify local landholder(s) and the appropriate government agency

8.10 Waste generation (on site)

Threat

- The operation, because of its very existence, generates the following wastes: domestic waste (human waste); containers; packaging. The waste represents both an environmental and hazard if not managed correctly

Frequency: Frequent

Basis of prediction:

- There are a number of sources of waste, the Plant Operators live on site and consequently generate domestic waste; most equipment arrives in a variety of containers and/or packaging. In general the site has a good history for being maintained in a clean and tidy state

Current Controls:

- Waste at the site comes under the control of the OERL/OCA 'Waste Management Plan', a guidance document held on site, which outlines methods to manage and dispose of site waste
- Plant and well sites kept free of physical waste (good 'housekeeping' is an operators obligation)
- Disposal of liquid (pump out of septic tank) and solid wastes in a timely fashion
- Wastes are kept within the fenced (man proof) confines of the plant and well yard areas, thus limiting the potential for any waste being blown around by the wind out side the Plant area

Consequences: *Amenity & Land Use/Personnel & Third Parties*

- Failure to manage waste at the site could lead to a fire hazard from combustible material; health hazard from overflowing septic tank; encourage vermin and potentially lead to sickness; and a general impact on the visual amenity of the site.
- As the management of waste is a management issue, the duration of the consequences from a failure in management would only be for a short duration and would rely on the site supervisor to instigate corrective action

Risk assessment	Severity	Likelihood	Risk
Personnel & 3rd parties	C	3	**MEDIUM**
Amenity & land use	D	2	**LOW**

Basis of prediction of consequences:

- The consequences outlined above are logical sequences if waste is not managed properly.

Actions:

- In the event that the consequences were realised there would have to be a review of site management processes

8.11 Cultural sites

Threats The disturbance or destruction of cultural site could occur through a lack of knowledge of the site(s) existence and conducting construction and earth works in or over the area

Frequency: Rare

Basis of prediction:

- Surveying for the identification of any cultural sites in a project area is done before any work commences.
- For Katnook, any disturbance to land use and cultural values occurred at the time of initial construction 10 years ago and 2 years ago for Katnook, Ladbroke Grove, wells and infield pipelines respectively, necessary inspections and approvals obtained at the time. No items of cultural values were observed or located at the site(s).

Current Controls:

- Construction activities confined to the existing gas plant/well yards so no impact to Aboriginal or European heritage
- OERL/OCA has procedures in place for the management of cultural heritage during any construction process

Consequences: *Cultural sites*

- If there was no cultural clearance work done then a potential consequence from any construction work could be disturbance or destruction of artefacts. Damage to artefacts could be permanent if no management programme in place
- From previous investigations it is concluded there are no cultural sites contained within the plant, well yards, and along pipelines.

Risk assessment	Severity	Likelihood	Risk
Cultural sites	D	2	**LOW**

Basis of prediction of consequences:

Cultural sites

- It is reasonable to assume that any artefacts would be of rock or wood, activity from construction would likely cause damage to these items if not identified beforehand

Actions:

Cultural sites

- Any expansion work outside existing areas will require appropriate investigations under approved procedures

8.12 Normal Operations

Threats

'Normal operations' are the day-to-day activities associated with the running of the gas plant and associated operations.

Typical threats to normal operations are: inadequate induction of visitors or employee; introduction of uncontrolled ignition sources into the Plant area; construction; accidental ESD trips; fire; electrical fault; equipment/instrumentation failure; process problems; and personnel morale

Frequency:

Infrequent

***Basis of prediction*:**

- A review of site induction records indicates that there are very few instances of a person not receiving an induction. There are normally only two operators at the site, any visitor is quickly noticed.
- There is only occasional minor construction at the site
- There have been several ESD trips that were related to contractor error, procedures have been modified to prevent reoccurrence
- There has been no record of fire at the site
- Historically problems associated with equipment and instrumentation failure have been frequent, this was in conjunction with the commissioning of the Ladbroke Grove Gas Plant (late 2000 – early 2001). The issues have in general been resolved
- Electrical faults are rare and are not considered to be an issue
- Unplanned plant shutdown (apart from 'operational trips' which are part of normal gas plant operations) can be caused by failure to operate the plant correctly, accidental tripping of the emergency shut buttons, and events outlined above. Plant records indicate that such shutdowns are infrequent
- The frequency was arrived at through a review of onsite Plant records, daily report sheets, issuing of Hot Work Permits, and conversations with onsite employees.
- Vessels and pipelines operated within design limits, fitted with pressure relief valves

Current Controls:

- For Normal Operations the Katnook and Ladbroke Grove and associated gas wells and pipelines are operated in accordance with set site procedures which link into the Origin Energy Health Safety and Environmental Management System, the 'Origin HSEMS'. It is the responsibility of both the company and the employees to make sure that the employees know and understand those aspects of the procedures and systems that apply to Katnook/Ladbroke Grove operations.
- Procedure - Visitor, contractor and staff have to undergo inductions before progressing into the plant area, this is part of standard operating procedures. Most visitors to the site are contractors who have to receive instruction before they can commence work.

- The site has been located in a relative isolated area and has a low profile; this is complemented by maintaining the tree-line to obscure the plant and the nearest residence is some distance away. Landowners are also compensated for the inconvenience of the presence of the Plant, wells and pipelines. There have been nil complaints about visual impact
- Electrical faults, equipment/instrumentation failure, and process problems are controlled by ongoing maintenance. More specifically, pressure vessels, safety valves, pipelines and other facilities are maintained such that they meet compliance requirements in accordance with the key Australian Standards that apply to the operation, these include:
  - AS 2430– Classification of Hazardous areas
  - AS 1940 – Storage and handling of flammable and combustible liquids
  - AS 2885 – Pipelines – Gas and liquid petroleum
  - AS 3000 – SAA Wiring rules
  - ASME B3 I – 3C Chemical plant and petroleum refining piping
  - API 6D – Specification for pipeline valves
  - AS 4041 – Pressure piping
  - AS 1210 – Unfired pressure vessels code

- Prevention of fire is managed by ensuring personnel and contractors are aware of the hazardous environment they are working in and likely consequence of introducing an ignition source into a flammable atmosphere. In addition to this appropriately engineered barriers are in place to prevent the generation of ignition sources during the day-to-day operation. Fusible loops are installed around the plant in case a fire does break out, once the loop is broken it will automatically close valves and isolate the plant
- The consequence of plant shut down can usually be managed by 'line pack' in the short term (30 minutes)

Consequences: *Personnel & Third Parties*

- Failure to undergo an induction could result in a person not being aware of the safety, environmental or health hazards at the site, which in turn could lead to an incident. Because the site is small and there is in general few third parties at the site the duration of the consequence would short. There is also the possibility of a contractor commencing work without receiving instruction
- If there is an unplanned release of gas there is a chance that if induction has not been done that ignition source may be available which could result in fire or explosion. A fire in the plant area would pose a significant danger to anyone in the vicinity. The extent of any fire would depend on the location of the fire and the available fuel.
- Release of gas under pressure also result in noise, however duration is very short approximately 5 minutes

Risk assessment	Severity	Likelihood	Risk
Personnel & 3rd parties	C	3	**MEDIUM**

Amenity & Land Use

- Failure to maintain the construction controls could lead to the Plant and facilities becoming a dominant (standout) feature in the area. This could lead to complaints from the local landholders
- Positive consequence is that the facility is noted as a tourist attraction. It is expected that a fire would be contained within the facility

Risk assessment	Severity	Likelihood	Risk
Amenity & land use	D	2	**LOW**

Security of Supply

- Unplanned plant shut down could lead to a security of supply issue, but this would be short term generally around 30 minutes. However if the shutdown was the result of a technical fault or equipment failure that could not be fixed locally there may be a longer delay while appropriate expertise was brought in, could be several days.
- A fire could also result in a longer period of no supply, this would be dependent on the location of the fire and if there were any secondary impacts such as explosion resulting in destruction of equipment.

Risk assessment	Severity	Likelihood	Risk
Security of supply	D	3	**MEDIUM**
Security of supply (Fire)	C	3	**MEDIUM**
Security of supply (explosion)	A	3	**HIGH**

Air

- Loss of some gas (controlled release) as a by-product of production and processing is typical and, to a large extent, unavoidable within the industry but no known incidents have arisen
- Emissions of gas under pressure occurs during Emergency Shut Down (ESD) and in preparation for maintenance of some equipment items in the plant
- An unplanned shut down may also result in a release of natural gas into the atmosphere, a duration of approximately 5 – 15minutes, an approximate volume of 900scm
- There is also traces of Hydrogen Sulphide in the gas however concentration is =< 11ppm which is a level that can be managed.

