Fluidised Catalytic Cracking Unit Reactor and Regenerator Upgrade Project

Environmental Assessment

Prepared for:

Shell Refining Pty Ltd

September 2007

CH2MHILL

CH2M HILL Australia Pty Ltd
Level 7, 9 Help Street
CHATSWOOD NSW 2067
Phone 02 9950 0200
Fax 02 9950 0600

Table of Contents

List of Figures

List of Tables

List of Appendices

Glossary

Basell	Basell is a Polypropylene Plant located next to the Refinery site
Biotreater	Water treatment plant utilising biological process.
Catalyst	A substance that enables a chemical reaction to proceed, usually at a faster rate, without being consumed by the reaction
Catchment Area	The area drained by a drainage system, stream or body of water.
Coke	Coke is formed from imperfect evaporation and coke precursors in the feed
Contamination	Concentration of substances above that naturally present that poses, or is likely to pose, an immediate or long-term risk to human health or the environment.
Corrugated Plate Interceptor	Water basin which has capability to remove oil from water and oil mixture.
Diesel	A hydrocarbon stream used as fuel for diesel engines
Calpuff Dispersion Modelling	A planning tool for determining the air quality impacts of existing and proposed developments.
Dredging	Removal of sediment or other materials from the riverbed.
Ecology	Branch of biology dealing with the relations of organisms to one another and to their physical surroundings.
Environmental Assessment Requirements	Issued by the Director General of the Department of Planning, they detail the necessary inclusions and key environmental issues which must be addressed in the environmental assessment.
Erodibility	The susceptibility of soil to detachment and transportation by erosive agents, being the function of the soil's mechanical, chemical and physical characteristics.
Feedstock	Intake of Crude Oil or other hydrocarbons for processing.
Fine Particles	Less than 10 micrometer in diameter particles, that result from incomplete combustion of carbonaceous materials.
Flare	To incinerate surplus gases to prevent over pressuring of equipment.
Flue gas	A by product of the regeneration process.
Fuel Gas	Gas produced in refinery processes for use as fuel in furnaces and boilers
Fuel Oil	Heavy hydrocarbon stream used as fuel for shipping and large industrial engines
Gasoline	Petrol.
Groundwater	Water found in soil, rock or in pores, crevices etc.
Hazard	A possible source of danger or risk.
HAZID	Hazard Identification - - a process involving identification of hazards

	using a "What if?" questioning.
Hydrocarbon	Chemical or organic compound of hydrogen and carbon.
Hydrology	Study of the properties of the earth's water, especially of its movement in relation to land.
Liquid Petroleum Gas (LPG)	Liquid Petroleum gases typically consist of propane and butane (or derivatives of)
Long Residue	Heavy hydrocarbon stream produced from atmospheric distillation and used either as fuel oil or feedstock to FCCU Unit
Maintenance Ploughing	Re-distribution of sediment or other materials on the riverbed to deeper regions restoring the depth of water.
Mangroves	Trees and shrubs that grow in saline coastal habitats.
Mitigation	To become milder, less intense or less severe.
pH	A measure of the acidity or alkalinity of a soil or water. A pH of 7 denotes neutrality, higher values indicate alkalinity and lower values indicate acidity.
Potential Acid Sulphate Soil (PASS)	Soil material which is waterlogged and contains oxidisable sulphur compounds, usually ferrous iron disulphide (pyrite) that has a field pH of 4 or more (1:5 soil: water).
Precinct	Enclosed or clearly defined area.
Propylene	A C3 hydrocarbon of the alkene series.
Ramsar Wetlands	The Ramsar Convention definition of wetland includes artificial and modified wetlands.
Reactor	An equipment/vessel which allows for mixing and reaction between catalyst and feedstocks to form products.
Regenerator	An equipment/vessel which allows for the regeneration of catalyst thus allowing catalyst to be reused within the reactor. For FCCU Unit, regeneration involves burning of coke from the catalyst.
Remediation Work	A work in or on contaminated land that a) removes the cause of the contamination of the land, or b) disperses, destroys, reduces, mitigates or contains the contamination of the land, or c) eliminates or reduces any hazard arising from the contamination.
Solid Waste	Any non-liquid waste which is acceptable by Solid waste class 1 or 2 landfill.
Stack	Chimney used to disperse and discharge exhaust gasses from the combustion processes.
Stripper	An equipment/vessel where steam is injected to strip residual hydrocarbons from the catalyst.
Threshold	Limit below which no reaction or response is required.
Topography	Detailed description on a map of the natural and artificial features of the area.

Turnaround	A planned maintenance activity in which key equipment are inspected and repaired to ensure ongoing integrity for the next production run.
Waste Water	Industrial water or process water.
Wetland	Habitats where the influence of surface or groundwater has resulted in development of plant or animal communities adapted to aquatic or intermittently wet conditions.

Abbreviations

AHD	Australian Height Datum
AS	Australian Standard
ASS	Acid Sulphate Soils
atm	Atmospheres
ANZECC	Australian and New Zealand Environment and Conservation Council
BB	Butanes/Butenes
BTEX	Benzene, toluene, ethyl benzene, xylenes
CDU	Crude Distillation Unit
CEMP	Construction Environment Management Plan
CCO	Chemical Control Order
CO	Carbon monoxide
CO_2	Carbon Dioxide
CPI	Corrugated plate interceptor
DA	Development Application
DCP	Parramatta Development Control Plan
DEC	Department of Environment and Conservation
DECC	Department of Environment and Climate Change (former DEC)
DEUS	Department of Energy, Utilities and Sustainability
DIPNR	former Department of Infrastructure, Planning and Natural Resources
DLWC	former Department of Land and Water Conservation
DoP	Department of Planning
DPH	Dissolved Phase Hydrocarbons
DUAP	Former Department of Urban Affairs and Planning
EA	Environmental Assessment
EARs	Environmental Assessment Requirements
EIA	Environmental Impact Assessment
EIS	Environmental Impact Statement
ENCM	Environmental Noise Control Manual
EMP	Environmental Management Plan
EP&A Act	*Environmental Planning and Assessment Act* 1979

EP&A Regulation	*Environmental Planning and Assessment Regulation* 2000
EPA	Environmental Protection Authority (now a division within the Department of Environment and Climate Change – DECC)
EPBC Act	*Environmental Protection and Biodiversity Conservation Act* 1999
EPIs	Environmental Planning Instruments
EPL	Environment Protection Licence
ESD	Ecologically Sustainable Development
EST	Eastern Standard Time
FCCU	Fluidised Catalytic Cracking Unit
GME	Groundwater monitoring event
GMP	Groundwater monitoring program
H_2S	Hydrogen sulphide
HAZOP	Hazard and Operability Study
HDS	Hydrodesulphurization
hr	Hours
HS&E Plan	Health, Safety and Environment Plan
HSEQ	Health, Safety, Environment and Quality
HVU	High Vacuum Unit
INP	Industrial Noise Policy
ISO	International Standard Organisation
km	Kilometre
L	Litre
LBL	Load Based Limit
LEP	Local Environmental Plan
LPG	Liquid Petroleum Gas
LR	Long Residue
m	Metre
min	Minute
mm	Millimetre
MAE	Major Accident Events
MS	Management System
NEPM	National Environmental Protection Measure

NES	National Environmental Significance
No.	Number
NO_x	Nitrogen oxides
NPI	National Pollutant Inventory
NPW Act	*National Parks and Wildlife Act* 1974
NSW	New South Wales
OH&S	Occupation Health and Safety
PCB	Polychlorinated Biphenyls
PCC	Parramatta City Council
PHA	Preliminary Hazard Analysis
PFM	Planning Focus Meeting
PM_{10}	Particulates less than 10 micrometres in diameter
POEO Act	*Protection of the Environment Operations Act* (NSW) 1997
PP	Propane/Propylene
ppm	Concentration expressed in parts per million
PRP	Pollution Reduction Program
PSH	Phase Separated Hydrocarbons
PWD	Public Works Department (now the Department of Commerce)
R & R	Reactor and Regenerator
REP	Regional Environmental Plan
RFI Act	*Rivers and Foreshores Improvement Act* 1948
RTA	Roads and Traffic Authority
SEE	Statement of Environmental Effects
SEPP	State Environmental Planning Policy
Shell	Shell Refining (Australia) Pty Ltd
SIS	Species Impact Statement
SO_2	Sulphur dioxide
SO_x	Sulphur oxides
t	tonne
TA	Turnaround
TPH	Total Petroleum Hydrocarbons
TSP	Total Suspended Particulates

TSC Act	*Threatened Species Conservation Act* 1995
VOC	Volatile organic compounds
Vph	Vehicles per hour
WorkSafe	National Occupational Health and Safety Commission (WorkSafe Australia)

Executive Summary

Introduction

This Environmental Assessment (EA) has been prepared for Shell Refining (Australia) Pty Ltd (Shell) to support a Major Projects Application (DA). The Project is for replacement of the reactor and stripper vessel from the Fluidised Catalytic Cracking Unit (FCCU) as well as an upgrade to the FCCU's regenerator.

An environmental impact assessment of the proposed construction and operation of the new components of the FCCU has been undertaken and presented in this EA, in accordance with the *Environmental Planning and Assessment Act 1979* (EP&A Act) and associated planning instruments. The Minister for Planning's approval is required in accordance with Part 3A of the EP&A Act. The Project is considered to be a "major project" owing to the level of capital expenditure involved and therefore an Environmental Assessment has been prepared.

Project Scope

The Project would involve replacing the old reactor and stripper vessels from the FCCU which have almost reached the end of their operating life with a new, more modern combined reactor and stripper component. Miscellaneous large bore piping, control valves and cyclonic separators of the FCCU which have also reached the end of their operating life, would also be replaced.

The second part of the Project would involve an increase in the coke burning capacity of the regenerator by modifying equipment in the regenerator overhead system.

The Proponent and Site Details

The Proponent is Shell Refining (Australia) Pty Ltd (Shell) which is a subsidiary of Shell Australia Limited. Shell Australia Limited is part of the Royal Dutch/Shell Group of Companies.

Clyde Refinery supplies approximately 40% of Sydney's petroleum requirements and about 50% of NSW's needs. Clyde Refinery directly employs approximately 330 employees, 200 contractors and contributes approximately AUD$60 million into the Sydney economy each year.

The Project would be located at the existing FCCU site in the Refinery, within Lot 1 DP 109739.

Justification of the Project

The FCCU was commissioned in 1962 and began operating in 1963. The reactor and stripper vessels are now approaching the end of their design life. Replacement of the reactor and stripper vessels would result in many benefits including:

- More modern reliable equipment reducing the amount of down time
- Improved unit efficiency
- Reduction in hydrocarbon inventory
- Reduction in waste coke formation
- Reduction in energy usage.

Increasing the coke burning capacity of the regenerator would result in benefits including increase in conversion and efficiency of the Unit and a reduction in fuel gas firing.

Alternatives

Alternatives examined in relation to the Project included the "do nothing" option. This would result in the existing reactor and stripper requiring maintenance checks and repairs at more frequent intervals. Alternative new modern designs for the reactor and stripper vessels were also considered. The preferred option for the FCCU components is a more modern design of a single unit comprising both the reactor and stripper vessel which would allow more efficient and safer operation of the Unit.

Key Environmental Issues

The various components of the biophysical, social and economic environment have been examined in this EA. The Project is essentially a replacement, or upgrade, of existing equipment within the Refinery, and no additional land or surrounding land uses would be affected. The key environmental aspects associated with the Project have been identified as those aspects which require a more detailed assessment to ensure that the FCCU R&R Upgrade will not adversely affect the environment. These key aspects relate to:

- Air quality
- Hazard and risk management
- Noise
- Surface Water Quality
- Visual Amenity and
- Waste Management.

The main findings of the impact assessment are summarised below.

Air Quality

Dispersion modeling was used to predict the concentrations from emissions of pollutants on the local air quality, in accordance with regulator requirements. The modelling included assessment of both the existing FCCU operation and the proposed new FCCU operational scenario. In addition, air quality modeling for the whole Refinery was completed for both the existing operation and proposed new

operational scenario to enable assessment within the broader site-wide perspective. The AUSPLUME model results showed that there is unlikely to be any significant impact on air quality in the local air shed during normal operations.

During the operation of a complex industrial facility there are occasions when temporary upset conditions occur. There may be occasions when the in-stack concentrations of total suspended particulates (TSP) exceed the regulatory criteria. However, there would be a much lower occurrence of upset conditions as the Project will provide improved performance with the installation of modern equipment.

The CALPUFF model results showed some discrepancies in relation to the AUSPLUME modelling results. As a result, Shell would commit to monitoring SO_2 and SO_3 concentrations in the background air for 12 months, to validate dispersion modelling and ensure that there are no adverse impacts on the local community.

Hazard and Risk Management

A Preliminary Hazard Analysis was prepared for the Project as it has the potential to create a risk to surrounding land uses as it is defined as a hazardous facility owing. The PHA assessed the risk levels associated with the operation of the FCCU after commissioning of the new reactor and stripper vessel.

The overall risk profile of the Refinery would be lowered owing to a reduction in the inventory of the Unit and leak frequencies. The potential for off-site impact would be below the NSW land use planning risk criteria. Shell would update its existing safety systems and undertake additional safety reviews to incorporate changes associated with the upgraded FCCU.

Noise

During construction there would be a marginal increase in traffic movements during construction, but there are no sensitive receptors in the vicinity of the access roads to the Refinery. It concluded that all noise generated would be well within acceptable guideline limits.

Surface Water Quality

During construction there would be the removal of a small amount of soil removed for new footings. Any seepage collected from the footings during instruction would be collected disposed of appropriately. Contaminated surface water from each part of the Refinery is sent via corrugated plate interceptors (CPI) to the underground drainage system. This combined stream then flows through an oil separator basin into the Refinery wastewater treatment plant before being used as either cooling water or discharged into Parramatta River. This existing process would not be changed as a result of the proposed upgrade.

Visual Amenity

The new combined reactor and stripper is expected to be 15m taller than the existing units but would be significantly smaller in diameter. New, more modern lighting would increase the visibility of the FCCU complex during the night time. As the

FCCU is well embedded in the Refinery site, and as existing structures would remain taller than the expected reactor and stripper component, the visual impact of the Project would be very minor.

Waste

During the demolition phase, waste would be generated from demolition of an old change shed and lift with the potential to generate asbestos contaminated waste. Steel from the old reactor and stripper would be recycled. Any PCB contaminated waste identified would be handled and disposed of in accordance with Shell's environment protection license (EPL) and other regulatory controls. Any asbestos contaminated waste would be handled by qualified licensed contractors and disposed of in accordance with the Protection *of the Environment Operations (Waste) Regulation 2005* and Shell's EPL 570.

During the operation of the FCCU, catalyst and coke waste are produced. The Project would produce the same quantity of spent catalyst, but amount of waste coke generated would be substantially reduced. Any waste would be handled in accordance with Shell's EPL and regulatory obligations.

Other Environmental Aspects

As the existing FCCU stands on concrete foundations and is surrounded by bitumen and concrete paths within the centre of the Refinery, there are some aspects of the environment that are very unlikely to be affected by the Project. These include:

- Hydrology and Flooding
- Groundwater
- Terrestrial and Aquatic Flora and Fauna
- Human Health
- Socio-Economic Setting
- Traffic and Transportation
- Non-Indigenous Heritage
- Indigenous Heritage
- Cumulative Environmental Impacts

These aspects have been addressed in this EA, and any mitigative measures would protect the environment during the construction and operation stages of the Project

Health, Safety and Environmental Management

A construction environmental management plan would be prepared for the construction phase of the Project to manage the environmental impacts of construction activities.

The construction environmental management plan would include but not limited to:

- Permits and approvals
- Complaints procedure
- Noise, waste and traffic management
- Incident reporting.

The Refinery has some 600 document controlled procedures and working instructions that cover all aspects of the site's operations. There are existing procedures for the FCCU which are being updated to incorporate the measures recommended to mitigate environmental impacts during operation including:

- FCCU Working Instructions
- Auxiliary Process Unit impacted by FCCU changes
- Environmental Compliance and Monitoring
- Emergency Response Manual
- Shutdown HS&E Management Procedure
- Auditing.

The Refinery has a fully integrated, externally certified and audited Health, Safety, Environment and Quality Management System. The systematic nature of this management system together with its long running experience means that there is a good body of knowledge available on the impact and management requirements of the Refinery. The Refinery also submits a detailed compliance report to the Department of Environment and Climate Change (DECC) on an annual basis.

Conclusion

No significant environmental impacts have been identified during the preparation of this EA. The environmental impacts identified are considered to be able to be mitigated by implementing the measures recommended during construction, commissioning and operation of the proposed upgrade. Where there is any uncertainty, Shell has made a number of commitments to ensure that the physical, social and economic environment would not be adversely affected.

1 Introduction

This Environmental Assessment (EA) has been prepared for Shell Refining (Australia) Pty Ltd (Shell) to assess the environmental impacts of the proposed upgrade to the Reactor and Regeneration Unit, located within the Fluidised Catalytic Cracking Unit (FCCU) complex at Shell's Clyde Refinery Rosehill, NSW.

The EA has been prepared in accordance with the *Environmental Planning and Assessment Act 1979* (the EP&A Act) and the *Environmental Planning and Assessment Regulation 2000* (the EP&A Regulation).

1.1 Background

The FCCU complex within the Clyde Refinery was commissioned in 1962. It is one of the main conversion units on site, responsible for converting heavy oil (fuel oil) from the crude oil into predominately petrol and LPG. Petrol produced from the FCCU represents approximately 50% of the petrol produced on site and therefore a major contributor to the petrol production within NSW.

Critical components of the Reactor and Regeneration (R&R) section are approaching end of life. This Project seeks to replace these key critical components.

1.2 Location

Clyde Refinery is located at Camellia, Sydney (see **Figure 1-1)**. The site is described as Lot 1 DP 109739, Lot 2 DP 224288, Lot 101 DP 809340, Lot 398 DP 41324 and Lot 1 DP 383675 (PCC, Section 149 Planning Certificate, November 2003). The FCCU is located within Lot 1 DP 109739. **Figure 1-2** shows an aerial view of the Refinery.

The Refinery site has a road frontage to Grand Avenue, Durham Street, Devon Street and Colquhoun Street and is bounded to the north-east and south-east by the Parramatta River and Duck River respectively. The FCCU is located on the southern half of the Refinery south of Tank Farm C (see **Figure 1-3)**.

1.3 Outline of the Project

The purpose of this Project is to replace critical components of the FCCU, that is, the reactor vessel and the stripper vessel, which are approaching the end of their design life. The Project would also involve the replacement of other minor components of the Unit also approaching the end of their design life, including the cyclones located inside the regenerator and miscellaneous large bore piping and control valves.

The Project is essentially a "like for like" replacement of part of the existing FCCU and would not take up any additional area within the Refinery. The throughput of the Unit and operation of the existing FCCU would not change, and the use of modern equipment as part of the replacement would result in beneficial environmental effects, including a significant reduction in energy consumption as well as a reduction in hydrocarbon inventory within the system, i.e. reduction in hazards as well as improved Unit efficiency.

The secondary part of the project aims to increase the coke burning capacity of the regenerator to allow increased conversion from the FCCU. This would result in improved process efficiency therefore producing a higher yield of product for the same feed intake. This is achieved through improved cyclone design for the regenerator and 4th stage separator, which are requiring replacement as end of life.

The Project would have an estimated capital investment value of approximately AUD$77.77 million, with a significant percentage of that cost associated with the new reactor and stripper.

1.4 The Proponent and Land Owner

Shell Refining (Australia) Pty Ltd (Shell), the proponent, is a subsidiary of Shell Australia Limited. Shell Australia Limited is part of the Royal Dutch/Shell Group of Companies. In Australia, Shell is engaged in the oil, gas, chemicals and other selected businesses. Shell Gore Bay Terminal, which is part of Clyde Refinery operations, celebrated 100 years of operation in Australia in June 2001.

Shell is part of the oil products sector. In Australia, this sector directly employs approximately 2,000 people and indirectly 18,000 people through its service station and distributor network.

Clyde Refinery is the longest operating oil refinery in Australia. Due to substantial investment over the years, the Refinery is arguably amongst the most complex of the seven refineries currently operating in the country. Built initially in the early 1920s, and purchased by Shell in 1928, Clyde Refinery supplies approximately 40% of Sydney's petroleum requirements and about 50% of NSW's needs. Clyde Refinery directly employs approximately 330 employees and 200 contractors and contributes AUD$60 million into the Sydney economy each year.

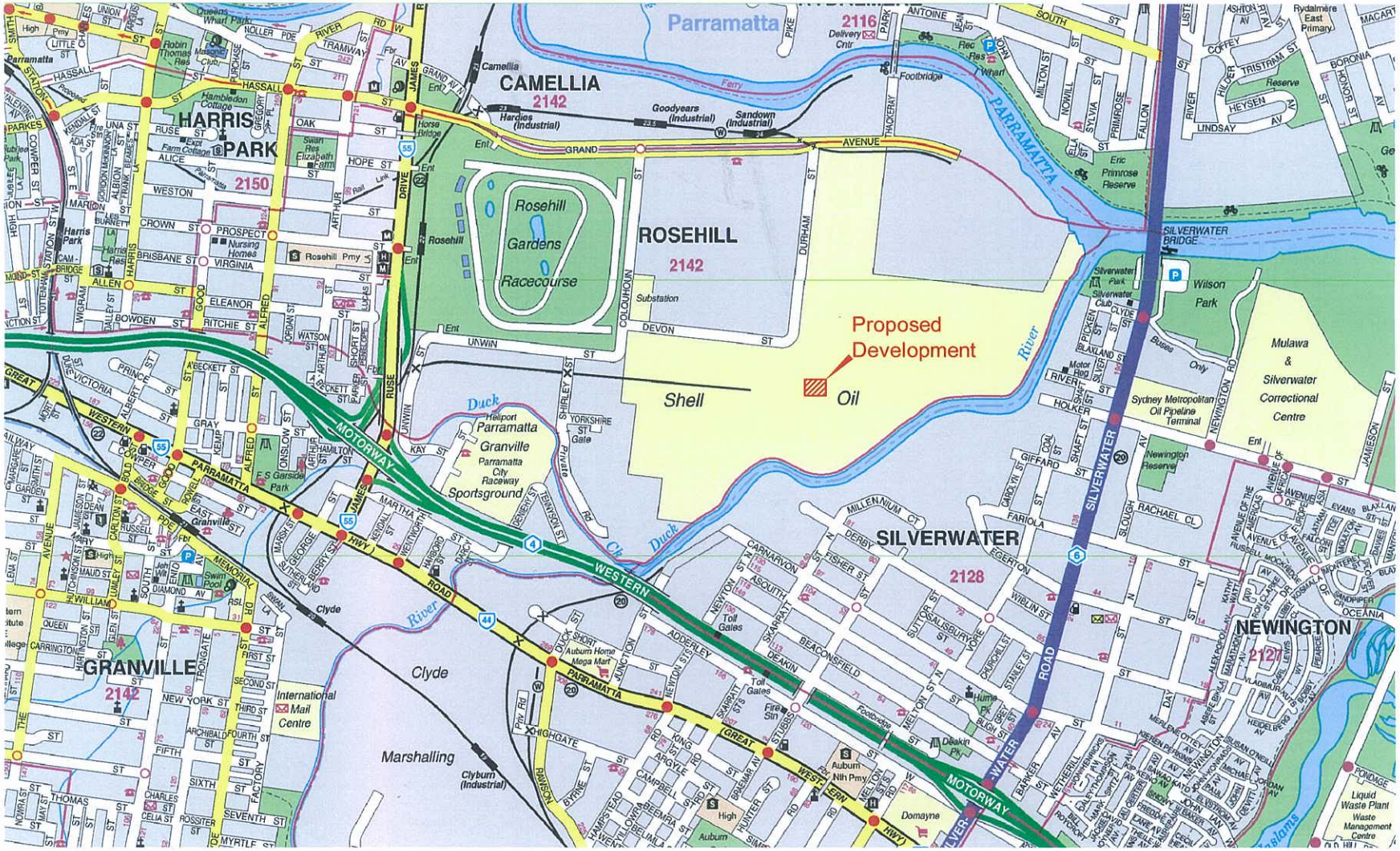

Figure 1.1
Regional Location of Clyde Refinery

The Clyde Refinery Management System (MS) has been developed to comply with:

- ISO 9001. Quality Management – externally certified
- ISO14001. Environmental Management – externally certified
- AS 4801. Occupational Health and Safety Management System – externally certified
- Worksafe National Standard for Control of Major Hazard Facilities.

1.5 Project Objectives

The objectives of the Project are to:

- Replace old equipment with new, more modern and reliable equipment to enable the continued operability and process efficiency of the FCCU
- Enable the continuous supply of petrol and LPG to meet the demand of consumers within the Sydney market
- Strengthen the long term viability of the Clyde Refinery.

1.6 Scope and Structure of the EA

This EA has been prepared to assess the potential environmental impacts of the proposed FCCU upgrade. In order to achieve this, the EA has considered the Environmental Assessment Requirements (EARs) issued by the Director-General on behalf of the Department of Planning. The requirement to prepare an EA is pursuant to Division 2, Part 3A of the *Environmental Planning and Assessment Act 1979* (EP&A Act).

The EA has been structured to allow thorough understanding of the Project, alternatives to the preferred option, its development, and its impacts. The structure of the EA is outlined in **Table 1-1**.

1.7 Contact Person for Public Enquiries

Name: Stuart Symons

Title: Technology Manager

Business: Shell Refining (Australia) Pty Ltd

Postal Address: PO Box 26, Granville NSW 2142

Tel: (02) 9897 8262

Fax: (02) 9897 8292

Figure 1.2
Aerial Photography of Clyde Refinery

Table 1-1 EA Structure

Section		Content
	Glossary	Glossary of terms utilised within the EA.
	Abbreviations	Comprehensive list of abbreviations utilised within the EA.
	Executive Summary	Summary of the EA.
1	Introduction	Introduces the Project, Shell Refinery and provides background to the Project.
2	Consultation	Outlines the consultation undertaken with government agencies and the community.
3	Statutory Context	Sets the legislative and statutory planning framework for the Project in a national, state, regional and local context. Identifies approvals and licences required for the Project and describes the planning approval process.
4	Existing Shell Operations at Clyde Refinery	Describes existing operations at Shell Refinery affected by the Project to set the baseline for the assessment.
5	Project Need and Alternatives	Discusses the need for the Project and describes the alternatives to the preferred option.
6	Description of the Project	Provides a description of the Project, including construction and operational phases, timing requirements, and other details of the Project as a basis for impact assessment.
7	Environmental Risk Assessment	Describes the environmental setting of the Project, identifies specific environmental aspects and their environmental impacts and then identifies those key environmental issues of high concern to be addressed further in section 8 of the EA.
8	Assessment of Key Environmental Issues, Potential Impacts and Mitigation Measures	Provides a detailed assessment of the key environmental issues identified in section 7. Assesses potential environmental impacts during construction and operation, and identifies mitigation measures to minimise environmental impacts.
9	Assessment of Other Environmental Issues, Potential Impacts and Mitigation Measures	Provides an assessment of the issues in section 7 that are not identified as key environmental issues. Potential impacts during construction and operation (including cumulative impacts) are identified as well as mitigation measures to minimise environmental impacts.
10	Environmental Management	Describes the environmental management of the Project, including a summary of all mitigation measures identified for the construction and operational phases, the preparation of environmental management plans for construction and operation, and monitoring, auditing and reporting requirements for both phases.
11	Project Justification and Conclusions	Presents the justification of the Project having regard to biophysical, economic and social considerations, and also the principles for Ecologically Sustainable Development. It also provides a conclusion in respect of the likely significance and acceptability of potential impacts.
12	Draft Statement of Commitments	Provides a draft Statement of Commitments outlining what actions Shell commits to undertake if approval for the Project is granted.
13	References	Lists all references cited in the EA.
	Appendices	The appendices provide supporting information to the EA.

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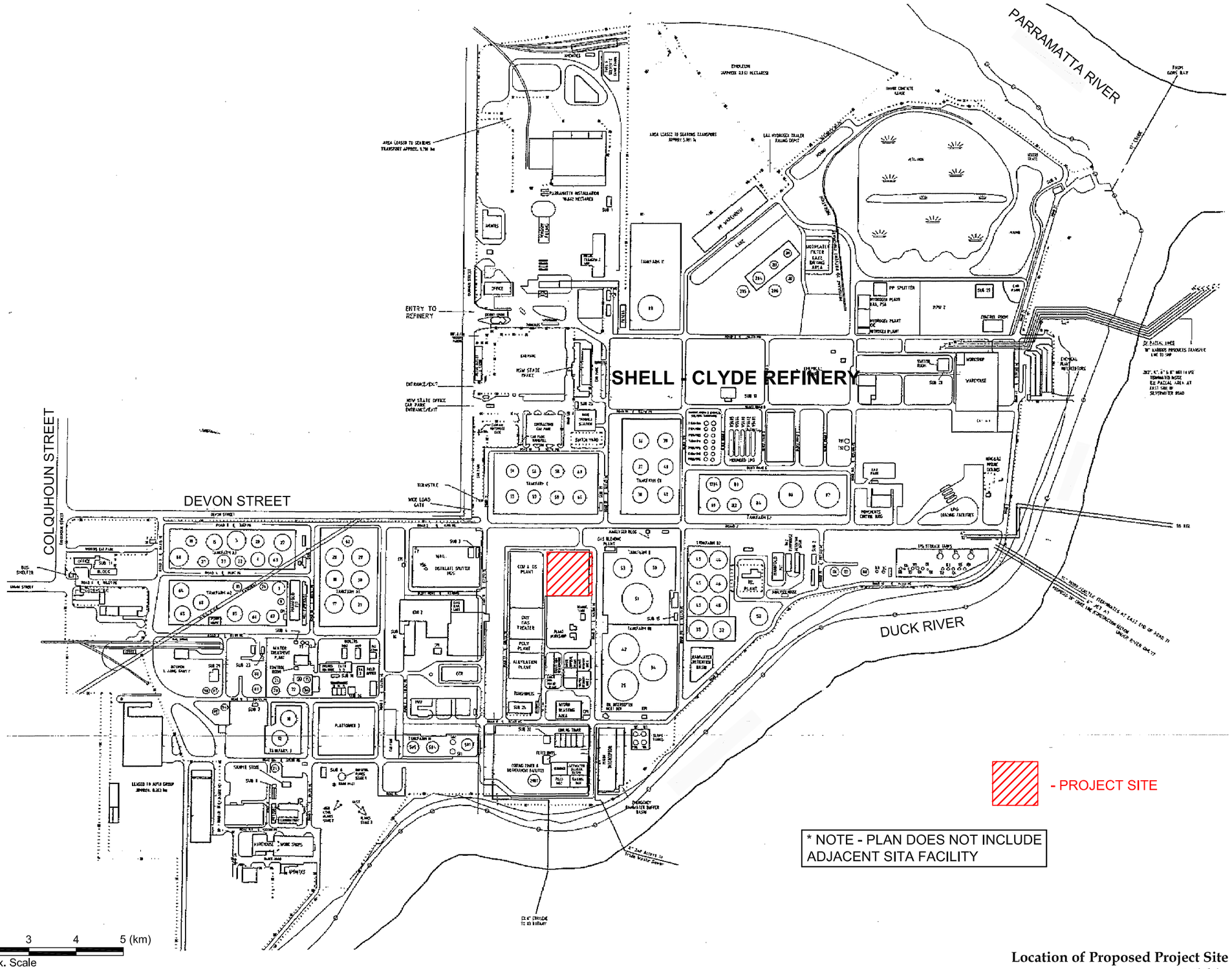


Figure 1.3
Location of Proposed Project Site FCCU Upgrade Within Clyde Refinery

2 Consultation

2.1 Consultation with Government Agencies

Consultation with relevant government agencies for this Project was undertaken by CH2M HILL. The Department of Planning (DoP) advised that a Planning Focus Meeting (PFM) to present the Project to government agencies was not required owing to the nature of the Project, which is an upgrade of an existing facility, with very little change to the existing environment.

2.1.1 Environmental Assessment Requirements

The *Environmental Planning and Assessment Act 1979 (EP&A Act)* and the *Environmental Planning and Assessment Regulations (2000) (EP&A Regs*) require proponents of a Part 3A major project to consult with the Director-General of the Department of Planning (DoP) to obtain Environmental Assessment Requirements (EARs). A Major Projects Application and Preliminary Assessment (see **Appendix A**) were submitted to the DoP. In response, the DoP issued EARs on the 28th February 2006 (see **Appendix B**). They outline the general requirements, key assessment requirements and consultation requirements which must be addressed in the Environmental Assessment (EA).

