9 Social Surroundings Impacts, Management and Monitoring

9.1 Introduction

The aim of **Section 9** is to identify the potential impacts and define management and monitoring strategies of key social issues associated with the construction and operation of the methanol complex.

A table summarising the potential social impacts, their effect, likelihood and associated risk during construction and operation of the complex is included in **Section 9.2** and continues on from construction and operation impacts identified in **Tables 7-4, 7-5 and 8-1.**

9.1.1 Potential Social Impacts

The potential social impacts that are relevant to the construction and operation of the proposal are related to the following factors:

- Risk and hazard to public safety;
- Road transport and traffic;
- Accommodation;
- Service and facility requirements;
- Aboriginal culture and heritage;
- European Heritage;
- Visual amenity; and
- Recreation.

During initial consultations, key stakeholders expressed concern about some of the factors listed above.

Potential social impacts that may result from the construction and operation of the methanol plant as well as cumulative social impacts that may arise from this and other projects proposed for the Burrup Peninsula are considered below. The assessment of risk is based on the methodology described in **Tables 7-1 to 7-3**.

9.1.2 Management and Monitoring Strategies

Since many of the social impacts are of a cumulative nature, their management will require a co-ordinated response from Methanex, other industry (proposed and established) and local and state government agencies. Mention has been made previously in **Section 8.1** to Methanex' commitment to assist and participate in activities investigated by the Burrup Industrial Council. It is recommended that such a body should also address social impacts from industry on a cumulative basis.

9.1.3 Management Commitments

Not withstanding the above recommendation, Methanex have nominated commitments where appropriate management can be implemented to minimise impacts. As previously discussed these commitments will be subject to auditing and approval by decision-making authorities.

9.1.4 Predicted Outcomes

Predicted outcomes of having adopted nominated management and monitoring strategies and commitments are specified for each environmental factor as previously discussed in **Section 7.1.4**.

9.2 Summary of Potential Social Impacts during Construction and Operation

Table 9-1 summarises the potential social impacts of construction and operation of the methanol complex on the social environment and assesses their significance, likelihood and associated level of risk.

The impacts, management strategies and monitoring for the relevant social factors are discussed in detail in the sections that follow.

It is important to note that these risk levels are based upon the impact occurring in the absence of the implementation of management strategies and any mitigation measures to reduce the risk.

■ Table 9-1 Summary of potential social impacts during construction and operation

Environmental Factor	Source of Impact	Potential Environmental Impact	Significance of Impact	Likelihood	Level of Risk
Risk and Hazard to public safety	■ Leak or Rupture ■ Shipping accident/vessel collision ■ Fire ■ Explosion ■ Cyclone	■ Soil contamination ■ Groundwater, surface water and marine water contamination ■ Risk to public safety ■ Property damage to complex, equipment and adjacent plants.	Minor Moderate Moderate Minor	Rare Rare Rare Rare	Low Moderate Moderate Low
Road Transport and Traffic	■ Workforce traffic ■ Shift changes ■ Transport of construction materials ■ Increased traffic from cumulative industries	■ Disruption to existing traffic flows ■ Increased traffic movements ■ Increased potential for accidents	Negligible Negligible Negligible	Unlikely Likely Moderate	Low
Accommodation	■ Construction workforce ■ Operation workforce ■ Population increase due to other proposed projects.	■ Shortage of land available for development ■ Shortage of established housing for purchase ■ Shortage of established housing for rent ■ Increase of rental costs	Significant Significant Significant Significant	Moderate Almost certain Almost certain Moderate	Major Significant Significant Major
Service and Facility Requirements	■ Construction workforce ■ Operation workforce ■ Population increase due to other proposed projects.	■ Shortage of medical and health services ■ Shortage of education facilities ■ Shortage of recreational facilities ■ Shortage of emergency services	Moderate Moderate Moderate Moderate	Likely Moderate Moderate Moderate	Major Moderate Moderate Moderate

▪ Table 9-1 Summary of potential social impacts during construction and operation (continued)

Environmental Factor	Source of Impact	Potential Environmental Impact	Significance of Impact	Likelihood	Level of Risk
Visual Amenity	▪ Construction activities ▪ Presence of complex during operation ▪ Lighting of complex ▪ Flare (infrequent)	▪ Loss of amenity at Hearson Cove, Cowrie Cove and the broader King Bay – Hearson Cove valley ▪ Light spill resulting in potential impacts to the marine environment and being of nuisance to nearby residents and recreational users	Moderate Minor	Almost certain Almost certain	Significant Major
Aboriginal Culture and Heritage	▪ Earthworks and excavation ▪ Disturbance to registered sites ▪ Disturbance to rockpiles	▪ Loss of archaeological and ethnographical sites ▪ Potential disturbance of adjacent archaeological and ethnographical sites by uncontrolled access by workforce	Significant Significant	Almost certain Unlikely	Significant Moderate
European Heritage	▪ Earthworks and excavation ▪ Disturbance to registered sites	▪ Loss of European heritage sites ▪ Impact on the condition of heritage sites, ie. water quality impacts on the Dampier Archipelago marine environment	Significant Moderate	Rare Rare	Moderate Moderate
Recreation Areas	▪ Closure of Cowrie Cove access road ▪ Lighting of complex ▪ Noise emissions from plant	▪ Loss of access to recreational areas ▪ Nuisance noise emissions ▪ Nuisance odorous emissions ▪ Public loss of amenity	Moderate Moderate Negligible Moderate	Almost certain Likely Rare Almost certain	Significant Major Low Significant

9.3 Public Safety – Risk and Hazards

Management Objective *– To ensure that risk is managed to meet the EPA's criteria for offsite individual fatality risk and that ALARP is demonstrated, and MPR's requirements in respect of public safety are met.*

9.3.1 Preliminary Risk Assessment

Halliburton KBR Pty Ltd was engaged to conduct a Preliminary Risk Assessment (PRA) of the proposed methanol facility. A comprehensive report was provided to the EPA and MPR as a supporting document to this PER (Halliburton KBR Pty Ltd, 2002). The document is summarised in the following sections.

The objectives of the PRA were to demonstrate that:

- The proposed development meets the EPA criteria for individual risk to public;
- Adequate design, operational and organisational safeguards will be incorporated in the development such that the risk is as low as reasonably practicable (ALARP); and
- Existing or proposed industrial developments on the surrounding land would not be adversely affected.

The scope of the study covers all operating facilities associated with the proposed development including the following:

- Methanol Plant;
  - Natural gas desulphurisation plant;
  - Reformer and synthesis gas production;
  - Methanol converter;
  - Distillation and methanol production;
  - Air separation unit;
  - Turbine Drives;
  - Major heat exchangers;
  - Waste heat recovery unit;
  - Methanol tankfarm;
- Methanol transfer pipeline; and
- Ship loading operations.

Risks associated with shipping activities in the Dampier Port were addressed through a separate study (Qest Consulting Group, 2002).

9.3.1.1 Risk Criteria

Individual risk at a given location is generally expressed as the peak individual risk, defined as the risk of fatality to the most exposed individual located at the position for 24 hours of the day and 365 days in the year. Since residential areas tend to be occupied by at least one individual all the time, the above definition would easily apply to residential areas. A person indoors would receive natural protection from fire radiation and hence the risk to a person indoors is likely to be lower than to one in open air. In this study, the individual risk levels have been calculated for a person in open air.

For land uses other than residential areas, (i.e. industrial or commercial) where occupancy is not 100% of the time, individual risk is still calculated on the same basis. However, the criteria for acceptability are adjusted for occupancy. Criteria have been established by the EPA in Western Australia. The risk criteria are summarised in **Table 9-2**.

■ **Table 9-2 WA EPA risk criteria**

Land Uses	Maximum Risk (per year)
Individual Fatality Risk	
Sensitive land uses - hospitals, schools, child care facilities, old aged housing	0.5×10^{-6}
Residential areas	1×10^{-6}
Any commercial activities, including retail centres, offices, showrooms, restaurants or entertainment centres, in buffer zone between industrial and residential zones	5×10^{-6}
Any non-industrial activities or active open spaces in buffer zone between industrial and residential zones	10×10^{-6}
Boundary of an industrial site (facility generating the risk) (maximum risk at boundary of the site which generates the risk)	50×10^{-6}
Boundary of an industrial site (facility subject to risk) (maximum cumulative risk imposed by all surrounding facilities)	100×10^{-6}

In addition to quantitative criteria, qualitative guidelines are also given to ensure that offsite risk is prevented and where that is not possible, controlled. For new proposals, in addition to meeting the quantitative criteria, risk minimisation and use of best practice must be demonstrated. These terms imply:

Best Practice: new plant should be designed using best practicable engineering design and operated using best industry practice management systems.

Risk Minimisation: regardless of calculated risk levels and criteria, risks should be reduced as low as reasonably practicable (ALARP).

9.3.1.2 Methodology

The methodology used in the PRA is in accordance with guidelines published by the EPA, and is summarised below.

The primary objective of the high-level hazard analysis study was to estimate the offsite public risk posed by the Methanex development. The results were then used to determine the acceptability of the risks in relation to the risk criteria published by the EPA in terms of land use planning for industrial developments.

Established hazard identification techniques were used to identify all significant potential hazards and credible accident events for the facility. This comprised a systematic review of the information currently available for the methanol complex, including the process flow diagrams, product inventories and other general project information as contained within the project design basis. Hazardous incidents that were considered non-credible from an operational perspective, or had limited localised impact were screened out from further analysis. Only incidents with potential off site consequences or with potential to escalate resulting in off site impacts were carried forward and subjected to a more detailed level of assessment in the consequence analysis. Consideration was also given to safety systems proposed for the facility and to the safety management philosophies, systems and procedures that will likely be in place for an operating plant of this nature.

The consequences of the events carried forward from the hazard identification were modelled using proprietary software packages. The events modelled included jet fires, vapour cloud explosions and pool fires.

Representative hole sizes were used to characterise the range of leaks that may occur from the different equipment items present within the facility.

The consequence distance predicted for the various scenarios considered are compared with the distance from the release source to the site boundary in order to determine whether the event will generate an offsite impact.

Following detailed assessment of incident consequence, those events shown to have off site impacts or potential to escalate and cause off site impacts were carried forward for frequency analysis and assessment of the risk level to land adjacent to the site. The incident frequencies were derived for the various scenarios using the most appropriate release frequency data, adjusting this data as appropriate and then taking account of the probability of ignition of the release.

The PRA evaluated risk in terms of Individual Fatality risk, which is the risk of death to a person at a given location exposed to the hazard 24 hours of the day and 365 days in the year. In the case of the natural gas supply and product pipelines, the individual risk of fatality was calculated at varying distances from the pipeline, to give a transect of risk perpendicular to the pipeline.