Risk assessment	Severity	Likelihood	Risk
Air	E	3	**LOW**

Basis of prediction of consequences:

Personnel & Third Parties

- There have been occasions at the site where actions (improper handling of chemicals, or introduction of an unauthorised ignition source) by a contractor have indicated that an induction has not been done or possibly not understood

Amenity & Land Use

- Visual amenity is a subjective aspect, as the current controls seem to be working, it could be assumed that failure of the controls could lead to complaint.
- Located in isolated area

Air

- The quantity of gas released compared to the wider environment is miniscule, and would be quickly diluted

Actions:

Personnel & Third Parties

- In the event that it becomes evident that a person has not undergone an induction, the person would immediately be given an induction or removed from the site

Amenity & Land Use

- Removal of plant from site at end of its life and rehabilitation of the site

* Visual impact is subjective

9 Conclusion

From the 12 key hazards identified, the risks associated with the consequences (severity & likelihood) have been determined and are summarised as follows using the risk ranking set out in Table 10.

Table 7 Summary

	Aspect							
Hazard	Air	Soil	Water	Flora/ Fauna	Amenity & land use	Security of supply	Third party & personnel	Cultural values
Normal Operations	Low	-	-	-	Low	High (explosion) Medium (Fire) Medium	Medium	-
Contained produced water	-	Low	Low (surface) Medium (subsurface)	Low	Low	-	-	-
Corrosion Corrosion (Slow leak)	Low Low	- -	- -	Low Low	Low Low	Medium Medium	Medium Low	- -
Gas well failure	-	-	Medium	-	Low	-	-	-
Condensate & chemical	-	Medium	Low (surface) Medium (subsurface)	-	Low	-	Low	-
Vehicles	-	Medium	Low	Low	Low	-	Medium	-
Hydrate/Emulsion	-	-	-	-	Low	Medium	Medium	-
Third Party Interference	Low	-	-	-	Low	Low	Medium	-
Cultural sites	-	-	-	-	-	-	-	Low
Waste	-	-	-	-	Low	-	Medium	-
Weeds	-	-	-	Low	Low	-	-	-
Mercury sludge		Medium	Medium	-	-	-	Medium	-

From the analysis of these hazards it is noted that all the risks can be managed and that the current controls, in general, are functioning and adequate. However, a number of events have been identified where further actions should be investigated to help mitigate the consequences of the hazardous event.

Environmental objectives that arise from relevant activities as identified in this EIR are set out in the Statement of Environmental Objectives prepared for the Katnook and Ladbroke Grove gas plants.

10 References

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11 Appendices

Appendix A. Site Plans

Appendix B. Process Flow Diagram

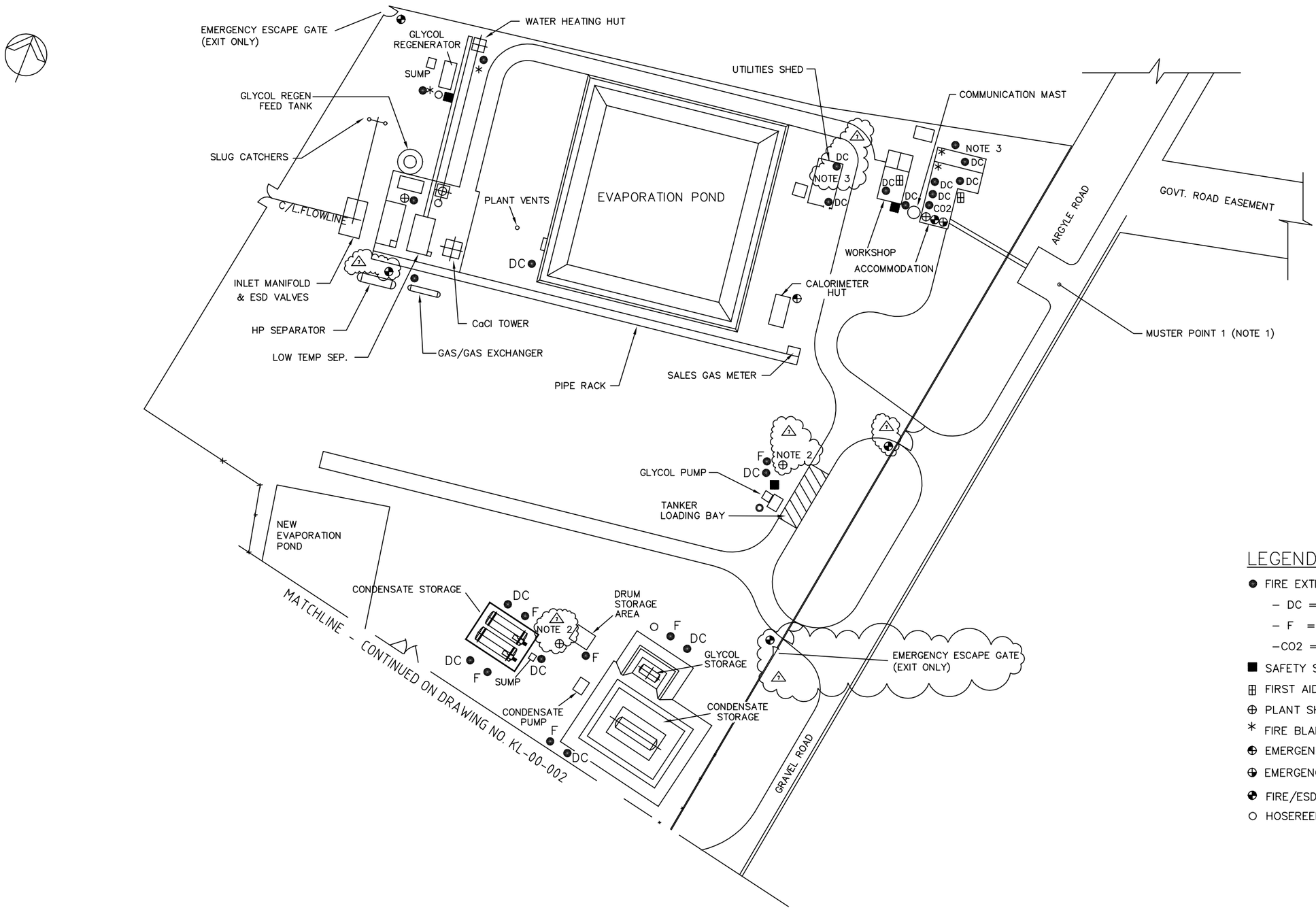
Appendix C. Environmental Licence

Appendix D. Well Construction

Appendix E. Indicative Gas Composition

Appendix A. Site Plans

- Both Ladbroke Grove & Katnook
- Ladbroke Grove
- Katnook



DANGEROUS GOODS STORAGE CAPACITIES

CONDENSATE – HAZ CHEM 3WE UNIT No. 1267 FLAMMABLE LIQUID 3 CAPACITY = 240,000 LITRES (80,000L/TANK)
MONOETHYLENE GLYCOL – COMBUSTIBLE LIQUID CAPACITY = 15000 LITRES

ABOVE EXCLUDES MINOR PACKAGE STORAGE

LEGEND

- FIRE EXTINGUISHER
  - DC = DRY CHEMICAL
  - F = FOAM (AFFF)
  - CO2 = CARBON DIOXIDE
- SAFETY SHOWER & EYE WASH
- FIRST AID BOX
- PLANT SHUTDOWN (PSD) PUSH BUTTON
- FIRE BLANKET
- EMERGENCY EVACUATION SIREN\LIGHT
- EMERGENCY EVACUATION PUSH BUTTON
- FIRE/ESD (PLANT BLOWDOWN) PUSHBUTTON
- HOSEREEL

0 5 10 20 30

SCALE : METRES

NOTES:

1. MUSTER POINT #2 IS AT THE LADBROKE GAS PLANT TURBINE ENTRY CAR PARK. REFER KL-00-002.
2. LOCAL SHUTDOWN ONLY.
3. FIRE EXTINGUISHERS IN NEW BUILDING FACILITIES TO BE INSTALLED BY BORAL FOLLOWING CONSTRUCTION OF THESE BUILDINGS.