2.1.2 Consultation with the Department of Environment and Conservation

A meeting was held between the then Department of Environment and Conservation (DEC - now the Department of Environment and Climate Change, DECC), Shell and CH2M HILL on 2 June 2006. Comments raised by the DECC during the meeting are summarised in **Table 2-1.** The main issues discussed during the meeting centred on air emissions, noise and waste handling.

2.2 Community Consultation

A community consultation program was undertaken as part of this EA by Shell.

Information on this Project was distributed by way of a letterbox drop to neighbouring areas in order to strengthen community relations and to inform and to invite feedback from the community. A three page newsletter (see **Appendix C**) was distributed to 9,000 properties surrounding the Refinery during May 2006. For consistency and to incorporate improvements to the process, Shell's Refinery Working Instruction was followed, which outlines the procedure for carrying out a letterbox drop. The distribution area included all residential, commercial and industrial areas within a reasonable distance to the Refinery, and particularly within line of sight of the Refinery.

Table 2-1 Summary of Issues Raised by the DECC

Issues Raised	Section addressed in this EA
Air Emissions	Section 8.1
Emission sources from the entire Clyde Refinery site to be identified and ranked.	
Modelling to be undertaken using the most updated and experienced modelling technique (CALPUFF suggested) to accurately predict stack plumes and dispersion.	
NO_X, SO_X, CO, VOCs, particulates and metals to be modelled.	
Identify air emission target levels.	
Ground level concentrations at nearest receptors to be identified.	
Would like to see a comparison of the modelled results with emission limits outlined in Shell's EPL.	
Noise	Section 8.3
Identify noise sources generated from the entire Clyde Refinery site.	
Identify ways to reduce the noise emissions from the top 3 noise sources Refinery wide.	
Waste	Section 8.6
Identify the waste streams during demolition and construction.	
Detail how Shell stores and disposes of waste.	
Other	Section 6.5
Secondary impacts to the Refinery as a result of downtime and during construction.	
Contingency plans?	

The size and shape of the area of notification was based on the number and source of complaints recorded over the duration of Clyde Refinery's operation. **Figure 2-1** delineates the letterbox distribution area bounded by Victoria Road, Silverwater Road, Parramatta Road and James Ruse Drive.

In addition, copies of the FCCU Upgrade Project newsletter were sent to:

- PCC
- Camellia Mutual Aid Group (industrial neighbours in the Camellia area)
- Clyde Refinery Occupational Health and Safety (OH&S) Committee
- Clyde Refinery and Gore Bay employees
- Clyde Refinery NSW State Office reception foyer, Rosehill.

The newsletter advised of a variety of means for interested or concerned individuals and groups to discuss the Project and facilitate feedback with the Refinery FCCU Project Team, including visitations to the Refinery. The following means of contact were established:

- Email address: CLY-Feedback@shell.com
- Postal address: Catalytic Cracking Unit Upgrade Team, Shell Clyde Refinery, PO Box 26, Granville, NSW, 2142
- In person – street address Gate 5, Durham Street, Rosehill NSW, 2142
- Telephone number: (02) 9897 8262. The call would be taken either by Stuart Symons, Andrew Harvey or Louise Butler between 0730 – 1630, Monday to Friday. Messages could also be left on this number if those listed above were out of the office.

Neighbouring communities were also advised that the FCCU Upgrade team welcomed opportunities to discuss the Project at a location convenient to them. The above means of communication would remain available both prior to, during and after the public exhibition phase of the EA. Subject to receiving the necessary approvals for the project to proceed, it is expected that a further newsletter on the Project would be distributed and these lines of communication would remain open.

There has been no response from any individual or community member to date. Any response that is received would be detailed and logged.

Complaints

Shell has a procedure to receive, document and respond to all complaints. The validity of the complaint is investigated by checking operational conditions, the wind direction and, if necessary, a boundary patrol of the Refinery is conducted. After completion of the investigation, where possible, the complainant is informed of the findings and any remedial action taken.

All complaints are recorded in the Refinery complaint logbook (including any complaints that are not related to the Refinery) in accordance with Condition M4 of EPA Licence No.570. The following information is collected:

- Date and time of the complaint
- Method by which the complaint was lodged
- Personal details of the complainant which were provided by the complainant or, if no such details were provided, a note to that effect
- Nature and description of the complaint
- Action undertaken in relation to the complaint, including any follow up contact with the complainant.

The complaint logbook is kept for a minimum of four years. The number of calls logged is reported to the DECC on an annual basis.

Five documented complaints were received by the Refinery over the period January 2006 to May 2007. Three complaints were related to H_2S alarm noise, one complaint related to flare noise and one complaint related to fork truck reverse alarm noise. With respect to flare and noise, this Project would make the Unit more reliable and hence reduce the need and frequency of flaring.

Community Feedback and Comments

No community feedback or comments were received during the preparation of the EA.

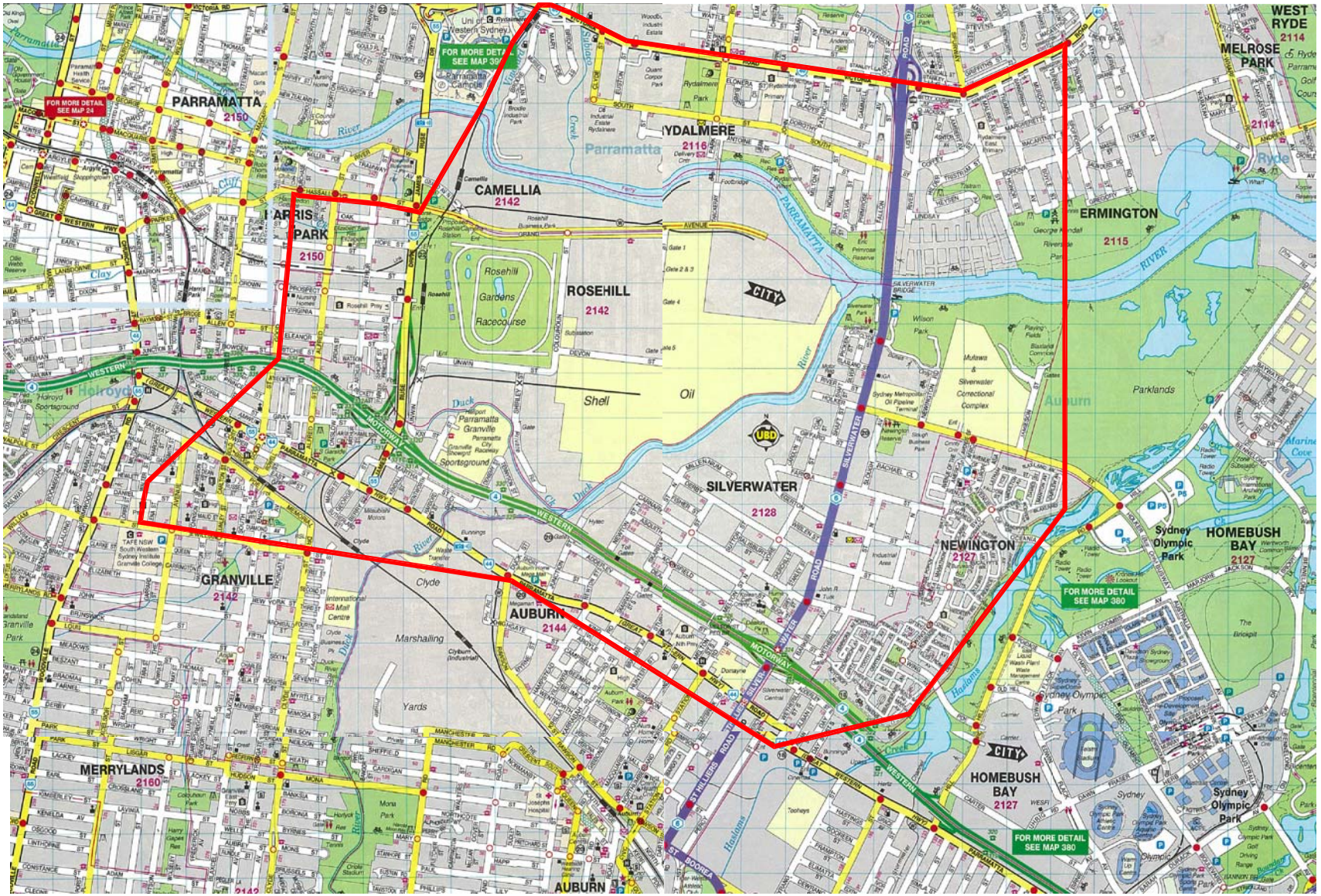


Figure 2.1
Letter Box Drop Distribution Area

3 Statutory Context

3.1 The Approvals Process

The EP&A Act and the EP&A Regulations provide the framework for the assessment of the environmental impact of development proposals in NSW. A summary of the approvals process for a Part 3A Major Project is shown in **Figure 3-1**.

3.1.1 Planning Approval

The Project triggers the provisions of a 'Major Project' under *State Environmental Planning Policy (Major Project) 2005* (SEPP 2005) (see **Section 3.3.1)** The capital investment involved would exceed AUD$30 million and the Project is for the purpose of "petroleum related works (including processing plants)" falling within the provisions of Clause 6, Schedule 1 of SEPP 2005.

Under Part 3A, a Preliminary Application and Preliminary Assessment must be sent to the Minister for Planning. If the Minister is in agreement that the project is a 'Major Project', the Minister will issue Environmental Assessment Requirements (see **section 7**) and the approval process will be undertaken in accordance with Part 3A of the EP&A Act. The Minister for Planning will be the approval authority for the Project.

3.2 Other Regulatory Requirements

3.2.1 Licensing and Permits

Under section 55 of the POEO Act, Shell is the holder of the existing Environmental Protection Licence (No. 570) (EPL) for a Scheduled Activity (Premises Based). Details of this licence are discussed below.

Shell Refining Environment Protection Licence

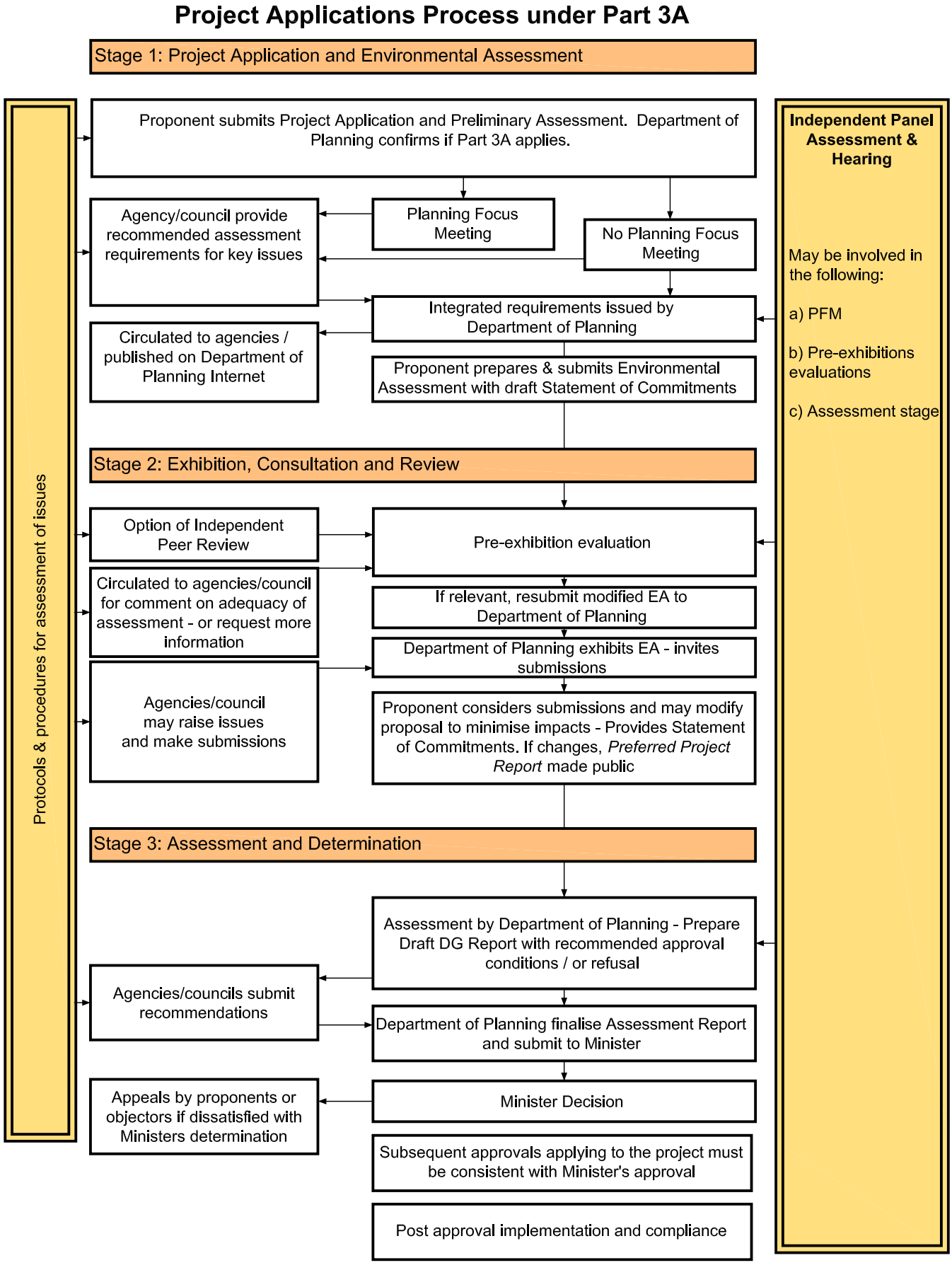
Under section 55 of the POEO Act, Shell Refining is the licensee of EPL No. 570 for Scheduled Activities (Premises). This licence is issued by DECC and controls activities undertaken by Shell at the Clyde Refinery.

Several conditions of the licence are relevant to the Project. These conditions and their interaction with the Project are outlined below.

L3 Concentration Limits – FCCU stack (discharge point No.9) must not exceed the prescribed air pollutant limits (see **Table 3-1**):

L5 Waste – Permits catalyst waste and waste water, hydrocarbons/water mixtures or emulsions to be generated and/or stored at the premises.

L5.8 Waste - The quantity of prescribed waste generated and/or stored on the premises must not exceed 50,000 tonnes at any one time.



Source: Steps in the Assessment Approval of Major Projects under Part 3A (DIPNR, Draft: 26 July, 2005)

Figure 3.1
Planning Approvals Process

Table 3-1 Environmental Protection License Concentration Limits

Pollutant	Units of Measure	100%ile concentration limit
Nitrogen Oxide	mg/m^3	2,500
Hydrogen Sulfide	mg/m^3	5
Sulfuric Acid mist and sulphur trioxide (as SO_3)	mg/m^3	100

L5.9 Waste – The quantity of prescribed wastes generated, stored, treated, or processed at the premises must not exceed 60,000 tonnes per year.

L6 Noise Limits – There are no prescribed noise limits in the EPL.

O1 Operating Conditions

O1.1 Activities must be carried out in a competent manner.

O2 Maintenance of Plant and Equipment

O2.1 All plant and equipment must be maintained in a proper and efficient condition and operated in a proper and efficient manner.

This provision of the EPL is one of the most relevant to this Project. The replacement of the reactor and stripper and other miscellaneous components are consistent with this provision i.e. to maintain in a "proper and efficient manner" the Refinery equipment.

O4 Processes and Management

O4.1 All waste generated, stored or treated, disposed or reprocesses at the premises is to be assessed and classified in accordance with the EPA Environmental Guidelines.

M2 Requirement to Monitor Concentration of Pollutants Discharged

M2.1 The FCCU stack must be monitored for the prescribed pollutants as outlined in the EPL.

M4 Recording of Pollution Complaints

M4.1 All complaints must be recorded in relation to pollution arising from any activity to which the license applies.

E1.1(b) By 1 December 2007, testing for the FCCU stack discharge point must be completed.

E4 Special Condition - An occupational acoustical report was submitted to the EPA in accordance with condition E4. The survey assessed operator noise exposure levels, identified noise sources and determined hearing protection zones, as well as providing general advice for noise control and hearing protection necessary to comply with WorkCover Regulations.

L5.3 Waste - Under this clause, asbestos is permitted to be generated and/or stored at the premises.

L7 Polychlorinated Biphenyls (PCBs) – Items listed under this clause have permission to continue to be operated on the premises provided that they are maintained and operated in a proper manner.

L8 Asbestos - Shell must comply with the conditions of its license relating to asbestos. Where the license does not detail any specific conditions, Shell must comply with the Protection of the Environment Operations (Waste) Regulation 2005.

3.3 NSW Planning Instruments

Environmental and planning decision making in NSW is made with respect to state, regional and local Environmental Planning Instruments (EPIs) which fall under Part 3 of the EP&A Act, including:

- State environmental planning policies (SEPPs)
- Regional environmental plans (REPs)
- Local environmental plans (LEPs).

The following sections provide an assessment of EPIs that may apply or be related to the proposed development.

3.3.1 State Environment Planning Policies

There are four SEPPs that apply to the Project:

- SEPP (Major Projects) 2005
- SEPP 33 – Hazardous and Offensive Development
- SEPP 55 – Remediation of Land.

These SEPPs are discussed in detail below.

SEPP (Major Projects) 2005

State Environmental Planning Policy (Major Projects) 2005 (SEPP 2005) classifies certain development of industrial infrastructure as a "Major Project". If a proponent believes the provisions of the SEPP are triggered, a preliminary application and preliminary assessment must be sent to the Department of Planning. The DoP will then forward the application to the Minister for Planning. If the Minister is in agreement that the project falls within the SEPP, the Director-General, on behalf of the DoP will issue Environmental Assessment Requirements and the development assessment and approval process will be undertaken in accordance with Part 3A of the EP&A Act. The Minister for Planning is the approval authority for a Part 3A application.

Under Clause 6 of Schedule 1 of SEPP 2005, a proposed development would be deemed a Major Project under Part 3A of the EP&A Act if it is:

Development for the purpose of petroleum related works (including processing plants) that:

(a) is ancillary to or an extension of another Part 3A project, or

(b) has a capital investment value of more than $30 million or employs 100 or more people.

After the completion of this Project, Shell would not employ over 100 new employees specifically in respect of the proposed upgrade.

SEPP 2005 applies as the Project is development for the purpose of petroleum related works and would have an estimated capital investment value of AUD$77.77 million.

A Preliminary Application and Preliminary Assessment were prepared and submitted to the DoP. In agreement that the proposed upgrade to the FCCU was a Part 3A project, the DoP, on behalf of the Minister, issued EARs. This EA has been prepared in accordance with those EARs issued under Part 3A of the EP&A Act.

SEPP 33 – Hazardous and Offensive Development

This SEPP links the permissibility of an industrial development proposal to its safety and environmental performance. Certain activities may involve handling, storing or processing a range of materials, which, in the absence of controls, may create risk outside of operational borders to people, property or the environment. Such activities would be defined by SEPP 33 as a 'potentially hazardous industry' or 'potentially offensive industry'. SEPP 33 applies to any industrial development proposals which fall within these definitions.

Under clause 3, a development is deemed part of a potentially hazardous industry if it satisfies the definition:

"a development for the purposes of any industry which, if the development were to operate without employing any measures (including, for example, isolation from existing or likely future development on other land) to reduce or minimize its impact in the locality or on the existing or likely future development on other land, would pose a significant risk in relation to the locality:

- *to human health, life or property, or*
- *to the biophysical environment,*
- *and includes a hazardous industry and a hazardous storage establishment."*

The Department of Urban Affairs and Planning (DUAP) (1997) guideline "Applying SEPP 33" provides a risk screening procedure to help determine if a proposed development should fall within the SEPP. If SEPP 33 is triggered, clause 12 of SEPP 33 requires that any proposal to carry out a potentially

hazardous development must be supported by a Preliminary Hazard Analysis (PHA).

As the Project falls within the definition of a "potentially hazardous industry", a PHA was undertaken in accordance with the relevant DUAP (now Department of Planning) risk guidelines. The PHA is attached in **Appendix E** and summarised in **Section 8.2.**

SEPP 55 – Remediation of Land

The objective of SEPP 55 is to provide for a coordinated state wide planning approach to the remediation of contaminated land. SEPP 55 aims to promote the remediation of contaminated land with the objective of reducing the risk of harm to human health or other aspects of the environment.

Clause 7 of SEPP 55 imposes an obligation on the consent authority to have regard to certain matters before granting development consent. These matters include:

- Whether the land is contaminated
- Whether the land is, or will be, suitable for the purpose for which development is to be carried out
- If remediation is required for the land to be suitable for the proposed purpose, whether the land will be remediated before the land is used for that purpose.

This obligation would apply to the consent authority in deciding whether to grant consent to the Project. SEPP 55 also imposes obligations to carry out any remediation work in accordance with relevant guidelines and to notify the relevant council of certain matters in relation to any remediation work.

Due to the very minor excavation required for footings and cable trenches, the provisions of SEPP 55 are not expected to be applicable to the proposed upgrade.

Information relevant to these matters is discussed in **Section 7.4**.

3.3.2 Regional Environment Plans

There are three REPs that apply to the Project:

- Sydney Regional Environment Plan No.22 – Parramatta River
- Sydney Regional Environment Plan No.28 – Parramatta
- Sydney REP (Sydney Harbour Catchment) 2005.

These REPs are discussed in detail below.

Sydney Regional Environment Plan No.22 – Parramatta River

Sydney REP No. 22 provides a framework for future planning, development and management of open space and recreation areas in the Parramatta River

region. The Plan applies to waterways and foreshores from Balmain and Hunters Hill west to Parramatta, including Clyde Refinery. Sydney REP No.22 planning aims that are relevant to the Project are:

> *(a) to establish a framework which encourages a consistent and co-ordinated approach to the planning, development and management of the waterway, and foreshore open space and facilities of the Parramatta River;*
>
> *(b) to establish an efficient and effective development control system for the Parramatta River and its foreshores;*
>
> *(e) to recognise, protect and enhance the natural, scenic, environmental, cultural and heritage qualities of the land to which this plan applies in future planning and development control;*
>
> *(h) to identify, conserve and enhance the environmental heritage of the region; and*
>
> *(i) to ensure that consistent guidelines are applied to the assessment of development of the Parramatta River and its foreshores.*

Matters relevant to the Project for consideration by the consent authority in determining development applications include;

> *(a) the appearance of the development from the waterway and the foreshores (see **section 8.4**);*
>
> *(b) whether the development will cause pollution or saltation of the waterway to an extent that would jeopardise any existing or potential uses of the waterway (see **section 9.3**);*
>
> *(c) whether the development will have an adverse effect on wetlands or flora or fauna habitats (see **section 9.4**);*
>
> *(d) the noise likely to be generated by the development and any adverse effect that any such noise would have on existing uses of the waterway or nearby land (see **section 8.3**);*
>
> *(e) whether the development will have an adverse effect on drainage patterns or cause shoreline erosion (see **section 8.4**);*
>
> *(m) any other relevant plan of management, urban design or other development control guidelines that apply to Parramatta River and its foreshores and which has been notified and to the consent authority by a public authority; and*
>
> *(n) the effects of the development on the heritage significance of a heritage item, its site, its vicinity or on a conservation area (see **sections 9.8 and 9.9**).*

The Project is consistent with the aims of the Parramatta River REP No. 22.

The matters identified above are addressed in this Environmental Assessment.

Sydney Regional Environment Plan No.28 – Parramatta

Sydney REP No. 28 – Parramatta identifies eight precincts within the Parramatta Primary Centre. The Shell Refinery falls within the Camellia Precinct.

The following planning aims of the Sydney REP No. 28 for the Camellia Precinct apply to this Project:

> *(a) to protect and support the integrity of the Camellia Precinct as one of Sydney's significant industrial hubs,*
>
> *(c) to promote industrial development in the Camellia Precinct that demonstrates innovation and environmental management best practice,*
>
> *(f) to ensure that development along the foreshore is of a scale and character in keeping with its foreshore location and that the unique visual and ecological qualities of the waterways and foreshore are protected and enhanced,*
>
> *(k) to achieve environmental management best practice that protects and promotes the natural assets of Camellia,*
>
> *(l) to improve environmental performance that minimises energy and resource use as well as off-site air quality, noise, odour, dust, water, soil and contamination impacts,*
>
> *(m) to protect and enhance local and regional biodiversity, particularly maximising the extent and integrity of aquatic and natural land areas along the Parramatta River, Duck River, Duck Creek and A'Becketts Creek corridors.*

Sydney REP No. 28 notes that these aims must be considered by the consent authority in assessing development applications. The Project would be consistent with the aims of the SREP No. 28 for the following reasons:

- It is an industrial land use and therefore consistent with the industrial nature of the precinct
- The scale and character are in keeping with the foreshore location (see **Section 8.5.2**)
- The Project would not adversely affect the natural assets of Camellia, such as surface water quality (see **Section 8.4)**
- The Project would minimise energy and resource use as well as decrease the amount of hazardous inventory kept on site as well as reduce the amount of waste produced (see **Section 8.6).**
- The Project is not expected to affect local and regional biodiversity of aquatic and natural land areas along the Parramatta River, Duck River, or Duck Creek corridors (see **Section 9.4**).

Under Part 11 of SREP No. 28, the following other provisions have the potential to apply to the Project:

- **Clause 76** - Development on flood liable land. The risk of flooding is negligible as the Project is replacing components already in existence and the equipment being replaced is located on foundations 11m above grade level. Most of the site is above the 1 in 100 years flood area and the development would not increase stormwater run off as the existing study area is already hard surfaced. Flooding impacts are discussed further in **Section 9.2**.
- **Clause 77** – Excavation and filling of land. The upgrade to the FCCU would involve very minor excavation. Excavation would be required for footings no deeper than 3m and cable trenches to lay new cabling where necessary.
- **Clause 83** – Acid Sulphate Soils. The Project would involve very minimal excavation. If any acid sulphate soils are identified and disturbed, Clyde Refinery has an approved remedial soil procedure for handling any acid sulphate soils.

Sydney REP (Sydney Harbour Catchment) 2005

This plan has the following aims with respect to the Sydney Harbour Catchment:

> *(a) to ensure that the catchment, foreshores, waterways and islands of Sydney Harbour are recognised, protected, enhanced and maintained:*
>
> *(i) as an outstanding natural asset, and*
>
> *(ii) as a public asset of national and heritage significance, for existing and future generations,*
>
> *(b) to ensure a healthy, sustainable environment on land and water,*
>
> *(c) to achieve a high quality and ecologically sustainable urban environment,*
>
> *(d) to ensure a prosperous working harbour and an effective transport corridor,*
>
> *(e) to encourage a culturally rich and vibrant place for people,*
>
> *(f) to ensure accessibility to and along Sydney Harbour and its foreshores,*
>
> *(g) to ensure the protection, maintenance and rehabilitation of watercourses, wetlands, riparian lands, remnant vegetation and ecological connectivity,*
>
> *(h) to provide a consolidated, simplified and updated legislative framework for future planning.*

The Project would not impact on Parramatta River or the Parramatta River foreshore unless maintenance ploughing of accumulated river silts was required to bring plant and materials in by barge. The FCCU is embedded well within the Shell Refinery boundary, and therefore the Project would have a minimal visual impact from the foreshore and would not change the nature of the industrial landscape.

In addition, operation of the FCCU is not expected to affect the water quality of Parramatta River. Should maintenance ploughing of river silts be necessary to allow some of the new FCCU units to be brought to the site by barge, then appropriate mitigative measures would be adopted (see **Section 8.4**).

3.3.3 Local Planning Instruments

Parramatta Local Environmental Plan (LEP) 2001

Parramatta Local Environment Plan s4(2) states that it does not apply to "land within the Camellia Precinct or Rydalmere Precinct within the meaning of Sydney Regional Environmental Plan No 28— Parramatta". As the FCCU is situated within the Camellia Precinct, the Parramatta Local Environment Plan does not apply.

3.3.4 Development Control Plan

Parramatta Development Control Plan 2005

Parramatta Development Control Plan 2005 does not apply to the FCCU as it is zoned under Sydney Regional Environmental Plan No. 28 - Parramatta (SREP No. 28).

3.4 State Planning Legislation

3.4.1 Protection of the Environment Operations Act 1997

Under section 55 of the *Protection of the Environment Operations Act* 1997 (the *POEO Act*), Clyde Refinery is the holder of the existing Environmental Protection Licence (No. 570, file number 501034) (EPL). This licence is issued by DECC and controls activities undertaken by Shell at the Refinery.

For more information on the relevant provisions of EPL No.570 see **Section 3.2**

3.4.2 Protection of the Environment Operations (Clean Air) Regulations 2002

The Protection of the Environment Operations (Clean Air) Regulations prescribes emission concentration limits which apply to "Petroleum Refining" industries. Under the regulation, as the upgraded FCCU Unit would be in operation post September 2005, Group 6 emission concentration limits generally apply to this Unit (see **Section 8.1.1** for more information).

3.4.3 Protection of the Environment Operations (Waste) Regulation 2005

The most relevant provision of this Regulation is Part 4, Management of Special Wastes. Clause 42 outlines the special requirements which must be complied with when any activity involves the transportation, collection, storage, or disposal of any type of asbestos waste. The Regulation also identifies asbestos as a Part 2 Schedule 1 waste which must be tracked when transported interstate.

The demolition of an old change shed is required to provide additional space for assemblage of cranes. Asbestos may have been used in the roofing material and its demolition has the potential to generate asbestos waste. In addition, the lift within the reactor structure contains asbestos fibro sheeting. In accordance with this Regulation and Shell's EPL 570, Shell would engage licensed contractors who are accredited to handle, demolish and dispose of this waste appropriately.

3.4.4 Waste Avoidance and Resource Recovery Act 2001

This Act repealed the *Waste Minimisation and Management Act, 1995*. The purpose of the Act is to encourage the most efficient use of resources and to reduce environmental harm in accordance with the principles of ecological sustainable development.

The Act provides for the making of policies and strategies to achieve these ends. The relevance of the Act to this project is to implement the strategies by adopting the hierarchy of avoidance; avoidance of unnecessary resource consumption; resource recovery (including reuse, reprocessing, recycling and energy recovery), disposal (as a last resort). It is an offence under the *Protection of the Environment Operations Act* to wilfully or negligently dispose of waste in a manner that harms or is likely to harm the environment.

Metal waste generated from the construction phase would be reused and recycled in accordance with the *Waste Avoidance and Resource Recovery Act* 2001. Any waste that cannot be reused or recycled would be classified and managed according to the *Environmental Guidelines: Assessment, Classification and Management of Liquid and Non-Liquid Wastes* (NSW EPA 1999)

Waste generated during the operation of the FCCU would be managed in accordance with the provisions of Shell's EPL No. 570 (see **Section 8.6**). There is not expected to be a change in waste production other than a substantial reduction in the formation and disposal of waste coke. Coke formation would be reduced from 200t to 5-10t and be removed every four years.

3.4.5 Threatened Species Conservation Act 1995

The aspects of this Act that are most relevant to the Project are those provisions requiring that licences are required to be obtained to pick or harm threatened species populations or ecological communities whether plant or animal or to damage any critical habitat. If a development may potentially

affect any flora or fauna species, population or ecological community listed by the *Threatened Species Conservation Act 1995* (*TSC Act*) an Eight Part Test is required. The Eight Part Test determines whether the proposed works represents a significant impact. If a significant impact is determined, a Species Impact Statement (SIS) and licence is required under the *TSC Act*.

No threatened species, populations or communities would be affected by the Project, and therefore an SIS is not required. For further information see **Section 9.4**.

There is an additional requirement under section 5A of the EP&A Act to assess whether there is likely to be a significant effect on threatened species, populations or ecological communities, or their habitats. Part 5A of the EP&A Act lists the factors which must be taken into account in making a determination.

3.4.6 National Parks and Wildlife Act 1974

The relevance of this Act to this Project is in respect to the protection and preservation of Aboriginal artefacts. The Act is administered by the DECC. Discovery of material on site suspected as being of Aboriginal origin must be reported and protected pending assessment.

The soils in the study area are highly disturbed and are dominated by landfill. In addition, the Project would use existing foundations to locate the new equipment and therefore excavation of soils would not be required. It is not expected that indigenous sites or places of cultural significance would be disturbed as part of the works. For further information see **Sections 9.8** and **9.9.**

3.4.7 Energy and Utilities Administration Act 1987

A "designated water/energy user" must prepare a draft Water/Energy Savings Action Plan as stipulated under s34Q of the *Energy and Utilities Administration Act 1987* as amended by the *Energy Administration Amendment (Water and Energy Savings) Act 2005*.