9.3.2 Hazard Identification

The major hazards identified for the Methanex facility were flammable gas and liquids that could result in jet, spray or pool fires and vapour cloud explosions following loss of containment. The material hazard matrix is shown in **Table 9-3** and the plant area hazard matrix in **Table 9-4.**

- **Table 9-3 Process and product material hazard matrix**

Material		Potential Hazards					
		Fire			Explosion/	Toxic Gas	Chemical Spill
		Jet	Spray	Pool	Flashfire		
1	Natural gas (CH_4)	✓			✓		
2	Saturator feed (CH_4)	✓			✓		
3	Reformed gas (H_2, CH_4, H_2O, CO_2, CO)	✓			✓		
4	Hydrogen (H_2)	✓			✓		
5	Synthesis gas (H_2, CH_4, CO)	✓			✓	✓	
6	Flash gas (CO_2, CH_4)					✓	
7	Methanol (CH_3OH) low pressure			✓			✓
8	Methanol (CH_3OH) high pressure		✓	✓	✓		✓
9	Oxygen (O_2)	✓[1]			✓[2]		

Notes: 1. Oxygen enhances the fire potential of a released hydrocarbon.
2. Oxygen increases the flammable range of a hydrocarbon air mixture.

■ Table 9-4 Plant area hazard matrix

Operation (brackets denote materials listed in Table 9-3)		Potential Hazards: Fire					
		Jet	Spray	Pool	Explosion/ Flashfire	Toxic Gas	Chemical Spill
1	Natural Gas Receival (1)	✓			✓		
2	Air Separation Unit (9)	✓[1]			✓[2]		
3	Desuphurisation (1)	✓			✓		
4	Saturation (2)	✓			✓		
5	Reforming (3)	✓			✓		
6	Methanol Synthesis (2,5,6)	✓			✓	✓	
7	Methanol Distillation (7,8)		✓	✓	✓		✓
8	Methanol Product Storage (8)			✓	✓		✓
9	Methanol Product Pipeline (8)			✓			✓
10	Wharf/ Jetty (8)			✓			✓
11	Shipping Channel	- Ship to ship collision - Grounding - Fire / Explosion on board - Collision whilst berthing and departing					

9.3.3 Consequence Analysis

A summary of the events carried forward for consequence analysis is given in **Table 9-5.**

The only scenarios that were found to result in an offsite impact (for normal release sizes) were releases from the methanol export pipeline.

■ Table 9-5 Hazardous events carried forward for consequence analysis

Event No.	Section of Facility	Hazardous Event	Potential Consequence
Methanol Plant and Storage Facility			
P1	Natural gas supply	Release of natural gas (CH_4) feedstock.	Jetfire/ Flashfire/ Explosion
P2	Desulphurisation unit	Release of saturator feed (CH_4)	Jetfire/ Flashfire/ Explosion
P3	Reforming	Release of reformed gas (CH_4, H_2)	Jetfire/ Flashfire/ Explosion
P4	ASU and Reformer	Release of liquid oxygen	Enhancement of fire
P5	Methanol Synthesis	Release of syngas (H_2, CO)	Jetfire/ Flashfire/ Explosion/ Toxic gas
P6	Methanol Synthesis Methanol Processing	Release of crude methanol (CH_3OH)	Poolfire
P7	Methanol Synthesis	Release of hydrogen (H_2)	Jetfire/ Explosion
P9	Methanol Distillation	Release of methanol	Poolfire
P10	Methanol Storage	Release of methanol	Poolfire
P11	ASU	Release of liquid oxygen	Enhancement of fire
P12	Diesel Storage	Release of diesel	Poolfire

Table 9-5 Hazardous events carried forward for consequence analysis (continued)

Event No.	Section of Facility	Hazardous Event	Potential Consequence
Methanol Product Pipeline			
PL1	Methanol transfer pipeline	Release of methanol from transfer pipeline, or at valve, flange or fitting due to design/ construction/ installation/ maintenance fault	Liquid release and pool fire if ignited. Escalation to adjacent pipelines/ structures
PL2	Methanol transfer pipeline	Release of methanol from transfer pipeline due to impact or third party interference	Liquid release and pool fire if ignited. Escalation to adjacent pipelines/ structures
Jetty			
J1	Jetty	Methanol release into water from MLA rupture	Environmental incident
J2	Jetty	Methanol; release into water from small MLA leaks	Environmental incident
J3	Jetty	Methanol release from fittings on jetty	Poolfire
J4	Jetty	Methanol release from fittings on ship's deck	Poolfire
J5	Jetty	Release of methanol cargo into water from ship's hull failure	Environmental incident
Shipping Channel			
	Shipping Channel	Release of methanol cargo from ship's hull failure due to ship to ship collision	Environmental incident

9.3.4 Frequency Analysis

The frequency of the releases from various parts of the methanol complex was calculated on the basis of generic data from Cox *et al* (1991) and an assumed quantity of pipework, flanges, valves, vessels and fittings from preliminary process flow diagrams. Incident frequencies for the process plants and associated storage are summarised in **Table 9-6.**

Table 9-6 Process plant and storage area event frequencies

Scenario	Flow rate (kg/s)	Base Failure freq (per m/yr)	Corrected failure freq (per yr)	Prob of explosion (after leak)	Event Frequency (per year)	Event
Natural gas leak	62.5	1.50E-07	3.75E-04	0.0900	3.4E-05	Explosion
	0.6	3.00E-05	7.50E-03	0.0004	3.0E-06	Not included - mass too small
Syngas leak (H_2 rich)	0.5	1.50E-05	1.20E-02	0.0004	4.8E-06	Explosion
	2.1	1.50E-06	1.20E-03	0.0084	1.0E-05	Explosion
	52.5	1.50E-07	1.20E-04	0.0900	1.1E-05	Explosion
	0.5	3.00E-05	2.40E-03	0.0004	9.6E-07	Explosion
Methanol (process area)	2.7	1.50E-06	1.50E-03	n/a	4.5E-05	Poolfire
	10.8	1.50E-06	1.50E-03	n/a	4.5E-05	Poolfire
	240	1.50E-07	1.50E-04	n/a	1.2E-05	Poolfire
	2.7	3.00E-05	3.00E-03	n/a	9.0E-05	Poolfire

■ **Table 9-6 Process plant and storage area event frequencies (continued)**

Scenario	Flow rate (kg/s)	Base Failure freq (per m/yr)	Corrected failure freq (per yr)	Prob of explosion (after leak)	Event Frequency (per year)	Event
Methanol (to storage area area)	0.2	1.50E-05	1.05E-02	n/a	1.1E-04	Poolfire
	0.7	1.50E-05	1.05E-02	n/a	1.1E-04	Poolfire
	16	1.50E-06	1.05E-03	n/a	3.2E-05	Poolfire
	0.2	3.00E-05	2.10E-03	n/a	2.1E-05	Poolfire
Storage tank fire					1.0E-04	Poolfire
Storage bund fire					5.0E-05	Poolfire

The incident frequencies for the hole sizes postulated are given in **Table 9-7** (allowing for intermittent pipeline use).

■ **Table 9-7 Methanol pipeline leak frequencies**

Equipment Type	Hole Size, mm	Leak Frequency per Year (Cox *et al*, 1991)	No. of Items in Pipeline	Overall Leak Frequency per Year
Valve gland	13	5×10^{-5} per valve	10	6.1×10^{-6}
Pipeline flange	13	3×10^{-4} per flange	32	1.2×10^{-4}
Instrument fitting	20	1×10^{-4} per fitting	1	1.2×10^{-6}
Pipe leak	75	5×10^{-7} per metre	4,000	2.4×10^{-5}

The overall frequency by hole size was combined with the probability of ignition of the release to give the frequency of the flammable events under consideration. The resultant fire incident frequencies are shown below in **Table 9-8.**

■ **Table 9-8 Methanol pipeline overall leak frequencies**

Equipment Type	Hole Size, mm	Overall Leak Frequency per Year	Ignition probability	Fire Incident Frequency per Year
Valve gland	13	6.1×10^{-6}	0.03	1.8×10^{-7}
Pipeline flange	13	1.2×10^{-4}	0.03	3.5×10^{-6}
Instrument fitting	20	1.2×10^{-6}	0.03	3.7×10^{-8}
Pipe rupture	75	2.4×10^{-5}	0.08	2.0×10^{-6}

Base leak frequencies for failures and incidents at the jetty were derived from a number of sources. The resultant leak frequencies are summarised in **Table 9-9**.

■ **Table 9-9 Jetty incident leak frequencies**

Description	Frequency (pa)
10mm leak (ship's deck) – early detection, ESD works	7.2×10^{-5}
50mm leak (wharf) – early detection, ESD works	5.4×10^{-4}
50mm leak (ship's deck) – early detection, ESD fails	1.13×10^{-7}
Full bore release from MLA, ERC fails, ESD works	1.61×10^{-6}
Leak from cargo tank (ship's hull failure)	1.57×10^{-4}

The overall fire frequency for a bund fire at the wharf was calculated to be 5.04×10^{-5}.

9.3.5 Safety Philosophy and Plant Design

Methanex has a very good safety and incident record, with no recorded fatalities.

In general, major incidents can be attributed to inadequacies in plant design, operating procedures and maintenance. Given that Methanex will, in-line with current industry practice, be incorporating risk and hazard studies throughout the design process, and given the safety management system that would be expected to be implemented for a facility of this nature, the probability of such incidents occurring at the proposed site is considered low.

In addition, the engineering designer will be providing due consideration to the inherent safe features of the plant and adopting a risk based design process for the provision of sufficient and adequate safety systems for the prevention, detection and mitigation of potential incidents.

Safety Systems
The plant will be designed in accordance with recognised engineering codes and standards and will include a number of safety systems. At this stage of the project, full details of the safety systems that will be included have not been developed in detail. However, a general outline of the proposed safety systems is provided, and where appropriate, certain assumptions have been made with regard to the operation of these systems. Where this is the case, the assumptions are clearly noted and justification provided.

Engineering Codes and Standards
Australian and International engineering codes and standards will be used in the project design. Some of the key codes and standards to be used are:

- AS3846 – The handling and transport of dangerous cargoes in port areas;
- API 650 – Welded steel tanks for oil storage;
- AS 1940 – The storage and handling of flammable and combustible liquids; and
- AS 2885.1 – Pipelines – gas and liquid petroleum, Part 1 Design and Construction

Process Safeguards
The process safeguards built into the design will include:

- Open plan to avoid the potential for accumulation (and explosion) of hydrogen in enclosed spaces;
- A flare system for planned or emergency depressurisation and blowdown of hydrocarbon streams and pressure relief valve releases during emergency situations.
- Fail safe design of equipment;
- Emergency Shutdown (ESD) System for individual plant items as well as the overall plant and methanol transfer system. The ESD system will be independent of the plant Distributed Control System; and
- Equipment and systems as listed in the Methanex Loss Prevention Summary e.g.
  - pressure safety devices such as PSVs
  - hydrocarbon pumps with double mechanical seals and seal failure detection
  - hazardous chemical pumps of sealess or canned type
  - double block and bleed isolation for gas supplies to reformers and fired heaters
  - methanol tanks of internal floating roof design with full spill containment

- duplication of sensing devices with two-out of -three logic voting and two independent power supplies for critical equipment.