NUMBER	TITLE
REFERENCE DRAWINGS	

No	DATE	DESCRIPTION	BY	CHK	ENG	APP
8	25/8/99	NEW POND ADDED (REQ SURVEY)	NKS			
7	25/8/99	REVISED AFTER LGP HAZOP	GPA	MGM	PRM	
6	16/7/99	AS BUILT (COND. TANK UPDATE)	GPA	MGM		
5	14/8/98	EQUIPMENT UPDATE	GPA	-		
4	14/8/97	AS BUILT	JMD	-		
3	28/2/97	ISSUED FOR CONSTRUCTION	DGM	-		
2B	6/1/97	POST HAZOP #3 FOR APPROVAL	JMD	-		
2A	14/11/96	PRELIMINARY ISSUE	JMD	-		

REVISION

CONTRACT REFERENCE 98186

GPA ENGINEERING PTY LTD
21 East Terrace Mile End
South Australia 5031
Fax (08) 8443 3303
Telephone (08) 8234 6366

BORAL ENERGY

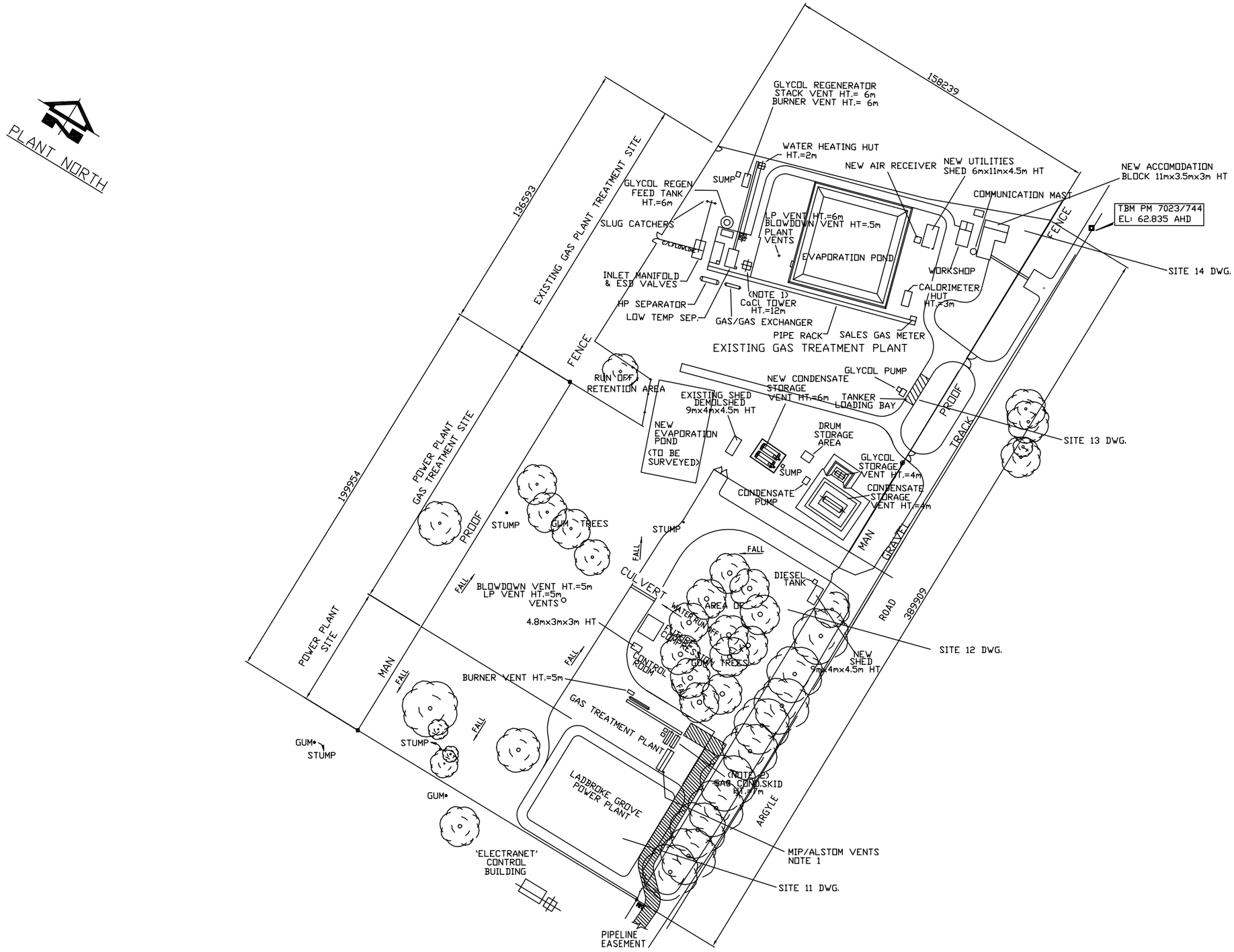
BORAL ENERGY SA PTY LTD

KATNOOK GAS PLANT
SITE SAFETY PLAN
–

DATE	DRAWN	CHK	ENG	APPROVED	SCALE
14/11/96	JMD	KL			NTS

PROJ No	DRG No	REV
98186	K-00-002	8

A1



NOTES:

1. TEMPORARY BLOWDOWN VENTS FROM MIP/ALSTOM TURBINE #1 DELIVERY PIPING.

NUMBER	TITLE
REFERENCE DRAWINGS	

No	DATE	DESCRIPTION	BY	CHK	ENG	APP
2	8/11/01	NEW POND INDICATED (REQ SURVEY)	NKS			
1	13/12/99	MIP/ALSTOM VENTS ADDED	GPA	MGM	PRM	
0	25/11/99	ISSUE FOR MDR	GPA	NRT	MGM	