A "designated water/energy user' is one which is prescribed by a savings order. The Water Savings Order 2005 and Energy Savings Order 2005 both nominate Shell Refining (Australia) Pty Ltd and specifically the Clyde Refinery as a designated user. The Shell Refinery, Clyde submitted both a Water Savings Action Plan for approval by April 2006 and an Energy Savings Action Plan by June 2006. The Energy plans have since been approved by the Department of Energy, Utilities and Sustainability (DEUS), and the Water plan is pending minor clarification following detail review by DEUS.

3.4.8 Rivers and Foreshores Improvement Act 1948

The *Rivers and Foreshores Improvement Act 1948* states in section 22B that a person can not remove, or allow to be removed, material from protected land

(including a river bed) without a permit and in accordance with any conditions outlined in that permit. Section 75U(1)(f) of the EP&A Act 1979 states that an approval under section 3A of the Rivers and Foreshores Improvement Act 1948 is not required for an approved Major Project, and accordingly the provisions of the Rivers and Foreshores Improvement act 1948 which prohibit an activity without such an authority do not apply.

It is likely Shell would transport to its Clyde Refinery a component of the proposed upgrade, namely the combined reactor and stripper component. This one-off transportation may require maintenance ploughing of a small part of the Parramatta River to enable the barge to access Shell's wharf at low tide.

Parramatta River was dredged in 2005 as part of a previous Shell Mogas Improvement Project which required component delivery by barge. It is expected that similar size barges would be used for the transport of the reactor/stripper as with the previous project. Shell would undertake further investigations to ascertain the need for maintenance ploughing prior to construction.

The requirement to dredge or undertake maintenance ploughing for the proposed Project is subject to prevailing silt movement and other variables and can only be confirmed in early 2008, closer to the arrival time of the barge.

3.4.9 Environmentally Hazardous Chemicals Act 1985

Under the *Environmentally Hazardous Chemicals Act 1985*, the EPA may declare substances to be chemical wastes and may issue 'chemical control orders' to regulate the handling and disposal of chemical wastes. Under this Act, polychlorinated biphenyls has been declared as a chemical waste and a chemical control order has been issued, "Polychlorinated Biphenyl (PCB) Chemical Control Order, 1997" (PBC CCO).

The PCB CCO sets controls on activities including the generation, processing, storing, conveying and disposing of PCB material or PCB wastes, depending upon the PCB concentration. Shell would, in accordance with this Act and Chapter L7 of the Shell EPL 570, handle and dispose of identified PCB contaminated waste.

3.5 Commonwealth Legislation

3.5.1 Energy Efficiency Opportunity Act 2006

The *Energy Efficiency Opportunity Act 2006* establishes an Energy Efficiency Opportunities program which requires corporations who are large energy users to assess the potential to improve their energy efficiency and report publicly on their assessment.

Corporations who exceed the threshold of 0.5 petajoules per year must apply to be placed on the Register of Corporations for the Energy Efficiency Opportunities Scheme. Registered corporations under Part 4 would then have 18 months to submit an assessment plan which, valid for 5 years, would assess areas for possible improvement.

Shell is aware of the provisions of this Act which commence on the 1st July 2006. In accordance with this Act, Shell has registered under the program and will commence its assessment of the Clyde Refinery during 2007.

3.5.2 Environment Protection and Biodiversity Conservation Act 1999

The Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (*EPBC Act*) commenced operation on 16 July 2000. The *EPBC Act* requires approval from the Commonwealth Minister for the Environment for certain actions which have, may have, or are likely to have a significant impact on a matter of national environmental significance (NES). An action that requires this Commonwealth approval is called a "controlled action".

As part of the EA process, an assessment of potential impacts on matters of NES was undertaken. Based on the assessment summarised in **Table 3-2**, it is considered the *EPBC Act* does not apply to the Project.

3.6 Project Specific Regulations and Standards

Clyde Refinery is managed in accordance with the local legal requirements, Shell global standards as well as the Refinery's HSEQ Management System, which is certified to ISO9001, ISO14001 and AS4801.

3.7 Building Code of Australia and Relevant Australian Standards

If the Project is approved by the Minister for Planning, compliance with the Building Codes of Australia would be verified by an independent Accredited Certifier who would check all the structural drawings as part of the approval process, prior to construction. A Fire Safety Study would be completed to determine compliance with the Building Code of Australia and relevant Australian Standards. The study would be submitted to the Department of Planning and the NSW Fire Brigade prior to final approval.

Table 3-2 EPBC Act Applicability Assessment

Matters of National Environmental Significance	Assessment
Declared World Heritage Areas	There are no World Heritage Properties in the vicinity of the Camellia area. The nearest World Heritage Property is the Greater Blue Mountains area located about 50km west of the site.
National heritage places	There are no National heritage places in the vicinity of the proposed development. The nearest National heritage place is First Government House, located in Sydney, approximately 20km west of the area.
Declared Ramsar wetlands	There are no Ramsar wetlands in the vicinity of the proposed development. The nearest Ramsar Wetland is Towra Point Nature Reserve located about 30km east of the area.
Listed threatened species and ecological communities Listed migratory species	The Camellia area is characteristically industrial with very little undeveloped land. The Refinery area is mostly covered by operational facilities (ie. buildings, plants, roads, storage areas, etc) and there is only limited landscape vegetation cover in the site. The existing environment in the Refinery and surroundings has been extensively modified for industrial purposes and it is considered that no flora or fauna of significance could reasonably be expected to occur at the site for the proposed development. A number of threatened and migratory species have been identified as potentially occurring within the Refinery site and region (see **Section 9.4** for details). It was concluded that the Project would not have any significant impacts on flora and fauna.
Nuclear actions	The Project is not a nuclear action.
The environment of Commonwealth marine areas	There are no Commonwealth marine areas or land in the vicinity of the proposed site.

4 Existing Shell Operations at Clyde Refinery

4.1 Overview of Shell and Operations

In 1908, the Commonwealth Oil Corporation owned the Clyde Refinery site and in 1913, John Fell & Co. (a shale oil company) acquired the assets of the Commonwealth Oil Corporation. Shell acquired the site from John Fell & Co. in 1928 and the land use has remained the same.

4.2 General Description of Shell Clyde Refinery

The Clyde Refinery is one of two refineries located in Sydney, the other being the Caltex Refinery at Kurnell.

The Clyde Refinery produces approximately 1.7 million tonnes or 2.3 billion litres of gasoline grades per annum. This equates to a supply of approximately 50% of petroleum products in NSW and has a production of about 5,000ML per annum. The throughput of approximately 14ML per day comprises of the products as outlined in **Table 4-1**.

Table 4-1 Breakdown of Daily Throughput of Approximately 14ML/day

Product	Percentage (%)	ML/day
Petrol	45	6.30
Diesel	25	3.50
Jet fuel	23	3.22
Fuel oil	4	0.56
LPG (2/3 is feedstock to Basell Polypropylene Plant located on the Refinery site)	3	0.42
Total	**100%**	**14ML/day**

About 90 ships per annum transport between 55,000 to 100,000 tonnes of crude oil each week for the Refinery. Crude oil, fuel oil and other feedstock and products are offloaded into tanks at the Gore Bay Terminal. An underground pipeline carries products in both directions between the Clyde Refinery and Gore Bay Terminal.

Virtually all of the Refinery output is distributed to NSW customers, approximately forty percent is distributed to other oil companies. Products are distributed by road tanker, by rail to inland NSW, by pipeline to Newcastle and the Sydney Airport (Clyde's largest single consumer supplier), by pipeline to Gore Bay, and by ship from Gore Bay to coastal ports.

In addition, the Refinery receives technical support from Shell Global Solutions International, which is responsible for the design of equipment, as well as undertaking fire safety review, technical support, Process Safety reviews and design reviews.

4.3 General Oil Refinery Operations and Systems

Clyde Refinery is a complex refinery with major process units consisting of a platformer and Benzene reduction unit, the fluidised catalytic cracker unit, one crude distiller, a high vacuum distillation unit, a hydrotreater, hydrodesulphurization (HDS) unit, a sulphur recovery plant, an alkylation plant, numerous treating units and an extensive utilities complex. The Refinery has been involved in hydrocarbon processing for close to 80 years. **Figure 4-1** shows the existing petrol blending process.

Crude oil is received by Clyde Refinery from the Gore Bay Terminal via a 16km 300mm diameter underground pipeline. Clyde Refinery's primary processing capacity is approximately four million tonnes of crude oil each year. From this, approximately 2,300ML of motor gasoline, 1,000ML of aviation fuels and kerosene, and 1,300ML of diesel are produced.

Product is dispatched to the market through the Parramatta Distribution Terminal on the Refinery site by road tankers and rail, and by pipeline connection to Sydney Airport, Newcastle oil company's distribution terminals, and an oil company at Silverwater. Clyde Refinery also provides propylene feedstock and other services to Basell's Polypropylene Plant which is located next to the Refinery site. Continued and reliable operation of the FCCU complex is also critical for the ongoing operation/long term viability of the Basell operation.

There are 94 storage tanks in operation at the Refinery. The current storage of petroleum products at Clyde Refinery is approximately 670,000m^3, of which approximately 88,000m^3 is unleaded petrol. Shell has been storing unleaded petrol at the Refinery for approximately 20 years.

There is over 10 years of extensive environmental monitoring data that provides a sound baseline of the current site performance.

4.4 Operating Hours and Staffing

Clyde Refinery operates 24 hours per day with a rotating 12 hour shift. The support functions operate five days per week from 7:30am to 4:00pm. Each operations shift is made up of twenty-two employees. This includes a shift controller and a fully trained emergency services officer. The security centre is manned twenty-four hours per day. In total, the Refinery employs approximately 330 permanent employees and over 200 contractor employees.

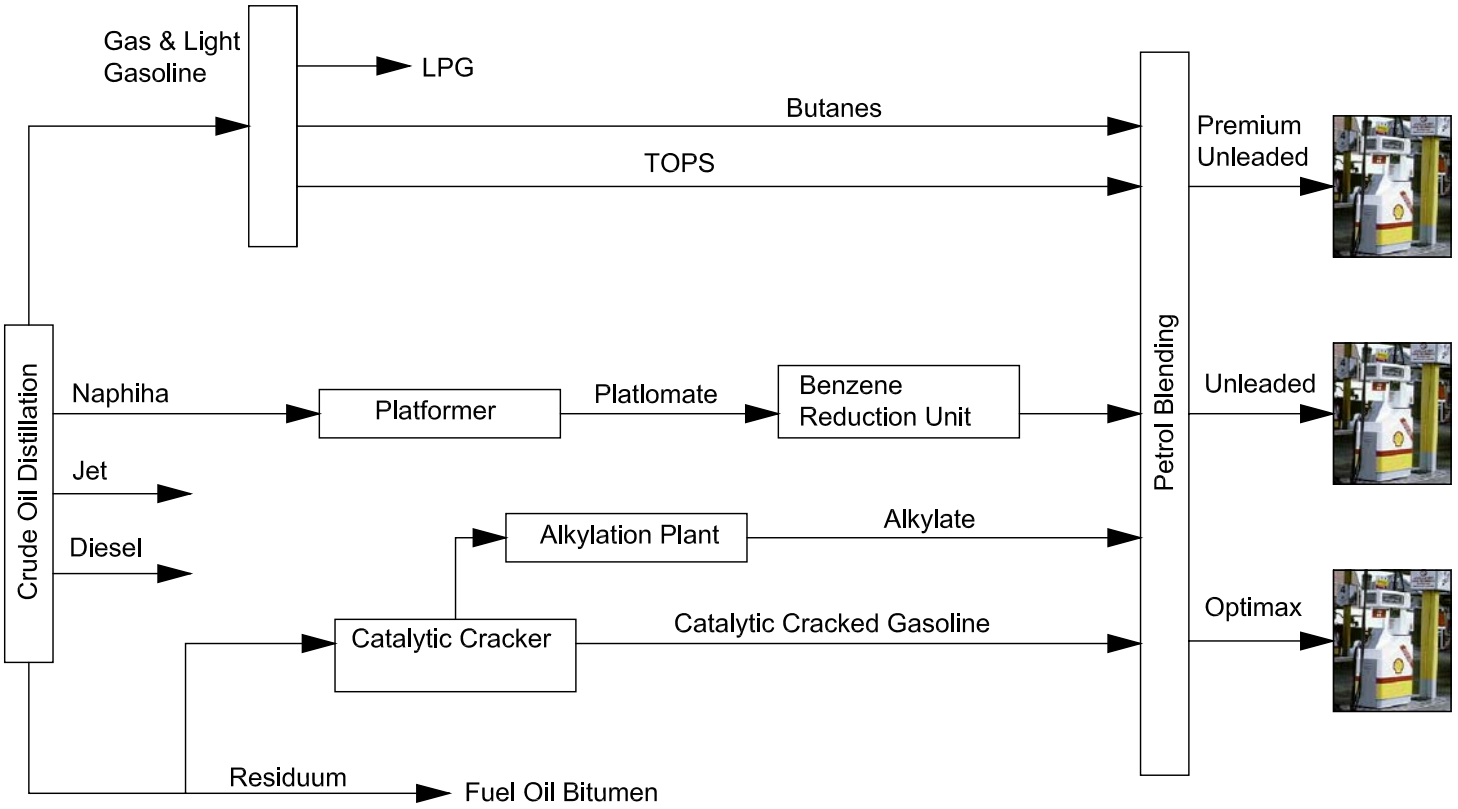


Figure 4.1
Existing Petrol Blending Process

4.5 Traffic Generation

The current level of normal vehicle movements per day that are associated with the combined Shell/Basell sites are as follows:

- 220 cars
- 250 fuel tankers
- 50 LPG or bitumen trucks
- 20 raw material and 20 product tankers to the Basell facility
- 50 delivery vehicles
- 3 fuel trains of 15-20 rail tank cars.

Major maintenance overhauls occur on the Refinery site every three to four years. During these times, an extra 300 to 400 workers are present on the site for a period of around two months without any adverse impact.

The size of Clyde Refinery workforce and hence the traffic load on access roads has fallen over recent years as technology utilised at the Refinery has improved. In the early 1980s, the Refinery employed approximately 800 personnel compared with current levels of around 530 people (staff and contractors).

4.6 Site Location and Access

The FCCU is situated south of Devon Street, and would be accessed via Durham Street and Devon Street (see **Figure 1.1** and Figure 1-3).

The wharf to which the major FCCU components would be delivered is located at the north east corner of the Refinery, at the confluence of Parramatta River and Duck River.

4.7 Existing FCCU Operations

The FCCU converts heavy oil from the crude oil into predominately Petrol and LPG. The site is concreted and equipped with a drainage system. The drainage system collects stormwater and diverts it to the Refinery interceptors via a CPI. It is then sent to the Refinery's waste water treatment plant for treatment prior to re-use or discharge.

There are three main components to the existing FCCU, the reactor, the stripper and the regenerator. Each component's role in the FCCU process is discussed below.

Reactor

The reactor is the main vessel in which the conversion from heavy oil into more valuable products takes place.

Hydrocarbon feed from numerous sources is vaporised and fed into the reactor liftpot. It is kept atomised by a constant injection of steam from the No. 8 boiler. The hydrocarbon feed is then mixed with regenerated catalyst (silica alumina) in the reactor vertical riser where a chemical reaction creates the "cracking" effect. During this process coke is formed on the catalyst.

A twin drum separator separates the catalyst and hydrocarbons. At this stage the hydrocarbons still contain catalyst fines and are transported to the secondary reactor cyclones where most of the catalyst is removed. The hydrocarbons are then sent to downstream equipment, the fractionator, where distillation of the hydrocarbons takes place (see **Figure 4-2**).

The catalyst is sent from the reactor's twin drum separator and secondary reactor cyclones to the Stripper liftpot.

4.7.1 Stripper

The stripper receives the catalyst and removes any hydrocarbons which were not separated in the twin drum separator. Steam is injected into the stripper liftpot where it "strips" the hydrocarbons from the catalyst. This takes place in the stripper vessel. Any vapours are sent to the fractionator, via the reactor, for distillation (see **Figure 4-2**). The catalyst is then sent to the regenerator.

4.7.2 Regenerator

The spent catalyst is sent to the regenerator where air is injected to burn the coke from the catalyst. Coke is formed from imperfect evaporation and coke precursors in the feed. The regenerated catalyst is sent back to the reactor liftpot to be recirculated through the process. Flue Gas is a by-product of this process and gets sent for further processing where cyclones remove catalyst fines. As the flue gas is hot, it is directed to a waste heat boiler to generate steam. The flue gas is subsequently vented to atmosphere via the No.8 boiler stack (see **Figure 4-2**) in accordance with air emission limits set by Shell's EPL. The catalyst is typically not visible from the stack, but a slight yellow particulate plume may be seen on a clear day when the stack is between the sun and the observer.

4.8 Maintenance Activities

To ensure that the Refinery's operates reliably, Shell has a maintenance program for all major operating units. The following section describes the maintenance activities associated with the FCCU.

4.8.1 Major Shutdowns

Shutdowns

The FCCU is turned off every four years for maintenance. This activity is known as a "planned shutdown" and is followed by a "startup". For environmental, safety and technical reasons, a shutdown happens over a

number of days (typically up to seven days). The typical shutdown procedure is as follows:

1. The hydrocarbon feed is removed from the Unit and replaced with steam to purge the hydrocarbons from the Unit. Steam is directed to the fractionation section where it is condensed, treated and returned as process water to the site. Excess water is treated in the biotreater and used as make-up for the cooling water tower.

2. Once the hydrocarbons are displaced, isolation is provided between the reactor section and fractionation section (to prevent back flow of residual hydrocarbons from the fractionation section back into the reactor).

3. Catalyst circulation and air injection to the regenerator is maintained to burn residual coke from the catalyst. Once the coke is removed, the catalyst is transported from the Unit to the catalyst storage hoppers. During this process air is vented and there is some catalyst loss as fugitive emissions. Once the Unit is removed from the regenerator system, air flow to the regenerator is stopped.

4. Steam purging through the reactor to atmosphere is continued for 1-2 days to cool down hot coke (~500C) in the reactor. This will be minimised with the new reactor design as the new reactor will not generate as much coke as present with the current Unit. Cooling is required as coke can spontaneously ignite when opened to air atmosphere.

5. Once cool, steam cooling is stopped and Unit is opened to atmosphere for inspection and maintenance.

Startups

The typical start-up procedure is as follows:

1. Introduce hot air to the Unit and commence with heat up and dry-out of the Unit. In most cases this is to allow curing of the refractory. Hot air is vented to atmosphere through silencers.

2. Once the Unit is hot, the catalyst is loaded from the spent catalyst hopper and returned to the regenerator only, maintaining air flow through to the regenerator and out to the flue gas system during this period. As air is exiting via the flue gas system it passes through all regenerator cyclones.

3. Steam is introduced to the reactor side venting to atmosphere to keep the Unit warm. Steam is vented via dedicated silencers.

4. Once the steam is in the reactor (and free of air), the flow path from reactor to fractionation section is opened and steam is forced across

into the main fractionators to be condensed and recovered as per shutdown procedure.

5. The catalyst circulation is then established on the Unit, using steam or air to move the catalyst around.

6. Once the catalyst circulation is steady, feed is reintroduced to the Unit and the Unit is stabilised.

Unplanned shut-downs

If there is a technical problem with the Unit (for example loss of feed to Unit, loss of instrument air/power, problems with the regenerator), an unplanned shutdown would be required. Unplanned shutdowns are infrequent; the last unplanned shutdown occurred in early 2000. An unplanned shutdown generally follows the same process as that for the planned shut-down, detailed above.

The startup and shutdown procedure would not change for the proposed operations.

4.8.2 Catalyst Unloading

During normal operation, catalyst unloading occurs at a small rate of approximately 2-3t/day. A lesser amount of air is required to push the catalyst into the hopper resulting in minimal generation of particulate emissions.

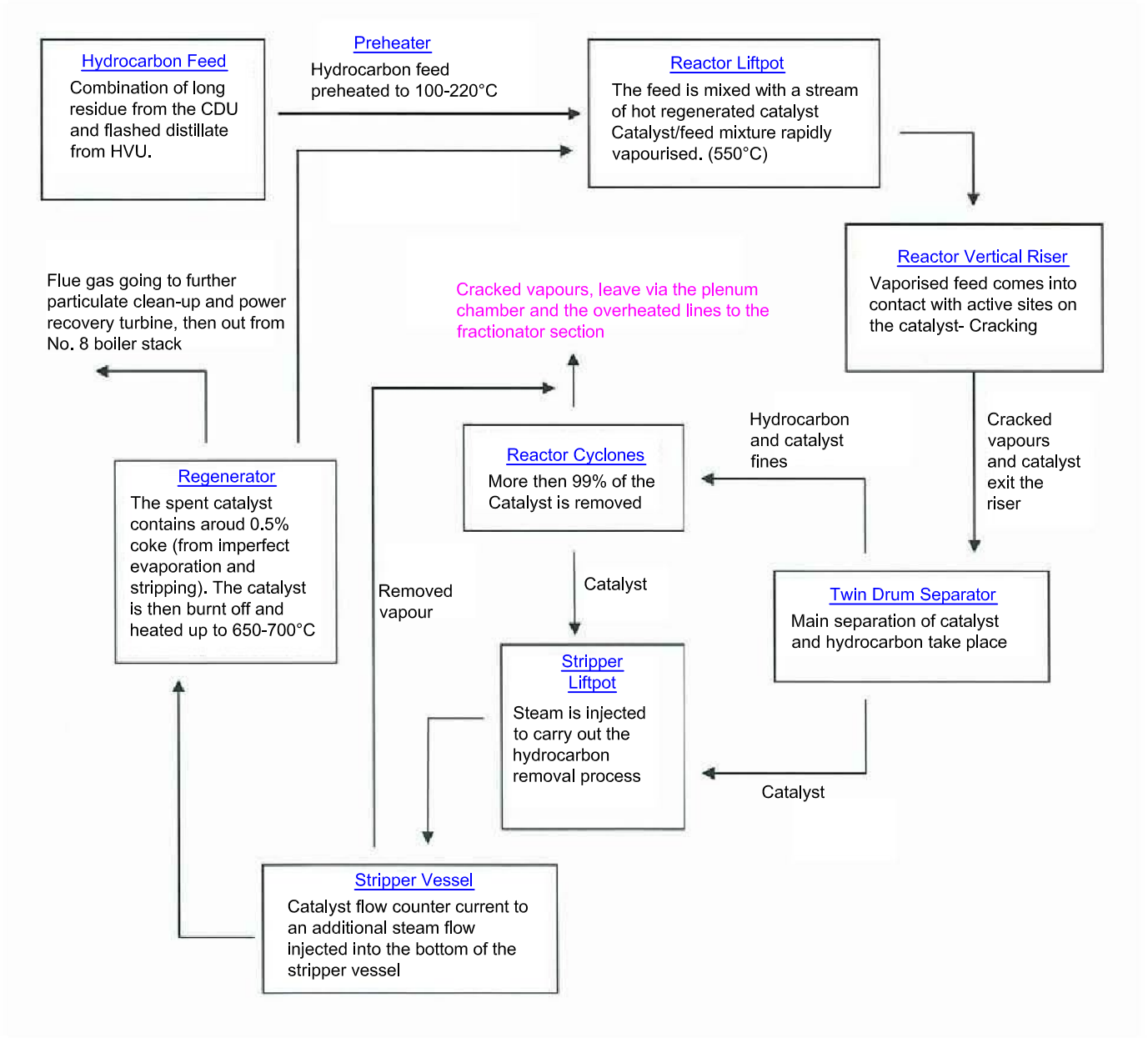


Figure 4.2
Process Flow Diagram of Existing FCCU Operations

5 Project Need and Alternatives

5.1 Need for the Project

The FCCU was commissioned in 1962 and has been in operation since 1963. Gradual wear and tear on the FCCU has resulted in the reactor vessel and stripper vessel reaching its final stages of efficient operability, with increased maintenance frequency and duration now required to enable proper operation. As a result of the deterioration of these key components, it has become necessary to replace these components in the near future.

In addition, the cyclones located within the regenerator also need to be replaced. While still performing adequately, the cyclones have been in operation for over 24 years and the opportunity is being taken to replace proactively given their age and service due to the fact that they are critical environmental control devices.

With this replacement, the opportunity would be taken to increase their capacity to allow additional coke burning capacity from the regenerator. This would be achieved by re-instating the 8th cyclone set located within the regenerator, which is currently blanked off due to the lower air flow.

Allowing increased capacity allows for increased product conversion in the reactor side and hence increases yield of more valuable products such as petrol or diesel. This reduces the need for recycling of the unconverted hydrocarbons from the reactor, reducing energy associated with processing and the cooling and heating of the recycled streams.

5.2 Benefits of the Project

Replacement of the reactor vessel, stripper vessel and miscellaneous components would result in the following benefits:

- Continued and reliable operation of the FCCU, allowing petrol production to service Sydney to be maintained
- More modern, reliable design reducing the amount of downtime due to maintenance and/or repairs as well as associated gas flaring with unplanned shutdowns
- Improved Unit efficiency and conversion for the same production intakes and elimination of waste streams
- Significant reduction in process inventory of flammable material from 890m^3 to 300m^3.

Reduction in coke formation would result in the following benefits:

  - reduction of coke waste build up in reactor from approximately 200t to 5-10t of coke waste every 4 years

  - Elimination of the difficult task of removing 200t of coke from within the reactor (an activity that requires working in confined space for up to 15 days), thus eliminating exposure to such high risk activities
  - Improved reliability as coke has tendency to fall and plug catalyst circulation lines. Such incidents can lead to increased flaring from the Unit, which would be eliminated with the new design.
- Significant reduction in energy (steam) consumption resulting in reduced steam demand and fuel gas consumption from Refinery boilers
- Reduced air emissions per tonne of product produced.

Increasing the coke burning capacity of the regenerator through the replacement of cyclones would result in the following benefits:

- Increased conversion/efficiency from the reactor section, thus increasing Petrol yield for same feed intake
- Increased conversion reduces the need for recycling of unconverted streams with the associated energy cost of recycling
- Extra energy associated with the increased generation of flue gas from the regenerator would be utilised to produce steam in the No. 8 boiler, thus reducing fuel gas firing at No.8 and other boilers, and associated emissions from the remaining boilers. This results in net reduction in NOx emissions.

5.3 Alternatives

5.3.1 "Do Nothing" Option

An alternative to this Project is the "do nothing" option which involves keeping the existing reactor and stripper components. The consequence of this option is an increase in more frequent maintenance periods or turnarounds (TA).

Such TAs:

- Are costly due to the need to import finished products into Sydney for significant periods
- Are timely due to the lengthy time required to remove the coke from the reactor
- Maintain the safety risks associated with the coke removal from the reactor
- Increased potential for flaring due to poorer reliability of the older Unit.

The process of coke removal is a difficult task with inherent safety issues associated with working within a confined space.

This alternative would ultimately result in the reactor and stripper coming to the end of their lives and replacement would still be required in the near future. This is less preferred as this option would result in more frequent down times and inconsistent and unreliable production and therefore supply of fuel. It would also fail to achieve the benefits outlined above.

5.3.2 Alternative Design Options

Current design

Consideration was given to replacement of the reactor and stripper with the same design. This option was rejected on the following basis:

- It would not improve the safety concerns associated with the removal of coke from the reactor
- Costly due to the larger reactor size
- Would not reduce hydrocarbon inventory
- Would not reduce steam, water or stack emissions.

Alternative Designs

Other design options available to Shell included those designs currently in use at over 30 existing sites which are part of current Shell operations. In addition, approximately 5 new units have been designed in the last 20 years which were considered for this project.

A detailed option review was undertaken by Shell Clyde Refinery with support from Shell Global Solutions. The chosen design is a copy of an existing Unit in the UK which has been in operation since 1986. It has proven to be reliable therefore minimising any technical or reliability risks associated with new designs.

As a result, the "do nothing" option of repairs and maintenance was deemed environmental and economically unviable. The chosen design was preferred for the following reasons:

- Proven and reliable design which was deemed critical to enable Clyde Refinery's future production capability
- Lowest coke formation potential out of all designs reviewed
- Allowed for easiest integration into the existing Unit
- Economically viable.

6 Description of the Project

6.1 Overview

The Project seeks to replace the Reactor and Regeneration (R&R) components of the FCCU (refer **Section 4.7**). As only the Reactor and Regeneration Unit is impacted by this Project, this document focuses on this specific Unit within the FCCU, as the downstream units are unaffected by these modifications.

The Project seeks predominantly to restore the integrity of the FCCU by replacing critical components rather than current practise of expensive and extensive repairs at planned maintenance intervals. Given the importance of this Unit in producing petrol for the Sydney Market, this Project would therefore ensure on going viability for the site and its approximately 530 staff and contractors. It is expected to be completed by the end of June 2008 subject to approval, and would cost approximately AUD $77.77 million.

The throughput and operation of the existing FCCU complex would remain essentially unchanged as the proposed replacement essentially replaces the existing components with the new, updated components. The use of modern equipment design allows significant reduction in water and energy consumption as well as hydrocarbon inventory within the system, i.e. reduction in hazards as well as improved Unit efficiency.

Clyde Refinery is managed in accordance with the local legal requirements, Shell global standards as well as the Refinery's HSEQ Management System, which is certified to ISO9001, ISO14001 and AS4801.

6.2 Timing and Project Staging

A maintenance shutdown of the FCCU complex has been scheduled for the second quarter of 2008. It is over this shutdown period the upgrade of the R&R Unit is expected to take place. The various stages of approval necessary to ensure the timely and successful upgrade of the project are as follows:

- Internal approval for order of the reactor vessel, stripper vessels and any other necessary components was given in April 2006 to ensure sufficient time to procure these components as well as the labour required to satisfactorily conduct the upgrade
- Scope finalisation as well as the completion of Engineering and HAZOPs by July 2006 to allow full financial support to be obtained in August 2006
- Manufacture of equipment would take place from mid 2006 to late 2007
- Construction and installation of new equipment would take place during the planned site-wide maintenance period in Q2 2008
- Start-up in Q2 2008.

6.3 Scope of the Project

Specifically, the FCCU Upgrade Project is a two-part project, involving:

- The upgrade of existing components (85% of the Project) of the Refinery associated with the FCCU to ensure ongoing integrity of the FCCU
- Synergetic projects (15% of the works) associated with the regenerator capacity to allow for more efficient operation and production .

The upgrade of the FCCU specifically relates to the reactor and stripper, ensuring the integrity of Unit to allow ongoing operation. Minor upgrades would include miscellaneous large bore piping and control valves to maintain the integrity of the units.

The synergetic projects involve the increase of the coke burning capacity of the regenerator which would result in an increase in production efficiency. This is achieved by replaced of the aged cyclones within the regenerator with more modern efficient cyclones.

6.3.1 Project Scope

Reactor and Stripper

The proposed upgrade to the FCCU includes the replacement of the reactor and stripper with a more modern and efficient design, including the larger associated piping connecting the equipment (see **Figure 6.1**). The new reactor and stripper would run under the same operating conditions and at the same levels of production input and output as the old Unit (see **Sections 6.3.2** and **6.3.3**). The proposed new reactor and stripper component would be a combined single vessel allowing gravity to move the catalyst from the reactor to the stripper, rather than needing stream which is currently required. In addition, the new proposed design is substantially smaller and is therefore less prone to coke formation. See **Figure 6-1** and **Figure 6-2** for a comparison of the elevation of the existing reactor, stripper and regenerator and the elevation of the new combined reactor and stripper vessel and regenerator.

Replacement of Equipment and Associated Regenerator Capacity Increase

Like the reactor and stripper, other pieces of equipment are approaching the end of their operational lifespan. The following additional pieces of equipment would also be replaced:

- Four large specialised control valves used in both the catalyst transfer system as well as overheads of the regenerator

- All cyclones within the regenerator due to the cyclones approaching end of their lifespan. This replacement would be a proactive measure to prevent future failure during operation, which could lead to an increase in catalyst loss to atmosphere and unplanned shutdown of the Unit. At present, not all the cyclones are utilised within the regenerator and these non utilised cyclones would be brought back into service to allow increased capacity from the regenerator.
- Additional cyclone capacity is required to handle the additional flue gas produced from the extra coke being burnt. Apart from the additional cyclones returning to service, the new cyclones would be like-for-like replacement given the good performance of the existing cyclones (24 years in service achieving high catalyst recovery efficiencies), though enhanced with some modern mechanical design principles.
- Modifications to the orifice chamber (vessel) in the regenerator overheads flue gas system, to accommodate increased flue gas flow. The modified design would be similar to the existing design, with slight internal modifications to accommodate the additional flue gas flow from the regenerator.
- Minor upgrade to No. 8 boiler (increased air blower capacity and relief valve sizing) to be able to handle the additional flue gas produced from the regenerator. This would enable full utilisation of the regenerator flue gas heat and energy. In addition, other boilers would be able to operate at lower capacities, therefore achieving fuel savings and reduction in air emissions.