Fire and Gas Detection System
As with all Methanex facilities, a robust fire and gas detection system will be provided. In general it will include:

- Fire (UV monitor) and gas detection provided around compressor area;
- Fire (UV monitor) and gas detection provided at methanol distillation;
- Fire detection in the control room building including smoke detectors under computer floor;
- Manual stations throughout the plant and buildings to initiate a fire alarm.
- Ionized gas detection at the jetty substation; and
- Fire and gas detection provided at synthesis plant.

Fire Protection Systems
Methanex proposes to provide a dedicated firewater system comprising a network of hydrants and hose reels. Fire protection requirements for the methanol storage will be in accordance with AS1940.

As firewater will not be available from a continuous reliable supply, a dedicated reservoir with a minimum of four hours continuous capacity will be provided.

In recognition of the risk from external fires (eg grass fires) a system will be implemented to enable the plant to be protected from such fires. There will not be any grassed areas internal to the plant and a fire break will be established around the perimeter. In addition, systems such as water curtains along the fence line may also be installed to protect the plant.

Emergency Power
The methanol facility will be provided with a pulse width modulated Un-interruptable Power Supply system as the primary power supply for all instrumentation and critical process control equipment.

Emergency power will be supplied by diesel powered engines.

Safety Management System
A comprehensive safety management system will be developed prior to the commencement of operation of the plant. The system will be adapted from similar plans currently in operation at other Methanex facilities, to Western Australian conditions. It will be similar to the safety management systems that are currently in place in other similar installations in Western Australia and would typically include, but not be limited to, the following elements:

- Safety policy, planning and objectives;
- Risk assessment and risk management systems;
- Employee training;
- Standard and emergency plant operating procedures;
- Maintenance management system;
- Maintenance procedures and philosophies including standard items such as permit to work system, isolations procedures etc;
- Incident reporting and investigation procedures;

- Management of change procedures; and
- Emergency response plan.

9.3.6 Risk Assessment Results

9.3.6.1 Process Plant

Individual fatality risk contours are presented in **Figure 9-1**.

These results show that the plant fully complies with the WA EPA individual fatality risk criteria, in that:

- The $50x10^{-6}$ per year risk contour fully contained within the process plant and storage areas, hence is well within the site boundary
- The $10x10^{-6}$ per year risk contour does not extend further than 80m from the process plant area and 100m from each methanol storage tank. It is fully contained within the site boundary, hence does not impact on any non-industrial activities or land uses.
- The $5x10^{-6}$ per year risk contour does not extend further than 90m from the process plant area and 110m from each methanol storage tank. It is fully contained within the site boundary, hence does not impact on any commercial activities or land uses.
- The $1x10^{-6}$ per year risk contour does not extend further than about 110m from the process plant area and 120m from each methanol storage tank. It is fully contained within the site boundary, hence does not impact on any residential activities or land uses.
- The $0.5x10^{-6}$ per year risk contour does not extend further than about 120m from the process plant area and 130m from each methanol storage tank. It is fully contained within the site boundary, hence does not impact on any residential activities or land uses.
- The risk levels at the site boundary are well below $1x10^{-7}$ per year, hence will not impose significant risk on existing or future industries (assuming the existing site layout with a buffer zone of 50 – 100m from process and storage areas to the site boundary).

9.3.6.2 Methanol Transfer Pipeline Risk Transect Calculation

The consequence of all identified hazardous incidents resulting from pipeline releases were combined with the estimated frequencies to assess the risks in terms of their impacts on surrounding land uses.

For releases from the methanol transfer pipeline, the individual risk of fatality was calculated at varying distances from the pipeline, to give a transect of risk perpendicular to the pipeline. The pipeline was nominally divided into two equal sections (high and low pressure) and transects calculated for each section. These risk transects are shown in **Figure 9-2**.

The individual risk posed by the pipeline does not exceed 10 chances of fatality per million per year for the high and low pressure side (10×10^{-6} is the maximum allowable risk for any non-industrial activities or active open spaced in a buffer zone between industrial and residential zones). **Table 9-10** summarises the distance to the 5, 1 and 0.5 chance of fatality per million per year (pmpy) for the different pressure region of the pipeline.

These results are considered to be adequate given the conservative assumption made in the analyses (e.g. release rates maintained at initial rate, pool fires were unconfined, low heat radiations selected for fatality etc). The pipeline will be laid in a dedicated pipeline corridor and it is assumed that there are no commercial activities, residential or industrial properties set within the 5 pmpy distance from the pipeline.

Table 9-10 Pipeline risk transect results

Pipeline Pressure	Approximate Distance to Fatality Risk Levels (m)		
	5 pmpy	1 pmpy	0.5 pmpy
High - 1470kPag	17	65	73m
Low - 500 kPag	13	55	63m

Methanex are aware of the potential knock-on effects of the product pipeline that may occur within the pipeline corridor. The scope of the risk assessment does not address these potential effects. It is understood that as part of OMP's development plan for the King Bay – Hearson Cove Industrial Area, including the provision of service corridors, a risk assessment will be undertaken to investigate knock-on effects from all proposed pipelines from industry. This will allow appropriate planning to take place such that risk is minimised. From OMP's investigation it is envisaged that a suitable layout of pipelines will be determined

9.3.6.3 Jetty

For environmental risk assessment, the risk of a methanol spill on water has been expressed in terms of an F-M curve, where F is the cumulative frequency with which M or more tonnes of methanol spill on water can occur. The F-M curve is shown in **Figure 9-3**.

Risk of Product Spill on Water

There are no established acceptance criteria for the risk of product spills on water. The guiding principle is generally that all product spills should be eliminated, or the risk of a spill reduced to as low as reasonably practicable (ALARP) levels. The consequence-frequency curve for the identified scenarios shows that the frequency of a spill exceeding 100 tonnes is approximately 1 chance in 5,000 per year. This risk is low.

The critical factors in minimising the spill quantity and likelihood are:

- Activating the ESD as soon as the leak is detected. Operating procedures should emphasise this aspect in the operator/shore watch training; and
- Minimising the potential for a collision, grounding or jetty strike by ensuring careful manoeuvring of the vessels, as well as minimising the chance of collision at angles where a structural failure could occur. For tankers, this aspect is outside the control of Methanex as the tugs would be operated by the Port of Dampier Authority.

Fire Risk Assessment

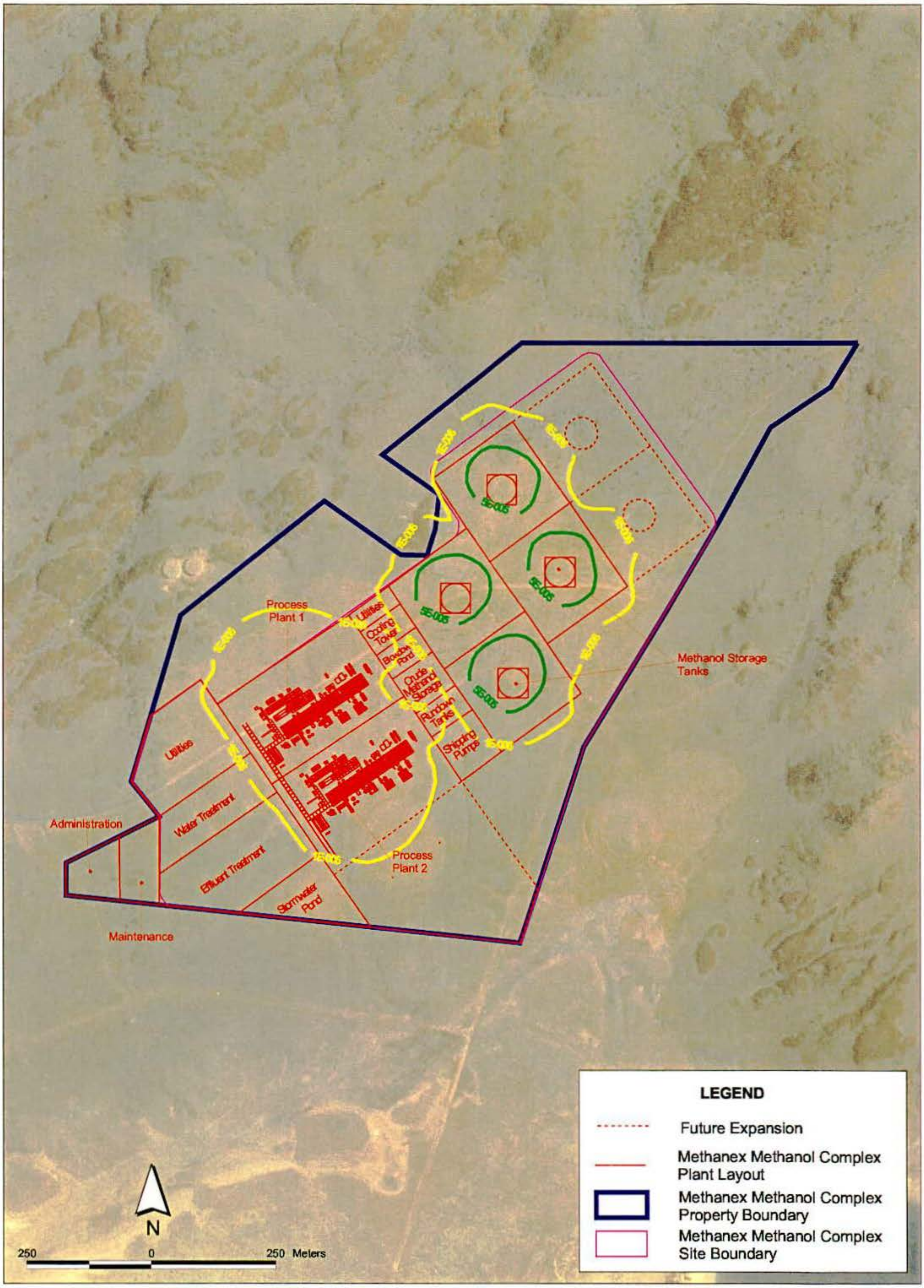
The total fire frequency from a methanol spill on the wharf was calculated as 5×10^{-5} per annum. This frequency is low.

The emergency procedure should call for taking shelter behind the fire shield and activating the remote firewater/ foam monitors in the event of a fire. This would reduce the heat radiation distances significantly.

The nearest structure is the shore operator's cabin. This location should be carefully considered to ensure that it is outside the $4.7 kW/m^2$ heat radiation contour for a full bund fire. Provided the operator stays in the cabin, at least till fire fighting commences, when the thermal radiation distances would be attenuated by the water/foam spray, there would be no injury potential.