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BORAL ENERGY

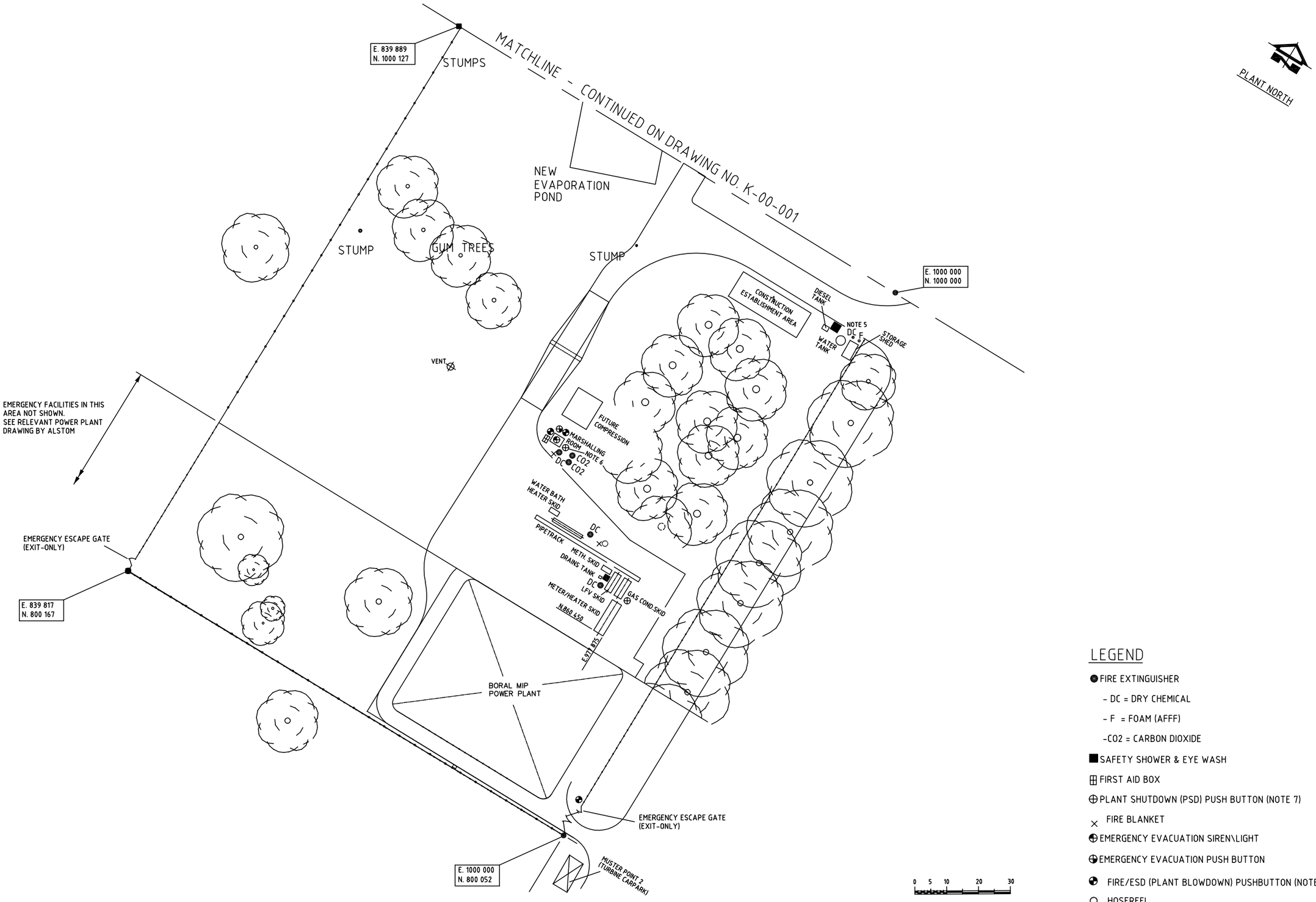
BORAL ENERGY SA PTY LTD

KATNOOK POWER PLANT
PLOT PLAN
-

DATE	DRAWN	CHK	ENG	APPROVED	SCALE
3/2/99	GPA	MGM	PRM		NTS

PROJ No	DRG No	REV
98186	KL-00-004	2

A1



LEGEND

- FIRE EXTINGUISHER
  - DC = DRY CHEMICAL
  - F = FOAM (AFFF)
  - CO2 = CARBON DIOXIDE
- SAFETY SHOWER & EYE WASH
- FIRST AID BOX
- PLANT SHUTDOWN (PSD) PUSH BUTTON (NOTE 7)
- FIRE BLANKET
- EMERGENCY EVACUATION SIREN\LIGHT
- EMERGENCY EVACUATION PUSH BUTTON
- FIRE/ESD (PLANT BLOWDOWN) PUSHBUTTON (NOTE 8(
- HOSEREEL

NOTES:

1. MUSTER POINT #1 IS KATNOOK GAS PLANT CAR PARK. REFER K-00-002.
2. KGP CONTROL ROOM CONTAINS EMERGENCY EVACUATION PUSH BUTTON FOR LGP.
3. ALL SAFETY EQUIPMENT SHOWN SURROUNDING THE MARSHALLING ROOM IS ACTUALLY LOCATED INSIDE THIS ROOM EXCEPT FOR ONE OF THE FIRE/ESD PUSHBUTTONS WHICH IS LOCATED WEST OF THE MARSHALLING ROOM (ADJACENT TO ROAD)
5. FIRE EXTINGUISHERS IN NEW BUILDING FACILITIES TO BE INSTALLED BY BORAL FOLLOWING CONSTRUCTION OF THESE BUILDINGS.
6. MARSHALLING ROOM PLANT SHUTDOWN 'PUSHBUTTON' IS ACTIVATED FROM CITECT.
7. ADDITIONAL LGP PSD BUTTON IS LOCATED IN KGP CONTROL ROOM ON CITECT.
8. AN ADDITIONAL LGP FIRE/ESD PUSHBUTTON IS LOCATED IN KGP CONTROL ROOM ON CONTROL PANEL.
9. CONDENSATE TANKS PSD BUTTON WILL CLOSE FEED OF CONDENSATE FROM LGP.

NUMBER	TITLE
	REFERENCE DRAWINGS

No	DATE	DESCRIPTION	BY	CHK	ENG	APP
4	08/11/01	NEW POND ADDED (REQUIRES SURVEY) TITLE CHANGE KATNOOK TO LADBROKE GROVE	NKS			
3	11/1/00	LG #2 WELLHEAD MOVED TO SEPARATE DRAWING	NJM	MGM	PRM	
2	22/11/99	ISSUE FOR MDR	NJM	MGM	PRM	
1	5/10/99	SAFETY SHOWERS RELOCATED/ADDED, NOTE 3 MODIFIED. ISSUED FOR CONSTRUCTION	DRG	-		
0	2/9/99	FOR APPROVAL	DRG	PRM		

REVISION

CONTRACT REFERENCE
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BORAL ENERGY

BORAL ENERGY SA PTY LTD

LADBROKE GROVE POWER STATION
SITE SAFETY PLAN
-

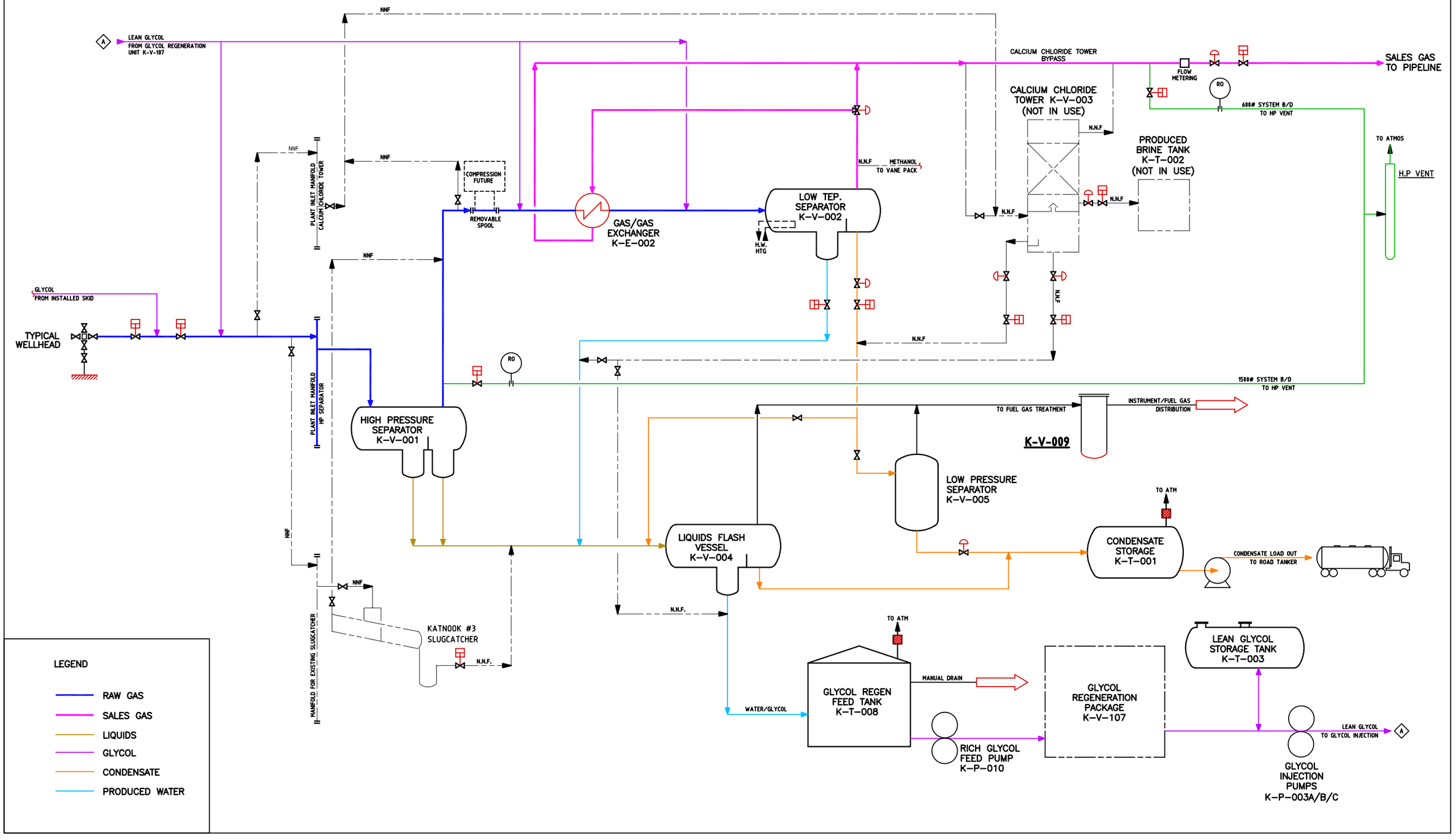
DATE	DRAWN	CHK	ENG	APPROVED	SCALE
6/8/99	GPA	PRM			NTS