In addition, the project will involve the demolition of an old brick change shed 10x5x3m and lift/stairwell on the FCCU area. The lift would be rebuilt with a smaller capacity to hold approximately three people.

As indicated above, the changes to the above equipment, which are approaching the end of their operational life spans, provide an opportunity for Shell to implement modern design to improve their capacity. This would result in improved efficiency from the FCCU, stemming from increasing reactor conversion, which is only possible if the regenerator can accommodate the additional coke that is formed within the reactor.

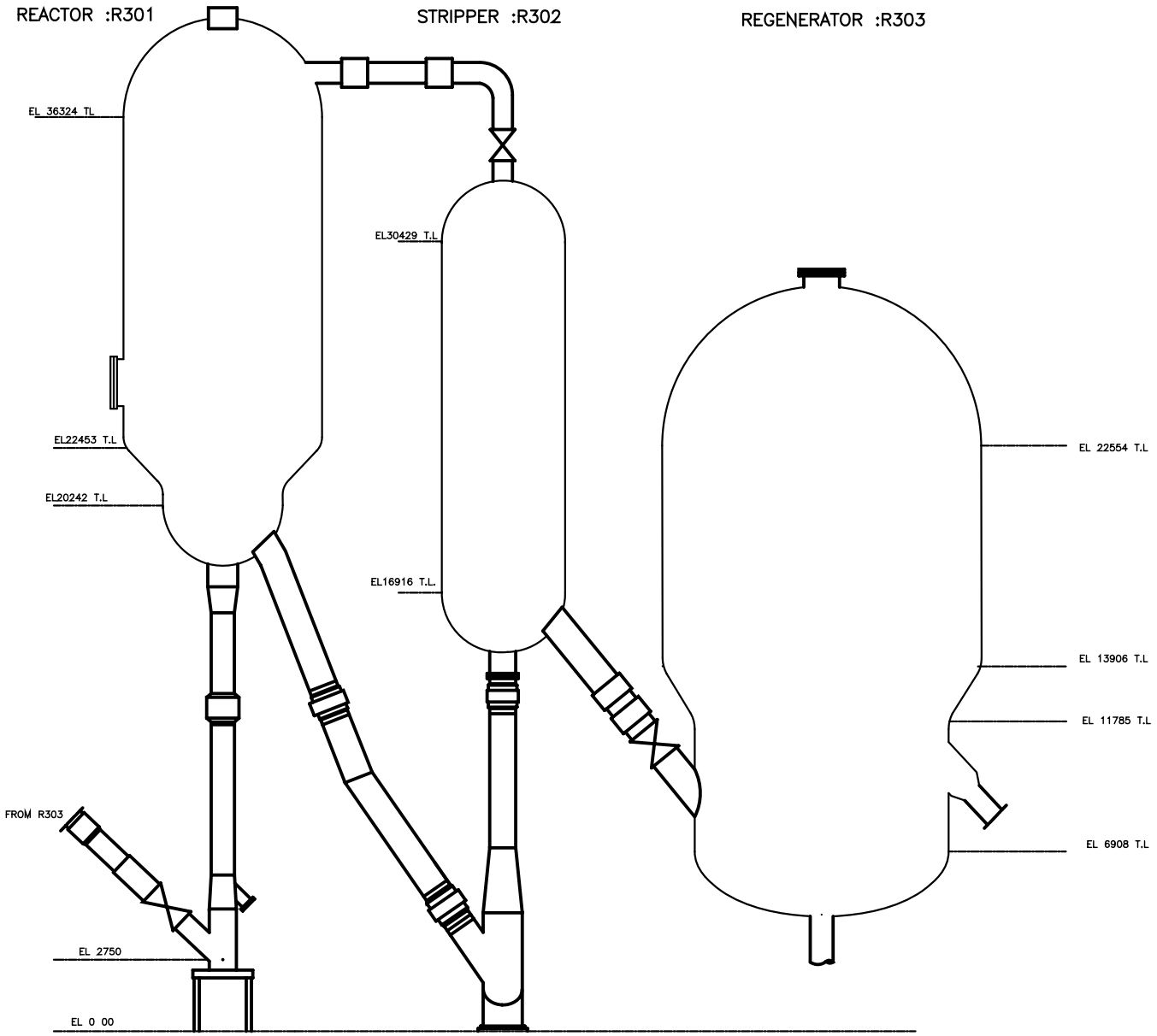


Figure 6.1
Elevation of Existing Components

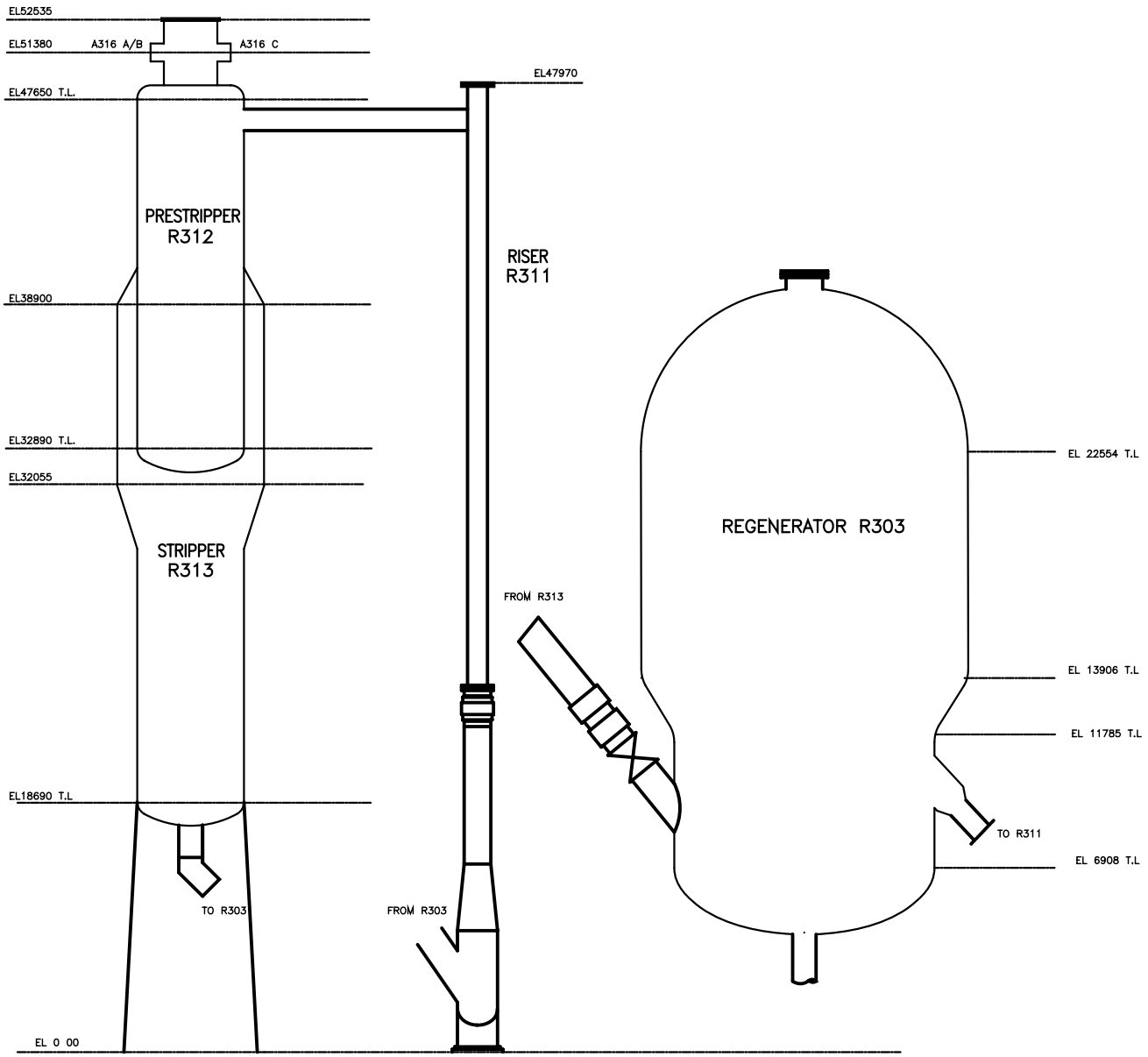


Figure 6.2
Elevation of New Components

6.3.2 Production Inputs

Hydrocarbon feed and a catalyst are the main production inputs for the FCCU (see **Figure 4-2** for a flow diagram of the FCCU operation).

Hydrocarbon feed

Hydrocarbon feed is a heavy product from the crude oil. The crude oil is treated in a distillation process in the atmospheric Crude Distillation Unit (CDU) which separates crude into numerous products, including a heavy fraction called long residue. This long residue makes up part of the hydrocarbon feed to the R&R or it can be sent to the High Vacuum Unit (HVU) for further distillation if required. The HVU, like the CDU, separates the long residue into fractions/products, including a stream called "flash distillate".

The flashed distillate and long residue are mixed and fed into the reactor of the R&R section. Known as "hydrocarbon feed', it is heated to 150-220C and injected into the reactor via a feed nozzle. This liquid feed upon contact with the hot catalyst vaporises, allowing reaction to take place with the catalyst.

Steam

Steam is used to assist with feed atomisation as well as within the stripper to aid hydrocarbon removal from the catalyst before being directed to the regenerator.

Air

Air is used in the regenerator to burn coke from the spent catalyst from the reactor/stripper. Heat produced from the combustion is used to maintain the catalyst at the required temperatures necessary for reaction with the reactor.

Catalyst

The final key production input is the catalyst. The FCCU requires a catalyst to assist in the conversion of the hydrocarbon feed into the final product. Silica alumina, a solid acid catalyst is mixed with the vaporised hydrocarbon feed. Approximately 3-4 tonnes of day of fresh catalyst are required.

The production inputs would be for a maximum intake up to 5500t/d of reactor feed. At this maximum rate, the following inputs are required:

- Additional electric power at 0.25MWhr/hr (a 1-2% increase for site)
- Steam at 3t/hr (15% reduction from existing FCCU and a 2% reduction for site)
- Long Residue feed up to 5500t/d (no change)
- Air at maximum of 4500t/d (25% increase from existing operation, but with original design of air blowers)
- Fresh Catalyst at 3-4t/d. (no change).

Production inputs would not change as a result of the proposed upgrade, except for the air flow which would increase by 25% (1-2% compared with existing operations on a Refinery wide basis). This additional air can be supplied with the existing air blowers, with the original design capacities now being realised.

6.3.3 Production Outputs

The outputs would be for a maximum intake up to 5500t/d of reactor feed. At this maximum rate, the following outputs are produced:

- Waste water 3t/hr (10-15% reduction for FCCU(5-10% for site)) associated with steam used in Reactor/stripper
- Petrol representing approximately 40-50% yield from the hydrocarbon feed, would increase by ~5%
- Diesel representing 15-20% yield from the hydrocarbon feed, would reduce by ~5% yield
- Fuel Oil representing 5-10% yield from the hydrocarbon feed, would reduce by ~5% yield
- LPG representing 15-20% yield from the hydrocarbon feed would increase by ~4.5% yield
- Fuel Gas representing 3-3.5% yield from the hydrocarbon feed, would increase by 0.5% yield
- Spent/waste Catalyst fines at 3-4t/d (no change)
- Flue Gas from regenerator/boiler.

The Project would result in the generation of outputs in greater market demand, including gasoline, increasing by 5%, with other products with a lesser market demand, such as fuel oil reducing by 5%. In addition, the improvement in efficiency means that emissions, when expressed in tonnes of emissions per tonne of petrol product produced remains constant.

6.4 Decommissioning and Construction Phase

An extended shutdown would be required for the planned turnaround of the FCCU complex to implement the proposed changes. During this turnaround, the remainder of the Refinery (Crude Complex) would be kept operational for the majority of the turnaround, which would assist in making the required products as per market demand. The product shortfall would be covered by the importation of products and blending components via the Shell supply network, which is standard practise during such turnarounds. This coverage will be provided from the Australian and wider Asian Envelope and will include appropriate contingencies to avoid supply disruptions.

Construction activities would involve decommissioning of existing equipment and construction of the new components of the FCCU, as well as a commissioning phase (see **Section 6.5**).

6.4.1 Decommissioning Activities

As the Project involves the upgrade of the reactor and stripper vessels the old reactor and stripper vessels would need to be decommissioned. This would firstly involve hydrocarbon decontamination, followed by coke removal (200t) from the old reactor as per current activity during planned turnaround, and thereafter the reactor/stripper would be lifted and removed from its existing foundations.

The old reactor/stripper may be cut in two to facilitate removal. This can be undertaken by water jet cutting.

A crane with the capacity to lift 1,600t would be required to lift and remove these components from their current position. Prior to the lift, surrounding piping and infrastructure (including large bore piping and control valves) would be removed to facilitate the removal of the equipment. The old reactor/stripper may then be moved to a suitable location on site to allow reactor/stripper to be cut into workable pieces to allow recycling.

For the regenerator cyclones, these would be removed by cutting the top dome of the regenerator and lifting the dome and cyclones to ground level where replacement would occur. The old dome, with new cyclones, would be lifted back into position and re-welded into position. Removal would be done by water jet cutting or oxy cutting. Once removed, a crane would be used to lift the old cyclones into a truck/container to facilitate metal recycling.

An old change shed (with dimensions 10x5x3m) in the FCCU area would be demolished to allow space for the crane to be assembled. It is a brick building with a concrete floor. This floor would be retained so excavation would not be necessary. If current investigations reveal asbestos in the rooking material, the shed would be demolished by appropriately qualified AS1 accredited contractors.

In addition, an old lift which would be demolished has been identified as containing asbestos fibro sheeting around the lift well. This process would be managed by appropriately qualified contractors (see **Section 6.4.2**).

6.4.2 Decommissioning Waste Handling and Site Remediation

The reactor and stripper vessels would be removed by a contracted recycling company to recover the metal for re-use. Insulation associated with the old reactor/stripper and other equipment and any other refractory materials which cannot be recycled would be handled in accordance with current site licence requirements for waste disposal under EPL No. 570.

As the new reactor, stripper vessels and other equipment including all piping and cyclone components would replace existing components, existing foundations would be utilised. In addition, the laydown area used is covered in concrete, bitumen or gravel. Therefore, no soil is expected to be disturbed curing decommissioning and therefore site remediation would not be necessary.

Polychlorinated Biphenyls (PCBs)

As part of the Project, a transformer for Air Blower No.8 would be removed. Although recent testing for PCBs has not been undertaken for this transformer, Shell would take a conservative approach and treat the transformer as PCB contaminated until proven otherwise.

The transformer and any other potentially PCB contaminated equipment would be classified, handled, transported and disposed of in accordance with the PCB CCO, as well as Chapter L7 of Shell's EPL 570. The PCB CCO and EPL 570 requires Shell to investigate all PCB contaminated equipment over 50mg/kg (Scheduled PCB wastes and materials) on the premises and to outline timing issues and options for the removal of all priority and non-priority PCBs.

A PCB Removal Plan for the Clyde Refinery is currently being prepared. A draft Removal Plan for all PCB contaminated equipment at the Clyde Refinery has been completed by Shell and would be submitted to the EPA for its approval. The Removal Plan would include directions on the removal and disposal of transformers and incorporates Shell's own "Guidelines for Safe Handling and Disposal of Polychlorinated Biphenyls (PCBs) 1985". These guidelines provide detailed information on the safe handling of PCBs, controlling PCB equipment, safe-working practices, how to handle spills as well as the transportation and disposal of PCB equipment.

Asbestos

As part of the Project, an old change shed would be demolished. There is potential for asbestos contamination in the change shed's roofing material. In addition, an old lift with asbestos fibro sheeting around the lift well would also be demolished. In accordance with Chapter L8 of Shell's EPL 570 and the Protection of the Environment Operations (Waste) Regulation 2005, Shell would detail measures in the project's Construction Management Plan, Safety Management Plan and Waste Management Plan to handle, transport and dispose of asbestos waste appropriately. The plans would include mitigative measures to reduce potential exposure to asbestos contaminated materials, such as dust suppression techniques.

6.4.3 Construction Methods and Equipment

Construction methods would involve:

- Fencing and signage of the laydown site at the wharf (see Section Temporary Works)

- Signage of the construction laydown area at the R & R location
- Securing crane support pads
- Removal of old equipment
- Replacement with new equipment and connection to existing equipment.

As the new equipment would be replacing old equipment, no excavation would be necessary as existing foundations would be utilised.

Construction equipment associated with the proposed development would include:

- Trucks
- Two small cranes
- Two large cranes
- One 80m crane requiring the other cranes to assemble it on site
- Two impact wrenches
- Two compressors
- Oxy cutters
- Ten (10) portable welders
- One (1) water jet cutter.

The crane with a capacity to lift 1,600t would be used to remove the old reactor and stripper from their current position and would also be necessary to lift the new reactor and stripper into place.

A water jet may be necessary to cut the old reactor and stripper into pieces to enable safe removal of the old components in smaller pieces.

6.4.4 Construction Materials and Procurement

The new reactor and stripper would be manufactured by a specialised vendor who is expected to be selected in late Q2 2006. Manufacture of the equipment is expected to take place from the later half of 2006 to late 2007. The new major pieces of equipment would be transported via sea cargo directly to the Refinery wharf 1-2 months before the scheduled maintenance period begins and then transported to R&R site via internal shell roads within Shell.

6.4.5 Construction Laydown Areas

The first construction laydown area would be located immediately south of the existing FCCU where the crane and other major equipment and bulk material would sit during the course of the proposed upgrade and maintenance. This area (approximately 25mx35m) was used during the initial construction in 1962, and has been used since this period for routine maintenance. It is a dedicated area with proper foundations and crane pads

for the placement of heavy equipment and cranes. Preliminary assessment of the area by a specialised lift contractor, Mammoet Australia Pty Ltd in February 2006, has confirmed that this existing area is adequate for the work to be undertaken.

It is expected that the same crane would be used for the removal of the old reactor and stripper vessels and installation of the new single reactor stripper Unit.

The new reactor/stripper would arrive on site in early 2008. The reactor/stripper would be dressed (i.e. platforms/ instrumentation/ small piping added) prior to moving it to the R&R site. This laydown/dressing area would be at the Refinery wharf area, the same area where the reactor/stripper would be delivered by barge.

This large area was used as the laydown area for previous projects and hence no further work/modifications are expected to this area. From the wharf, the reactor/stripper would be transported to the R&R site by internal roads.

The other key lay down area is located immediately east of the Main office. This area would be used for some of the structural steel pre-assembly. This area is fully concreted and requires no excavation.

The preliminary internal route for the transportation and construction laydown areas is shown in **Figure 6-3**.

6.4.6 Temporary Works

It would be necessary for the new reactor to be transported to Shell's Clyde Refinery by barge, up the Parramatta River to the Refinery wharf at the junction of the Duck and Parramatta Rivers. This is a one-off movement as the old reactor would not be removed via the barge but would be cut in two for easy removal and transport via road for recycling.

The barge would be a similar size as the barge utilised for the Shell Mogas Improvement Project (2005), which required the transportation of components via the Parramatta River. As a result, previous dredging already undertaken is expected to be adequate for this Project. However this can only be confirmed six months prior to arrival of the barge, at which stage proper processes would be followed for approval for maintenance ploughing (see **section 8.4.3**).

Although maintenance ploughing maybe likely, any activity would be minor and would not have a significant impact on the environment.

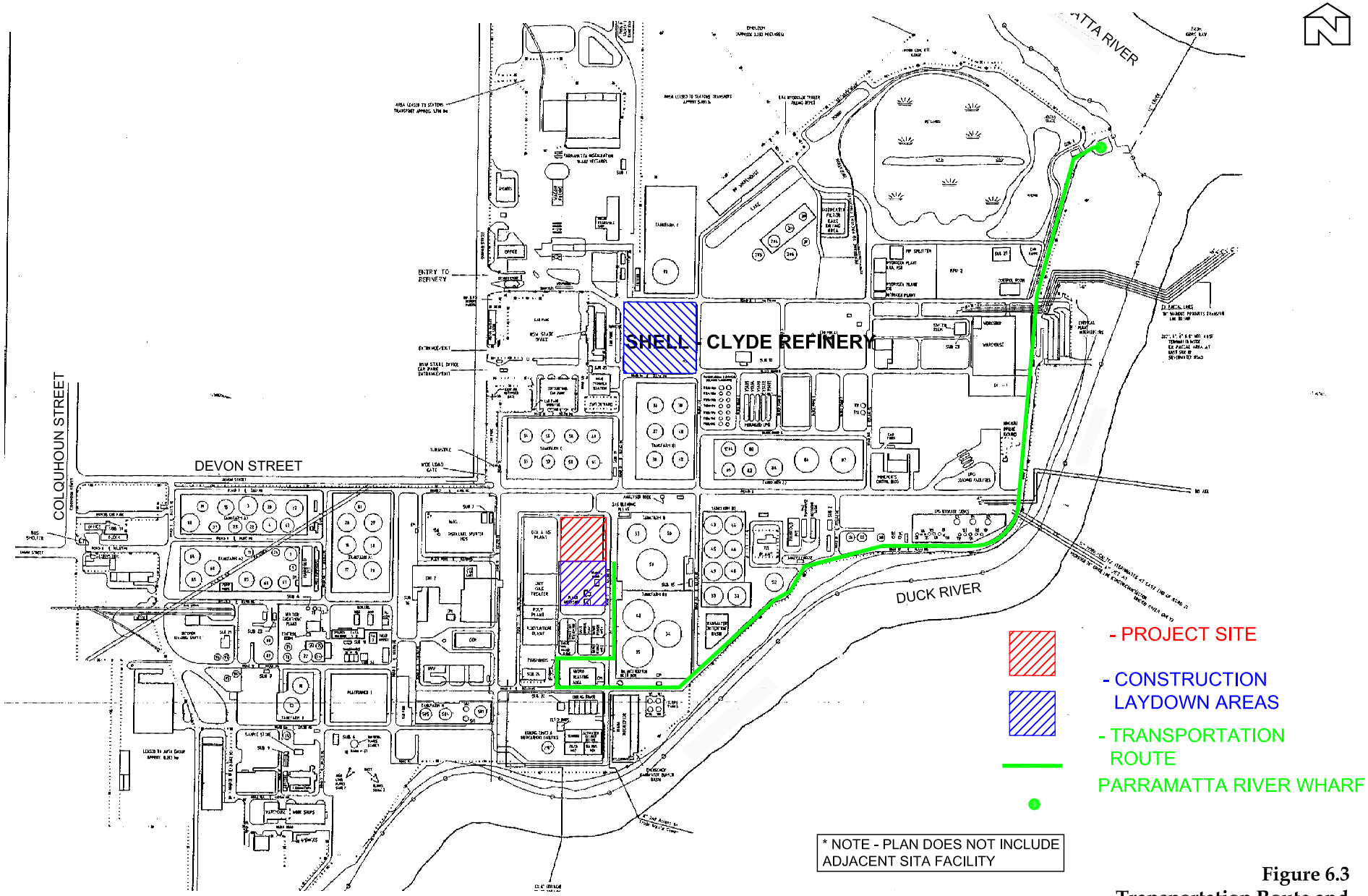


Figure 6.3
Transportation Route and Construction Laydown Areas

6.4.7 Construction Waste

General construction waste would be classified and managed according to the *Environmental Guidelines: Assessment, Classification and Management of Liquid and Non-Liquid Wastes* (NSW EPA, 1999). See **Section 8.6.1** for further construction waste details.

All wastes would be tracked as necessary in accordance with EPL 570.

6.4.8 Number and Management of Construction Personnel

The construction workforce would increase by approximately 25 additional contractors during the lead up to the shut down. During the upgrade and maintenance of the FCCU over the 2-3 month period, an expected 500 additional contractors would be required. A job safety analysis would be undertaken at all levels so that all additional construction and maintenance contractors, whatever their task, are managed to appropriate safety standards.

6.4.9 Construction Traffic

During the construction phase, traffic movements would increase owing to the presence of construction personnel and the movement of heavy components. Traffic associated with the construction phase has been estimated to involve one-off transport of the new equipment via barge to Shell's wharf at the junction of Parramatta and Duck Rivers. From there it would be transported via internal roads to the FCCU site.

Smaller equipment would be brought to the site via road. Small control valves, large piping spools and regenerator cyclones are estimated to require 10 – 15 trucks. The removal of old equipment, namely the reactor, would be undertaken by a contracted third party. Any old equipment would be transported via road off site and disposed of appropriately.

In addition, car traffic associated with approximately 500 construction and maintenance contractors during the 2-3 month period would result. However the construction and maintenance period is relatively short and maintenance of this size is conducted every four years on a regular basis and has been effectively managed. Traffic would also be divided between day and night shift and so not all occurring at the same time.

6.5 Commissioning Phase

Commissioning of the FCCU would be completed by the end of June 2008.

The commissioning phase for the new reactor and stripper as well as the upgraded regenerator is not expected to introduce significant environmental issues, as the process remains essentially unchanged, for which the operations department are familiar with. The major activities that would be undertaken during start up activities for the FCCU include:

- Close out of all identified process hazard mitigation actions
- Commissioning and testing of R&R safety systems by Shell specialists
- Proceed thereafter with normal start-up procedure as per normal start-up following major planned maintenance.

Start up of the FCCU is expected during the second quarter of 2008.

7 Environmental Risk Assessment

A Major Project Application accompanied by a Preliminary Environmental Assessment, prepard by Shell, was submitted to the Department of Planning (DoP) to determine whether the proposed development was a project to which Part 3A of the Act applies (see **Appendix A**). The DoP subsequently issued Environmental Assessment Requirements (EARs), in accordance with Part 3A (see **Appendix B**) **.**

The EARs stipulated that a general environmental risk analysis be undertaken to identify potential environmental impacts. In accordance with this requirement, a general risk analysis has been undertaken, based upon the Preliminary Assessment.

7.1 Environmental Setting

7.1.1 Existing Land Uses

The Shell Refinery at Clyde has operated as a refinery since the 1920s. Individual process and structures have been constructed and demolished since then, however the site's character has remained an oil refinery from its origins. Visually, it is characterised by pipes, vessels, tanks, columns, flares and stacks.

Clyde Refinery is located in the Camellia Industrial area (see **Figure 1.1**). All adjoining properties are utilised as light or heavy industry with the exception of Rosehill Racecourse (Masterplan Consultants, 1988). Major industrial premises within the vicinity of the Refinery include the James Hardie Building Products site, the old Capral Aluminium (aluminium smelting) site, Simmons Timber, Patricks Container Freight and the Shell Parramatta Terminal, Emoleum, Sami Bitumen, Boral, Australia Gypsum and SITA Environmental Solutions.

Rydalmere and Silverwater industrial estates are located to the north and southeast of the Refinery site respectively, which effectively separates the Refinery from residential population in those directions. A variety of industrial land uses occur at Rydalmere and Silverwater although the majority consist of light assembly, manufacturing and warehousing.

Duck River is a tributary of the Parramatta River, which drains a highly urbanised and industrial catchment. The lower Duck River is a restricted waterway to all vessels. Permission for boat access in the Duck River and Parramatta River past Silverwater Bridge is required from Waterways Authority. Shell maintains a boat for maintenance and inspection purposes (EDAW, 1997).

Clyde Refinery has relatively easy vehicular access to major arterial roads serving the metropolitan area. Due to the topography of the area, the residential suburbs of Dundas and Ermington overlook the Refinery but are

approximately 1.5km away from the proposed development site. These areas consist primarily of single detached cottages, developed mainly in the 1950s and 1960s (Masterplan Consultants, 1988). The nearest residential property is in John Street, Ermington, which is approximately 500m from the Refinery boundary and approximately 720m from the proposed development.

7.1.2 Topography and Drainage

The Clyde Refinery and the general Camellia area are relatively flat and less than 10m Australian Height Datum (AHD) in elevation.

Probability flood levels for the lower Parramatta River and Duck River and general flooding characteristics of the study area were reported by Sinclair Knight Merz in, "Flood Assessment for the Proposed Benzene Reduction Unit" April 2004. According to this report, the Clyde Refinery is above the 1 in 100 years flood contours, with the only exception of the area immediately adjacent to the Duck River and Parramatta River.

Existing water retention basins in the Refinery are designed to retain 6,600m^3 of water. The development would not increase storm water run off, as the existing study area is already hard surfaced and the project would have little change on storm water run off.

7.1.3 Local Climate

On average, January is the warmest month at North Parramatta with a mean monthly maximum temperature of 28.2°C. July is the coolest month experiencing a mean monthly minimum temperature of 6.2°C.

The relative humidity observed at 9 am is lowest in September and October (63%) and highest in May (79%). For the 3 pm observations, the lowest relative humidity occurs in August and September (48%) and the highest in March and May (60%).

The mean annual rainfall is 964.6 mm. On average, the wettest month is February (monthly average 124.4 mm over an average of 12.1 days) and the driest is July (monthly average 46.3 mm over an average of 7.7 days (see **Appendix D**).

7.2 Overview

A general environmental risk assessment has been undertaken to assist in the identification of key environmental issues, which have the potential to be impacted as a result of the Project. Those risks identified in the general risk assessment are those inherent risks before mitigation measures have been implemented. Any necessary mitigation measures to reduce the potential impact on the environment are discussed in detail in the relevant section of the EA.

7.3 Identification of Environmental Impacts

Table 7-1 identifies types of potential environmental impacts and general characteristics, both adverse and beneficial, which could be impacted as a result of a Major Project development. The general outline of the assessment has been based upon the Preliminary Assessment Table 2(a) which accompanied the Preliminary Application (see **Appendix A**). Table 2(a) required the proponent to briefly analyse the extent of the potential impacts resulting from the Project.