9.3.6.4 Societal Risk

Societal risk is a measure of the probability of incidents affecting a human population, and takes into account the number of people exposed to risk. Whereas individual risk is



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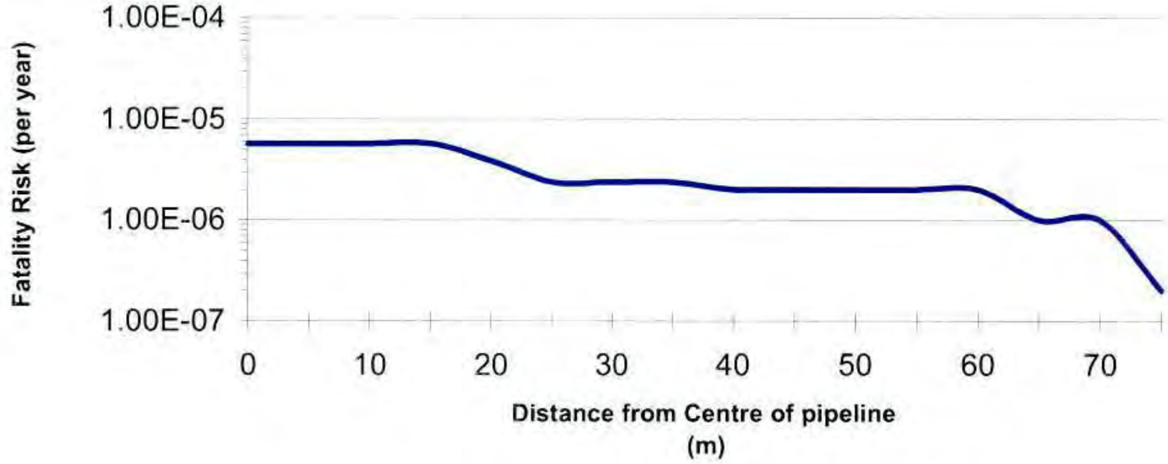
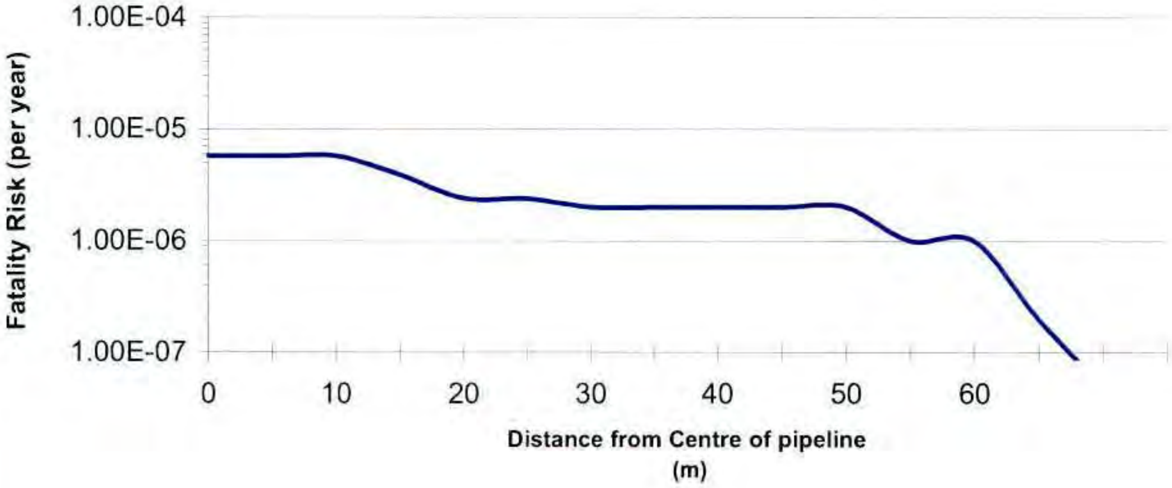
METHANEX METHANOL COMPLEX
INDIVIDUAL RISK CONTOUR

FIGURE 9-1



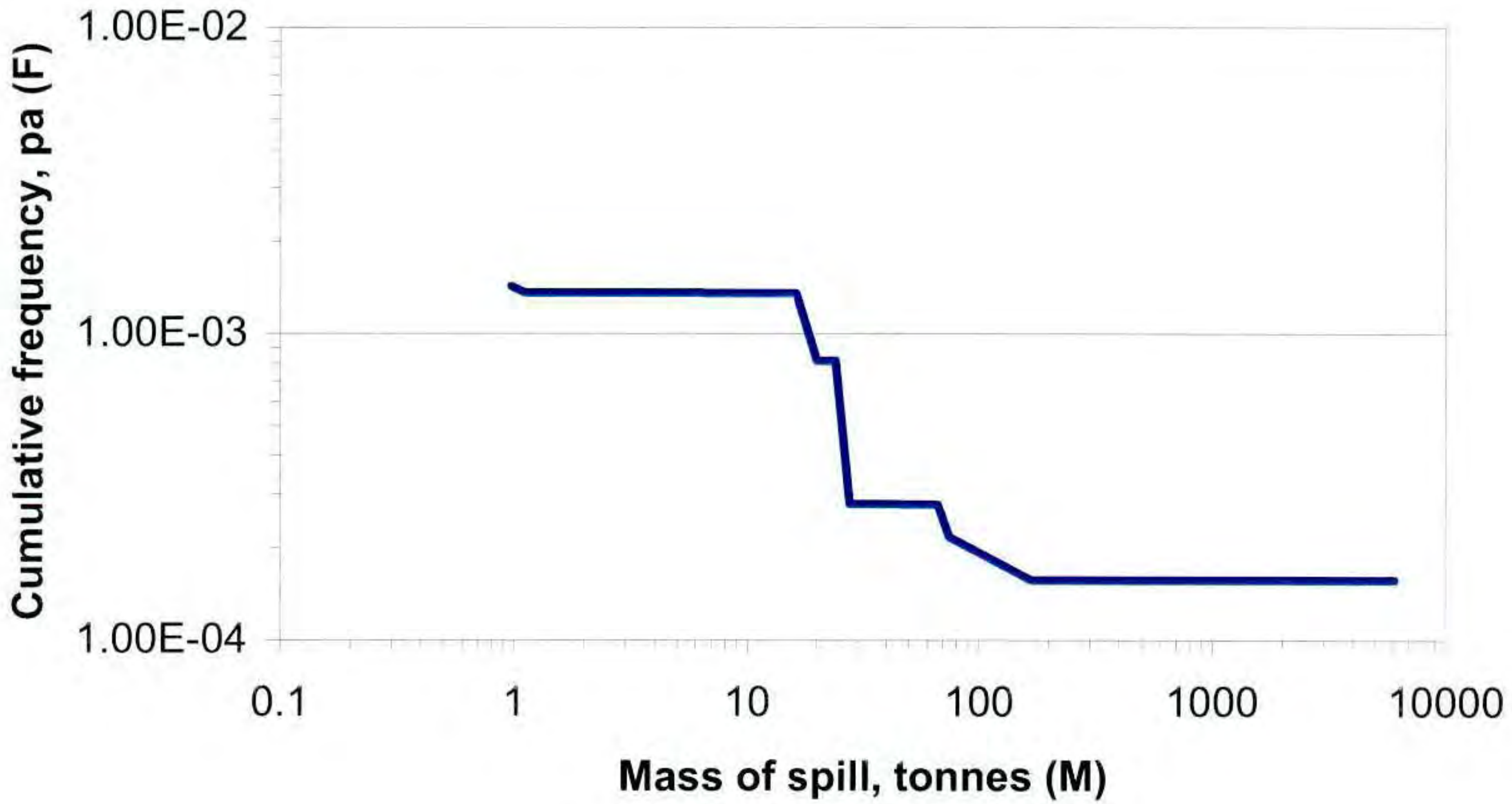


HALLIBURTON
KBR

METHANEX METHANOL COMPLEX

Methanol Transfer Pipeline Risk Transect for 1470 kPag and 500 kPag

FIGURE 9-2



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F-M CURVE FOR A METHANOL SPILL

FIGURE 9-3

concerned with the risk of fatality to a (notional) person at a particular location, societal risk considers the likelihood of actual fatalities among people exposed to the hazard.

The consequence results demonstrate that the effect zones of the identified incidents (for both the process plant and methanol pipeline), under worst case wind weather conditions, do not extend to areas of significant population.

As no significant populations outside the site are within the effect zones, the proposal is not considered to have an impact on societal risk levels.

9.3.6.5 Shipping

There will be about 100 export ship movements per year for one plant and 200 movements for two plants. All vessels will be under the control of a local pilot and under radar surveillance from the Dampier Port Authority. Management procedures are in place for preventing major vessels from coming within one nautical mile of each other.

Hazardous events that were identified included collisions, grounding, onboard incident, collision during berth and departing and the combination of these events. These events are not considered to be a problem on their own as Methanex has adequate control measures in place to manage risk. The only reasonable scenario that had sufficient release frequencies and consequences to be carried forward for full risk assessment, was the collision of vessels due to propulsion system on either the methanol tanker or another large vessel.

The risk of methanol release due to ship collision is predicted to be 9.3×10^{-7}pa, assuming that 20% of the collisions are severe enough to penetrate one of the inner methanol tanks resulting in a significant release of methanol. The vessels will be double hulled and for a methanol release to occur, both hulls will need to be breached. Therefore the release frequency is very low, coupled with the fact that ignition of a full methanol tank is unlikely due to the high miscibility of methanol in water.

9.3.7 Cumulative Risk

Burrup Fertiliser's proposed Ammonia Plant is located o the south west of the Burrup Methanol Complex. From **Figure 9-4,** the 10×10^{-6} risk contour from the Burrup Fertiliser Ammonia Plant extends marginally offsite on the eastern boundary onto the south west corner of the methanol complex. The contour will not have a major impact on the methanol complex site as both plants comply with individual risk criteria on their common boundary. The maximum cumulative risk contour due to the fertiliser plant and methanol complex is well below the EPA criteria of 100×10^{-6}.

Both Plenty River's proposed ammonia/urea plant and Syntroleum's proposed synthetic fuels plant are located to the south west of the methanol complex. However, both proposed facilities are sufficiently distant, such that neither will be a significant contributor to the cumulative risk levels imposed within and around the methanol complex.

9.3.8 Conclusions

9.3.8.1 Process Plant and Product Storage

The proposed Methanex site is located in an industrial area well away from residential areas. The majority of hazardous scenarios are fires or explosions that are essentially localised within the site.

The following conclusions were made as a result of the hazard analysis study for the methanol production facility:

- On a consequence basis alone, heat radiation of $23kW/m^2$ was contained wholly within the site;
- The contour for individual risk of fatality at 50 chances in a million per year was contained within the site; and
- The contours for individual risk of fatality at 0.5 and 1 chances in a million per year were limited to the site and do not reach the nearest residential areas or Hearson and Cowrie Coves.

It can be seen that the risk resulting from the proposed operation of the site will meet the risk criteria specified in the EPA Criteria.