PROJ No	DRG No	REV
98136	KL-00-002	4

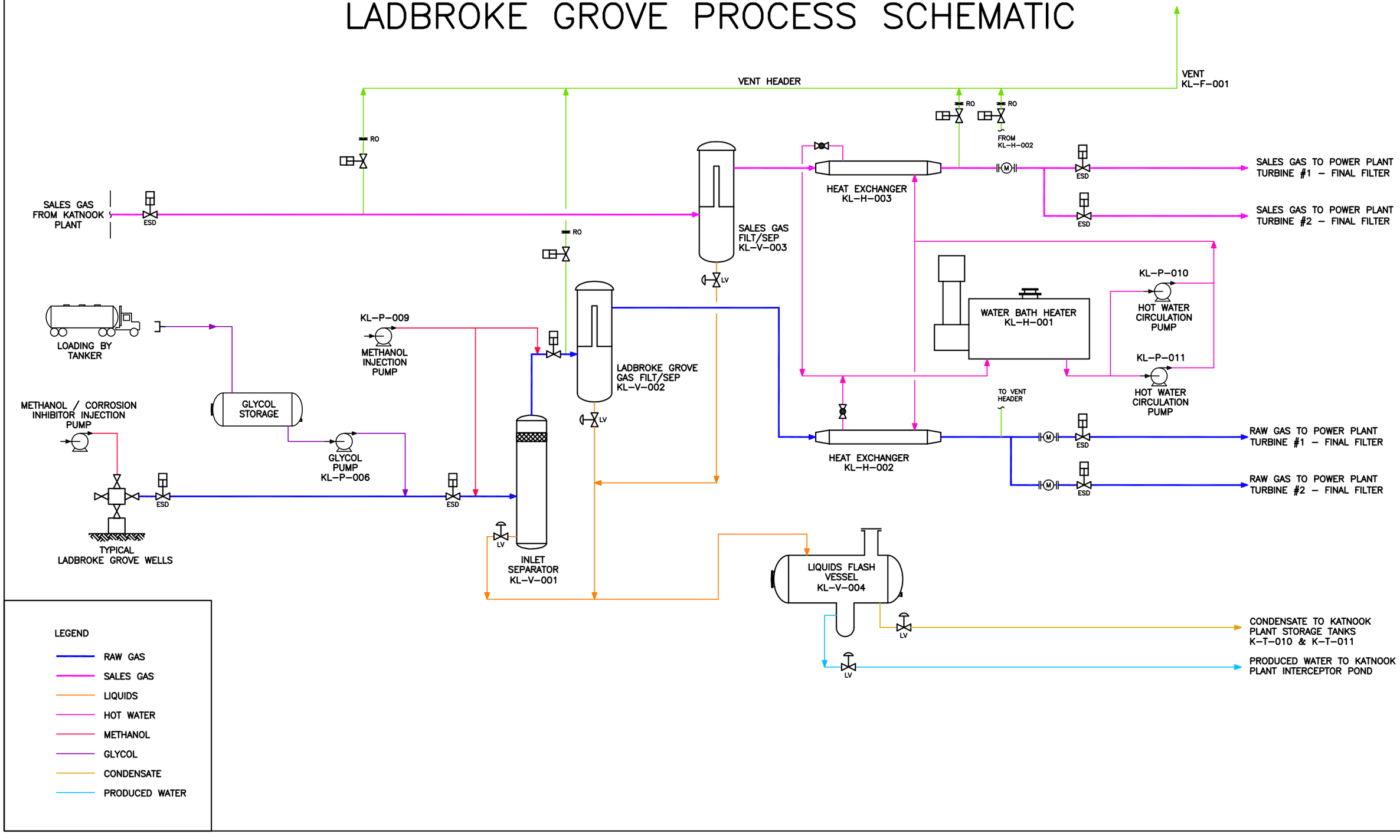
A1

Appendix B. Process Flow Diagram

KATNOOK PROCESS SCHEMATIC



LADBROKE GROVE PROCESS SCHEMATIC



Appendix C. Environmental Licence

EPA Licence 12559

ENVIRONMENT PROTECTION AUTHORITY
SOUTH AUSTRALIA

ENVIRONMENTAL AUTHORISATION UNDER PART 6 OF THE ENVIRONMENT PROTECTION ACT, 1993.

LICENCE

EPA 12559

- Origin Energy Resources Limited

  C/- Katnook Gas Plant GPO Box 2576
  ADELAIDE SA 5001

Premises

- Section 336 HUNDRED OF MONBULLA, Argyle Road SA (the Premises)

Licensed Activities

The Licensee/s

- Origin Energy Resources Limited

is authorised to undertake the following activities of environmental significance under Schedule 1, Part A of the Environment Protection Act 1993 (the Act), and any Environment Protection Policies (eg. Air Quality, Industrial & Machine Noise, Marine, etc). These requirements govern permissible emission or concentration levels as well as operation and/or maintenance standards of plant and equipment, subject to the conditions of the licence set out in the attached pages.

- 1(5)(b) Petroleum Production
- 3(4) Activities Producing Listed Waste

Term of Licence

Commence Date	01-SEP-2001
Expiry Date	31-AUG-2002

Delegate
Environment Protection Authority
This licence is not valid unless signed

12 September, 2001
Conditions of Licence follow

Licence Co-ordinator: Uma Preston (08) 8204 9067

Page 1 of 6

CONDITIONS OF LICENCE

The Licensee is authorised to conduct the prescribed activities as described in this licence on the premises nominated, subject to the following conditions:

		Compliance Date
400-262	Definitions	
	"Act" means the Environment Protection Act 1993 as amended.	
	"ADG Code" means the Australian Dangerous Goods Code 6th edition.	
	"Agency" means the body in a State or Territory responsible for administering environment legislation or a body or bodies nominated for that purpose.	
	"Authority" means the Environment Protection Authority of South Australia.	
	"Consignment Authorisation" means an approval which includes a unique identifier granted by an agency or a facility delegated by an agency in the jurisdiction of destination to allow the movement of controlled waste.	
	"Controlled Waste" means any waste in List 1a or List 1b provided that the waste possesses one or more of the characteristics in List 2. Unless otherwise demonstrated to the satisfaction of the agency in the jurisdiction of destination, wastes in List 1a and 1b are considered to possess one or more of the characteristics in List 2.	
	"EPA" means the Environment Protection Agency of South Australia.	
	"Facility" means a place where Controlled wastes are received.	
	"Listed Waste" means any waste set out in Part B of Schedule 1 of the Environment Protection Act 1993.	
	"Measure" means the National Environment Protection (Movement of Controlled Wastes between States and Territories) Measure.	
	"Medical Waste" is defined in the Environment Protection (Waste Management) Policy 1994 and includes Clinical Wastes as referred to in the Australian/New Zealand Standard AS/NZS 3816:1998 "Management of Clinical and Related Wastes".	
	"Producer" means a person who produces Controlled Waste or a person authorised by an agency in the jurisdiction where the Controlled Waste is produced, to act on behalf of the producer.	
	"Related Wastes" means Cytotoxic waste, Pharmaceutical waste and Chemical waste referred to in the Australian/New Zealand Standard AS/NZS 3816:1998 "Management of Clinical and Related Wastes".	
	"Worksafe Code of Practice for Asbestos" means the Code Of Practice and Guidance Notes for Asbestos published by Worksafe Australia dated August 1988.	
400-211	If the name and/or address (postal or site) of the Licensee changes, then the Licensee must inform the Environment Protection Authority within one (1) month of the change occurring.	

CONDITIONS OF LICENCE

The Licensee is authorised to conduct the prescribed activities as described in this licence on the premises nominated, subject to the following conditions:

		Compliance Date
400-262	Definitions	
	"Act" means the Environment Protection Act 1993 as amended.	
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	"Worksafe Code of Practice for Asbestos" means the Code Of Practice and Guidance Notes for Asbestos published by Worksafe Australia dated August 1988.	
400-211	If the name and/or address (postal or site) of the Licensee changes, then the Licensee must inform the Environment Protection Authority within one (1) month of the change occurring.	

400-213 1. The last date for an application for renewal of this licence is sixty (60) days before expiry.

2. The last date for payment of the licence fee for a renewed licence period is thirty (30) days before expiry.

400-214 A copy of this licence is to be displayed on a notice board or other suitable place at each place named as a site on which the licensed activities are to be undertaken.

400-215 The Licensee must ensure that every employee, agent or contractor responsible for carrying out any task controlled by this licence is properly advised as to the requirements of this licence and the general environmental duty under Section 25 of the Act that relate to that person's tasks and responsibilities as employee, agent or contractor.