7.4 Identification of Key Environmental Issues

A qualitative determination has been made to identify which environmental impacts are key environmental issues. If an impact is identified as a key environmental issue, it is addressed in detail in **Section 8**. If the impact is one which is not identified as a key environmental issue, it has been addressed in **Section 9.**

Table 7-1 Environmental Risk Assessment

General Potential Impacts (Adverse and Beneficial)	Specific (Project Related) Potential Impacts	Effect of Potential Impact	Predicted Impact (High/Med/ Low)	Reference
Air Quality Impacts	NO_X, SO_X, Dust (PM_{10}, particulates) VOC	Due to a predicted minor change in licensed emissions from the FCCU stack, a detailed assessment was undertaken to more accurately measure the predicted impact on air quality. Overall, emissions are expected to reduce when expressed as a tonne per tonne of product due to improved efficiency although levels of some emissions would rise slightly. Dust is expected to be generated during demolition of the old change shed and lift. Dust suppression methods would be employed to reduce dust generation. This impact is considered to be a key environmental issue.	Low	Section 8.1
	Greenhouse / ozone implications	CO_2 emissions are expected to increase marginally from the FCCU stack. Overall, emissions would remain constant when expressed in terms of tonnes of product produced. This impact is not considered to be a key environmental issue.	Low	Section 8.1
Surface Water Quality Impacts	Impacts from the use of surface water	Excavation is required for cable trenches and six small footings 3mx1m^2 for the new lift. Due to the minimal excavation required as part of this Project, surface water is not expected to be impacted. The existing FCCU site is concreted and equipped with a drainage system. The drainage system collects stormwater and diverts it to the Refinery interceptors. It is then sent to the Refinery's waste water treatment plant for treatment. This Project would not interfere with the current process. This is not considered to be a key environmental impact.	Low	Section 8.4

General Potential Impacts (Adverse and Beneficial)	Specific (Project Related) Potential Impacts	Effect of Potential Impact	Predicted Impact (High/Med/ Low)	Reference
	Impacts from changes to natural waterbodies, wetlands or runoff patterns	In the event that maintenance ploughing may be required, this has the potential to affect the surface water quality of Parramatta River. This is not considered to be a key environmental impact.	Low	Section 8.4
	Impacts from change in water quality with economic, health, ecosystem or amenity considerations	In the event that maintenance ploughing is required, the potential would exist to affect the water quality of Parramatta River. However, previous experience has shown that there would not be any adverse impact on the economy, or public amenity as a result. There is the potential to impact on the aquatic ecology in Parramatta River due to the removal or redistribution of aquatic habitat. This is considered to be a key environmental impact.	Med	Section 8.4
	Any other impacts on water or from the use or storage of water	It is likely that a water jet would be used to assist in the removal of the old reactor. This would result in the generation of a small amount of surface water. In addition, during the demolition of the old shed and lift, dust suppression techniques such as regular watering may be required to reduce the potential for dust generation. There are no other impacts on surface water as a result of this Project. Potential impacts on surface water is considered to be a key environmental impact.	Low	Section 8.4

General Potential Impacts (Adverse and Beneficial)	Specific (Project Related) Potential Impacts	Effect of Potential Impact	Predicted Impact (High/Med/ Low)	Reference
Ground-water Impacts	Impacts on groundwater	Groundwater is likely to be reached when excavation at depths of up to 3m is undertaken for footings for the new lift. Dewatering or containment of groundwater may be required and re-directed to the Refinery's Biotreater. Due to the minimal amount of excavation, groundwater is not expected to be significantly impacted. Groundwater impact is not considered to be a key environmental issue.	Low	Section 9.3
Hydrology and Flooding	Impacts from changes to flooding or tidal regimes	There would not be any impacts to this Project as there would not be any changes to the flooding or tidal regimes. The Refinery is equipped with a drainage system which collects stormwater and diverts it to the Refinery interceptors. It is then sent to the Refinery's waste water treatment plant for decontamination. This Project would not interfere with the current process. This is not considered to be a key environmental impact.	N/A	Sections 9.2 and 8.4
Land and Soil Management	Remove soil, topsoil or underlying layers	The Project requires minor amounts of soil to be excavated during the construction associated with the cable trenching and footings for the new lift. No soil is impacted during the operation phase of the project. This impact is not considered to be a key environmental issue.	Low	Section 9.1
	Degradation of soil quality including contamination, salination, acidification	Minor excavation for cabling and for footings would be required. The works associated with the minor excavation of soil is unlikely to degrade or contaminate the quality of the soil further. This is not considered to be a key environmental issue.	Low	Section 9.1
	Loss of soil from wind or water erosion	Small stockpiles may be generated as a result of minor excavation. Techniques to minimise loss of soil would be utilised and is not expected to result in a significant environmental impact. This is not considered a key environmental issue.	Low	N/A

General Potential Impacts (Adverse and Beneficial)	Specific (Project Related) Potential Impacts	Effect of Potential Impact	Predicted Impact (High/Med/ Low)	Reference
	Loss of structural integrity of soil	The Project would not cause loss of structural integrity of soil.	N/A	N/A
	Results in land instability with high risks from land slides or subsidence	The Project would not affect land stability or result in land slides or subsidence.	N/A	N/A
Noise and Vibration Impacts	Results in increased noise or vibrations	The FCCU generates noise during its operation and the Project is limited to the replacement of static equipment only. As a result, the Project's impact on noise must be considered and a noise assessment has been undertaken. This impact is considered a key environmental issue.	Med	Section 8.3
	Affects sensitive properties	The noise impact assessment undertaken by Bridges Acoustics has assessed the possibility and extent of affecting sensitive properties.	Med	Section 8.3
	Any other impacts from noise, blasting or vibration	As the Project is a replacement of static equipment, there would not be the need for blasting or other activities resulting in vibrations.	N/A	N/A
Terrestrial and Aquatic Flora and Fauna	Results in the impact on terrestrial and aquatic flora and fauna including biodiversity and threatened species	In 2006, Urban Bushland Management Consultants Pty Ltd undertook a survey entitled "Draft Flora and Fauna Survey of a Wetland within this Shell Refinery". The survey identified the presence of the Downy Wattle within the area surrounding the wetland. It also recorded four native mammals, 40 native birds, four reptiles and six frogs. This survey also detected a number of introduced animals within the wetland area. The proposed Project is not located near the wetland and is not expected to impact any flora or fauna identified by the survey. A search of the National Parks and Wildlife Service's Atlas of NSW Wildlife (which contains records of sighted flora and fauna species	Low	Section 9.4

General Potential Impacts (Adverse and Beneficial)	Specific (Project Related) Potential Impacts	Effect of Potential Impact	Predicted Impact (High/Med/ Low)	Reference
		and their status under the TSC Act and the NPW Act) was undertaken on 27th April 2006. The search revealed 19 threatened species of fauna and 9 threatened species of flora within a 10km radius of the study site since 1980. A search of the Department of the Environment and Heritage website which outlines matters of national environmental significance revealed that there are 14 threatened species, 9 migratory species and 13 listed marine species listed under the Commonwealth EPBC Act and no threatened ecological communities within a 2km radius of the study area. The study area is highly disturbed and there is almost no vegetation of habitat value nearby, no significant environmental impact is considered likely to occur. Therefore this impact is not considered to be a key environmental issue.		
Land Use	Any significant increase in the demand for services and infrastructure resources	The additional construction contractors would have a temporary impact on the demand for services and infrastructure. However, the increase in contractors is relative to the increase in numbers for maintenance purposes which is a regular event every 3-4 years. Therefore previous maintenance periods indicate that there would not be a significant adverse impact on the local community. In addition, the FCCU is a net exporter of energy within the Refinery. Increased energy efficiency would result in reduced natural gas imported to site. Electricity consumption would increase slightly by approximately 2%. Therefore this impact is not considered to be a key environmental issue.	Low	Section 7.1.1

General Potential Impacts (Adverse and Beneficial)	Specific (Project Related) Potential Impacts	Effect of Potential Impact	Predicted Impact (High/Med/ Low)	Reference
	Diversion of resources to detriment of other communities or natural systems	There would not be any cause for diversion of resources to the detriment of other communities or natural systems.	N/A	Section 8 and
	Sensitive because of physical factors	As the existing site is modified due to its industrial nature, there are not expected to be any physical factors sensitive to the Project.	N/A	Sections 8 and 9
	Sensitive because of biological factors	As the existing site is modified due to its industrial nature, there are not expected to be any biological factors sensitive to the Project.	N/A	Section 8 and 9
	Sensitive because of conservation factors	There are no known conservation factors which could be sensitive to the Project.	N/A	Section 9.4
	Sensitive because of community factors	There are no existing community factors which would be sensitive to this Project. Community consultation via a letterbox drop did not reveal any community concerns.	Low	Section 2.2
Transportation Impacts	Impacts on existing transportation systems	During the decommissioning phase, transportation of old equipment from site (by road) 1-2 months before and after installation is expected. In addition, approximately 500 contractors over 2-3 months would have a temporary effect on the road network during the construction phase. This volume of traffic is a cumulative figure as construction of the Project would be undertaken during a whole-of Refinery shut-down which is undertaken every four years. This impact is not considered to be a key environmental issue.	Low	Section 9.7

General Potential Impacts (Adverse and Beneficial)	Specific (Project Related) Potential Impacts	Effect of Potential Impact	Predicted Impact (High/Med/ Low)	Reference
	Encourages directly/ indirectly additional traffic	Operation of the Project would not lead to a significant increase in traffic. There would be no change to truck movements associated with disposal of catalyst as the amount to be disposed of would not change after upgrade to the FCCU. A minor decrease in trucks would result from the transport of coke waste every four years as the amount of coke generated after the FCCU upgrade would significantly reduce.	Low	Section 9.7
	Degradation of infrastructure	The Project would not result in any degradation of existing infrastructure.	N/A	N/A
	Increases demand for parking (off and on street including in residential areas)	There would not be any increase in parking demand as Shell Refinery has the capacity to cater for the increase in the number of workers during the construction phase.	Low	Section 9.7
Socio-Economic	Impacts which result in a change in the demographic structure of the community	There would be no impact on the demographic structure of the community as the Project is maintaining and upgrading part of an existing facility.	N/A	N/A
	Substantial change or disruption to the community	There would not be a substantial change or disruption to the community. The construction period is temporary and would be mitigative measures would be implemented such as those used during routine maintenance which is conducted every 3-4 years at the Refinery.	Low	Section 9.6
	Individuals/commu nities being significantly disadvantaged	There would not be any disadvantage to either individuals or communities as a result of the Project.	N/A	N/A

General Potential Impacts (Adverse and Beneficial)	Specific (Project Related) Potential Impacts	Effect of Potential Impact	Predicted Impact (High/Med/ Low)	Reference
	Change in the level of demand for community resources	There is not expected to be any negative increase in demand for community resources.	N/A	N/A
	Any impacts which result in a decrease to net economic welfare	Restoration of FCCU is important in ensuring long term future of the Refinery due to its importance in petrol production for Sydney. Failure to upgrade would result in limited life for the Refinery and jeopardise current full time employment and contractors. This would indirectly affect small businesses which provide services to the Refinery.	High	Section 9.6
	Any impacts which result in a decrease in the economic stability of the community	There are not expected to be any impacts which result in a decrease in the economic stability of the community. This Project would strengthen the economic stability of the community by ensuring the long term viability of the Refinery.	Low	Section 9.6
	Change to the public sector revenue or expenditure base	There would not be any impacts on the public sector revenue or expenditure base.	N/A	N/A
Human Health	Impacts on health, safety, security, privacy or welfare of individuals or communities	There is not expected to be any significant impact on human health as a result of the Project.	Low	Section 9.5

General Potential Impacts (Adverse and Beneficial)	Specific (Project Related) Potential Impacts	Effect of Potential Impact	Predicted Impact (High/Med/ Low)	Reference
Non-Indigenous Heritage	Impacts on items of non-indigenous heritage	Statutory registers including the NSW Heritage Register and Register of the National Estate provided no listing of heritage items on the proposed development site or the Clyde Refinery. The components of the FCCU that would be upgraded were built in the late 1960s, and are not considered to be relics. The Project is not expected to be any impact on non-indigenous heritage. Therefore this impact is not considered to be a key environmental issue.	Low	Section 9.8
Indigenous Heritage	Impacts on items of indigenous heritage	A search of the National Parks and Wildlife Register for items of Aboriginal heritage revealed that 26 sites have been recorded within a 5km radius of the study area. The closest site is approximately 2.5km north west of the study area. No impact to indigenous heritage is expected. Therefore this impact is not considered to be a key environmental issue.	Low	Section 9.9
Visual Amenity	Impacts on visual amenity	The new combined reactor and stripper vessel would be taller than the existing components however smaller in diameter. The change in lighting would increase the potential for the FCCU to be more visible during the night time. However, the FCCU is embedded well within the Refinery and would have minimal effect on the surrounding environment. Improvements to the Unit would result in an improved benefit of reduced flaring events which is noticeable beyond the Refinery. Although addressed as a key environmental issue, the impact on visual amenity is expected to be negligible.	Low	Section 8.4
Waste Impacts	Any significant resources recycling or reuse schemes to reduce resource usage	Shell would assess and classify all waste material removed from site in accordance with NSW's EPA (1999a) *Guidelines for the Assessment, Classification and Management of Liquid and Non-Liquid Waste* and in accordance with its EPL, the PCB CCO and the *Protection of the Environment Operations (Waste) Regulations* 2005. The old reactor and stripper would be sent to a third party for recycling. Waste management is considered to be a key environment issue.	Medium	Section 8.6

General Potential Impacts (Adverse and Beneficial)	Specific (Project Related) Potential Impacts	Effect of Potential Impact	Predicted Impact (High/Med/ Low)	Reference
	Generates or disposes of gaseous, liquid or solid waste	Coke is generated as a by-product of the FCCU and is disposed of in accordance with Shell Refinery's EPL 570 and NSW's EPA (1999a) *Guidelines for the Assessment, Classification and Management of Liquid and Non-Liquid Waste*. The amount of coke produced as a result of the Upgrade would be considerably reduced. This impact is considered a key environmental issue.	Medium	Section 8.6
Land Use Safety Planning (SEPP 33 Requirements)	Uses, stores, disposes or transports hazardous substances	The Project would have a positive impact by reducing the amount of hydrocarbon inventory due to more modern and efficient equipment. Hazardous substances are considered to be a key environmental issue.	High	Section 8.2

8 Assessment of Key Environmental Issues, Potential Impacts and Mitigation Measures

The following section provides a detailed assessment of the key environmental issues associated with the Project, as defined in **Section 7.4**. These issues can have beneficial or adverse effects on the environment, but represent the issues that require the greatest level of assessment.

8.1 Air Quality

The air quality impact assessment was undertaken by Holmes Air Sciences (HAS). An unabridged version of this report is included in **Appendix D**.

8.1.1 Air Quality Goals and Objectives

The NSW DECC has historically noted air quality goals determined by the World Health Organisation (WHO), the United State Environmental Protection Agency (USEPA) and the National Health and Medical Research Council of Australia (NHMRC).

The FCCU upgrade Project would need to comply with the following assessment criteria:

- The requirements of the Protection of the Environment Operations (Clean Air) Regulations 2002 relating to the in-concentration of No.8 Boiler stack of the FCCU
- The requirements of the NSW DECC air quality impact assessment criteria (Approved Methods for the Modelling and Assessment of Air Pollutants in NSW 2005) for ground-level concentrations (GLC) at the nearest sensitive receptors due to emissions from the No.7/9 boiler and No.8 boiler stacks.

8.1.2 Nearest Sensitive Receptors

A total of eight sensitive receptors have been included in the air quality impact assessment. They are located at:

- Receptor 1- Carnarvon Street, approximately 500m south of the FCCU
- Receptors 2 to 4- along John Street, approximately 800m north of the FCCU
- Receptors 5 to 8- along James Ruse Drive, next to the Rosehill Racecourse. Approximately 1400m west of the FCCU.

8.1.3 Methodology

The AUSPLUME dispersion model was used to predict ground-level concentrations of emissions after commissioning of the new components of the FCCU. The changes in existing emissions and the expected emissions were then compared with the requisite standards outlined by the National Environment Protection Council of

Australia (NEPC) and DECC. In addition, a cumulative impact assessment has been undertaken to account for all emissions from the Refinery.

Owing to the presence of tall stacks onsite, the DECC requested that additional modelling be carried out using the puff dispersion model, CALPUFF. **Appendix D** presents a summary of the differences between AUSPLUME and CALPUFF and a comparison of the proposed cumulative impacts using both models.

8.1.4 Background Air Quality

Air quality standards and goals refer to pollutant levels which include the Project and existing sources. To fully assess impacts against all the relevant air quality standards and goals, it is necessary to have information or estimates on the existing background pollutant concentrations in the area in which the project is likely to contribute to these levels. As the Clyde Refinery is an existing emissions source, these data are provided for information purposes only.

The closest DECC monitoring station was located at Lidcombe, approximately 10 km southwest of the site. The Lidcombe site operated until April 2002. The closest site that is currently operating is located at Liverpool, approximately 20km southwest of the study area. SO_2 data are collected at Randwick, which is approximately 20km south-east of the site, and were also collected at Lindfield, approximately 14 km to the north-east of site, until February 2005. All background data are presented in Table 6-8 in **Appendix D**.

The data are taken from the National Ambient Air Quality Status and Trends Report, 1991 – 2001 (DEH, 2004) and the NSW DEC quarterly air quality reports (NSW DEC, 2006). Ozone, NO_2 and PM_{10} are monitored at Liverpool.

The data revealed that maximum 1-hour and 4-hour average O_3 concentration occasionally exceeds the air quality goals at both sites. These exceedances can be attributed in part to variability in meteorological conditions. Bushfires can also cause amplified ozone concentrations. The maximum 1-hour NO_2 concentration at Lidcombe exceeded the goal in 1992 and 1998, and in 1993 at Liverpool, however there has been a general decrease in concentrations. The annual average concentrations are below the air quality goal at both sites.

Annual average concentrations of PM10 are below the NSW DEC air quality goal of 30 ug/m^3. However, maximum concentrations are on occasions above the 24-hour goal of 50 ug/m^3, for example in 2003, the maximum recorded 24-hour average concentration recorded at Liverpool was 283 ug/m^3 (see **Appendix D** for tabulated data). Particle pollution is affected by environmental factors such as bushfires and dust storms and some of these high levels may be attributed to these factors.

8.1.5 Existing Operations

As described in **Section 4.7**, the FCCU is the major secondary processing Unit in which crude oil residue is converted into gasoline, diesel, LPGs, propylene and other fuel oil blending components.

The flue gas from the FCCU travels out of the regenerator via two sets of cyclones which separate the entrained catalyst from the vapour. Due to environmental reasons and to protect the power recovery machines from erosion, the flue gas travels through an additional stage of clean up, the third stage separations. Flue gas then travels via the power recovery turbines, or via bypassline to the orifice chamber, before going to No.8 Boiler for further heat recovery from the flue gas. This is considered to be the main gas and particulate emission source associated with the FCCU.

Fugitive emissions

The FCCU process is a fully closed process. There are minimal fugitive emission sources along the process line. However, during stage 1 of the reactor / stripper replacement, there would be minor fugitive emission of particulate matter from construction activities and exhaust emissions (mainly diesel exhaust) from construction traffic and machinery.

Other fugitive emissions are during major planned and unplanned shutdowns of the FCCU. During planned shutdown of the Unit (see **Section 4.8.1**), process air from the Unit is used to push catalyst across to the catalyst storage hopper, and hence particulate emissions are associated with the venting of this excess air from the hopper to a safe location. The concentrations of particulate emissions are estimated to be between 250 mg/Nm^3 and 1000 mg/Nm^3. The rate of air flow is estimated to be 100 tonnes per day (t/d)), compared with the normal airflow to the FCCU of between 3,000 and 4,500 t/day. This occurs once every four years for approximately six to eight hours, associated with planned shutdown of the Unit.

Unplanned Shutdowns

As discussed in **Section 4.8.1** , unplanned shutdowns occur infrequently, with the last event occurring in 2000. If there are technical problems with the regenerator (which is where the catalyst/flue gas separation takes place), this can result in elevated concentrations of TSP emissions in the plume.

An upset situation is detected based on operating experience and test results which uses the opacity of the No.8 Boiler plume as a surrogate for TSP concentrations. On observation of opacity greater than 15% there is an investigation into the source of the increased particulates. If the opacity remains above 20% for more than one week then stack testing is carried out to determine the in-stack concentration of the particulate matter.

There are three typical scenarios of problems with the regenerator:

(a) Steam injection nozzle can fail due to erosion from the catalyst moving at high rates in the Unit. When it fails, there is less resistance to flow and hence flow can increase significantly causing attrition and an increase in fines make/losses. This is currently resolved within a few days by cutting back the steam once the source is identified. With the proposed upgrade there would additional flow monitoring to provide information on the flow increases and hence there would be a faster response. In addition to this, improvements to the design of the proposed nozzles would help prevent such erosion/failure.

(b) There is a temporary stalling of the catalyst in the cyclone. This can be resolved by altering catalyst levels in the regenerator. This takes a few days to diagnose and implement the changes. Such events are typically during start-up and shutdown of the Unit, and not during normal operation.

(c) There is significant cracking/damage to the regenerator cyclones (typically age related failure), resulting in loss of cyclone performance and hence catalyst loss. In this severe case, the Unit will be shutdown once this mechanism is confirmed and hence inability to reduce the catalyst losses for repairs to be undertaken.

8.1.6 Proposed Operations

In addition to the changes to the FCCU emissions (which exit via No. 8 Boiler stack), this Project would reduce the steam production from Boiler 7/9 stack as a result of increased steam production/efficiency from No. 8 boiler. No other units at the site would be affected.

The proposed upgrade would use a modern design of regenerator cyclones which will lead to a reduction in unplanned shutdowns discussed above.

8.1.7 Emission Rates

The AUSPLUME dispersion model (Version 6.0) was used to predict ground-level concentrations of emissions of the following pollutants:

- CO
- NO_x
- PM_{10}
- TSP
- SO_2
- SO_3
- Benzo(a)pyrene
- Speciated VOCs
- Metals

Air pollutants emission rates prior to the proposed upgrade work have been calculated by multiplying the discharge concentration of the No. 8 Boiler stacks by

their respective discharge air flow rates. The stack parameters of air pollutants and mass emission rates to be modelled are presented in **Table 8-1** and **Table 8-2**.

Table 8-1 Stack Parameters

Parameter		FCCU (Boiler No.8 stack)		Boiler 7/9 Stack	
Location	X (m)	318510		318135	
(MGA)	Y (m)	6255109		6255048	
Height	(m)	80.1		100.6	
Diameter	(m)	2.35		3.35	
Scenario		Existing	Proposed	Existing	Proposed
Temp	(^{o}C)	257.5	275.0	246	200
Flow	(Nm^3/min)	2,372	2,846	2,340	1,755
	(Am3/min)	4,609	5,713	4,449	3,041
Velocity	(m/s)	17.7	22.0	8.4	5.7

8.1.8 Modelling Results for FCCU/Boiler Impact

Table 8-3 presents a summary of the maximum predicted off-site concentrations. The location of the maximum concentrations are shown on Figure 7 to Figure 21 in **Appendix D** which present contour plots for the pollutants CO, NO_x, PM_{10}, TSP, SO_2 and SO_3. These figures also show the cumulative impacts with all stack sources. The cumulative impacts are discussed in **section 8.1.9**.

All the predicted concentrations due to emissions from the FCCU (Boiler No. 8 stack) and Boiler 7/9 are below the relevant impact assessment criteria for both the existing and proposed operations. Modelling shows that the predicted ground-level concentrations of all pollutants are all below the DECC assessment criteria.

On the basis of the dispersion modelling results of the proposed changes to the operations at the site, it is unlikely that there would be any significant impact on air quality at the nearby residential areas.

Table 8-2 Stack Emission Rates

Pollutant	Unit		
	FCCU (Boiler No.8 stack)		Boiler 7/9
	TSP = 50 mg/m^3	TSP = 75 mg/m^3	
	Emission rate pre-FCCU upgrade (g/s)		
SO_3	1.34		0.34
SO_2	24.67		3.08
NO_x	1.82		6.47
CO	218.86		1.09
TSP	2.07	3.10	0.39
PM_{10}	1.520	2.281	0.23
PAHs	1.05E-03		5.79E-04
Benzo(a) pyrene equivalents	7.03E-07		1.94E-06
Metals Total	2.63E-02		1.03E-02
Antimony	6.29E-04		7.16E-04
Arsenic	3.28E-04		2.93E-04
Beryllium	2.69E-04		2.74E-04
Cadmium	4.35E-05		1.13E-04
Chromium	9.80E-04		1.30E-03
Cobalt	1.76E-04		3.45E-05
Lead	2.26E-03		4.25E-04
Manganese	1.77E-03		9.69E-04
Mercury	2.78E-03		7.28E-05
Nickel	2.08E-03		1.74E-03
Selenium	2.13E-04		2.26E-04
Tin	5.24E-03		2.90E-03
Vanadium	3.06E-04		3.71E-05
	Emission rate post-FCCU upgrade (g/s)		
SO_3	1.52		0.25
SO_2	27.96		2.31
NO_x	2.06		4.85
CO	218.86		0.82

Pollutant	Unit		
	FCCU (Boiler No.8 stack)		Boiler 7/9
	TSP = 50 mg/m^3	TSP = 75 mg/m^3	
TSP	2.52	3.78	0.29
PM_{10}	1.824	2.736	0.17
PAHs	1.20E-03		4.34E-04
Benzo(a) pyrene equivalents	8.02E-07		1.45E-06
Metals Total	2.99E-02		7.76E-03
Antimony	7.12E-04		5.37E-04
Arsenic	3.72E-04		2.20E-04
Beryllium	3.05E-04		2.05E-04
Cadmium	4.93E-05		8.48E-05
Chromium	1.11E-03		9.78E-04
Cobalt	1.99E-04		2.58E-05
Lead	2.56E-03		3.19E-04
Manganese	2.00E-03		7.26E-04
Mercury	3.15E-03		5.46E-05
Nickel	2.36E-03		1.31E-03
Selenium	2.42E-04		1.69E-04
Tin	5.94E-03		2.17E-03
Vanadium	3.47E-04		2.78E-05

Note: STP defined as Standard Temperature Pressure (dry 0 ^{0}C, 1 atm)
Pollutant concentrations expressed as (mg/m3 dry 0 ^{0}C, 1 atm)

Table 8-3 Maximum Predicted Offsite Ground Level Concentrations due to Emissions from the FCCU and Boiler 7/9

Pollutant	Assessment criteria		Averaging time	Scenario	Concentration	
Carbon monoxide (CO)	30	mg/m³	1-hour maximum	Existing	0.55	mg/m³
				Proposed	0.53	
	10	mg/m³	8-hour maximum	Existing	0.14	mg/m³
				Proposed	0.12	
Nitrogen dioxide (NO_2)	246	µg/m³	1-hour maximum	Existing	22	µg/m³
				Proposed	22	
	62	µg/m³	Annual Mean	Existing	0.16	µg/m³
				Proposed	0.17	
Particulate matter < 10 µm (PM_{10})	50	µg/m³	24-hour maximum	Existing – normal operations	0.44	µg/m³
				Proposed – normal operations	0.42	
				Existing – upset conditions	0.65	
				Proposed - upset conditions	0.63	
	30	µg/m³	Annual mean	Existing – normal operations	0.05	µg/m³
				Proposed – normal operations	0.05	
				Existing – upset conditions	0.07	
				Proposed - upset conditions	0.07	
TSP	90	µg/m³	Annual mean	Existing – normal operations	0.06	µg/m³
				Proposed – normal operations	0.07	
				Existing – upset conditions	0.09	
				Proposed - upset conditions	0.09	
Sulfur dioxide	712	µg/m³	10-minute maximum	Existing	318	µg/m³
				Proposed (maximum emission rate)	659*	
	570	µg/m³	1-hour maximum	Existing	224	µg/m³
				Proposed (maximum emission rate)	488*	
	228	µg/m³	1 day	Existing	19.9	µg/m³
				Proposed (maximum emission rate)	19.8*	
	60	µg/m³	Annual average	Existing	1.2	µg/m³
				Proposed (maximum emission rate)	4.9*	
Sulfuric Acid (as SO_3)	1.80 E-02	mg/m³	1-hour 99.9th percentile	Existing	8.82E-04	mg/m³
				Proposed	8.84E-04	
PAHs (as B[a]P)	4.00 E-04	mg/m³	1-hour 99.9th percentile	Existing	1.17E-06	mg/m³
				Proposed	1.20E-06	
Arsenic	9.00 E-05	mg/m³	1-hour 99.9th percentile	Existing	6.32E-07	mg/m³
				Proposed	6.85E-07	
Beryllium	4.00 E-06	mg/m³	1-hour 99.9th percentile	Existing	2.60E-07	mg/m³
				Proposed	2.72E-07	
Cadmium	1.80 E-05	mg/m³	1-hour 99.9th percentile	Existing	4.12E-07	mg/m³
				Proposed	4.45E-07	
Cobalt	-			Existing	1.19E-06	mg/m³
				Proposed	1.11E-06	
Chromium VI	9.00 E-05	mg/m³	1-hour 99.9th percentile	Existing	9.91E-04	mg/m³
				Proposed	6.31E-06	

Pollutant	Assessment criteria		Averaging time	Scenario	Concentration	
Mercury (organic)	1.80 E-04	mg/m³	1-hour 99.9th percentile	Existing	5.01E-06	mg/m³
				Proposed	5.24E-06	
Manganese	1.30 E-02	mg/m³	1-hour 99.9th percentile	Existing	4.45E-06	mg/m³
				Proposed	7.41E-06	
Nickel	1.80 E-04	mg/m³	1-hour 99.9th percentile	Existing	4.45E-06	mg/m³
				Proposed	7.41E-06	
Antimony	9.00 E-03	mg/m³	1-hour 99.9th percentile	Existing	8.03E-07	mg/m³
				Proposed	8.38E-07	
Selenium	9.00 E-03	mg/m³	1-hour 99.9th percentile	Existing	1.49E-05	mg/m³
				Proposed	1.56E-05	
Tin			-	Existing	4.58E-05	mg/m³
				Proposed	3.78E-05	
Vanadium			-	Existing	1.97E-06	mg/m³
				Proposed	1.86E-06	
Lead	5.00 E-04	mg/m³	Annual Mean	Existing	4.60E-09	mg/m³
				Proposed	4.61E-09	

**These figures are not the predicted typical emission rates but are maximum emission rates to identify the worst case scenario.*

8.1.9 Cumulative Impacts

There are two points to consider regarding the cumulative impacts. Firstly, there is the cumulative off-site impact due to emissions from the other stack sources at the Shell Clyde site, and secondly there is combined impact of all the off-site impacts with existing background concentrations, for both the existing and proposed operations.

Emissions from the Shell Clyde site are released from a total of six stacks and a twin flare. There are also fugitive emissions from tanks, flanges and valves. However the FCCU is a fully closed process and therefore fugitive emissions are not included in this assessment.

Cumulative impacts of all stacks

Maximum predicted off-site concentrations

Table 8-4 presents a summary of the maximum predicted off-site concentrations. The location of the maximum concentrations are shown on Figure 7 to Figure 21 of **Appendix D** which present contour plots for the pollutants CO, NO_x, PM_{10}, TSP, SO_2 and SO_3.

All the predicted concentrations due to cumulative stack emissions are below the relevant impact assessment criteria for both the existing and proposed operations.

Table 8-4 Maximum Predicted Off-site Ground Level Concentrations due to Emissions from All Sources

Pollutant	Assessment criteria		Averaging time	Scenario	Concentration	
Carbon monoxide (CO)	30	mg/m³	1-hour maximum	Existing	0.57	mg/m³
				Proposed	0.55	
	10	mg/m3	8-hour maximum	Existing	0.14	mg/m3
				Proposed	0.13	
Nitrogen dioxide (NO_2)	246	mg/m³	1-hour maximum	Existing	0	mg/m³
				Proposed	49	
	62	mg/m³	Annual Mean	Existing	0.43	mg/m³
				Proposed	0.46	
Particulate matter < 10 µm (PM_{10})	50	µg/m³	24-hour maximum	Existing – normal operations	0.56	µg/m³
				Proposed – normal operations	0.61	
				Existing – upset conditions	0.78	
				Proposed - upset conditions	0.84	
	30	µg/m³	Annual mean	Existing – normal operations	0.06	µg/m³
				Proposed – normal operations	0.06	
				Existing – upset conditions	0.08	
				Proposed - upset conditions	0.08	
TSP	90	µg/m³	Annual mean	Existing – normal operations	0.09	µg/m³
				Proposed – normal operations	0.10	
				Existing – upset conditions	0.12	
				Proposed - upset conditions	0.12	
Sulfur dioxide	712	µg/m³	10-minute maximum	Existing	336	µg/m³
				Proposed (maximum emission rate)	685*	
	570	µg/m³	1-hour maximum	Existing	239	µg/m³
				Proposed (maximum emission rate)	261*	
	228	µg/m³	1 day	Existing	20.6	µg/m³
				Proposed (maximum emission rate)	21.0*	
	60	µg/m³	Annual average	Existing	1.4	µg/m³
				Proposed (maximum emission rate)	1.4*	
Sulfuric Acid (as SO_3)	1.80E-02	mg/m³	1-hour 99.9th percentile	Existing	7.44E-03	mg/m³
				Proposed	7.15E-03	
PAHs (as B[a]P)	4.00E-04	mg/m³	1-hour 99.9th percentile	Existing	2.22E-08	mg/m³
				Proposed	2.32E-08	
Arsenic	9.00E-05	mg/m³	1-hour 99.9th percentile	Existing	3.46E-06	mg/m³
				Proposed	3.85E-06	
Beryllium	4.00E-06	mg/m³	1-hour 99.9th percentile	Existing	1.23E-06	mg/m³
				Proposed	1.32E-06	
Cadmium	1.80E-05	mg/m³	1-hour 99.9th percentile	Existing	6.49E-07	mg/m³
				Proposed	7.07E-07	
Cobalt	-			Existing	1.19E-06	mg/m³
				Proposed	1.11E-06	
Chromium VI	9.00E-05	mg/m³	1-hour 99.9th percentile	Existing	9.49E-06	mg/m³
				Proposed	1.01E-05	
Mercury (organic)	1.80E-04	mg/m³	1-hour 99.9th percentile	Existing	5.98E-06	mg/m³
				Proposed	6.47E-06	
Manganese	1.30E-02	mg/m³	1-hour 99.9th percentile	Existing	8.94E-06	mg/m³
				Proposed	9.41E-06	
Nickel	1.80E-04	mg/m³	1-hour 99.9th percentile	Existing	1.03E-05	mg/m³
				Proposed	1.40E-05	
Antimony	9.00E-03	mg/m³	1-hour 99.9th percentile	Existing	6.04E-06	mg/m³
				Proposed	6.27E-06	
Selenium	9.00E-03	mg/m³	1-hour 99.9th percentile	Existing	2.18E-06	mg/m³
				Proposed	2.24E-06	
Tin	-			Existing	4.58E-05	mg/m³
				Proposed	3.78E-05	
Vanadium	-			Existing	1.97E-06	mg/m³
				Proposed	1.86E-06	
Lead	5.00E-04	mg/m³	Annual Mean	Existing	9.05E-08	mg/m³

**These figures are not the predicted typical emission rates but are maximum emission rates to identify the worst case scenario.*

All the predicted concentrations are below the relevant impact assessment criteria for both the existing and proposed operations.