9.3.8.2 Product Pipeline

Overall, the risk along the entire length of the proposed methanol product pipeline will not exceed the EPA criteria of $10x10^{-6}$ for non-industrial activities or active open spaces in the buffer zone between industrial and residential zones. The pipeline will be laid in a dedicated pipeline corridor and it is not expected that residential areas or sensitive land uses will be located within the 1 pmpy or 0.5 pmpy contour distances, respectively. It is also assumed that there are no commercial activities set within the 5 pmpy distance from the pipeline.

9.3.8.3 Jetty

Fire incidents at the jetty will be localised in their potential impact on people, the fire consequence distances would not be expected to impact on public areas.

9.3.8.4 Shipping

The risk associated with shipping methanol is low. All events other than tanker/vessel collision were determined to have a negligible frequency of occurrence or consequences and were not considered further.

Predicted Outcome *– The predicted risks from the complex are acceptable and well within EPA risk criteria. The proposed complex is not considered to have an impact on societal risk levels.*

9.4 Public Safety - Emergency Response – Fire and Tropical Cyclones

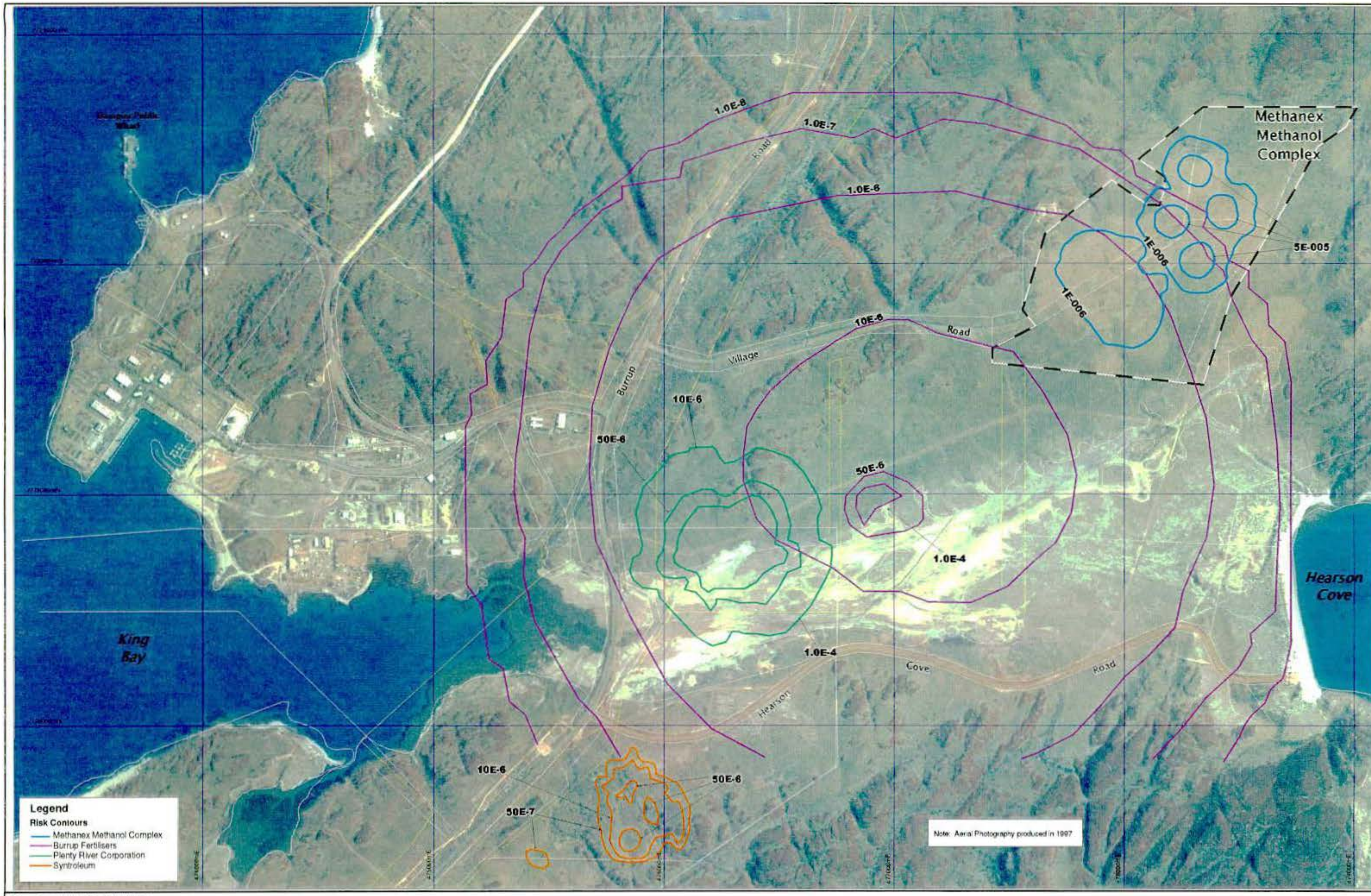
Management Objective *– To ensure that emergency response procedures for bush fires and tropical cyclones meet an adequate standard of service and safety.*

9.4.1 Construction

The construction of the methanol complex is likely to take up to 27 months. Over this period there is the potential for the project to be affected by fire or a tropical cyclone. Such events can lead to significant damage to property and equipment. Risk to the public and workforce in terms of safety is also a significant issue.

The EPC contractor will establish emergency response procedures for bush fires and tropical cyclones during the construction period of the project.

Commitment 9.01: Methanex will ensure that the EPC contractor and implements prepares (as part of the CEMP) a Construction Safety Management Plan that will address all emergency response procedures required during construction. In general, the Construction Safety Management Plan will address:



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METHANEX METHANOL COMPLEX
PLENTY RIVER PLANT, SYNTROLEUM FUELS AND BURRUP FERTILISERS PLANTS
CUMULATIVE RISK CONTOURS

0 250 500m

FIGURE 9-4

- Provision of fire fighting equipment;
- Reporting of fires;
- Alarms and communication signals;
- Muster points;
- Evacuation procedures; and
- A Cyclone Contingency Plan that will include procedures for the three different cyclone warning stages (blue, yellow and red).

In preparing the Construction Safety Management Plan relevant decision-making authorities will be consulted including FESA and the Department of Mineral and Petroleum Resources – Explosives and Dangerous Goods Division (**Commitment 9.01**). The Plan will also be developed to comply with the National Standard for the Control of Major Hazard Facilities [NOHSC:1014 (1996)].

During the detailed engineering design Methanex will ensure that provision is made for adequate fire fighting facilities. A perimeter road will be located around the complex which will serve as a fire break. A number of options are available to Methanex for the design of adequate facilities that are readily accessible in the event of a fire. As a minimum, these include:

- Provision of storage for firefighting water;
- Provision of a fire water pipeline around the perimeter of the complex;
- Provision of several fire hydrants which will be strategically located around the complex and hoses and pumps that will be required to connect to the hydrants; and
- Provision of water curtain established with the perimeter fence for support to shield the plant from external fires.

All of the above options will be investigated during the detailed engineering design in consultation with FESA and CALM.

9.4.2 Operation

Similarly in the operation phase, emergency response procedures are required to manage the potential impacts from fire (both external bush fires and internal fires), tropical cyclones and other incidents. Although the risk assessment indicates that individual and societal risks are within EPA criteria, it remains necessary for Methanex to provide guidance in managing emergency situations should they occur. Therefore,

Commitment 9.02: Methanex will prepare a Operation Safety Report prior to commissioning that encompasses a Safety Management System, a Safety Management Plan and a Safety Emergency Response.

Methanex' other operating plants have well established Safety Plans, Systems and Procedures which have all been proven successful. The Safety Report for the Burrup methanol complex will be based upon Methanex' existing plans with modifications to suit Western Australian requirements, national standards etc.

Further to the above, the Operation Safety Report will be established in consultation with FESA **(Commitment 9.02).**

There is a potential that external fires from adjacent plants or naturally occurring bushfires may impact the methanol plants. The impact of smoke is being incorporated into the design of the air separation unit of the complex, so that the methanol complex will continue to operate during bush fires. Similarly, the prevention of an external fire encroaching within the boundary of the complex will be considered in the design as part of providing fire fighting facilities as discussed in **Section 9.3.8.1**.

The methanol complex is being designed with due consideration to its location within a tropical cyclone region. Therefore, the plants will continue to operate during a cyclone, as is the case with the Woodside facility. Methanex will prepare a cyclone contingency plan prior to commencement of operations.

Predicted Outcome - *Risk to public safety will be negligible, as appropriate emergency response procedures will be established. The procedures will form part of the Operation safety report that will be completed to the satisfaction of the Department of Minerals and Petroleum Resources.*

9.5 Public Safety - Road Transport and Traffic

Management Objective – *To ensure that roads are maintained and road traffic managed to meet an adequate standard of level of service and safety and Main Roads Western Australia requirements.*

9.5.1 Potential Impacts

Construction Phase

The majority of construction material will be imported through a combination of facilities at the Port of Dampier. The largest load expected will be about 1,500t. Plant components will be transported from the off-loading facility via Burrup and Village Roads. At this stage it is envisaged that only minor equipment will be road-freighted to the site from Perth.

During construction, traffic and access to the site will be from Village Road. Special consideration will be given to other projects that are likely to commence construction in the short term.

The construction of industrial plants typically occur in a number of stages, for example earthworks followed by site foundations followed by the import of plant components. There is the potential for large machinery and plant components from other projects to cause a conflict of road space availability. This is especially important for Village Road, as this road is narrow and restricted by adjacent rockpiles. Methanex will work with other industries proposed for the King-Bay Industrial area to ensure that the scheduling of oversized traffic loads is considered and coordinated.

Operation Phase

During the operation phase of the project, access to the methanol complex will be provided in accordance with OMP's development plan to provide service corridors and infrastructure to the King Bay – Hearson Cove Industrial Area.

The methanol complex will have secured site access and designated areas for employee parking and visitor parking areas.

The methanol complex will be operated on a two-shift basis with up to 100 day shift employees and up to 10 night shift employees. This will result in about 150 traffic movements per day.

9.5.2 Management Strategies

During construction it will be necessary for traffic movements to be co-ordinated with Main Roads Western Australia and the Shire of Roebourne. Special consideration will also be given to the construction traffic movements associated with any other projects that commence construction and any other potential projects that commence construction.

- **Commitment 9.03**: EPC contractor will develop and implement a Traffic Management Plan prior to construction that will address:
  - Traffic flow patterns and scheduling of traffic movements such that impacts on road thoroughfare and the general public is minimised;
  - Public safety, awareness and signage during construction;
  - The capacity of existing road conditions to support proposed heavy loads and road usage;
  - Monitoring the transportation of oversized loads;
  - Design and construction of a loop road around the plant footprint; and
  - Restricting vehicle access to designated routes such that unnecessary disturbance to the surrounding environment is prevented.

During construction, the construction supervisor will ensure that the Traffic Management Plan is implemented. The construction supervisor will also liaise on a regular basis with other projects, Main Roads Western Australia and the Shire of Roebourne, in particular the scheduling of traffic movements and delays.