80-36 GENERAL CONDITIONS OF LICENCE APPLYING TO PRODUCERS OF LISTED WASTES

1. Any waste which is a substance within the meaning of the Dangerous Substances Act 1979 and any waste that is a poison within the meaning of the Drugs Act 1908 must be managed in the same manner as if it was a Controlled Waste for the purposes of this licence.

2. All material used in the course of the activity that becomes part of any listed waste must be stored, contained or treated in a manner that does not cause any of the following:
   (a) environmental harm; or
   (b) a risk to health and safety.

3. All listed waste storage containers must be marked to identify the waste contained within them.

4. All containers of listed waste leaving the Licensee's premises must display safety warnings in accordance with the Australian Code for the Transport of Dangerous Goods.

5. All listed waste leaving the premises must be removed only by a Waste Transporter currently licensed by the Environment Protection Authority.

6. The Licensee must not spill listed waste onto soil.

7. No listed waste is permitted to enter any sewerage system or stormwater drain.

8. Before any listed waste leaves the premises the Licensee must advise the transporter of the waste of the following matters:
   (a) the nature of the waste;
   (b) any hazards associated with the waste; and
   (c) any precautions to be taken during the collection, transport or disposal of the waste.

9. The Licensee must render such assistance as is necessary to prevent the spillage of any listed waste during loading.

10. The Licensee must provide such equipment as is necessary to contain and recover any spill at the loading point.

11. The Licensee must not mix solid listed waste with liquid listed waste.

[Note: In general, wastes are incompatible if when mixed or otherwise brought into contact, they are likely to interact and increase the risk to human health and/or the environment. If a waste is classified as a dangerous good, the Australian Dangerous Goods Code relating to the mixing of incompatible goods must be observed. Notwithstanding the above, for the purpose of the Measure, mixing incompatible wastes also includes mixing of incompatible liquids and mixing solid waste with liquid waste.]

WHEN WASTE IS TO BE TRANSPORTED TO A DESTINATION WITHIN SOUTH AUSTRALIA.

12. The information set out in Schedule X must be entered on a Waste Transport Certificate by the Licensee and the information set out in Schedule Y must be entered by the waste transporter on the same Waste Transport Certificate before any controlled waste on List 1(a) is transported off the Licensee's premises.

13. The information set out in Schedule A must be entered on a Waste Tracking Form by the Licensee and the information set out in Schedule B must be entered by the waste transporter on the same Waste Tracking Form before any controlled waste on List 1(b) is transported off the Licensee's premises.

14. In the event of a Waste Transport Certificate being required, the Licensee must:
(a) retain the green copy of the Waste Transport Certificate for no less than 12 months; and
(b) post or otherwise send the pink copy of the Waste Transport Certificate to the Authority within seven days of collection of the waste; and
(c) give the white, yellow and blue copies of the Waste Transport Certificate to the transporter of the waste at the time of collection.

15. In the event of a Waste Tracking Form being required, the Licensee must;
(a) retain the green copy of the Waste Tracking Form for no less than 12 months; and
(b) give the yellow and blue copies of the Waste Tracking Form to the transporter of the waste at the time of collection.

WHEN CONTROLLED WASTE IS TO BE TRANSPORTED TO A DESTINATION OTHER THAN WITHIN SOUTH AUSTRALIA.

16. The information set out in Schedule X must be entered on a Waste Transport Certificate by the Licensee and the information set out in Schedule Y must be entered by the waste transporter on the same Waste Transport Certificate before any controlled waste on Lists 1(a) or 1(b) is transported off the Licensee's premises.

17. The Licensee must;
(a) retain the green copy of the Waste Transport Certificate for no less than 12 months; and
(b) post or otherwise send the green "Tear-Off" slip to the environment Regulatory Authority or a delegated facility in the State or Territory to which the waste is to be taken; and
(c) post or otherwise send the pink copy of the Waste Transport Certificate to the Authority within seven days of collection of the waste; and

(d) give the white, yellow and blue copies of the Waste Transport Certificate to the transporter of the waste at the time of collection.

18. No controlled waste destined for another State or Territory is permitted to be removed from the Licensee's premises unless a Consignment Authorisation has been obtained by the Licensee from an agency in the jurisdiction of destination or from a facility delegated by that agency prior to the collection of such wastes.

19. The Licensee must confirm that the waste transporter is appropriately licensed in all States or Territories through which the controlled waste will be transported.

400-203 Listed Waste Producer only:

The Environment Protection Authority may impose or vary conditions during the term of this licence relating to handling and disposal of listed wastes.

45-9 The Licensee shall - 31-OCT-2001

1. Forward to the Environment Protection Authority (the 'Authority') a contingency plan acceptable to the Authority for the control, containment or mitigation of any spill, accident or plant failure which may result in or increase the risk of the release of pollutants to the receiving environment.

2. Thereafter implement and maintain the contingency plan, upon approval in writing by the Authority.

3. The contingency plan shall be reviewed annually and if amended significantly regarding environmental matters, submit a summary report to the Authority.

400-212 CONSENT FOR ALTERATIONS/PROCESS CHANGE

During the term of this licence, the Licensee must not:

1. carry out any works for the development or alteration of a construction, or the installation or alteration of plant or equipment; or
2. undertake any change to the operating processes or established procedures

(for use for an activity the subject of this licence) where such proposed changes are likely to alter the nature of, or increase, the risk of environmental harm, unless the Licensee has first:

(a) submitted an application to the Authority, providing sufficient details to enable a thorough assessment of the environmental impacts of the proposed alterations or process change; and
(b) received formal, written approval from the Authority allowing the proposed works or process change to proceed, in the form of either:
(i) an updated licence incorporating conditions imposed or varied as a result of the proposed alterations or process change with a commencement date set at, or prior to, the present date; or
(ii) a formal written response from the Authority stating that no changes to conditions of licence are necessary in respect to the proposed alterations or process change.

400-210 Where a Licensee or related body corporate is required to furnish information of the kind referred to under section 299(1)(f) of the

Corporations Law in any annual report to the Australian Securities and Investments Commission (ASIC), the Licensee must provide a copy of the report to the Environment Protection Authority within one (1) calendar month of the lodgement of the report with ASIC.

400-201 The Environment Protection Authority may during the term of this licence impose or vary conditions:

(1) in relation to testing, monitoring and reporting referred to in Section 52(1)(a) of the Environment Protection Act 1993 (the 'Act');

(2) which require the Licensee, in accordance with Section 53 of the Act, to prepare a plan of action to be taken in the event of an emergency;

(3) which require the Licensee to develop an Environment Improvement Programme (EIP) as set out in Section 54 of the Act and to comply with the requirements of the EIP;

(4) in relation to any activity the conduct of which has not required a licence relating to protection of the environment prior to the commencement of the Act;

(5) which relate to provision of information relating to the Licensee or any agent or contractor operating on behalf of the Licensee;

(6) which relate to provision of information relating to the activity subject to the licence including the levels of inputs and outputs and the amounts of pollutants or waste generated by the activity.

Delegate
Environment Protection Authority
Date 13 September 2001

12 September, 2001

End of Licence document

Licence Co-ordinator: Uma Preston (08) 8204 9067

SCHEDULES

SCHEDULE Y (WTC Requirements for Transporters)

Transporter to insert in Part 2

- Name of transporter(s)
- Address of transporter(s)
- Vehicle registration number(s)
- Type of transport eg road, rail
- Transporters licence number(s)
- Date of transport
- Signature of the waste transporter

Transporter to insert in " tear-off"

- Name(s) of transit State(s)/Territory or Territories
- Name of Transporter
- Transporter Licence Number

SCHEDULE A (WTF Requirements for Producers)

Producer to insert in Part A the following;

- Name of waste producer
- Address of waste source (producer)
- Type of waste collected by marking one of the boxes in Part A of the form
- Amount of liquid waste in litres or numbers of tyres.
- signature of the producer of the waste (or authorised agent)
- date of collection from the producer of the waste

SCHEDULE B (WTF Requirements for Transporters)

Transporter to insert in Part B the following;

- The name of the licensed waste transporter
- EPA license number for the waste transporter
- Vehicle registration no. for the waste transporter
- Signature and name of the waste transporter or authorised agent
- Date of collection of by the waste transporter.