Discrete receptor concentrations

All the predicted concentrations are below the relevant impact assessment criteria for both the existing and proposed operations. For more details see section 7.1.2 of **Appendix D**.

8.1.10 Decommissioning/Construction Impact Mitigation Measures

During demolition and construction, the local air quality could potentially be impacted as a result of the following emissions:

- Dust generation from demolition and construction activities, particularly from demolition of the brick old change shed, lift and the movement of machinery and trucks
- Exhaust emissions (mainly diesel exhaust) from construction traffic and machinery.

Dust Generation

Whilst all laydown areas for machinery and equipment are anticipated to be on hardstand areas (see **Section 6.4.5**), some construction and demolition activities may be undertaken on exposed surfaces (eg. truck parking bays). Further identification of these areas would be undertaken as part of the Construction Environmental Management Plan (see **Section 10.3.1**). If any such areas are identified, these areas would be regularly watered to minimise the production of dust. Moisture in soils increases aggregation and cementation of the particles, which reduces the potential for dust emissions.

The nearest residential areas to the construction sites are not expected to be impacted by dust due to distance to these areas and the low potential for significant dust generation. Dust may however impact on demolition and construction contractors. Standard health and safety procedures for demolition and construction contractors would be implemented at the site, including requirements for protective equipment (masks, etc) where dust generation is unavoidable. During demolition, when asbestos contaminated dust has the potential to be generated, specific protective equipment would be worn to reduce the potential for dust inhalation. Dust emissions during construction are not anticipated to result in significant air quality impacts if the above recommendations are implemented.

Exhaust Emissions

Exhaust emissions (mainly diesel exhaust) from construction traffic and machinery have the potential to temporarily impact on local air quality.

Given the relatively low number of vehicles and machinery required for construction compared to existing traffic at the Clyde industrial area, exhaust emissions are unlikely to cause significant impacts on the local and regional air quality. Vehicle

and machinery exhaust systems, however, should be maintained so that exhaust emissions comply with relevant standards.

8.1.11 Operational Impacts on Air Quality and Mitigation Measures

As discussed above, AUSPLUME dispersion modelling has been used to assess the potential for impacts on local air quality owing to emissions from the existing and proposed operations of the FCCU (Boiler No. 8 stack) and Boiler 7/9 at the Shell Refinery site at Clyde. The AUSPLUME cumulative impact including emissions from all the stack sources shows compliance with all the impact assessment criteria.

On the basis of the AUSPLUME dispersion modelling results of the proposed changes to the operations at the site, it is unlikely that there would be any significant impact on air quality at the nearby residential areas.

Shell has identified that due to upset temporary conditions there may be occasions when the FCCU (Boiler No.8) in-stack concentration of TSP may exceed the POEO standard of 50 mg/Nm3. The dispersion modelling has demonstrated that the impact of the elevated concentrations will have a minimal impact on local air quality and would not result in an exceedance of the impact assessment criteria. The maximum predicted annual average TSP concentrations under upset conditions is 0.09 mg/m3, which is equal to 0.1 % of the impact assessment criteria of 90 mg/m3. This proposal to replace the critical components of FCCU's Reactor and Regenerator will result in a much lower likelihood of the occurrence of upset conditions owing to the improved operating conditions.

As there is currently no monitoring data in the local area with which to validate the dispersion modelling results, and based on the large differences between the results from the two models (AUSPLUME and CALPUFF), there needs to be further investigations undertaken to determine the source of the discrepancies.

Shell would monitor SO_2 and SO_3 concentrations in the ambient air for a period of 12 months to facilitate the validation of the dispersion modelling and provide assurance that there are no detrimental impacts on the local community. If the ambient monitoring detects an exceedance of the SO_2 or SO_3 impact assessment criteria, Shell would commit to improve operational conditions to ensure that there are no future exceedances.

8.2 Hazard and Risk Management

A landuse safety risk assessment has been prepared for this Project by Sherpa Consulting. A full copy of this Report is included in **Appendix E**.

8.2.1 Land Use Safety Planning Considerations

The minimum distance from the FCCU to residential land uses is approximately 720m which is a significant buffer distance in terms of land use safety planning issues. Other land uses surrounding the Refinery include heavy industry and

commercial uses approximately 150 metres North West of the FCCU. The nearest boundary to the FCCU has been identified as the corner of Devon Street and Durham Street, 90m from the Unit.

8.2.2 Preliminary Risk Screening

The DoP developed a risk screening procedure to assist in determining whether a proposed development falls within the definition of a "potentially hazardous industry". To determine whether there might be a land use safety planning concern, base storage quantities for hazardous goods are specified in the document *Applying SEPP 33* (DUAP, 1997). For quantities below the screening thresholds, it can be assumed there is unlikely to be a significant risk off-site.

Based on the inventories of dangerous goods and activities at the Refinery it has been assumed that the site would exceed the SEPP 33 screening criteria and hence would be potentially hazardous and potentially offensive (see **Appendix E**). As a result, a Multi-Level Risk Assessment (MLRA) using the NSW Planning Methodology (DUAP, 1997) has been undertaken by Sherpa Consulting Pty Ltd (see **Appendix E**). MLRA is a systematic and analytical assessment that enables the nature of hazards, and the leading risk contributors, to be identified and understood from a design, operational and organisational viewpoint. This allows for focused safety management and control, complementary to adherence to the requirements of codes and standards.

The MLRA outlines three levels of risk assessment. These are outlined in **Table 8-5**.

Table 8-5 Risk Assessment Levels

Level	Type of Analysis	Comments
1	Qualitative	Where there are no major offsite consequences and societal risk is negligible.
2	Partly Quantitative	Where there are offsite consequences but with a low frequency of occurrence.
3	Quantitative	Where level 1 and 2 are exceeded.

The MLRA guidelines state that:

> "A fully quantitative risk assessment is advisable where the scale and nature of an activity creates a significant potential for a major accident. Examples of such activities would include large scale manufacture of chemicals, petroleum refining, and storage and distribution terminals involving large quantities of dangerous goods".

A quantitative risk assessment has been undertaken in accordance with the MLRA guidelines.

8.2.3 PHA Methodology

The PHA evaluates the acute land use safety planning risks which the proposed facility imposes on surrounding land uses. DoP guidelines for the preparation of Hazard Analysis Reports (Hazardous Industry Planning Advisory Planning Papers

No.4 and No.6) were used as a basis for the assessment. The assessment considered abnormal (accidental) events, and not normal (or licensed) site emissions. As outlined by the Department of Planning (DUAP 1999), the level and extent of the analysis reflects the nature, scale and location of the proposed development.

The overall methodology included hazard identification, consequence analysis, frequency analysis and risk assessment.

Hazard identification involves the qualitative definition of possible initiating events which could lead to hazardous incidents and assessment of their possible implications. It determines which events and incidents should be considered in more detail, such as flammable liquid releases and flue gas releases.

Consequence analysis is the estimation and examination of consequences from identified events in terms of the physical effects such as heat flux, overpressure and toxic impact, on plant, people and the environment.

If the consequence analysis demonstrates that significant impacts might occur offsite, then frequency or likelihood analysis is performed. Likelihood analysis involves the estimation and examination of the likelihood of each identified event and the probability of impacts from such events for example a leak from a flange or reactor overpressure.

Risk levels can then be calculated for each event by combining the results of the consequence analysis and the frequency analysis to produce a cumulative risk result. The quantified risk result is used for comparative purposes against risk criteria recommended by the NSW Department of Planning.

If the cumulative risk result meets the acceptance criteria, a discussion of the technical controls, risk reduction measures and management measures in place must be undertaken.

8.2.4 Potential Hazards

Hazard Identification

The core of the Hazard Identification process was a series of HAZID workshops conducted by Shell's Safety Case Advisors. One of the main objectives of these workshops was to identify scenarios that covered all of the potential hazards and initiating events associated with the reactor and regenerator operation.

The scenarios identified were based on a review of the appropriate sections of the Shell HAZID checklist, which is a structured list of HSE-related hazards drawn from experience. The checklist contains a list of guidewords and definitions, which are used as prompts for the HAZID study. Major Accident Events (MAE) were identified including flammable liquid/vapour releases and flue gas releases.

The HAZID concluded the following:

- No new hazardous materials would be introduced resulting from the proposed FCCU upgrade
- No new release scenarios would be created
- Inventories of hazardous materials would be reduced
- The increase in temperature and throughput of the flue gas systems do not result in a an increase in risk offsite
- Leak sources would be minimised
- There is no reduction in the level of safeguarding provided for the identified hazards.

Design Safety Safeguards associated with Proposed Development

The new reactor and stripper vessel would incorporate appropriate pressure and temperature protection as well as second layers of instrumented safeguarding to prevent temperature/pressure excursions including:

- Indicators/alarms/safeguarding trips on the reactor and stripper vessel to warn operators of temperature or pressure concerns
- An open path from the reactor/stripper to the main fractionator, with relief valves on the main fractionator to prevent system from overpressure
- An open path for the regenerator to the boiler stack at all times to prevent overpressure
- Low pressure differential trips to prevent intermixing of air and hydrocarbons
- Panel activated feed trips to allow hydrocarbons to be removed from feed remotely and instantaneously.

Potential Land Use Safety Implication

From a land use safety perspective (i.e. potential accident risk scenarios that might impact outside site boundaries), the main issues at the site relating to the proposed development is leak or release of flammable liquid or vapour.

8.2.5 Consequence Analysis

Framework for Analysis

Consequence analysis involves the analysis and quantification of a potential hazardous scenario to cause injury, fatality, damage or loss. The consequences of the following risks were calculated:

- Leak of residue feed to cracker

- Leak from remote cooling of HVU distillate
- Leak of ASO, LCO feed
- Release of reactor vapour.

The results of the consequence analysis indicated that no consequences would reach the site boundary and there are no increased consequence distances as a result of the proposed upgrade. Therefore, the proposed development falls within the SEPP 33 Risk Criteria.

8.2.6 Likelihood Analysis

Although the consequence analysis concluded that there would be no increased consequences of releases from the proposed upgrade, a likelihood analysis was still undertaken. Likelihood analysis is a method for predicting the occurrence of future events based on historical data.

A leak frequency data set was developed from recent Refinery studies for loss of containment scenarios. The frequency data set and a Refinery parts count were combined to generate the likelihood analysis.

The likelihood analysis concluded that the only significant change affecting the likelihood of an event is the selective application of flanges with welded membrane seals. The adoption of these flanges reduced the overall flange count by 25% from 25 to 19 reducing the amount of vapour space of the reactor. Therefore the likelihood of a vapour release would be reduced.

8.2.7 Risk Analysis and Assessment

A risk analysis was undertaken to identify the potential for incidents associated with the proposed project to impact on surrounding land users. The results were compared against NSW land use planning criteria. The analysis concluded that there are no incidents associated with the proposed project that have the potential for offsite impact.

Escalation risk was also analysed. Escalation risk is the risk for incidents which are initiated in the reactor and regenerator units to escalate to other units, causing an offsite risk. To prevent escalation within the site, the R&R unit, as well as surrounding units are already equipped with equipment designed to provide earlier detection of problems as well as take appropriate action to minimise hydrocarbon inventory and pressure within the R&R as well as surrounding units. Such systems are already automated and are operable remotely from the Central Control Room. The design intent is to prevent escalation both on site and off site. A summary of the key measures to minimise escalation include:

1. Process shutdown systems (trips and interlocks) that provide early detection of deviations from normal operation and take action to restore to normal or undertake safe shutdown of the unit;

2. Melt tubes, gas detection and CCTV are employed and strategically applied to provide early detection of problems/leaks to ensure appropriate response is taken as soon as is possible to prevent escalation.

Mitigation responses include:

1. Both manual and automated shutdown and depressuring systems are available to allow safe and quick removal of hydrocarbons and pressure from the unit, minimising the source of fuel in the inventory;

2. The units are equipped with adequate relief valve and blowdown systems to protect equipment and piping against overpressure; and

3. The units are equipped with fixed and strategically placed fixed fire water monitors to allow quick application of fire water to equipment including surrounding units.

See Table 9 Proposed Safety Systems, **Appendix E** for further information.

The frequency associated with incidents resulting in escalation of risk was identified at $1x10^{-6}$. This is substantially below the NSW risk criterion for escalation leading to offsite impacts at adjacent industrial developments.

The assessment concluded that the potential for offsite impact is below the NSW risk criteria and that the proposed project does not present a significant risk to the surrounding land uses.

8.2.8 Risk Controls

The reactor and stripper vessel would be constructed in accordance with Australian and International Standards including AS1170.2 and AS1170.4 for wind and earthquake design loadings, respectively. In addition, the design would be subject to the Shell risk management process.

Existing safety systems and their modification in relation to the proposed upgrade include gas detection, fire proof skirts, emergency relief and automated shutdown and snuffing steam. Further Safety reviews and pre start-up safety reviews would be undertaken by HSE technical specialists within Shell Global Solutions.

In addition, Shell's internal HSSE management system includes relevant safety operations such as training for new employees, preparation, communication and control of Unit operating procedures and maintenance of new equipment.

The overall Refinery quantitative risk assessment would be updated to incorporate the changes associated with the proposed upgrade to the FCCU.

8.3 Noise

A desktop noise assessment (**Appendix F**) was conducted by Bridges Acoustics Pty Ltd in order to assess the predicted construction, operation and traffic noise levels generated as a result of the Project.

8.3.1 Existing Noise Environment

The existing FCCU is centred within Clyde Refinery, surrounded by an approximate 700m radius of other industrial operations. Surrounding the Refinery are main transport routes including Silverwater Road and the Western Motorway (M4). The nearest industrial receivers not associated with the Refinery are approximately 150m north west of the FCCU on the opposite side of Durham Street, along Durham Street and Grand Avenue.

The closest Silverwater residences are approximately 720m to the south east of the existing FCCU, Rydalmere residential area is approximately 1.25km to the north east and Harris Park residences are over 1.5km to the west.

Bridges Acoustics undertook an independent survey in November 2004 to determine the background noise levels of the locality, excluding the noise contribution from the Refinery. Noise loggers were employed at 11 different locations (see **Figure 8-1**) at attended 15 minute intervals during the day, evening and night. A summary of the results is detailed in **Table 8-6.**

Table 8-6 INP Background Noise Levels Excluding Refinery Contribution, dB(A)

Receiver Type	Location	Background Level, LA90*,15min		
		Day	Evening	Night
Residential	Silverwater	48	47	43
	Rydalmere (John Street)	45	45	46
	Harris Park	48	47	40
Industrial	Silverwater (Carnarvon Street)	47	46	42
	Silverwater (Holker Street)	45	45	46
	Camellia (Grand Avenue)	55	55	55
	Camellia (Devon Street)	66	66	66

*Background noise levels are reported in LA90 (which is the level of noise exceeded for 90% of the time) as required by the NSW DEC Industrial Noise Policy.

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Figure 8.1
Area Plan Showing Noise Monitoring Locations

Many industrial operators within the Rosehill locality and its surrounds affect general ambient noise levels. In addition, due to the main traffic routes surrounding the Refinery, constant heavy vehicle movements also impact upon the general noise levels of the vicinity. It can be seen from **Table 8-6** that the industrial operators within Camellia increase the ambient noise levels consistently during the day, evening and night hours.Noise Criteria

Construction Noise Criteria

Criteria for the construction period are sourced from Section 171 of the DEC's *Environmental Noise Control Manual* (ENCM), partly reproduced below:

Level Restrictions

(i) Construction period of 4 weeks and under:

The L10 level measured over a period of not less than 15 minutes when the construction site is in operation must not exceed the background level by more than 20 dB(A).

(ii) Construction period greater than 4 weeks and not exceeding 26 weeks:

The L10 level measured over a period of not less than 15 minutes when the construction site is in operation must not exceed the background level by more than 10 dB(A).

Time Restrictions

Monday to Friday, 7am to 6pm.

Saturday, 7am to 1pm if inaudible on residential premises, otherwise 8am to 1pm. No construction work to take place on Sundays or Public Holidays.

The construction and erection of the Project is expected to take approximately 10-11 weeks during the morning and night times as well as weekends. As construction is expected to take more than 4 weeks but less than 26 weeks, Level Restrictions (ii) would generally apply and background level of noise during construction should not exceed existing levels by more than 10dB(A). However, the Clyde Refinery operates 24 hours 7 days a week. As the construction work would meet operational noise criteria, construction activities can occur at any time during the Refinery's operating hours.

Table 8-7 outlines the noise threshold levels for normal construction hours based on the background levels from **Table 8-6** and noise criteria for the existing Refinery as reported to the EPA in 2004. As the FCCU would be shut down during this period, the noise criteria in **Table 8-6** have been based on background noise levels that would be measured in the absence of the FCCU. Construction noise criteria of 10db(A) above background noise levels only applies to sensitive receptors (residential receptors). Acceptable levels of construction noise criteria for industrial receptors is 70dB(A) in accordance with the NSW DEC Industrial Noise Policy.

Table 8-7 Construction Noise Criteria, dB(A)

Receiver Type	Location	Construction Noise Criteria, LA10,15min		
		Day	Evening	Night
Residential	Silverwater	58	52	48
	Rydalmere (John Street)	55	50	47
	Harris Park	58	50	45
Industrial	Silverwater (Carnarvon Street)	70	70	70
	Silverwater (Holker Street)	70	70	70
	Camellia (Grand Avenue)	70	70	70
	Camellia (Devon Street)	67	67	67

Construction Road Traffic Noise

Construction work would generate traffic movements on public roads near the site, mainly on the Western Motorway (M4), Silverwater Road, James Ruse Drive and Grand Avenue. Changes in noise level due to this traffic flow are assessed to the *EPA's Environmental Criteria for Road Traffic Noise (ECRTN) (EPA, 1999*).

A criteria of 60dB(A)$L_{eq,15hr}$ during the day and 55dB(A)$L_{eq,9hr}$ during the night applies, for case 7 in the ECRTN of "Land use developments with potential to create additional traffic on existing freeways/arterials". A further recommendation, where existing criteria are already exceeded, is "In all cases, traffic arising from the development should not lead to an increase in existing noise levels by more than 2dB". As the estimated increase in truck movements is expected to be negligible to the current traffic movements along these main arterial roads, construction road traffic noise is not expected to affect receivers.

Statutory Noise Criteria

The *Occupational Health and Safety Regulations* discuss management of noise if employees are exposed to levels exceeding the prescribed limit during an 8 hour working day. Clause 49 of the OH&S Regulations 2001 states:

(1) An *employer* must ensure that appropriate control measures are taken if a person is exposed to noise levels that:

(a) Exceed an 8-hour noise level equivalent of 85 dB(A)

(b) Peak at more than 140 dB(C).

In 2005, Shell complied with Special Condition E4 of its EPL which required an occupational noise assessment to be undertaken. The occupational noise survey was undertaken by Foster Pty Ltd in September 2005 at the Shell Clyde Refinery over a period of several months, between October 2004 and April 2005. The objective of the survey was to assess operator noise exposure levels, identify noise sources to

determine hearing protection zones and provide general advice for noise control and hearing protection necessary to comply with WorkCover Regulations. The survey was completed and provided recommendations for Shell's continued compliance with its occupational health and safety requirements.

Operational Noise Criteria

Operational noise criteria is detailed in the EPA's Industrial Noise Policy (Jan 2000) (INP). The predicted received noise levels during operation of the upgraded FCCU are shown below in **Table 8-8** .

The results were generated from the worst case sound power level of 103dBA.

The results show that noise levels from proposed new or refurbished equipment easily comply with the relevant INP criteria at all residential or other noise sensitive properties.

In addition, the proposed upgrade to the FCCU would incorporate new steam lines and valves, which would reduce current noise levels and result in reduced leaks with new piping.

Table 8-8 Predicted Received Noise Levels from New/Refurbished Equipment

Receiver	Distance, metres	Received Level, LA10		Criteria, LA10		
		Day	Even, Night	Day	Even.	Night
Closest Residential Areas						
Silverwater (south east)	720	28	33	53	51	35
Rydalmere (north)	1250	21	29	48	35	35
Harris Park (west)	1500	19	26	53	50	45
Closest Commercial Property						
Silverwater (east)	600	30	35	70	70	70
Closest Industrial Property						
Camellia (west)	150	53	54	67	67	67

Shell is currently discussing with the DECC an appropriate PRP as part of its EPL which would see Shell identify and rank the noise sources from the Clyde Refinery and take steps to reduce the greatest noise emitters. This is however, outside the scope of the proposed upgrade to the FCCU.

8.3.2 Noise Sources

The main sources of noise which would directly result from the Project is noise generated from construction activities and the possible increase in noise generated

from an increase in traffic movements during construction. See **section 6.4.3** for details on the sources of noise generated during construction.

8.3.3 Traffic Noise Impact Assessment

There would be an insignificant increase in traffic noise as a result of the construction phase.

An estimated ten trucks would be required to remove the old components and miscellaneous equipment from the site. An estimated 30 trucks would be required to deliver new equipment and another 30 trucks to deliver heavy construction machinery and equipment to site. In addition, large pieces of equipment (i.e. the new reactor/stripper component) would be transported to Clyde Refinery via waterway. Approximately four boat or barge movements may be required on the Parramatta and Duck Rivers.

An estimated 25 temporary contractors would be employed to assist in the planning, organising and winding-up of the Project. Approximately 500 temporary contractors would be required during the shutdown phase to replace the old equipment for the new and undertake various maintenance tasks on the remainder of the FCCU. The construction workforce is estimated to generate approximately 450 vehicle movements during the beginning and end of work hours.

Traffic noise impacts are not expected to occur as the expected increase in traffic is deemed insignificant to the current levels of existing traffic along the main routes surrounding the Refinery. There are currently heavy truck movements due to the surrounding industrial developments in the area and with no sensitive residential developments nearby, noise impacts are not expected to occur. In addition, these extra traffic movements are consistent with Shell's regular maintenance periods which occur every four years.

8.3.4 Noise Impact Assessment and Mitigation Measures

The noise assessment undertaken by Bridges Acoustics concludes that received noise levels from construction activities would be acceptable at all industrial, commercial and residential properties. Construction noise would be barely audible at all noise sensitive properties.

Operation of the FCCU would meet the INP criteria of 35LAeq, 15 min at all sensitive receivers.

Although a slight increase in traffic would be generated during the construction phase, the surrounding road network would be able to absorb the additional traffic without impacting on sensitive properties.

Therefore, no mitigation measures are recommended for the construction, operation phases or road traffic associated with the Project.

8.4 Surface Water Quality

8.4.1 Existing Surface Water Quality

The water quality of the upper Parramatta River and its three major tributaries has been monitored on a monthly basis since January 1990 Water Quality of the Upper Parramatta River on behalf of the Upper Parramatta River Catchment Trust by John H Laxton and Robert Gittins. The purpose of this study was to determine the present environmental health of the river.

This monitoring programme has accumulated thirteen full years of data from which it is possible to identify any longer term trends in water quality that have occurred over the sampling period.

The water quality of Duck and Parramatta Rivers has been improving, but further improvements within the catchment are required to achieve the medium and long term targets that have been established. Under this monitoring program Shell is not identified as a major source of pollution.

8.4.2 Drainage Catchments and Discharges

Stormwater Control

The Refinery has an extensive storm water management system that underwent an AUD$7million upgrade in the mid 1990s. Stormwater from the main office block and car park is directed via reed beds to artificial wetlands. Stormwater from the Refinery is directed through roadside and underground drains to stormwater holding basins.

The stormwater captured in this system may be directed to the Refinery's biological water treatment system. The PRP, U3 "Wet Weather Treatment Facilities Stage 2" includes future wastewater and stormwater improvements that were negotiated with the EPA and incorporated into the Clyde Refinery "Five Year Environmental Plan".

Currently at the site, contaminated water is directed to corrugated plate interceptors for treatment. This system removes sediment and oil from the water before directing the water to further downstream processing.

The nature and quantity of pollutant loads in stormwater run-off are not expected to change with the upgrade of the FCCU.

Wastewater Control

There are three wastewater streams that are treated at the Refinery:

- Process wastewater
- Normally contaminated surface water
- Occasionally contaminated surface water.

The process waste water is removed via sour water strippers and then a pipeline directly to the Refinery wastewater treatment plant before recycling to cooling water.

The normally contaminated surface water from each Refinery area is sent via corrugated plate interceptors (CPI) to the underground drainage system where it joins the occasionally contaminated water. This combined stream then flows through an oil separator basin into the Refinery wastewater treatment plant.

The Clyde Refinery wastewater treatment plant removes free oil and sediment from water and then uses a biological process to remove the dissolved contaminants. The water is then filtered and the majority is reused within the Refinery as cooling water. The volume of water that is in excess of the cooling water demand is discharged to the Duck River at an EPA licensed discharge point LD01. The biological treatment plant is designed to process five million litres of water per day.

Most refineries discharge between 100 and 200 million litres of water per day. Clyde Refinery uses recycled water as cooling water and as a result it discharges around 1.2 million litres per day.

8.4.3 Construction Surface Water Impacts and Mitigation Measures

Demolition Activities

Demolition of an old change shed and lift has the potential to generate dust. Appropriately licensed contractors would be engaged to undertake the demolition activities due to the potential for asbestos contamination. Demolition would be carefully undertaken to reduce the generation of dust. Dust suppression techniques would be employed. The regular watering of the concrete site would be undertaken to mitigate the potential migration of dust. Excess water is unlikely to be generated but in the event, sediment traps would be placed around the site to prevent runoff and excess water would be contained and disposed of appropriately.

Removal of Old Equipment

A water jet may be necessary to cut the old reactor and stripper into pieces to enable safe removal of the old components in smaller pieces. Water run-off from the cut would be collected either within the reactor/stripper or within the existing FCCU complex drain. From here, the water would be routed to the biotreater for treatment, and thereafter used as either make-up for the cooling water tower with any excess directed to river.

The amount of waste water used in this cutting process is far less than typically produced from the FCCU and no additional load on the surface water management system is expected.

Maintenance Ploughing

Maintenance ploughing may need to be carried out. If some maintenance ploughing is required, a Part 7 Permit would be obtained from the NSW Department of Primary Industries under the *Fisheries Management Act 1994*, and appropriate mitigative measures would be implemented.

FCCU

Excavation would be minimal during the construction phase. It would be limited to minor excavation for footings, and trenching for additional cabling.

Construction impacts on surface water quality could arise from disturbing soils and transportation of sediments to holding areas. The construction activities would take place on flat land within an industrially developed site. The erosion potential at the construction site is expected to be minimal. Recommended control measures to reduce the potential environmental impact during excavation include:

- Minimisation of soil exposure. Land disturbance would occur for the shortest time possible. Access to the construction site would be controlled and vehicles and machinery would be kept to well defined areas away from excavation sites
- Run-off generated outside construction sites would be diverted away from the construction sites.

Excavated material would be stockpiled and located away from traffic areas and from potential disturbances. Stockpiles of any contaminated material would be located on impervious material and covered if necessary. Any leachate from stockpiles, as well as water from dewatering operations would be re-directed to the Biotreater via the Main Interceptor. Excavated material would be analysed, assessed and disposed of in accordance with EPA Guidelines (1999a) as well as Shell's EPL 570 On-site Waste Management Treatment and Disposal condition O4.5.

Surface water is not expected to be significantly impacted as a result of excavation.

8.4.4 Operational Surface Water Impacts and Mitigation Measures

There would not be any operational impacts on the surface water quality therefore no mitigation measures have been recommended.

8.5 Visual Amenity

8.5.1 Existing Visual Environment

The Camellia Precinct is dominated by heavy industrial uses. To the east and south of Clyde Refinery across the Duck River is the residential suburb of Silverwater and to the west is Rosehill Gardens Racecourse. The northern portion of the Clyde Refinery is screened from residential suburbs to the north by adjacent industrial land uses such as SITA Environmental Solutions and Patricks Post Services.

8.5.2 Visual Impacts and Mitigation Measures

Construction

During the construction phase, an 80m high crane would be assembled and would be used to replace the old reactor and stripper with the new. As the construction phase is estimated to take between two to three months and the FCCU site is embedded

well within the boundary of Clyde Refinery, this impact is considered to be of a temporary nature and of minimal impact.

Operation

The existing Reactor component of the FCCU stands at approximately 40m above ground level. The new combined reactor and stripper vessel is expected to be approximately 15m taller but would be substantially smaller in diameter and would still be shorter than existing boiler stacks and other structures on site. See

Figure 8-2 for the visual impact from Devon Street, Millennium Circuit, Grand Avenue and Wentworth Street from the proposed upgrade.

New modern lighting standards would be employed which would increase the visibility of the Reactor at night. However, due to the centralised position of the FCCU within the Clyde Refinery, the visual impact on the closest residents is expected to be negligible.

The upgrade to the reactor and stripper would also result in a reduction in the amount of hydrocarbon inventory. This reduction in inventory would result in a decrease in the amount of process gas that would need to be flared during a process upset. As a result, the need for flaring would decrease as well as its associated visual impact. As the new Unit would be more reliable, it would reduce the frequency at which upsets and flaring would occur.

8.6 Waste

Shell has defined, documented waste handling procedures for different types of waste streams. All waste material removed from site would also be assessed and classified in accordance with NSW EPA (1999a) *Guidelines for the Assessment, Classification and Management of Liquid and Non-liquid Waste* as well as Shell's EPL No. 570 (see **Section 3.4.1**) so that the material is either reused or disposed of in an environmentally responsible manner.

8.6.1 Demolition and Construction Impacts and Mitigation Measures

During the construction phase the following waste would be produced:

- General building waste (from old change shed and lift)
- 200 - 250 tonnes of coke
- 600-800 tonnes of steel
- 150 tonnes of insulation
- 35-40 tonnes of refractory/insulation.

Clyde Refinery's existing waste management facilities and practices would be used to handle any construction waste. The existing paper, concrete and metal recycling facilities would be able to manage the majority of the additional waste generated.

Photo 1 – From Devon Street

Photo 2 – From Millennium Circuit

Photo 3 – From Grand Avenue

Photo 4 – From Wentworth Street

Figure 8.2
Visual Impact of Proposal on Surrounding Streets

The old reactor and stripper shells which would generate the greatest quantity of steel waste would be sent to a third party for recycling. They would be sent cladded and insulated for safety purposes. The recycling company would determine the amount of steel which could be recycled and send the remaining waste including insulation and cladding to an appropriate waste management facility in accordance with Shell's EPL No. 570 waste provisions.

All necessary waste tracking would be undertaken in accordance with EPL No. 570.

The coke would go to an enclosed kiln (cement kiln), power station or steel manufacturing site as fuel. This is an existing initiative with the DECC under the Alternative Fuels program. Wastes are tested in accordance with industry standards as well as Shell's internal waste management policy. Testing would include hydrocarbon content and trace metals content.

Any PCB contaminated waste including transformers or other identified PCB contaminated equipment which would require disposal would be undertaken accordance with the PCB CCO and Shell's EPL 570. The PCB CCO regulates the handling, conveying, transport and disposal of PCB contaminated equipment.

Any asbestos contaminated waste including waste generated from the old change shed and lift would be disposed of in accordance with Appendix 1 of Shell's EPL which provides waste tracking codes for asbestos as well as the Protection of the Environment Operations (Waste) Regulations 2005 which outlines the requirements for handling, transporting and disposing of asbestos contaminated waste.

Minor amounts of soil would be generated due to excavation required for footings and cable trenches. The soil would be classified and if appropriate, reused on site.

8.6.2 Operational Impacts

Every four years approximately 200 -250 tonnes of coke is produced in the reactor which is removed and disposed of. This procedure is routinely undertaken and is always conducted in accordance with Shell's EPL No 570 and the NSW EPA (1999a) Guidelines. It is expected that the upgrade to the FCCU would result in less than 10 tonnes of coke produced over a four year period. The generated coke would be disposed of appropriately.