Predicted Outcome - *The risk of traffic accidents is not expected to be increased by this project, and appropriate scheduling will attempt to minimise delays and road closure. Liaison with relevant parties will ensure that any potential impacts from proposed traffic movements will be minimised.*

9.6 Accommodation

Management Objective – *To ensure that sufficient housing and accommodation is available for the proposed construction and operation workforces.*

As described in **Section 6.1.6.3**, the availability of housing and accommodation facilities in Karratha is limited and fluctuates greatly. As at December 2001, about 98 houses were available in Karratha for purchase and about 65 houses available for rent. Existing resource companies such as Hamersley Iron and Woodside Energy have provided company-owned housing and accommodation to their own workforce. Although many of the company-owned homes are vacant (up to 230 homes in 2000) these are not available to the general public. Woodside has recently established a construction camp to accommodate the workforce being utilised for the LNG Train 4 expansion. This camp is able to accommodate 520 single persons.

Methanex is also aware that Burrup Fertilisers' propose to establish a construction camp to accommodate a construction workforce estimated at 750 people.

9.6.1 Potential Impacts

Construction
The construction of the methanol complex is scheduled to commence in March 2003 and will require a workforce peaking at 1000. Construction will involve the establishment of one methanol plant and ground preparation for the second plant. The second methanol plant is likely to be constructed in 2010, depending upon market demands for methanol.

Construction of the first methanol plant will occur over a period of about 30 months and is expected to be completed by mid 2005.

Methanex is unlikely to depend on the private housing market to accommodate the construction workforce. A number of options are being investigated including potential synergies with other projects. Accommodation facilities could be shared or usage timed to occur when other projects are beginning to decrease away from peak demands.

Methanex is a member of the Nickol Bay Accommodation Taskforce that was established in August 2001 to investigate accommodation issues in Karratha. As a member of the Taskforce Methanex has been liaising with:

- Pilbara Development Commission;
- Chamber of Commerce and Industry;
- Shire of Roebourne;
- Office of Major Projects;
- Department for Planning and Infrastructure;
- Department of Land Administration;
- Department of Housing and Works;
- LandCorp;
- Land developers, including Clough Ltd/ Rapley Wilkinson Joint Venture; and
- Other industry, including Burrup Fertilisers, Woodside, Syntroleum, Hamersley etc to develop a full picture of options available.

Operation

The operation of the first methanol plant will require a workforce of about 130 to be housed locally in Karratha. This will increase to about 150 following the establishment of the second methanol plant. Current housing availability indicates that there will be shortage of housing for the operation workforce which is likely to be exacerbated by other projects seeking accommodation for their own operation workforce. Investigations by the PDC indicate that sufficient land is available for the establishment of new housing, however the land must be released in a timely manner.

A number of options are available to Methanex and liaison with the Nickol Bay Accommodation Taskforce will continue to ensure that housing will be made available for the proposed operation workforce.

9.6.2 Management Strategies

Recognising that there is the potential for shortage of housing and accommodation in Karratha and Dampier ,Methanex will:

- Continue to actively participate in meetings and workshops, and assist the Nickol Bay Accommodation Taskforce wherever possible;
- Continue to liaise with relevant parties in developing a suitable accommodation plan for the construction workforce; and
- Comply with the Shire of Roebourne's Development Approval Conditions.

Predicted Outcome - *Sufficient housing and accommodation will be available for the proposed construction and operation workforces thus preventing shortages for the current residents.*

9.7 Services and Facilities

Management Objective – *To ensure that government, community and industry are aware of the issues relating to educational, health and recreational facilities such that appropriate mitigation measures can be implemented to minimise pressure on services and facilities from an increasing population.*

The expected expansion of downstream processing in the area will create population growth in the townships of Karratha and Dampier. Should all currently proposed projects go ahead, the townsites will need to accommodate an additional 1300 (people or families) on a permanent basis and a construction workforce of up to 6500 (**Table 6-3**).

The anticipated growth in both the permanent and transient urban population will need to be matched by the provision of facilities and services. It has been previously highlighted in WAPC (1998) that urban expansion in the region needs to be co-ordinated with the provision of community infrastructure. A gradually aging permanent population, a large transient population that are typically young and healthy, hobby enthusiasts and recreation users will require a diverse range of lifestyle opportunities.

The several industries proposed for the Burrup Peninsula will result in a large population influx in Dampier and Karratha. The cumulative impacts of a large population increase on education, health and recreational facilities in Karratha are discussed in the following sections.

9.7.1 Education

9.7.1.1 Potential Impacts

A review of the educational facilities in Karratha and Dampier indicate that primary, secondary and post secondary facilities have excess capacity. Day-care facilities will be placed under greater pressure and it is likely that further day-care facilities will be required.

The West Pilbara TAFE is well equipped to assist in any local training requirements which will aid in Methanex' philosophy of employing local people, where practicable.

9.7.1.2 Management Strategies

Methanex will develop a workforce profile that will detail the demographics of the expected workforce, a timeline and likely education and recreational requirements:

Commitment 9.04: Develop a workforce profile and forward it onto relevant planning stakeholders such that future planning and training requirements can be co-ordinated.

Furthermore, Methanex will liaise with the Education Department of Western Australia and will provide them with the workforce profile.

9.7.2 Health

9.7.2.1 Potential Impacts

Discussions with the West Pilbara Health Service indicate that there is an existing shortage of General Practitioners (GP) in the Karratha and Dampier district. This has resulted in patients waiting up to 10 to 12 days for an appointment. Visitations to the Outpatients Department at the Nickol Bay District Hospital have increased by about 30% whilst the number of GPs in Karratha and Dampier have decreased.

This existing problem is likely to be exacerbated by the forecasted population increases. Woodside provide their own medical services to their construction workforce such that no additional pressure is placed on the existing services in Karratha and Dampier.

Other health services provided in Karratha and Dampier that are currently under pressure and are likely to be further impacted by an increase in population include:

- X-ray and physiotherapy;
- Drug and alcohol counselling; and
- Mental health services.

9.7.2.2 Management Strategies

Although Methanex' construction and permanent workforces will increase demand for health services in Karratha and Dampier, the future provision of services should consider cumulative demands from all proposed developments.

Methanex recommends that government agencies progress an audit and regional assessment of the health and medical needs of communities in Karratha and Dampier and service responses until the year 2010. Short-term recommendations could assist in overcoming current capacity constraints while in the longer-term appropriate arrangements could be made to meet the health needs of construction and permanent workforces. The outcomes and recommendations from the audit should be implemented as soon as possible to firstly rectify the existing pressure on health and medical services and then in a progressive nature in accordance with the scheduling of construction and operation workforces.

9.7.3 Recreation

9.7.3.1 Potential Impacts

Karratha and Dampier have numerous sporting clubs and facilities that service the 46 sports that are played in the district. Many of the sporting clubs that provide services for several sports are approaching full capacity whilst the single sport clubs are finding it difficult to increase membership numbers (pers.comm. Karratha Sporting and Recreational Club). The majority of the clubs do not have a suitable planning strategy to co-ordinate competitions to cope with additional teams and to smoothly integrate new teams. Clubs have found it difficult where teams, comprised of young transient workforce, are introduced only for one season and expose the club to a sudden drop of members once they have moved on. New teams often require clubs to make many changes so that teams are integrated into the competition as smoothly as possible. It is rare to find teams who provide a long-term commitment to the club.

9.7.3.2 Management Strategies

The Shire of Roebourne, Department of Sport and Recreation and the Department of Recreation and Community Development have recognised the need to assist sporting clubs in planning for the future and have proposed to develop a Strategic Plan that will specifically target sport, recreation and leisure. This is likely to commence in mid 2002 and will involve an audit, to determine the current level of service, and to develop a planning framework for the longer-term. The needs of construction and operational workforces will be considered as part of the strategic planning exercise.

Methanex will assist in providing information, including a workforce profile, to the Shire of Roebourne such that the proposed workforces for the methanol complex are considered and relevant planning can be undertaken.

9.7.4 Emergency Services

9.7.4.1 Potential Impacts

With an increasing population and the nature of the industries that are proposed for the Burrup Peninsula there is potential for current emergency services to be stretched to satisfy demand. Emergency services in Dampier are operated by Hamersley Iron and dedicated to Hamersley Iron operations whilst services in Karratha are operated mainly by volunteers.

9.7.4.2 Management Strategies

The operation workforce employed on the methanol complex will be adequately trained to manage emergency situations. In the first instance, Methanex employees will manage and contain the emergency situation within the plant site. Any further assistance that may be required will be secondary assistance provided by the local emergency services groups.

There will be a need to educate local emergency services groups about the methanol substance, its chemical and physical characteristics and handling procedures. Methanex will assist FESA in providing information and suitable training for emergency services groups, where practicable.

Methanex has had initial discussions with FESA and will continue to liaise with this authority to determine the needs of the complex.

As the numbers of industries proposed for the Burrup Peninsula increases, so does the likelihood of an incident occurring that will require a response from FESA. Emergency services are currently stationed in Dampier and Karratha and have an estimated response time of about 15 to 20 minutes for the Burrup Peninsula. There is the potential that industries may require a more rapid response and it may be necessary to establish an emergency service station on the Burrup Peninsula. Methanex recommends that government and FESA continue to liaise with industry to determine industry needs and to investigate the feasibility of establishing an emergency service station on the Burrup Peninsula to fulfil industry needs.

Predicted Outcome - *By working with local service providers, pressure on services and facilities from an increasing population will be minimised.*

9.8 Visual Amenity

Management Objective – *To ensure that the visual amenity of the methanol complex from adjacent public areas should not be adversely impacted.*

9.8.1 Landscape

The site for the methanol complex is located on a portion of land in the King Bay – Hearson Cove valley that was previously the site of Woodside's construction camp. As a result of the previous land use, the majority of the site is relatively level. The two methanol plants, four storage tanks and associated facilities will be constructed on the most level terrain available on the site. Rockpiles occurring along the western boundary of the project site will be avoided as they contain Aboriginal heritage sites and significant vegetation communities and flora. To develop suitable foundations and raise the complex above the 1-in-100 year flood level, the site will be cut and filled to an elevation of about 7 mAHD.

A three dimensional digital terrain model was developed to provide views of the methanol complex from six vantage points surrounding the project site. The vantage points are referenced in **Figure 9-5**. The model was developed such that the complex could be overlayed on photography to provide 'real' images of the proposed complex. The 3-D model has been developed using the initial plot plan that located the process elements of the complex to the south and the storage facilities to the north of the lease area. However, as part of the detailed design phase, the layout of the complex will be optimised and as such the actual location of some of the elements of the complex may change.

Where possible, neighbouring plants were also included to provide the opportunity for a cumulative assessment. Publicly available information was obtained for the Burrup Fertilisers and Syntroleum plants such that they could be included in the three dimensional model. This information should not be considered as an exact illustration or model of the actual proposed plants as it is expected that the design of these plants will change slightly during detailed engineering design. Information was not available for Plenty River or Japan DME who also propose to develop in the King Bay – Hearson Cove valley.