SCHEDULE X (WTC Requirements for Producers)

Producer to insert in Part 1

- Description of the waste(s) [Use proper shipping name/technical name if applicable for Dangerous Goods]
- The physical nature of the waste
- Waste code(s) (As specified in List 1a)
- Contaminant(s)
- UN Number(s)
- UN Code(s)
- Dangerous Goods Class(es) (UN Class(es)) [and Subsidiary Risk if applicable for Dangerous Goods]
- Packaging Group number
- Amount of waste(s)
- Waste origin code (ANZ Standard Industry Code)
- Type of package (eg bulk) [and number of packages of each type if applicable for Dangerous Goods]
- Facility name
- Facility address
- Facility licence number
- State/Territory of destination
- Name of waste producer
- Address of waste source
- Producer's telephone number
- Emergency contact number in the event of accident or spillage
- Consignment authorisation number (When waste is to be transported to another State or Territory)
- Producer licence number
- Date of dispatch
- Signature of the producer or authorised agent

Producer to insert in "tear-off"

- Name of waste producer
- Address of waste source
- Description of the waste(s) [Use proper shipping name/technical name if applicable for Dangerous Goods]
- Producer licence number
- Quantity of waste

Waste stream or wastes having as constituents:	
Inorganic fluorine compounds excluding calcium fluoride	D110
Inorganic sulphides	D330
Isocyanate compounds	M220
Lead; lead compounds	D220
Mercury; mercury compounds	D120
Metal carbonyls	D100
Nickel compounds	D210
Organic phosphorus compounds	H110
Organic solvents excluding halogenated solvents	G110
Organohalogen compounds - other than substances referred to in this list	M160
Perchlorates	D340
Phenols, phenol compounds including chlorophenols	M150
Phosphorus compounds excluding mineral phosphates	D360
Polychlorinated dibenzo-furan (any congener)	M170
Polychlorinated dibenzo-p-dioxin (any congener)	M180
Residues from industrial waste treatment/disposal operations.	N205
Selenium; selenium compounds	D240
Soils contaminated with a controlled waste	N120
Surface active agents (surfactants), containing principally organic constituents and which may contain metals and inorganic materials	M250
Tannery wastes (including leather dust, ash, sludges and flours)	K140
Tellurium, tellurium compounds	D250
Thallium; thallium compounds	D180
Triethylamine catalysts for setting foundry sands	M230
Vanadium compounds	D270
Waste chemical substances arising from research and development or teaching activities including those which are not identified and/or are new and whose effects on human health and/or the environment are not known	T100
Waste containing peroxides other than hydrogen peroxide	E100

LIST 1a

Waste stream or wastes having as constituents:	
Acidic solutions or acids in solid form	B100
Antimony; antimony compounds	D170
Arsenic; arsenic compounds	D130
Asbestos	N220
Barium compounds (excluding barium sulphate)	D290
Basic solutions or bases in solid form	C100
Beryllium; beryllium compounds	D160
Boron compounds	D310
Cadmium; cadmium compounds	D150
Ceramic-based fibres with physico-chemical characteristics similar to those of asbestos	N230
Chlorates	D350
Chromium compounds (hexavalent and trivalent)	D140
Clinical and related wastes	R100
Cobalt compounds	D200
Containers which are contaminated with residues of substances referred to in this list	N100
Copper compounds	D190
Cyanides (inorganic)	A130
Cyanides (organic)	M210
Encapsulated, chemically-fixed, solidified or polymerised wastes	N160
Ethers	G100
Filter cake	N190
Fire debris and fire washwaters	N140
Fly ash	N150
Halogenated organic solvents	G150
Highly odorous organic chemicals (including mercaptans and acrylates)	M260

LIST 1b

Waste stream or wastes having as constituents:	
Animal effluent and residues (abattoir effluent, poultry and fish processing waste)	K100
Grease trap waste	K110
Non toxic salts	D300
Tyres	T140
Waste mineral oils unfit for their original intended use	J100
Waste oil/water, hydrocarbons/water mixtures or emulsions	J120
Wool scouring waste	K190

Waste stream or wastes having as constituents:	
Waste from heat treatment and tempering operations containing cyanides	A110
Waste from the manufacture, formulation and use of wood-preserving chemicals	H170
Waste from the production, formulation and use of biocides and phytopharmaceuticals	H100
Waste from the production, formulation and use of inks, dyes, pigments, paints, lacquers and varnish	F100
Waste from the production, formulation and use of organic solvents	G160
Waste from the production, formulation and use of photographic chemicals and processing materials	T120
Waste from the production, formulation and use of resins, latex, plasticisers, glues and adhesives	F110
Waste from the production and preparation of pharmaceutical products	R140
Waste pharmaceuticals, drugs and medicines	R120
Waste resulting from surface treatment of metals and plastics	A100
Waste tarry residues arising from refining, distillation, and any pyrolytic treatment	J160
Waste, substances and articles containing or contaminated with polychlorinated biphenyls (PCBs), polychlorinated naphthalenes (PCNs), polychlorinated terphenyls (PCTs) and/or polybrominated biphenyls (PBBs)	M100
Waste of an explosive nature not subject to other legislation	E120
Zinc compounds	D230

Dangerous Goods Class (UN Class*)	UN Code	
		Substances or wastes which, if they are inhaled or ingested or if they penetrate the skin, may involve delayed or chronic effects, including carcinogenicity.
9	H12	**Ecotoxic**
		Substances or wastes which if released present or may present immediate or delayed adverse impacts to the environment by means of bioaccumulation and/or toxic effects upon biotic systems.
9	H13	**Capable of yielding another material which possesses H1-H12**
		Capable by any means, after disposal, of yielding another material, eg., leachate, which possesses any of the characteristics listed above.
		Other Reasons
		Potential to have a significant adverse impact on ambient air quality.
		Potential to have a significant adverse impact on ambient marine, estuarine or fresh water quality.
*UN Class and Code relates to the hazard classification system included in the United Nations Recommendations on the Transport of Dangerous Goods as used in Australia.		

LIST 2: CHARACTERISTICS OF CONTROLLED WASTES

Dangerous Goods Class (UN Class*)	UN Code	
1	H1	**Explosive**
		An explosive substance or waste is a solid or liquid substance or waste(or mixture of substances or wastes) which is in itself capable by chemical reaction of producing gas at such a temperature and pressure and at such a speed as to cause damage to the surroundings.
3	H3	**Flammable Liquids**
		The word "flammable" has the same meaning as "inflammable". Flammable liquids are liquids, or mixtures of liquids, or liquids containing solids in solution or suspension (for example, paints, varnishes, lacquers, etc., but not including substances or wastes otherwise classified on account of their dangerous characteristics) which give off flammable vapour at temperatures of not more than 60.5 degrees Celsius, closed-cup test, or not more than 65.6 degrees Celsius, open-cup test. (Since the results of open-cup tests and of closed cup tests are not strictly comparable and even individual results by the same test are often variable, regulations varying from the above figures to make allowances for such differences would be within the spirit of the definition.)
4.1	H4.1	**Flammable solids**
		Solids or waste solids, other than those classified as explosives, which under conditions encountered in transport are readily combustible, or may cause or contribute to fire through friction.
4.2	H4.2	**Substances or wastes liable to spontaneous combustion**
		Substances or wastes which are liable to spontaneous heating under normal conditions encountered in transport, or to heating up in contact with air, and being then liable to catch fire.
4.3	H4.3	**Substances or wastes which, in contact with water, emit flammable gases**
		Substances or wastes which, by interaction with water, are liable to become spontaneously flammable or to give off flammable gases in dangerous quantities.
5.1	H5.1	**Oxidising**
		Substances or wastes which, while in themselves not necessarily combustible, may, generally by yielding oxygen, cause or contribute to, the combustion of other materials.
5.2	H5.2	**Organic peroxides**
		Organic substances or wastes which contain the bivalent-O-O-structure are thermally unstable substances which may undergo exothermic self-accelerating decomposition.
6.1	H6.1	**Poisonous (acute)**
		Substances or wastes liable either to cause death or serious injury or to harm human health if swallowed or inhaled or by skin contact.
6.2	H6.2	**Infectious substances**
		Substances or wastes containing viable micro-organisms or their toxins which are known or suspected to cause disease in animals or humans.
8	H8	**Corrosives**
		Substances or wastes which, by chemical action, will cause severe damage when in contact with living tissue, or in the case of leakage, will materially damage, or even destroy, other goods or the means of transport; they may also cause other hazards.
9	H10	**Liberation of toxic gases in contact with air or water**
		Substances or wastes which, by liberation with air or water, are liable to give off toxic gases in dangerous quantities.
9	H11	**Toxic (delayed or chronic)**