Spent silica alumina, the catalyst used in the reactor vessel, would be generated at a rate of approximately 3-4t/day. This is consistent and would not change from the amount of spent catalyst currently being produced. The catalyst would also be disposed of in accordance with Shell's EPL No. 570 and the NSW EPA (1999a) Guidelines.

9 Assessment of Other Environment Issues, Potential Impacts and Mitigation Measures

9.1 Land and Soil Management

9.1.1 Existing Environment

The existing FCCU is situated on concrete foundations. Surrounding the FCCU is bitumen, gravel and paved roads and paths. There is no open soil in close proximity to the FCCU.

Acid Sulphate Soils

Clyde Refinery is mapped on the Prospect/Parramatta acid sulphate soil (ASS) risk map as having soils of one of three zones:

- Low probability of the occurrence of ASS materials within soil profile
- High probability of the occurrence of ASS materials between 1-3m below ground surface
- High probability of the occurrence of ASS materials at or near ground surface.

Given that only minor excavation would be required for the Project, the potential impacts on soils or impacts resulting form the disturbance of contaminated or acid sulphate soils during construction activities are minor. If any acid sulphate soils are identified, a management plan to handle and dispose of the soil would be prepared.

9.1.2 Construction Impacts and Mitigation Measures

During the construction phase, minor soil excavation would be required for lift footings 3mx1m^2. In addition, trenches for cabling would also require minor excavation.

The excavated soil would be sampled to determine the most appropriate method of handling and disposal. Preferentially the soil would be retained and used on-site, however that is dependent on the soil classification. Any contaminated material would be remediated in the Refinery landfarm where the biological degradation of hydrocarbons is achieved by turning the soil and adding nutrients and microbes from the site biological water treatment plant.

See **Section 10.3.1** for an outline of the mitigation measures which would be undertaken during the construction phase of the Project.

9.1.3 Operation Impacts and Safeguards

Operation of the upgraded FCCU is not expected to impact on underlying soils.

9.2 Hydrology and Flooding

9.2.1 Existing Hydrological and Flooding Conditions

The FCCU and R&R area scale is such that the area it occupies is approximately 0.3ha out of a site area of 126ha, representing approximately 0.24 percent of the Refinery site.

Clyde Refinery and the general Camellia area are relatively flat. According to the 1 in 25,000 scale topographic map, this area is less than 10m AHD (Australian Height Datum) in elevation.

Parramatta River is the main waterway in the area. It crosses the Camellia/Rydalmere area in a west to east direction. The river divides the two Precincts with Rydalmere to the north and Camellia to the south. Parramatta River in this area is within the tide-affected section of the river (located between Ryde Bridge and Charles Street Weir that is west of the study area).

Charles Street Weir at Parramatta acts as a tidal barrier limiting the length of the tide-affected reach to approximately 9.2km. The mean tidal range in the tidal section of Parramatta River is approximately 1m. Parramatta River's catchment is 290km^2 which makes it the largest catchment within the Sydney Harbour basin (PCC, 1997). Part of the Shell Refinery, near the confluence with Duck River, fronts Parramatta River.

Duck River is the major tributary of the Parramatta River downstream of Parramatta. The catchment area of Duck River is 45km^2. Duck River is tidal in the study area. According to SKM (1999) Duck River is tidal up to Clyde Weir which is located near the Main Western Railway line at Granville (upstream of the study area). Duck River and its tributary Duck Creek drain densely urbanised land as the flat terrain attracted early development (SKM, 1999). Duck River bounds the Clyde Refinery to the south.

In 2004 SKM undertook a flood assessment, which included the study area. The report concluded that the Clyde Refinery is mostly above the 1 in 100 years flood contours, with the only exception of the area immediately adjacent to the Duck River and Parramatta River.

Existing water retention basins in the Refinery are designed to retain 6,600m^3 of water. The development would not increase storm water run off as the existing study area is already hard surfaced and the project would have little change on storm water run off.

9.2.2 Construction Hydrology and Flooding Impacts and Mitigation Measures

The construction phase of the Project would not affect the existing hydrological or flooding regimes of the Parramatta River and Duck River, or the general internal Refinery drainage system.

Based on the information available, the construction and lay-down areas are located above the 1 in 100 years flood level and therefore the risk of flooding at the construction site is low.

"Potentially contaminated" runoff during construction is directed via CPIs where sediment and oil are removed at the wastewater treatment plant prior to the water joining the normal drainage system.

9.2.3 Operational Hydrology and Flooding Impacts and Mitigation Measures

With the Project using existing foundations, it would not increase the volume of stormwater runoff generated at the site. No changes are planned to the stormwater system.

9.3 Groundwater

9.3.1 Existing Groundwater Environment

The current Clyde Refinery groundwater monitoring program includes 81 operating monitoring wells covering all parts of the Refinery. As part of the Clyde Refinery's *Groundwater Pollution Reduction Program & Remedial Action Plan* 2002 the groundwater monitoring program (GMP) involves fluid gauging, groundwater sampling and subsequent laboratory analysis of groundwater samples. The GMP is conducted biannually, annually or six monthly across the site. Wells with little or no history are sampled biannually, boundary wells or impacted up gradient wells are sampled annually with new wells or wells with no trend in impact are sampled six monthly. Groundwater flow has been described as tending north east and south east towards Parramatta River and Duck Creek.

The nearest down gradient groundwater monitoring well is MW98/7 approximately 200m south east of the FCCU. The nearest up gradient groundwater monitoring wells are TW94/1 and TW94/2 approximately 50m north east of the FCCU.

The Clyde Refinery groundwater monitoring program is an integral part of the EPL No. 570. 'Pollution Reduction Program 2 – Groundwater Remediation' and 'Special Condition E3 – Annual Reporting on Progress with Groundwater Remediation' set out the 3-year 'Groundwater PRP and Remedial Action Plan' for Clyde Refinery.

The Groundwater PRP and Remedial Action Plan (RAP) was independently audited by the NSW EPA accredited site auditor in August 2002 and reviewed by the EPA. As a result, a Groundwater Monitoring Event (GME) and gauging program was re-initiated in the first quarter of 2004. The GMEs were to be implemented by IT Environmental Pty Ltd and later Coffey Environments Pty Ltd (Coffey). The other commitments are to be completed in line with the agreed 3 year plan for Clyde Refinery. These commitments included the completion of six GMEs which were completed between December 2003 and October 2006. The current GME, GME (6) was completed as the final component of the actions outlined in the RAP (2002). In

addition, Coffey indicated that Shell and DECC are currently revising Licence 570 conditions that could potentially affect current monitoring activities.

As specified in the RAP, each GME involved gauging, purging and sampling of existing wells on site. Groundwater samples were collected and submitted for laboratory analysis for the following analytical suite; Benzene, Toluene, Ethylbenzene and Xylene collectively known as BTEX, Total Petroleum Hydrocarbons (TPH), Polycyclic Aromatic Hydrocarbons (PAHs), Phenols, Polychlorinated biphenyls (PCBs), Organochlorine pesticides (OCPs), Organophosphate pesticides (OPPs) and selected heavy metals. Additionally, selected wells were also sampled for dissolved phase metals and dissolved phase speciated chromium, hydraulic conductivity testing and natural attenuation indicators.

A number of observations were made regarding the current status of the chemical impact on site. These included:

- Phase Separated Hydrocarbons (PSH) appears to have generally decreased in specific wells sampled
- A plume of Dissolved Phase Hydrocarbons (DPH), within the PTA terminal appears to have decreased since the implementation of the RAP
- The geometry of the main plume does not appear to have dramatically changed
- A number of monitoring wells reported concentrations of selected heavy metals in the north eastern and south western portion of the site
- Generally, the work undertaken has demonstrated that major areas of the RAP are now compliant.

Additionally, the DPH plume in the south west portion of the site was observed to have increased by several orders of magnitude during sampling undertaken in October 2006. As result, a recommendation was made involving an additional GME event specifically in the vicinity of this area (Groundwater Monitoring Report, GME 6 2007). The subsequent laboratory analysis of samples collected during the limited GME indicated an observed reduction in concentrations of TPH in comparison to concentrations reported in October 2006. A recommendation was made by Coffey in their letter report dated 2 January 2007 (*Shell Clyde Refinery December 2006 Groundwater Gauging and Limited GME)* that suggested:

> *"further monitoring of these wells (MW94/6 and MW94/7) in order to assess the extent of TPH levels within this area and flow of potential contamination"*

Continual monitoring will be undertaken to monitor TPH concentrations within these wells.

Additional recommendations made regarding future areas of investigation to meet the requirements of the RAP (2002) were reported. Coffey's indicated that a number of areas that should be addressed to complete gaps in meeting the requirements of the RAP. These included:

- The collection of additional soil samples in the vicinity of the underground pipelines to assess the potential of the pipelines acting as a preferred pathway for contaminant migration
- The installation of oil absorbent socks upon the detection of PSH in any selected monitoring well.

Shell is currently reviewing the frequency of monitoring across the site based on a risk-based analysis of data obtained since 2002.

Geological and Hydrogeological Information

Previous investigations indicate that the Clyde Refinery site is generally underlain by fill, unconsolidated clay and clayey silt/sand. These sediments are estimated to be from 11m to 30m thick across the site. The clay sequence is an alluvial deposit of Quaternary to Tertiary age related to the Parramatta and Duck River Drainage system.

The groundwater gauging data indicate that the deeper aquifer (in the south western region) is flowing in a south easterly direction towards Duck River (under a hydraulic gradient of 0.005units) and the groundwater in the eastern region is flowing in an easterly direction towards the Duck and Parramatta Rivers (under a hydraulic gradient of 0.02units). The seepage velocity for the deeper aquifer is estimated to be less than 1m per year to the south east and less than 0.1m per year to the north east.

Within the south-western region of the site, the shallow aquifer is moving through the fill layer in a south-easterly direction towards Duck River (under a hydraulic gradient of 0.03). In the eastern region of the site the inferred groundwater flow is in an easterly direction under a hydraulic gradient of 0.009units. Based on the above estimates, the seepage velocity for the shallow aquifer is 0.55m per year to the south east and 0.16m per year to the east.

The "Shell Clyde Refinery and Parramatta Terminal - Proposed Groundwater Monitoring Program", (August 2002), and related annual progress report recommendations are currently being used by the Refinery to direct soil and groundwater monitoring at the Clyde site. GMEs are scheduled to be undertaken at approximately 12 monthly intervals.

There is no known use of groundwater in the region.

9.3.2 Construction Impacts

Minor excavation would be required for cabling associated with the FCCU upgrade and footings for the new lift. Potential impacts on groundwater at the site may result from the construction of those footings and trenches for cabling. Installation of the footings would involve excavation to a depth of up to 3m. It is likely that groundwater would be reached requiring the area to be dewatered and potentially

contaminated groundwater contained and re-directed to the Biotreater via the Main Interceptor.

Direct impacts on groundwater quality are not expected since construction activities that have the potential to pollute (such as refuelling of equipment) would not be performed on the excavation site. Excavation equipment would be maintained and clean to reduce the potential for spillages or leakages. Routine vehicular maintenance would be performed at an appropriate off-site location.

There are not expected to be any significant impacts on groundwater during the construction phase of the Project as excavation required is minor and most construction activities would be undertaken on fully paved areas and would make use of existing foundations.

9.3.3 Operation Impacts

Operation of the FCCU would not result in any impact to groundwater. As a result, mitigation measures have not been recommended.

9.4 Terrestrial and Aquatic Flora and Fauna

9.4.1 Existing Terrestrial and Aquatic Flora and Fauna

The Clyde Refinery site is highly modified, consisting mostly of industrial area but also containing an artificial wetland near the confluence of the Parramatta and Duck Rivers. The wetland has been filled with water since the early 1980's and it is occupied by some indigenous plant species (UBMC, 2006). Extensive planting has also been undertaken in the areas surrounding the wetland. Most of the vegetation within the study area has been planted, or consists of weed species.

Flora

The Clyde Refinery lies on the Sydney Sheet of the 1:100,000 vegetation map (Benson, 1994). Benson describes the study area as 'cleared', with a small section of Estuarine Complex occurring in the southeast portion of the study area. A larger stand of Estuarine Complex occurs within 1km to the south (UBMC, 2006).

The NSW National Parks and Wildlife Service (NPWS 2002) has more recently produced a series of vegetation maps for the Cumberland Plain. The NPWS mapped all bushland remnants greater than 0.5 ha in size, as opposed to the five (5) ha limitation used by Benson and Howell (1994). The NPWS has identified several stands of Mangrove/Saltmarsh complex occurring along the Parramatta and Duck Rivers, the closest of which is within 40m of the southeast boundary of the study area. No native vegetation was mapped within the study area (UBMC, 2006).

One species listed as vulnerable under the TSC Act and EPBC Act – the Downy Wattle (*Acacia pubescens*) was recorded within the area surrounding the wetland during a flora survey undertaken by UBMC. Another threatened flora species listed as vulnerable under the TSC Act, but not listed under the EPBC Act - *Wilsonia*

backhousei – has previously been recorded within the wetland area (Gunninah Consultants, 1990), but was not relocated during the survey undertaken by UBMC.

The study area supports two (2) ecological communities - Freshwater Wetlands and Swamp Oak Floodplain Forest. Both communities are listed as endangered under the TSC Act, but not under the EPBC Act.

The existing FCCU is situated on the same foundations since its commissioning in 1963. The FCCU is surrounded by bitumen and concrete roads and paths. Stormwater within, and around, the FCCU drains to the main interceptors (as discussed in **section 8.4.2)**. There is no vegetation around the existing FCCU.

The nearest waterbody is Duck River, approximately 250m south east. The artificial wetland is approximately 500m north east of the study area and is within 50m of the existing Basell petrochemical plant that operates twenty four hours per day. The wetland ultimately drains to the Parramatta River.

Fauna

A bird observation survey of the artificial wetland issued by R.J. Turner – Consultant Forester was undertaken by R.J and G.R Turner, in company with M. Cass (Shell) and S. Galloway, on 13 September 2000. No bird species classified as threatened under the NSW *Threatened Species Conservation Act 1995 (TSC Act)* were sighted during the survey.

In addition, the flora and fauna survey of the artificial wetland area undertaken by Urban Bushland Management Consultants (2006) recorded four native mammals, 40 native birds, four reptiles and six frogs. This survey also detected a number of introduced animals within the wetland area. In regard to the native species recorded:

- Grey-headed Flying Fox (*Pteropus poliocephalus*), is listed as vulnerable under the EPBC and TSC Acts
- Green and Golden Bell Frog (*Litoria aurea*), is listed as vulnerable under the EPBC Act and endangered under the TSC Act
- The Great Egret (*Ardea alba*) is listed as migratory under the EPBC Act
- The Nankeen Night Heron (*Nycticorax caledonicus*) is regionally significant.

State Significance

A search of the National Parks and Wildlife Service's Atlas of NSW Wildlife, which contains records of sighted flora and fauna species and their status under the *TSC Act* and the *National Parks and Wildlife Act 1974 (NPW Act),* was undertaken on 27 April 2006. The online fauna search provides a list of threatened species under the *TSC Act* which were recorded within the 10km radius since 1980. The search revealed 19 threatened species of fauna and 9 threatened species of flora.

The Regent Honeyeater (*Xanthomyza phrygia*), classified as endangered on Schedule 1 of the *TSC Act*, was recorded near Parramatta Park, 3km west of the site. The Gang Gang Cockatoo population is located in the Hornsby & Ku-ring-gai LGAs.

The only threatened species found within the vicinity of the Refinery site was the Green and Golden Bell Frog *(Litoria aurea)*, which is listed as an endangered species in Schedule 1 of the *TSC Act*. Green and Golden Bell Frog sightings were recorded from 3 sites within a 1km radius of the Refinery. The site located within the vicinity of the Refinery was likely to be located near the wetland habitat located in the north-east corner of the Refinery.

An assessment made under Section 5A of the *EP&A Act* outlines the eight factors that must be addressed to enable a decision to be made as to whether the Project is likely to have a significant effect on threatened species, populations or ecological communities or their habitats in which case a Species Impact Statement (SIS) is required. A 7-Part Test for the Green and Golden Bell Frog is outlined in **Table 9-1.**

Table 9-1 EP&A Act '7-Part Test' Green and Golden Bell Frog Assessment

Section	Criteria	Assessment
a)	In the case of a threatened species, whether the life cycle of the species is likely to be disrupted such that a viable local population of the species is likely to be placed at risk of extinction;	No threatened species were identified as being present in the area of the proposed modifications. With no local populations present in the area where impacts would occur, the life cycle of threatened species is not likely to be disrupted or placed at risk of extinction.
b)	In the case of an endangered population, whether the life cycle of the species that constitutes the endangered population is likely to be disrupted such that the viability of the population is likely to be significantly compromised;	No populations of the Green and Golden Bell Frog were found within the proposed development area.
c)	In relation to the regional distribution of the habitat of a threatened species, population or ecological community, whether a significant area of known habitat is to be modified or removed;	The proposed development would not impact on any existing known habitat of the Green and Golden Bell Frog.
d)	Whether an area of known habitat is likely to become isolated from currently interconnecting or proximate areas of habitat for a threatened species, population or ecological community;	The Project would not result in the isolation or fragmentation of any areas of vegetation or waterways.

Section	Criteria	Assessment
e)	Whether critical habitat would be affected;	The site of the proposed development does not provide suitable ecological habitat or conditions for the Green and Golden Bell Frog.
f)	Whether a threatened species, population or ecological community, or their habitats, are adequately represented in conservation reserves (or other similar protected areas) in the region;	The Green and Golden Bell Frog are adequately represented in reserves in metropolitan Sydney.
g)	Whether the development or activity proposed is of a class of development or activity that is recognised as a threatening process;	The development is not a class of development that is recognised as a threatening process.

Matters of National Significance

Under the assessment and approval provisions of the Commonwealth *Environment Protection and Biodiversity Conservation Act (EPBC Act),* actions that are likely to have a significant impact on a matter of national environmental significance are subject to a rigorous assessment and approval process. An action includes a project, development, undertaking, activity, or series of activities.

The *EPBC Act* currently identifies seven matters of national environmental significance, namely:

- World Heritage properties
- National heritage places
- Ramsar wetlands of international significance
- Listed threatened species and ecological communities
- Listed migratory species
- Commonwealth marine areas
- Nuclear actions (including uranium mining).

Actions that are likely to have a significant impact on the environment of Commonwealth land (even if taken outside Commonwealth land), and actions taken by the Commonwealth that are likely to have a significant impact on the environment anywhere in the world, may also require approval under the *EPBC Act*. A search of the Department of Environment and Heritage website *EPBC Act* online database was undertaken on 27 April 2006. The following information was found in relation to a 2km radius area from the modification site:

- No world heritage properties

- Fourteen listed threatened species
- Nine listed migratory species
- Thirteen listed marine species
- The site is located within the same catchment as the Towra Point Reserve Wetland, a Ramsar wetland site of international significance
- No commonwealth marine areas.

The Project does not constitute a nuclear action.

Listed migratory species may migrate or move through the site. The existing FCCU and immediate surroundings do not provide suitable ecological habitat due to the highly disturbed nature of the site. Therefore, threatened or migratory species are not likely to depend on the site and industrial area for food, habitat or reproduction.

9.4.2 Construction Impacts and Mitigation Measures

The wetlands are located approximately 500m north east of the study area. During the construction phase, work at the study area would not have any significant impacts on flora and fauna.

Stormwater from the area would be directed to the sites existing facilities. There would be limited vegetation clearing associated with the project, with expected clearing being pruning of vegetation around the fence line which would otherwise be impact upon during transportation. Ponding of water would be minimised by appropriate mitigation measures during construction activities.

9.4.3 Operational Impacts and Mitigation Measures

The Refinery main office and carpark areas are within the wetland drainage catchment. Stormwater from the existing FCCU goes to a separate storm water management system and hence there is a no potential for any impact on the wetlands water quality from the upgrade to the FCCU.

9.5 Human Health

9.5.1 Construction Impacts and Mitigation Measures

During the construction phase of the Project, a job safety analysis would be undertaken so that all construction workers are managed to the required level of safety. In addition, contractors affected by the construction phase of the Project would also be taken into consideration to have the least impact over the 2-3 month construction period.

Each environmental impact during the construction phase is assessed with regards to human health. Specific environmental impacts which may directly affect human health during the construction phase include:

- Noise Impacts: An assessment of the risks associated with noise impacts during the operation of the Project has been undertaken in **Section 8.3**
- Land and Soil Management: The potential for construction workers to come into contact with contaminated soil is negligible. No excavation is required for the upgrade to the FCCU and hence no spoil would be generated. See **Section 9.1.**

See **Sections 8.3.4** and **9.1.2** for mitigation measures during the construction phase.

9.5.2 Operation Impacts and Mitigation Measures

Each environmental impact during the operation phase is assessed with regards to human health. Specific environmental impacts which may directly affect human health during the operation phase include:

- Air Quality: Potential impacts on air quality during operation of the FCCU are assessed in **Section 8.1** and include NO_X, SO_X, and PM_{10} particulates
- Land Use Safety Planning: An assessment of the risks associated with the use of hazardous goods during operation of the Project can be found in **Section 8.2**
- Noise Impacts: An assessment of the risks associated with noise impacts during the operation of the Project has been undertaken in **Section 8.3.**

Mitigation measures for these impacts can be found in **Sections 8.1.11, 8.2.7** and **8.3.4**.

9.6 Socio-Economic Setting

9.6.1 Existing Socio-Economic Environment

The Camellia precinct is ideally located as an employment and distribution centre for Sydney. As well as providing petroleum fuel to the Sydney market, the associated Shell distribution terminal also provides the only remaining rail distribution facility for moving petroleum fuel to country NSW.

The site also provides petroleum product to Newcastle and Sydney Airport by pipeline. These activities reduce the amount of product that would otherwise need to move by road. James Hardie, Boral, Mauri Foods, Patrick, Simmons Timber, Collex and CSR Wunderlich are other major employers in the area.

Clyde Refinery makes a positive contribution to a variety of local organisations and contributes approximately AUD$60M into the Sydney economy each year.

9.6.2 Construction Impacts and Mitigation Measures

The upgrade to the FCCU would require 25 additional contractors leading up to the major maintenance period. During the actual upgrade and scheduled maintenance period an additional 500 contractors would be required thus resulting in a positive economic impact for the local area during the construction phase.

9.6.3 Operational Impacts

There would be no impact on the socio-economic setting of the local area during operation of the FCCU. The current workforce would continue to operate the FCCU.

The upgrade would require an investment of approximately AUD$77.77 million in the Clyde Refinery. This investment would result in improved efficiency, operability and reliability of the FCCU to create petrol and other gasoline products, such as LPG or diesel, for distribution in NSW. By assisting Shell Refinery to continue to operate at an efficient and competitive level, the economy of the Camellia Precinct would continue to benefit from the activities of this industry.

No mitigation measures for the construction or operational phases of the Project have been recommended.

9.7 Traffic and Transportation

9.7.1 Existing Transportation Network and Traffic Volumes

The local area surrounding the Refinery experiences heavy peak period and daily traffic flows, primarily concentrated in James Ruse Drive to the south (a key regional connector between the M4 and Parramatta Road) and Victoria Road, Pennant Hills Road and Windsor Road to the north.

According to 1996 Traffic Volume data, James Ruse Drive was reported as carrying 60,000 vehicles per day. The annual average daily volume along Grand Ave was recorded in 1994 at 10,200 vehicles per day (CH2M HILL, 2001).

Traffic surveys were conducted at the intersection of James Ruse Drive and Grand Avenue, and at the intersection of Grand Avenue, Thackery Street and Patrick's access road on Friday September 12 2003 by Traffic and Transport Surveys Pty Ltd (SITA Environmental Solutions, 2003). The survey identified the following key trends:

- Two-way vehicle flows in James Ruse Drive approached 5,000 vehicles per hour (vph) during morning and evening peak periods, north and south of the intersection
- Two-way flows in Grand Avenue were approximately 800vph in the morning peak period and 600vph in the evening peak period
- Two-way flows in Hassall Street were approximately 1,750vph in the morning peak period and 1,950vph in the evening peak period.

The site has adequate parking spaces available as evidenced by the fact that 400 to 500 additional spaces are available during major maintenance overhauls.

9.7.2 Construction Traffic Impacts and Mitigation Measures

Construction traffic will be generated from the regular Refinery wide shut-down maintenance period which occurs every four years. During this period the FCCU

would undergo the upgrade. Additional 500 contractors are expected over the Q2 2008 period as a result of the Refinery wide shutdown.

The two access routes into the Camellia precinct and Clyde Refinery are via:

- James Ruse Drive, Grand Ave, Durham Street
- Parramatta Road, Wentworth, Kay, Unwin, Colquhoun, Devon and Durham Streets.

Neither of the access routes impact on any residential streets and therefore there would be no impact on school buses or other sensitive road users. Some cyclists use Grand Avenue, and any effect on them would be minimal as there would be a negligible change in road use as a result of the project. Rail transport crosses Grand Avenue into the Patrick Transport yards approximately twice per day.

Large pieces of equipment would be transported to the Refinery via sea cargo and then transported via the Refinery's internal roads to the FCCU site.

Approximately 50 delivery trucks visit the Refinery on a daily basis. An estimated 6 additional trucks would be required to transport the old reactor, stripper and other miscellaneous material off site. However as the removal of this equipment is a once-off movement it would have a negligible effect on local traffic conditions.

Clyde Refinery also has substantial parking facilities to absorb the additional construction workers over the construction period. Therefore surrounding areas would not be affected by additional vehicles seeking parking.

The following mitigation measures have been recommended for implementation during the construction phase of the Project:

- Transport of wide loads would be scheduled to an off peak period with appropriate control measures in place during transportation.
- Construction traffic would utilise the existing public road network of arterial roads in the area.
- A traffic management plan would be implemented for the movement of the larger items of equipment not being transported via sea cargo.

9.7.3 Operational Impacts and Mitigation Measures

There would be no operational changes expected to traffic volumes as a result of the Project. The FCCU would be operated by existing Clyde Refinery employees. Therefore as there are no additional vehicle movements associated with normal operation of the FCCU, no mitigation measures have been recommended.

9.8 Non-Indigenous Heritage

9.8.1 Existing Non-Indigenous Heritage Environment

Items of non-indigenous heritage value are listed in statutory registers and schedules that provide the individual heritage item with a level of statutory protection. In Australia, statutory protection of heritage items is applied at the national, state and local level. Statutory registers relevant to the Project site include:

- Register of the National Estate (Australian Heritage Council)
- NSW Heritage Register
- Parramatta Regional Environmental Plan No 28 (REP) - 1999
- Parramatta Local Environmental Plan (LEP) - 2001.

9.8.2 Impacts on Non-Indigenous Heritage Items and Mitigation Measures

A search of the above registers provided no listings of heritage items on the proposed development site or the Clyde Refinery. The Parramatta LEP (2001) identified the following heritage items of local or regional/state significance in the vicinity of the Refinery site:

- The Clyde Wetlands at the Parramatta River, Camellia, including the Arthur Phillip's 1788 landing site and wetland
- The Silverwater Bridge, located on Silverwater Road, Ermington, east of the site
- Several items along Grand Ave with historic and aesthetic significance, including the Clyde Carlingford Rail Bridge, pumping station and former tram alignment
- The RTA Depot and Capral Aluminium on Unwin Street, Rosehill, west of the site.

The Parramatta Historical Archaeological Landscape Management Study (Godden Mackay Logan, 2000) confirmed that the Clyde Refinery site is important for industrial development in Parramatta and concluded that the area is of "no archaeological significance" and has "no current archaeological research potential". Godden Mackay Logan (2000) noted that any archaeological evidence at the site is likely to be subject to major disturbance.

None of the above identified heritage items are anticipated to be impacted by the proposed modification or associated construction works. No impacts are expected on the Parramatta River wetlands or mangroves.

9.9 Indigenous Heritage

9.9.1 Existing Indigenous Heritage

Indigenous heritage items are registered with the NSW Parks and Wildlife on the Aboriginal Heritage Information Management System (AHIMS). Under the *NPW*

Act, it is illegal to damage or destroy an aboriginal relic or site without written permission from the Director of NPWS.

A search of the National Parks and Wildlife Register for items of Aboriginal Heritage revealed that twenty six sites have been recorded within a 5km radius of the study area (CH2M HILL, 2001). These sites comprise mainly locations where artefacts such as stone, bone, shell, glass and ceramics have been recorded. One site features art (pigment or engraved) and one features a modified tree (carved or scarred). None of the recorded sites are within the Clyde Refinery site.

The closest site is located approximately 1.5km north west of the site on the corner of Hassall Street and James Ruse Drive and consists of artefacts relating to an open camp site.

The Australian Heritage Council lists no indigenous sites for the Parramatta Local Government area.

As the Clyde Refinery site has been highly modified with past land uses, and large quantities of fill material have been placed on the site, it is considered unlikely that any items of indigenous heritage would be present (SITA Environmental Solutions, 2003).

9.9.2 Impacts on Indigenous Heritage and Mitigation Measures

No excavation is necessary to upgrade the FCCU. Existing foundations would be adequate for the new components and the surrounding area is paved with bitumen and concrete paths.

All statutory heritage items in the local area are considered to be located at a sufficient distance away so as not to be affected by the development works. Therefore the upgrade is not expected to disturb or have any impact on heritage items or places in the vicinity.

9.10 Cumulative Environmental Impacts

9.10.1 Refinery Wide Shutdown 2008

During the replacement of the reactor and stripper and upgrade to the regenerator, the entire FCCU process would be shut down due to the extent of the proposed upgrade. The FCCU is routinely shutdown every four years for scheduled maintenance.

The next Refinery wide scheduled maintenance is the second quarter 2008 which coincides with the proposed development. During the shut down period when the FCCU is off-line, other infrastructure including steam systems and flare systems would be shut down for a brief period of approximately 2-3 weeks for maintenance, however, they would be re-started while the FCCU is still off-line.

The traffic generated during this maintenance period would increase to an additional 500 vehicles. As this is a regular but temporary occurrence, the activities associated with the maintenance period are not expected to have a significant impact on the local community. As entrance to the Clyde Refinery is via large arterial roads, no sensitive receptors such as schools or hospitals would be impacted.

The Refinery is surrounded by other industrial receptors with the closest residential receiver approximately 720m south east of the FCCU. Noise generated across the site would be in accordance with the Industrial Noise Policy 2000.

In addition, Shell plans to upgrade its hydrodesulphurisation (HDS) unit to reduce its sulphur content in diesel from 50ppm to 10ppm in accordance with the Fuel Quality Standards Act 2000. This activity is planned for the second half of 2008.

9.10.2 Other Local Developments

Parramatta City Council has identified, in May 2007, a number of smaller developments in the vicinity of the Shell Refinery. These include activities at:

- 11 Grand Ave – Armguard
- 5 Devon Street
- 10 Colquhoun Street.

These development applications are for minor activities such as building expansions and parking facilities. As these developments are only minor in nature the FCCU project is not expected to create a significant cumulative impact on the local environment.

10 Health, Safety and Environmental Management

10.1 Summary of Recommended Mitigative Measures

Measures to mitigate the predicted environmental impacts of the proposed FCCU upgrade has been recommended in **Sections 8** and **9**.

Table 10-1 summarises the proposed mitigative measures which would be implemented during the construction phase of the Project. **Table 10-2** summarises the proposed mitigative measures which would be implemented during operation and maintenance of the upgraded FCCU.

Table 10-1 Recommended Mitigative Measures during the Construction and Commissioning Phase of the Project

Issue	Summary of Mitigative Measures
Air Quality	Although dust is not expected to be generated, watering of areas that have the potential to produce dust is recommended. General maintenance on machinery and vehicles is also recommended to reduce the levels of exhaust emissions during construction.
Noise	Any noise generated would be in accordance with the NSW Industrial Noise Policy 2000.
Land and Soil Management	Soil to be sampled and classified. Handling and disposal in accordance with classification.
Visual Amenity	No recommendations.
Waste	Classification and disposal in accordance with EPA Guidelines, EPL 570 and PCB CCO. Waste would be recycled where possible in accordance with the *Waste Avoidance and Resource Recovery Act* 2001.
Land Uses	No recommendations.
Human Health	No recommendations.
Terrestrial and Aquatic Flora and Fauna	No recommendations.
Socio-Economic Setting	No recommendations.
Traffic and Transportation	No recommendations.
Hydrology and Flooding	No recommendations.
Surface Water Quality	Minimise area and time of soil exposure. Control access to construction site and keep vehicles and machinery away from stockpiles and excavation areas.