Preliminary engineering design drawings were utilised to develop the three dimensional model of the methanol complex. The height of structures of the two methanol plants will be up to 80m. The four methanol storage tanks will be prominent features of the complex with the general dimensions of 65m in diameter by 20m in height.

9.8.1.1 Potential Impacts

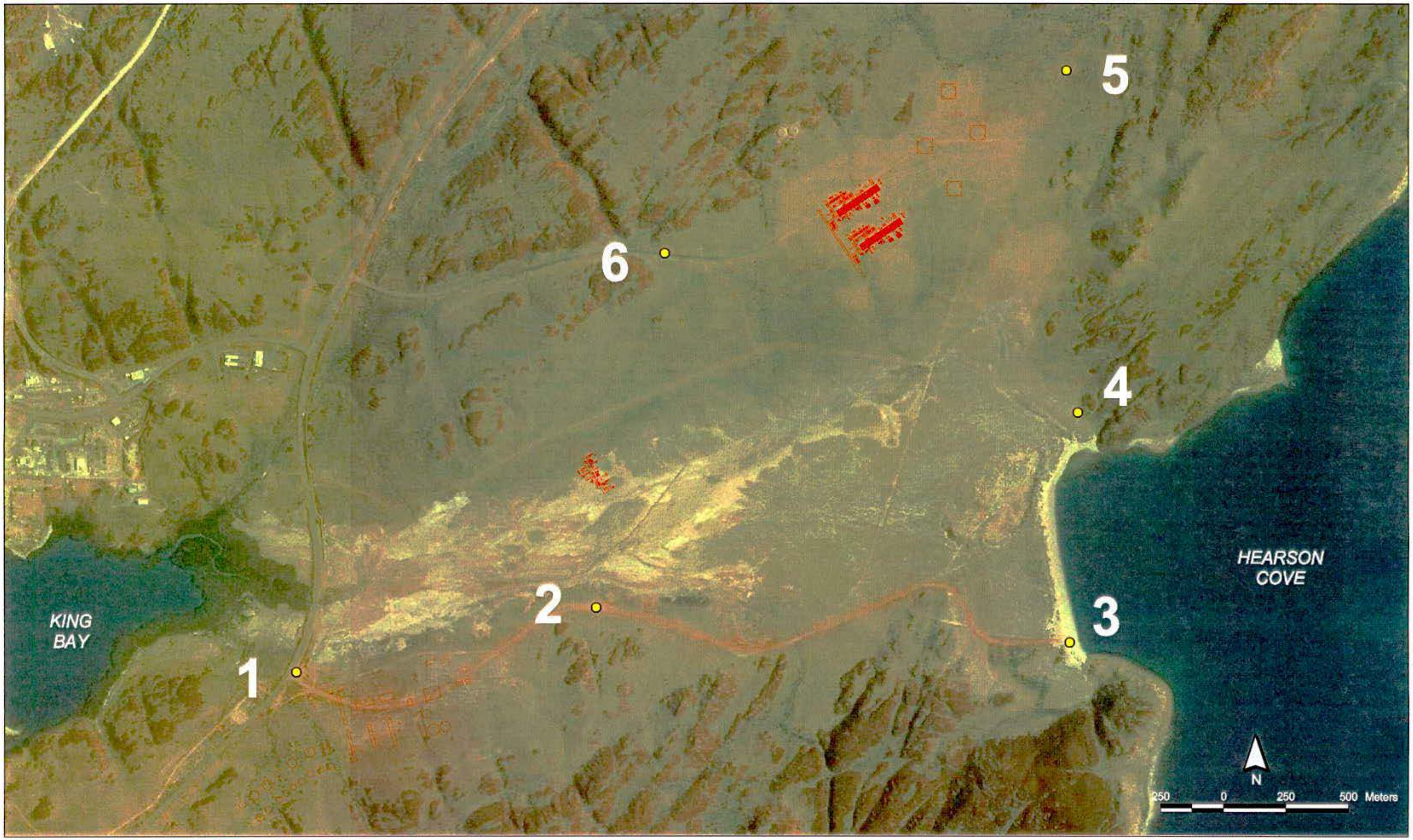
The preliminary footprint for both plants of the methanol complex is large and occupies an area of 84ha which is similar to that of Syntroleum's gas to liquids plant (**Figure 9-5**). The gas to liquids plant occupies about 50ha which is more than twice the area of Burrup Fertiliser's ammonia plant. The ammonia plant is relatively small in comparison.

From the junction of Burrup Road and Hearson Cove Road, the methanol complex is visible and partly concealed by the ammonia plant (**Figure 9-6**). The tall stacks of the two methanol plants can be seen allowing the two plants to be distinguished. About 1km from Burrup Road on Hearson Cove Road (**Figure 9-7**; view point 2) the methanol complex is visible and one storage tank can be seen in the background. This view point overlooks the low lying intertidal mudflat of the King Bay – Hearson Cove valley. The landscape does not provide any opportunity for screening the complex. Burrup Fertilisers' ammonia plant is located in the foreground and is a prominent feature from this view point. The future establishment of Japan DME's plant will add to the array of industrial plants as viewed from Hearson Cove Road.

At Hearson Cove, the dunes and vegetation provide minimal screening (**Figure 9-8**). The methanol plants and storage tanks are clearly visible at the entrance point to Hearson Cove. It is expected that the dunes will conceal the majority of the plant when standing at the shoreline of the Cove as there is a considerable drop in elevation from the beach to the water's edge.

North of Hearson Cove, from view point 4 (**Figure 9-9**), the methanol complex is clearly visible over the low lying alluvial slopes and intertidal mud flats. The predominant grassland provides little opportunity to conceal the plant, however widely scattered shrubs and trees are able to provide some limited screening from specific, but few, locations. Similarly views from the north east of the plant (ie from Cowrie Cove) (**Figure 9-10**) also indicate that the plant is clearly visible with limited screening from vegetation.

From Village Road, approximately 500m from the complex (**Figure 9-11**), the methanol plants are clearly visible against the rockpiles in the background. The two storage tanks can also be seen from this view point with the remainder being concealed by the topography.



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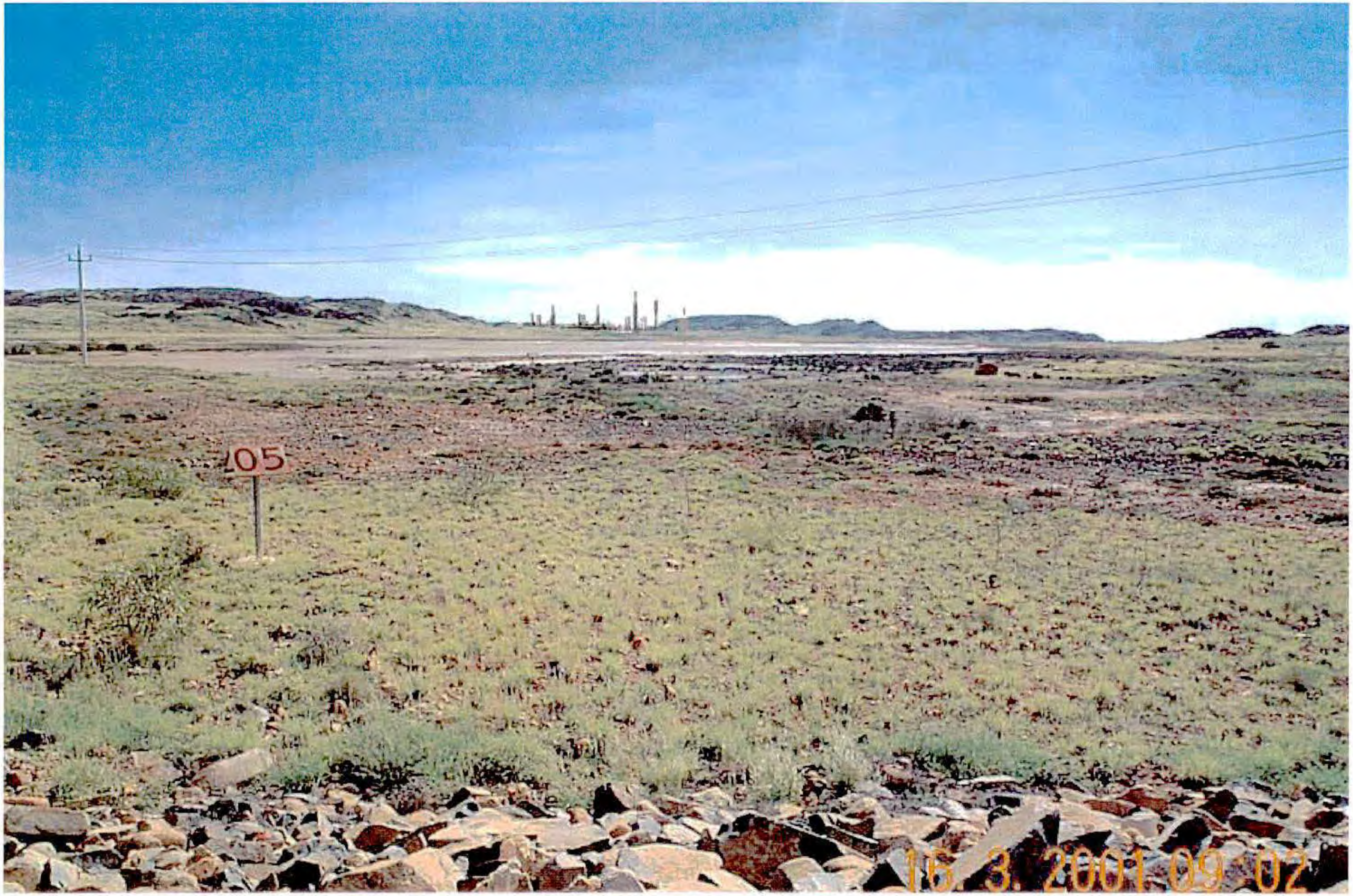
KING BAY AND HEARSON COVE INDUSTRIAL AREA
PHOTOGRAPH AND MODEL INDEX
SHOWING VANTAGE POINTS

FIGURE 9-5



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KING BAY AND HEARSON COVE INDUSTRIAL AREA
VIEW OF INDUSTRY FROM VIEW POINT 1

FIGURE 9-6

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KING BAY AND HEARSON COVE INDUSTRIAL AREA
VIEW OF INDUSTRY FROM VIEW POINT 2

FIGURE 9-7

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METHANEX METHANOL COMPLEX
VIEW OF THE COMPLEX FROM VIEW POINT 3

FIGURE 9-8

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METHANEX METHANOL COMPLEX
VIEW OF INDUSTRY FROM VIEW POINT 4

FIGURE 9-9

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METHANEX METHANOL COMPLEX
VIEW OF THE COMPLEX FROM VIEW POINT 5

FIGURE 9-10

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METHANEX METHANOL COMPLEX
VIEW OF THE COMPLEX FROM VIEW POINT 6

FIGURE 9-11

The methanol complex will not be visible from Dampier as several series of rockpiles, including the Pistol Ranges, which occur on the southern portion of the Burrup Peninsula, will conceal the complex. However, the methanol complex may be visible at night from lookout points in Karratha, as the town is 8km in a direct line through Hearson Cove from the complex.