Appendix D. Well Construction

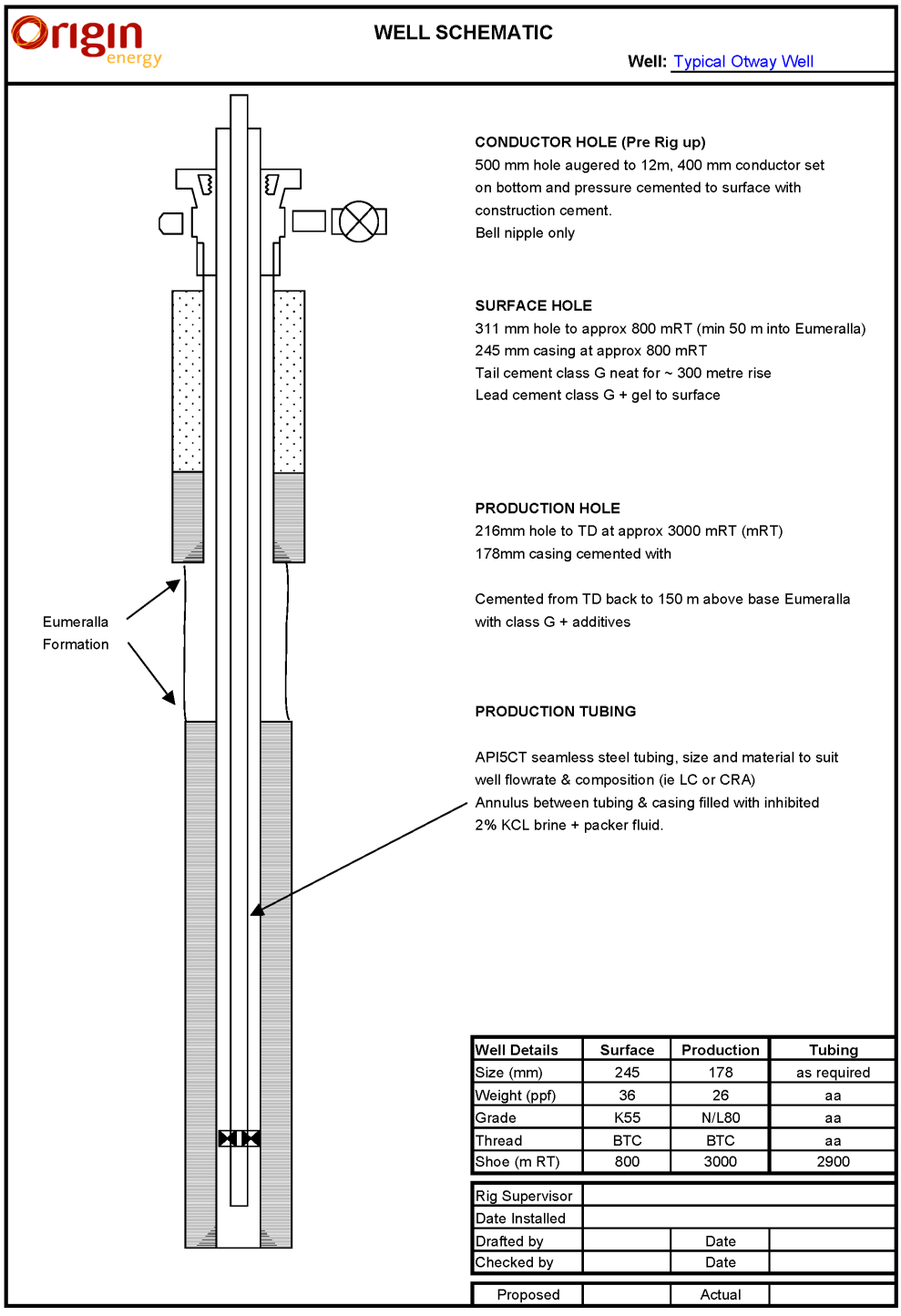


FIGURE 5

CASING AND CEMENTING REPORT

WELL: Limestone Ridge 1 SUPERVISOR: Jim Dingle DATE: 14/07/01

CASING DETAILS

Size (")	9 5/8	Weight (ppf)	36	Grade	K-55	Landed depth (mRT)	854.9	Av. Length	11.95	Collapse (psi)	2020	Burst (psi)	3520
Joints on location	74	No. of joints run	71	Joints in shoe track	1	Float shoe (Y/N)	N	Float collar (Y/N)	Y				
Final displ. (psi)	690	Buoyed wt. (klb)	87	Set weight (klb)	37	Dirty (Y/N)	N	Coupling	BTC				

PRE JOB CIRCULATION

Pump 1 (spm)	110	Pump 2 (spm)	110	Pressure	300	Time (mins)	40	Vol. Pumped (Bbls)	491	Mud wt (p.p.g)	9.1

PRE FLUSH

Volume (Bbls)	30	Wt (ppg)	8.40	Hyd. Loss (psi)	18	Additives	20	Kg	ID Citric	Kg	

TAIL SLURRY

Wt (ppg)	15.8	Class	G	Volume (cu ft)	114	Yield	1.16	Sacks	550	Water (gal/sx)	5.11	Water (Bbls)	67	Design rop	555
OH/Cal	OH	Excess (%)	102	Hole size (")	12.25	Mix (bpm)	5.2	Mix (psi)	170	Start	17:35	Finish	17:55		
Additives:		%		%		Kg									
		%		%		Kg									

LEAD SLURRY

Wt (ppg)	12.8	Class	G	Volume (cu ft)	212	Yield	1.97	Sacks	605	Water (gal/sx)	11.18	Water (Bbls)	161	Design rop	5
OH/Cal	OH	Excess (%)	109	Hole size (")	12.25	Mix (bpm)	5.5	Mix (psi)	110	Start	16:45	Finish	17:25		
Additives:	2.5	%	Pre hydrated gel	%		Kg									
	0.1	%	CFR-3	%		Kg									

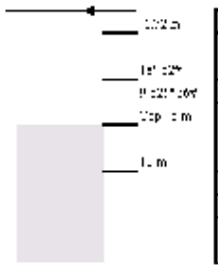
DISPLACEMENT

Fluid type	MUD	Wt	9.10	Calculated (bbl)	213	Actual (bbl)	216	Bump pressure (psi)	2000	Used (Rig/Unit)	HOWCO		
Time: Start	18:00	Finish	18:35	Returns (%)	80	Top plug (Y/N)	Y	Bottom plug (Y/N)	N	Floats held (Y/N)	Y		
Pressure (psi)	Initial	160	Final	720	max	870	min	160	Rate (bpm)	initial	8.0	final	2.5	max	8.0	min	2.5

LOT / FIT

OMW (ppg)	8.60	FIT (ppg)	13.50	FIT Pressure (psi)	715	Test pressure (psi)	750	EMW (ppg)	13.74

CASING RUN LIST



QTY	DESCRIPTION	LENGTH	FROM	TO
1	Guide shoe	0.41	854.42	854.86
1	9 5/8" 36# K55 Std casing	11.83	842.59	854.42
1	Float collar - NR	0.59	842.00	842.59
70	9 5/8" 36# K55 Std casing	836.80	5.20	842.00
1	Landing joint	6.92	1.72	5.20

LimestoneRidge01CementReport01.XLS 9 5/8 Csg 7/11/2001

Appendix E. Indicative Gas composition

Ladbroke Grove

Gas	MOL %
Nitrogen	5.06
Carbon Dioxide	39.05
Methane	53.35
Ethane	1.72
Propane	0.48
I-Butane	0.08
N-Butane	0.11
I-Pentane	0.03
N-Pentane	0.02
Hexanes	0.04
Heptanes	0.04
Octanes and higher hydrocarbons	0.02
Total	100.00

Katnook

Gas	MOL %
Nitrogen	1.42
Carbon Dioxide	0.04
Methane	91.12
Ethane	4.09
Propane	2.02
I-Butane	0.42
N-Butane	0.54
I-Pentane	0.14
N-Pentane	0.09
Hexanes	0.09
Heptanes	0.03
Octanes and higher hydrocarbons	0.00

Gas	MOL %
Total	100.00

[1] Fitness For Purpose Assessment
For
Origin Energy resources limited
Penola, South Australia.
Prepared by: Myrna Hepburn
Date: April 2001
Document No.: A002-08-01