Issue	Summary of Mitigative Measures
Groundwater Quality	Maintenance checks of equipment and regular cleaning are recommended to reduce the potential for spillages and leakages. Dewatering or groundwater containment and redirected to the Biotreater if required.
Non-Indigenous Heritage	No recommendations.
Indigenous Heritage	No recommendations.
Cumulative Environmental Impacts	Noise generated would be in accordance with the NSW Industrial Noise Policy.

Table 10-2 Recommended Mitigative Measures during Operation and Maintenance of the Project

Issue	Summary of Mitigative Measures
Air Quality	Undertake monitoring of SO2 and SO3 concentrations in the ambient air for a period of 12 months to facilitate the validation of the dispersion modelling and provide assurance that there are no detrimental impacts on the local community. If the ambient monitoring detects an exceedance of the SO2 or SO3 impact assessment criteria, Shell would investigate opportunities to improve operational conditions to ensure that there are no future exceedances.
Noise	Compliance with INP 2000 and provision of safety equipment for personnel working in close proximity to generating equipment.
Land and Soil Management	No recommendations.
Visual Amenity	No recommendations.
Waste	Catalyst and coke removal and disposal in accordance with Shell's EPL and NSW EPA Guidelines.
Land Uses	No recommendations.
Human Health	See Air Quality and Noise.
Terrestrial and Aquatic Flora and Fauna	No recommendations.
Socio-Economic Setting	No recommendations.
Traffic and Transportation	No recommendations.

Issue	Summary of Mitigative Measures
Hydrology and Flooding	No recommendations.
Surface Water Quality	Maintain existing surface water monitoring program (see **section 10.5**).
Groundwater Quality	No recommendations.
Non-Indigenous Heritage	No recommendations.
Indigenous Heritage	No recommendations.
Cumulative Environmental Impacts	No recommendations.

10.2 Health, Safety and Environmental Management Plans

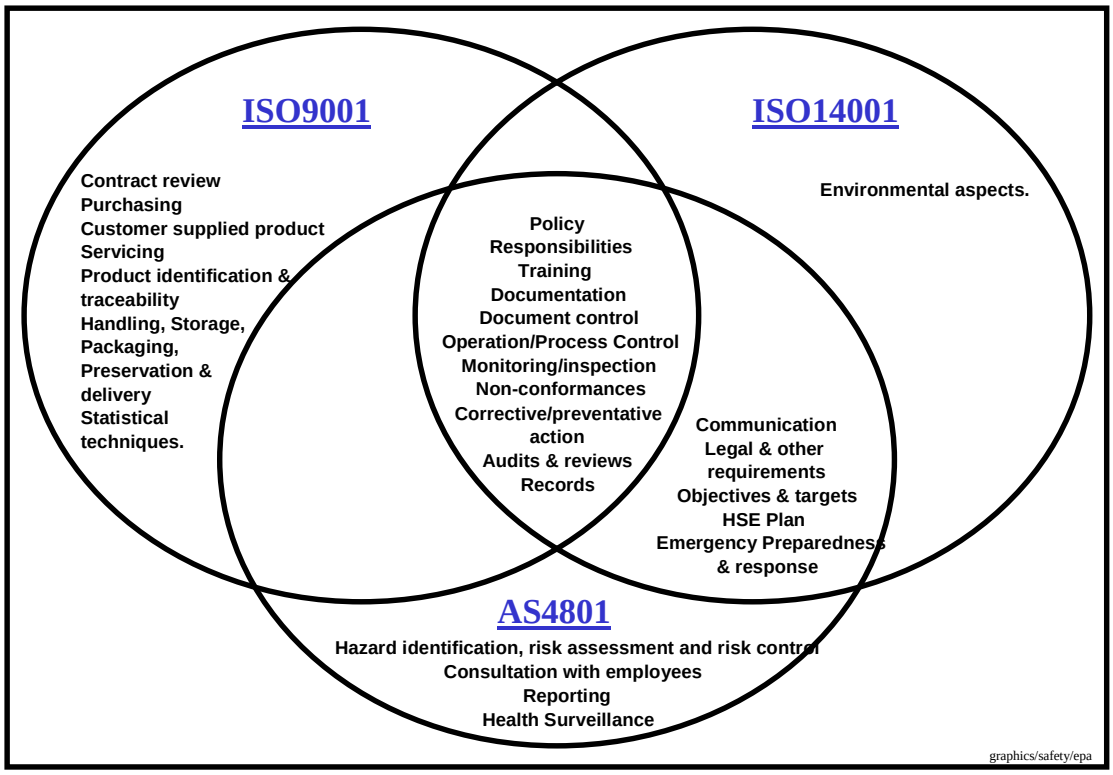
10.2.1 Management System

The Clyde Refinery Management System (MS) has been developed to comply with:

- ISO 9001. Quality Management – externally certified
- ISO14001. Environmental Management – externally certified
- The AS 4801. Occupational Health and Safety Management System – externally certified
- The Worksafe National Standard for Control of Major Hazard Facilities.

The inter-relationship of the above-mentioned standards, which were used to set up the structure of the MS, is depicted in **Figure 10-1**.

Figure 10-1 Inter-Relationship of ISO9001, ISO4001 and AS4801



The structure derived from these standards provides the framework for the systematic management of the Refinery Health Safety Environment and Quality (HSEQ) issues. The Clyde MS system is externally audited every six months.

The process of hazard identification and analysis is a key element of the Management System. It provides a demonstration that potentially significant hazards have been identified, the risks evaluated and the controls required are in place.

The hazard management processes used at Clyde Refinery has been divided into several categories. These are:

- Process Safety
- Occupational Health and Safety
- Environmental.

The Process Safety Hazards are managed by reference to the Major Hazard Facilities Code. This process was used in the Preliminary Hazard Analysis – **Appendix E**. Occupational Health and Safety Hazards are managed using a variety of methods under the framework of AS 4801. Environmental hazards are managed under the framework of ISO 14001.

A common link in the management of these different hazards is the Risk Assessment Matrix. The relationship between the potential consequences and frequency of an event, i.e. the risk, was used to carry out the identification of "high" and "medium"

risk hazards. The Shell Risk Assessment Matrix, shown below in **Figure 10-2** was used for this purpose. The Potential Consequence is the *realistic worst-case consequence* of an incident, if the conditions are the least favourable. If more than one consequence is applicable, use the worst case. Likelihood is the frequency of occurrence of this *realistic worst-case consequence,* due to this type of incident.

The *NSW Occupational Health and Safety Regulation 2001* now require risk management at places of work. The regulation requires employers to identify hazards and to assess the risk of any hazard by evaluating the likelihood and likely severity of any injury or illness that may occur.

Figure 10-2 Risk Assessment Matrix

Severity	CONSEQUENCE				INCREASING LIKELIHOOD →				
	People	Assets	Environment	Reputation	A	B	C	D	E
					Never heard of in the industry	Has occurred in the industry	Has occurred within Shell Refineries	Occurs > once a year in Shell Refineries	Occurs > once a year in Shell Clyde Refineries
0	No health effect/injury	No damage	No effect	No impact	Area 1 - 'Low Risk				
1	Slight health effect/injury	Slight damage	Slight effect	Slight impact					
2	Minor health effect/injury	Minor damage	Minor effect	Limited impact					
3	Major health effect/injury	Localised damage	Localised effect	Considerable impact		Area 2 - Medium Risk			
4	Single fatality	Major damage	Major effect	National impact					
5	Multiple fatalities	Extensive damage	Massive effect	International impact			Area 3 - 'High Risk'		

The Refinery has three risk registers that document the site hazards and classify the risks.

The Risk Registers are:

- Significant Occupational Health & Hygiene Hazards – AS4801
- Significant Environmental Aspects and Impacts – ISO 14001
- Hazard Register – Major Hazard Facility Code.

The key to the risk management approach is that organizations should spend the bulk of their time and effort managing their greatest risks.

Documented controls need to be in place for all high and medium risk hazards.

The Refinery has some 600 document controlled procedures and working instructions that cover all aspects of the site's operations. There are existing procedures for the following activities relevant to this EA:

- FCCU (reactor, stripper and regenerator)
- Refinery Management HSE Manual, including Environmental Compliance and Monitoring; and Emergency Response
- Refinery Management System Manual
- Shutdown HSE Management
- Auditing.

The following procedures would be updated as a result of this project:

- FCCU Working Instructions – prior to commissioning
- Emergency Response Manual to take account of the recommendations in the PHA and Final Hazard Assessment
- The existing Shutdown HSE Management Procedure would be modified to form the Construction Management Procedure. It would take account of statutory requirements.

10.3 Site Management Plan

Specific plans to manage the environmental impacts of construction activities would be prepared as part of the Project Management Plan for the construction phase of the Project. The following plans would be prepared (among others):

- Environmental Management Plans (EMPs)
- Safety Management Plan (SMP)
- Incident Management Plan.

This EA has recommended that certain mitigative measures be implemented during the construction phase of the Project. These mitigative measures are listed in

Table 10-1 and would be incorporated into these plans as outlined below.

10.3.1 Outline of Construction Environmental Management Procedure (CEMP)

A Construction and Environmental Management Procedure (CEMP) for the construction phase of the proposed upgrade to the FCCU would be prepared. The scope would cover relevant HSE issues. The CEMP would include (but not be limited to) the following information and control plans.

Project Objectives and Scope

Once approval of the Project has been obtained, the project scope and objectives would be reassessed within the terms of any approval conditions. This may require additional measures to mitigate environmental impacts specified in the approval conditions.

Permits, Approvals and Consent Conditions

All permits, approvals and consent conditions required prior to and or during the construction phase would be identified in the CEMP. This would provide a checklist for the Construction Manager to ensure all permits and regulations are complied with and relevant approvals are obtained.

Complaints Procedure

The existing Refinery complaints procedure would be used in accordance with the EPA License conditions. This existing procedure provides details on the actions required following a complaint.

Construction Methods

This section would provide a summary description of the proposed construction activities.

Noise Management

A section for construction noise control would be developed as part of the CEMP. This would include details of noise standards to be met, noise monitoring requirements and noise control measures to be implemented.

Traffic Management

A section would be included as part of the CEMP. The main purpose of this section would be to coordinate construction traffic operations and maximise safety. The plan would detail construction traffic routes, access management, traffic safety requirements, traffic timing and parking requirements.

Waste Management

This section would outline waste management procedures, including waste recycling and reuse measures, waste disposal measures (when reuse is not feasible), and the identification of the correct waste disposal areas. The waste management plan would be developed to minimise the generation of waste and maximise reuse, recovery and recycling of waste products.

Monitoring and Auditing

A monitoring program would be developed during the preparation of the CEMP. The monitoring methods, locations, frequency, criteria, reporting and responsibilities would be detailed in this section of the CEMP. Audit requirements, audit frequency and responsible personnel would also be outlined.

Communications and Training

Induction training and awareness programs have been developed to make employees and contractors aware of HSE responsibilities and potential consequences of departure from procedures. Communication procedures would also be developed in the CEMP.

Incident Notification and Reporting

Reporting pathways, responsibilities and accountabilities for environmental and safety incidents has been developed. A procedure to establish appropriate actions in response to incidents has been established as well as follow up procedures to enable confirmation that incidents have been addressed and corrective action has been taken.

10.3.2 Operational Environmental Management

The FCCU already has a set of operating procedures that would be reviewed and updated to accommodate the new, more modern components. Any additions due to approvals and consent conditions would be included at the same time.

10.4 Safety Contingency Plan

The Refinery has an existing emergency response plan that covers a range of incidents. Several of these potential incidents have been exercised with external agencies in the past.

The risk assessment process outlined under the framework of the Major Hazard Facilities Code has identified several accident events that could give rise to the need for an emergency response. Pre Incident Plans have been developed for a range of incidents. The accident events identified in the PHA (**Appendix E**) are being reviewed to develop a specific emergency response plan for the construction phase of the project as there would be increased numbers of people working in and around the existing plant.

10.5 Environmental Monitoring, Auditing and Reporting

HSE monitoring would be undertaken during construction and operation of the upgraded FCCU.

Whilst detailed monitoring programs would be developed during the preparation of the CEMPs (following approval), an outline of the existing programs is provided as an indication of the current system.

10.5.1 Existing HSE Monitoring

Water Quality

Potentially contaminated process water is treated physically, chemically and biologically using on-site facilities prior to discharge to the Duck River. A proportion of this treated water is used as Cooling Tower make-up water. Water samples are taken on a daily basis from each process step of the waste water treatment plant. The samples are analysed on site in the Refinery water laboratory. Prompt action can then be taken if any parameters are outside the control range. Compliance monitoring takes place on a weekly or fortnightly basis for EPA licence purposes and every eight days for the Trade Waste Sewer consent (Sydney Water), including continuous online monitoring for temperature, pH and flow rate.

Stormwater quality is monitored on an as needs basis. All six water discharge points to the Duck River are regulated by the EPL No. 570.

Noise and Vibration

Noise contour maps are available for each process area. These maps are used to advise people of the noise levels and any precautions that may be necessary. Monitoring equipment is available on site should levels need to be checked for any reason.

Emissions to Air

Key air pollutants for Clyde Refinery associated with existing operations include VOC, NO_x, CO, SO_x, and PM_{10}. Mass emissions to the air are determined annually for LBL and NPI purposes in accordance to the Load Based Protocol and NPI guidelines. LBL and NPI calculations are verified and improved calculation techniques are utilised, where possible. On stream analysers (CEMS) are in place across the Refinery which monitor opacity, NO_x and stack emissions. CEMS are located at the CCU stack, Boiler 7 stack, Boiler 9 stack and combined boiler stack. Boiler CEMS measures NO, NO_x, O2, volumetric flow rate, moisture, and temperature.

Safety Monitoring/Environmental Audits

During shutdown extensive health monitoring of employees and contractors is undertaken. This enables Shell to monitor exposure of employees and contractors to certain chemicals. The monitoring results assist Shell in providing the appropriate level of personnel protection equipment to restrict exposure of employees and contractors to chemicals within acceptable threshold limits.

Refinery wide safety audits are undertaken on a regular basis, for example approximately ten per week.

10.5.2 Construction Phase Monitoring

Water that may be generated on-site during the construction period is water resulting from the use of a single water jet to cut the old reactor for removal purposes. Stormwater during wet weather may also be generated. No water contamination is expected. All water generated would be directed as per normal operations to the main interceptors with water processed in the Biotreater and injected as make-up water to the Cooling Towers.

Safety Monitoring/Environmental Audits

During construction, extensive health monitoring of employees and contractors is undertaken. This enables Shell to monitor exposure of employees and contractors to certain chemicals. The monitoring results assist Shell in providing the appropriate level of personnel protection equipment to restrict exposure of employees and contractors to chemicals within acceptable threshold limits.

Refinery wide safety audits now take place on a regular basis, eg approximately 10 per week. The frequency would be increased to take account of the increased activity during upgrade of the FCCU.

10.5.3 Operational Phase Monitoring

Water Quality

There would not be any changes to the capture and treatment of surface water from the upgraded FCCU. All surface water would continue to be collected and routed to the Refinery main interceptor system prior to treatment in the Biotreater and discharge to Duck River.

Noise and Vibration

Clyde Refinery's existing EPA licence 570 has the "Special Condition E4 - Report on Noise Limits". This condition required Shell to provide several requirements related to noise such as "project-specific noise levels" or "sleep disturbance criterion" for Clyde Refinery by 1 December 2004. This special condition was completed and its results were reported to the EPA. Shell is currently in discussion with the EPA to implement a noise reduction plan targeting key noise generating equipment within the Refinery.

Emissions to Air

Monitoring of the FCCU stack and 7/9 boiler stack would continue in accordance with the Clyde Refinery existing EPA licence 570.

Safety Monitoring/Environmental Audits

No changes are recommended to the safety monitoring program i.e. Refinery wide safety audits would continue on the existing frequency of approximately ten per week.

10.5.4 Environmental Reporting

Reports are produced for the DECC, Trade waste sewer consent compliance (Sydney Water), State and Federal Government initiatives such as Energy Efficient Opportunities program, Water Savings Action Plan, Energy Savings Action Plan, National Pollutant Inventory and Online System for Challenge Plus reporting and for Shell corporate purposes. The site also has a comprehensive incident reporting and investigation system that would be used for the upgraded FCCU.

10.5.5 External Communications

A telephone enquiry number, postal address and email address have been provided to approximately 9000 properties around the Refinery. Prior to construction, a further information leaflet would be distributed. Any complaints received as a result of the FCCU upgrade construction activities would be passed to the project team to be addressed.

11 Justification and Conclusions

11.1 Project Justification

The justification of the Project is discussed below having regard to biophysical, economic and social considerations.

11.1.1 Biophysical Considerations

The biological and physical components of the environment were examined in this EA and the impacts of the Project on these components assessed. The main findings are summarised below.

Surface Water Quality

During the construction phase, any run off from the water jet would be collected in the existing drainage and treatment system. Any excavated materials would be stockpiled on impervious materials and covered. Any leachate from these small stockpiles would be re-directed to the Biotreater via the Main Interceptor.

Groundwater Impacts

Groundwater is likely to be reached due to the excavation for footings and cabling. Groundwater containment or dewatering measures would be used if required. The groundwater would be re-directed to the Biotreater via the Main Interceptor.

Hydrology and Flooding

The construction and operation of the upgraded FCCU would not impact on the hydrology or flood risk to the site.

Land and Soil Management

A small amount of soil would be required to be excavated for six footings for the new lift and trenches for necessary cabling. Soil would be sampled and analysed and subsequently used or disposed of appropriately.

Terrestrial and Aquatic Flora and Fauna

The Proposed site for the development is of very little significance in terms of flora and fauna, both terrestrial and aquatic. No flora or fauna of significance was observed in the study area and it is considered that no flora or fauna of significance could reasonably be expected to occur or depend on the site.

However, potential impacts on the aquatic biota of Parramatta River during the construction phase of the Project would be managed by existing leakage or spill management controls. Although maintenance ploughing is highly unlikely, it is not expected to impact on aquatic flora and fauna as the Environmental Assessment did not identify any endangered or threatened species in the local area.

11.1.2 Economic and Social Considerations

Economic Benefits

The Project would provide a range of economic benefits for the Parramatta local government area. The Project represents an investment in the future viability of the

Clyde Refinery by ensuring continuous supply of Petrol, LPG and other products to the Sydney and NSW market.

The capital investment in the FCCU is predicted at AUD$77.77 million. In terms of employment, the construction phase would generate substantial temporary demand for local conveniences.

Air Quality

Air quality is not expected to be adversely affected during normal operations of the FCCU, and emissions are expected to be within acceptable limits prescribed by DECC. Owing to inconsistencies between the models used, additional monitoring of SO_2 and SO_3 would be undertaken.

Human Health

Human health is not expected to be impacted as a result of the proposed upgrade. Stringent safety measures would be implemented during demolition to ensure that workers are not placed at risk during asbestos removal in the demolition stage, and during the construction period.

Noise

The only additional noise generated from this project would occur during the construction phase of the Project. However, any noise generated either through construction activities or additional traffic would be very minor, and would not impact on any sensitive receptors.

Traffic

The large new components of the FCCU would be transferred to Clyde Refinery via sea cargo and then would be transferred via Shell's internal road network to the site. There are expected to be an additional ten trucks during the construction phase to transport on and off the site materials required.

The additional construction workers during the 2-3 month construction period would have sufficient parking at the Shell Refinery and would not require street parking. In addition, the two access routes (Parramatta Road and James Ruse Drive) are main routes and would not impact on any residential streets. There would be no impact on school buses or other sensitive road users.

The additional traffic generated during the construction phase of the Project is only temporary. During the operation of the FCCU, there would not be an increase in traffic generated.

Visual Amenity

The FCCU components, although significantly smaller in diameter, would stand approximately 15m taller than the existing FCCU components. In addition, new lighting methods would enhance the visibility of the FCCU during the night. However, as the FCCU is embedded well within the Refinery, a large industrial

landscape, and there are other existing structures taller than the new components, the impact on visual amenity is not expected to be significant.

Non-Indigenous Heritage

No items of heritage would be impacted by the Project.

Indigenous Heritage

No items of Indigenous heritage would be impacted by the Project.

Waste Management

Construction waste would be managed in accordance with regulatory requirements including Shell's EPL 570. In addition, waste from the old reactor and stripper would be sent to a third party to be recycled.

11.1.3 Implications of Ecologically Sustainable Development

The Precautionary Principle

The Precautionary Principle is, namely, if there are threats of serious or irreversible environmental damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation.

The precautionary principle has been applied in the environmental impact assessment process documented in this EA. Where scientific uncertainty was identified, monitoring and mitigation measures have been recommended. In addition to providing assurance that required mitigation measures are effectively mitigating potential impacts, monitoring and auditing would assist detection of uncertainties during construction and operation and enable them to be clarified to enable appropriate action to be taken to mitigate any unforeseen impacts.

The proposed FCCU upgrade has been assessed as not posing threats of serious or irreversible environmental damage.

Intergenerational Equity

Intergenerational equity is, namely, that the present generation should ensure that the health, diversity and productivity of the environment are maintained or enhanced for the benefit of future generations.

The environmental value of the heavy industrial area around Camellia is low. The health, diversity and productivity of the local environment would not be significantly impacted as a result of the Project.

Potential impacts resulting from construction and operation of the Project have been assessed in the EA which concluded that, subject to the implementation of the recommended mitigation measures, potential local environmental impacts can be controlled and reduced to acceptable levels. Therefore, the health diversity and productivity of the environment would not be compromised for future generations.

Conservation of Biological Diversity and Ecological Integrity

The terrestrial habitat has been heavily modified in the past, with no flora or fauna of significance occurring on or near the existing FCCU site. Similarly, the aquatic ecology of nearby waterways has been largely altered through past activities.

The proposed FCCU upgrade would be neutral with respect to emissions to water. Any maintenance ploughing which may be undertaken in Parramatta River would involve mitigative measures to reduce any impacts resulting from sediment removal. The potential for a slight increase in air emissions remain well within EPL requirements. Previous works at the Shell site have reduced the impact of the Refinery's operation on the environment and areas of the site have been set aside to encourage biological diversity.

Improved Valuation and Pricing of Environmental Resource

This principle recognises that decision making needs to take into account the value of changes to the quality or quantity of environmental resources and or environmental impacts.

The upgrade to the FCCU would significantly improve the productivity and reliability of petrol supply, specifically Petrol, from the Shell Clyde Refinery without significantly impacting on the environment.

11.2 Conclusions

An environmental assessment of the proposed upgrade to the FCCU at the Shell Clyde Refinery has been undertaken and presented in this EA. Increased demand for petroleum products within the Sydney metropolitan and adjoining regions has created the need for more efficient production of petrol products.

The Project has been shown to be consistent with the relevant local and state government planning instruments.

No significant environmental impacts have been identified during the preparation of the EA. The environmental impacts identified are considered to be able to be mitigated by implementing the measures recommended during construction, commissioning and operation of the proposed facilities.

The construction of the proposed development would result in minor short-term impacts in the local environment. These temporary impacts would be confined to the Refinery, and neighbouring properties, mainly associated with an increase in traffic.

The operation of the FCCU would provide for increased supply robustness and flexibility in the petroleum market within the Sydney metropolitan and adjoining regions. The upgrade to the FCCU would increase the efficiency of crude oil processing at the Refinery to enable the Refinery to meet current and future demand.

The key potential environmental issue associated with the upgrade to the FCCU is the upgrade to the regenerator which would increase its coke burning capacity. This would result in an increase to the amount of flue gas sent to atmospheric stack from the No. 8 boiler stack. Modelled results have however, indicated that this increase in emissions would have a negligible impact on the surrounding environment and would remain within the limits outlined by Shells' EPL No. 570.

In addition, the Refinery has a fully integrated, externally certified and audited Health Safety Environment and Quality Management System. The implementation of Shell's well defined operating procedures and maintenance routines would minimise the potential for incidents which would be applied to the operating conditions for the proposed upgrade to the FCCU.

The systematic nature of this management system together with its long running experience means that there is a good body of knowledge available on the impacts of the Refinery. The Refinery also submits a detailed compliance report to the DECC on an annual basis.

The environmental impacts of the proposed development predicted in this EA would be mitigated by implementing the measures recommended. These measures would be incorporated in a Construction EMP and into the Shell's operating and maintenance procedures.

12 Draft Statement of Commitments

12.1 General

Following the requirements of Part 3A of the EP&A Act, this section describes Shell's commitment to environmental mitigation, management and monitoring for the proposed upgrade to the FCCU.

12.2 Overview

The environmental assessment of the proposed FCCU upgrade has identified a range of environmental outcomes and management measures that would be required to avoid or reduce the environmental impacts of the project. Environmental mitigation, management and monitoring options have been proposed by Shell to reduce the environmental risk of the project. Where possible, the measures have been based on achieving a defined performance standard or implementing a proposed process. Specific actions which aim to deliver the desired outcomes where practicable are based on:

- Developing project designs which are capable of achieving the outcomes
- Developing environment management and mitigation measures during the planning and design phase
- Implementing, monitoring and review of these measures during the construction and operational phases.

Following approval of the project, the finalised commitments would guide the subsequent phases of the project development process to reduce impacts on the environment. Unless otherwise directed by the DoP or other relevant authority, Shell would endeavour to comply with the following environmental commitments.

12.3 Statutory Commitments

Shell would obtain all licenses, permits and approvals and maintain them as required throughout the life of the development. Copies of all relevant licenses, permits and environmental approvals would be available on site at all times during the project.

12.4 Project Compliance

12.4.1 Responsibility

Shell would be responsible for the project and the environmental impacts that may result, and would update its environmental management system governing the conduct of all persons on the site, including contractors, subcontractors and visitors.

12.4.2 Communications and Training

Reasonable steps would be taken so that employees, contractors and sub-contractors are trained and are made aware of, and comply with, the conditions of the DoP's consent relevant to their respective activities. In addition, all employees, contractors

and sub-contractors would be made aware of HSE responsibilities and potential consequences of departure from procedure.

12.4.3 Certification of Compliance

In accordance with any Conditions of Consent issued by the DoP, Shell would certify in writing to the satisfaction of the Director-General that it has complied with those Conditions of Consent relating to activities including the following:

- The performance of any physical works associated with the project
- Re-commissioning of the FCCU.

12.4.4 Report Updates

Any update reports with regard to compliance with all, or any part of, the conditions of consent would be supplied upon request. Any such update would meet the requirements of the Director-General and be submitted within such period as the Director-General may agree.

12.5 Management of Key Issues

12.5.1 Air Quality Impacts

Shell would monitor SO_2 and SO_3 concentrations in the ambient air for a period of 12 months to facilitate the validation of the dispersion modelling and provide assurance that there are no detrimental impacts on the local community. Monitoring would include periods before, during and after the major Refinery shut-down proposed in the second quarter of 2008.

If the ambient monitoring detects an exceedance of the SO_2 or SO_3 impact assessment criteria, Shell would commit to improve operational conditions to ensure that there are no future exceedances.

12.5.2 Construction Traffic

Although the proposed upgrade to the FCCU would not require a large number of traffic movements, excluding temporary contractor movements, a traffic management plan would be prepared to manage the transport of any large critical pieces of equipment which would not be transported via barge on the Parramatta River.

12.5.3 Noise Impacts

During the demolition, construction and operation phase of this project, Shell would conduct activities in accordance with the NSW INP and other regulatory limits.

12.5.4 Soil and Water Quality Impacts

Surface water and stormwater would be managed via the existing drainage system which collects and transports water to the waste water treatment plant for decontamination.

Risks to groundwater contamination would continue to be managed by Shell via the implementation of its environmental management systems and procedures.

Section 120 of the Protection of the Environment Operations Act 1997 (prohibition of pollution of waters) would be complied with in connection with the carrying out of the development.

Maintenance ploughing has the potential to impact upon the water quality of Parramatta River. Any activity in Parramatta River would incorporate mitigative measures to reduce any potential impact and would be undertaken in accordance with a Part 7 permit, which may be required under the Fisheries Management Act 1994.

12.5.5 Hazards and Risk Impacts

Prior to the commencement of works, Shell would submit for the approval of the Director-General, a Hazard and Operability Study (HAZOP) of the development (and related systems). The Study would be chaired by an independent, qualified person or team, approved by the Director-General, and would be carried out in accordance with the Department's publication Hazardous Industry Planning Advisory Paper No. 8 - HAZOP Guidelines.

Prior to the commencement of works, Shell would submit for the approval of the Director-General, a Construction Safety Study for the development, prepared in accordance with the Department's *Hazardous Industry Planning Advisory Paper No. 7 - Construction Safety Study Guidelines*. The Study would specifically identify and address potential hazards associated with the construction of the development and its interaction with other parts of the Refinery, while the works permitted under this consent are undertaken. This would be split into 2 phases, pre-turnaround construction and turnaround construction.

12.5.6 Waste Generation and Management

A waste management plan would be prepared to outline the treatment and/or beneficial reuse of waste materials associated with the development. The plan would enable the minimisation of temporary storage of waste on the site and minimisation of waste volumes requiring disposal by maximising recycling of metal from the old equipment.

Shell would not cause, permit or allow any waste generated outside the site to be received at the site for storage, treatment, processing, reprocessing, or disposal on the site, except as expressly permitted by an EPL issued under the Protection of the Environment Operations Act 1997 and in accordance with its provisions.

Where possible, waste types would be identified prior to the commencement of construction. Depending on the waste classification of material to be removed, the use of licensed waste transporters would be used.

Any PCB contaminated waste would be handled and disposed of in accordance with the PCB CCO and Shell's EPL 570.

12.5.7 Community Information, Consultation and Involvement

Community Complaints

Prior to the commencement of works, Shell shall provide the following and make available for community complaints:

- A telephone number on which complaints about the development may be registered
- A postal address to which written complaints may be sent
- An email address to which electronic complaints may be transmitted.

The telephone number, the postal address and the email address shall be provided in a letterbox drop prior to the commencement of construction.

Details of all complaints received via those methods listed above as well as complaints received in person either at the Refinery or elsewhere would be recorded in an up-to-date Complaints Register. The Register shall record, but not necessarily be limited to:

- The date and time, where relevant, of the complaint
- The means by which the complaint was made (telephone, mail, email or in person)
- Any personal details of the complainant that were provided, or if no details were provided, a note to that effect
- The nature of the complaint
- Any action(s) taken in relation to the complaint, including any follow-up contact with the complainant
- If no action was taken in relation to the complaint, the reason(s) why no action was taken.

The Complaints Register shall be made available for inspection by the Director-General upon request. Summaries of the Register, without details of the complainants, would be made available to the public for inspection upon request.

All monitoring, including recording and reporting of monitoring results, as required by the DoP's consent and as may be specified in an Environment Protection License applicable to the development would be undertaken. Such records would be retained on site in a legible format and would be made available to authorized persons upon request.

12.6 Environmental Management and Reporting

12.6.1 Construction Environmental Management Plan

A Construction and Environmental Management Procedure (CEMP) would be prepared and implemented to outline environmental management practices and procedures to be followed during the construction phase of the Project. A copy shall be submitted to the Director-General prior to the commencement of any construction works. This CEMP would be split into two packages, i.e. pre-construction and construction.

12.6.2 Operational Environmental Management

Prior to the re-commissioning of the FCCU, Shell shall demonstrate to the satisfaction of the Director-General that it has updated environmental and safety management systems for the Refinery to reflect any necessary modifications.

Incident Reporting

The site has an incident reporting and investigation system that would be utilised if an incident occurred. This is a detailed and comprehensive system to monitor incidents but also the remedial response.

12.6.3 Environmental Auditing

After completion of the construction phase, Shell would formalise an audit programme in accordance with ISO 19011 and would undertake internal audits in accordance with the programme to assess compliance with any Conditions of Consent including construction management plans associated with the proposed project. The level of compliance with Conditions of Consent would be documented and any observations would be noted, actioned as appropriate and documented.

12.7 Validation of Commitment

Such commitments as identified above remain current for the life of the project to the extent that they do not become subject to change as a result of some other form of subsequent agreement with recognised authorities, or where they may contradict a legal or other requirement currently or subsequently imposed on the project or Shell, that was not known at the time of making this commitment.

This commitment is made under authority of the following person, who is legally empowered to make this undertaking on behalf of Shell Refining (Australia) Pty Ltd:

Name	David W. Johnston
Position	Refinery Manager
Signature	David Johnston
Date	24/9/07

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Legislation

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Waste Avoidance and Resource Recovery Act 2001

Threatened Species Conservation Act 1995

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Energy and Utilities Administration Act 1987

Rivers and Foreshores Improvement Act 1948

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SEPP 55 - *Remediation of Land*

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Sydney Regional Environment Plan No.28 – Parramatta

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