9.8.1.2 Management Strategies

To minimise the potential for adverse impacts on visual amenity the following management strategies will be undertaken by the Methanex:

- Building will be coloured to blend into the surrounding landscape, where possible. Colours will be selected considering the existing colours of the landscape and suitable colours for reflecting heat;
- A Landscaping Plan will be prepared and implemented in consultation with CALM where local native species will be re-established where practicable (**Commitment 7.01);** and
- A high standard of housekeeping will be maintained such that the complex is left in a tidy condition with items and waste being stored or disposed appropriately.
- When plant layouts are finalised, additional representation of the proposed visual impacts will be completed. Included will be representations at various locations on Hearson Cove beach

Predicted Outcome *- The methanol complex has been sited to minimise the impact on significant environmental attributes. Although the methanol complex will impact the visual amenity of the area, the appearance of the plant will be consistent with the industrial zoning of the land.*

9.8.2 Light Spill

Management Objective *– To manage potential impacts from plant light overspill to visitors at Hearson and Cowrie Coves and potential offshore fauna, such as turtles.*

9.8.2.1 Potential Impacts

Light spill from industrial plants has the potential to impact on marine organisms, in particular their ability to distract or attract marine fauna such as turtle. There are no nesting beaches on the Burrup including Hearson and Cowrie Coves (pers. comm. P. Kendrick, CALM). As such there is little likelihood that artificial lights will cause misdirection and mortality of turtle hatchlings and adult turtles. Further details are provided in **Appendix I**.

Light spill can also be of nuisance to nearby residents and recreational users. Extensive lighting for industrial plants is mandatory for general safety, however there are guidelines and standards by which lighting can be applied with minimum light spill.

Hearson Cove is a popular beach where the reflection of the moon on the water and wet sand of Nickol Bay can be seen to form what is called the 'Stairway to the Moon'. This effect is observed by looking eastwards from the shoreline of Hearson Cove beach. Light spill will not impact this reflection as industry will be located westwards of Hearson Cove and will not be in the direction of the observer's line of sight.

The determination of when light spill becomes obtrusive to others is difficult since it is an issue dependent upon personal perception. The residents of Karratha and Dampier and recreational users of Hearson and Cowrie Coves are well accustomed to industrial lighting from existing industry, including the Woodside LNG plant. The flare from the LNG plant is a prominent feature of the landscape and can be seen from Karratha across the waters of Nickol Bay. The LNG plant is a popular tourist attraction during the day and at night.

9.8.2.2 Management Strategies

Although industrial lighting is mandatory for safety, the methods by which lighting is implemented can be undertaken in a manner by which light overspill is minimised. Methanex will adopt *Australian Standard AS 4282 (Int) 1997 Control of the Obtrusive Effects of Outdoor Lighting* during detailed engineering design to minimise light spill. This standard provides guidelines for relevant lighting parameters to control obtrusive effects and refers specifically to effects on nearby residents (eg. dwellings such as houses, hotels and hospitals), users of adjacent roads (eg vehicle drivers, pedestrians, cyclists), transport signalling (eg. air, marine and rail) and on astronomical observations (Sinclair Knight Merz, 2001).

Special consideration will be given to the direction of lighting such that no direct light is angled at Hearson Cove.

Predicted Outcome - *Light overspill is likely to have a negligible impact on users of Hearson and Cowrie Cove and the surrounding environment. Ensuring that Hearson Cove is not impacted by direct light and considering that there are no nesting beaches on the Burrup, the impact on turtles will be negligible.*

9.9 Aboriginal Heritage

Management Objective – *To ensure that the proposal complies with the requirements of the Aboriginal Heritage Act 1972 and to ensure that changes to the biological and physical environment resulting from the proposal do not adversely affect cultural associations with the area.*

Archaeological surveys of the project site and ethnographic consultation with relevant Aboriginal groups will be undertaken in March and April 2002:

Commitment 9.05: Methanex will undertake Archaeological surveys of the project site and ethnographic consultation with relevant Aboriginal groups prior to construction.

Methanex is establishing a good working relationship with relevant Aboriginal groups. The Aboriginal groups were provided with the opportunity to express their environmental concerns relevant to the project in December 2001. This consultation is ongoing with progressive updates being scheduled throughout the environmental approval process. Future consultations planned with relevant Aboriginal groups are discussed further in **Section 11**.

In the absence of project specific archaeological and ethnographical studies, a baseline survey undertaken by Vinnicombe (1997) for the former Department of Resources Development has been utilised to determine the potential impacts of the establishment of the methanol complex on Aboriginal heritage. Vinnicombe's extensive survey covers the King Bay - Hearson Cove valley and the Burrup West Corridor, and also examines the findings of several previous surveys that have been undertaken by others (Wright in DAS, 1979; Novak in DAS, 1979; Kirkby, 1981; Clark in DAS, 1980a, b; Rhoads *et al.*, in DAS, 1984; Vinnicombe, 1987; Veth *et al.*, 1993; Morse *et al.*, 1996; Robinson et al., 1996). This survey was also undertaken in consultation with 26 community members from Roebourne.

9.9.1 King Bay – Hearson Cove Aboriginal Heritage Survey Results

As documented in **Section 6.3.2** there are numerous sites that are located within and near to the project site. Sites that will be impacted by the project are listed in **Table 9-11** and those sites that may be impacted but require further confirmation during archaeological surveys are listed in **Table 9-12**.

Table 9-11 Archaeological sites that will be impacted by the proposed methanol complex

Site Id	Status	Site Type	Approximate Location
123KBH	Unregistered	Not available	Near southern boundary on undisturbed land.
125KBH	Unregistered	Not available	Middle portion of site near the edge between undisturbed and disturbed land.
8991	Registered[1]	Occupation site (artefact and/or shell scatter)	Western portion of site on disturbed land.
9609	Registered[1]	Occupation site (artefact and/or shell scatter)	Adjacent to eastern boundary in the southern portion of site on disturbed land.
9640	Registered	Occupation site (artefact and/or shell scatter)	Near southern boundary on undisturbed land.
9674	Registered[1]	Occupation site (artefact and/or shell scatter)	Adjacent to eastern boundary in the middle portion of site on disturbed land.
9837	Registered	Artefact	Middle portion of site on disturbed land.
9839	Registered[1]	Occupation site (artefact and/or shell scatter)	Adjacent to the southwestern boundary near the edge between undisturbed and disturbed land.
10700	Registered[1]	Occupation site (artefact and/or shell scatter)	Middle portion of site on disturbed land.

Notes: 1. located on previously disturbed site

KBH – unregistered site surveyed by Vinnicombe (1997) in the King Bay-Hearson Cove study.

Table 9-12 Archaeological sites that may be impacted by the proposed methanol complex

Site Id	Status	Site Type	Approximate Location
106KBH	Unregistered	Not available	Adjacent to the northern boundary on undisturbed land
110KBH	Unregistered	Not available	Adjacent to the northern boundary on undisturbed land
111KBH	Unregistered	Not available	Adjacent to the northern boundary on undisturbed land
9608	Registered	Occupation site (artefact and/or shell scatter)	Adjacent to the eastern boundary (southern portion of the site) on undisturbed land
9673	Registered[1]	Occupation site (artefact and/or shell scatter)	Adjacent to the eastern boundary (middle portion of the site) on disturbed land

Notes: 1 located on previously disturbed site

KBH – unregistered site surveyed by Vinnicombe (1997) in the King Bay-Hearson Cove study.

The impacts to Aboriginal sites as described in **Tables 9-11** and **9-12** are the best estimates that can be provided by Methanex prior to archaeological and ethnographical surveys being undertaken. A total of fourteen sites are listed with six of these sites being noted as already being cleared. The location of all the above sites will be confirmed during the surveys and the significance of the impacts will be determined.

9.9.2 Management Strategies

As discussed previously in **Section 9.9**, Methanex will undertake cultural and ethnographical surveys (**Commitment 9.05**) of the project site to confirm the potential impacts on Aboriginal heritage that may result from the establishment of the methanol complex. These surveys will be undertaken in consultation with relevant Aboriginal groups and representatives. Based upon the potential impacts outlined in **Section 9.9.1** the following management strategies will be undertaken by the Methanex:

- Continue to develop a working relationship with Aboriginal communities and support this relationship throughout the life of the proposal;
- **Commitment 9.06:** Develop and implement a cultural heritage protocol which will include heritage surveys and ongoing consultations with Aboriginal groups;
- Obtain necessary approvals from Aboriginal groups and the Minister for Environment and Heritage in the event that Aboriginal sites will be disturbed by the proposal;
- Ensure that the layout of the two methanol plants and associated infrastructure is optimised by considering the location of heritage sites, in particular granophyre rockpiles should be avoided, where practicable;
- Provide adequate guidance in the Construction Environmental Management Programme for the management of heritage sites (**Commitment 7.03**); and
- **Commitment 9.07:** Develop and implement an Aboriginal Awareness Program in consultation with Aboriginal groups for the construction and operation workforces.

Further management strategies are likely to be adopted by Methanex following detailed cultural and ethnographical surveys.

The EPA will be notified of any additional commitments that may be made prior to the assessment of the proposal.

Service corridors for the establishment of the product pipeline will be provided by the Office of Major Projects. These service corridors will be subject to a separate approval process where by environmental and heritage issues will be investigated. The gas supply and sea water supply pipelines will be constructed by others and is also subject to a separate approval process.

9.9.3 Monitoring

There have been several incidents in Western Australia where Aboriginal sites have been revealed during excavations and other earthworks. It is unlikely that Aboriginal sites will be found during excavations as the majority of the site has been previously disturbed by the construction camp and as part of rehabilitating the site, dredged spoil was spread over the site. Not withstanding the above, Methanex will ensure that nominated Aboriginal representatives are engaged during the construction phase by the EPC contractor to monitor ground disturbances. Particular attention will be given to ensuring that earthworks are kept to designated areas and any unnecessary disturbance is avoided.

The Construction Environmental Management Plan (**Commitment 7.01**) will outline procedures and actions that need to be taken in the event that an Aboriginal heritage site is exposed during excavations.

Predicted Outcome - *The requirements of the Aboriginal Heritage Act 1972 will be met. Loss of nine (registered and unregistered) archaeological sites and potential disturbance of a further five sites is unavoidable. Six of the fourteen sites are on previously disturbed land.*

9.10 National Estate and European Heritage

Management Objective *– To identify any areas which are in the close proximity to the proposal that are listed on the Register of National Estate or those areas on the Interim List, under the Australia Heritage Commission Act 1975 and those listed on the Register of the Heritage Council of WA.*

A search of heritage areas listed on the Register of National Estate and the Register of the Heritage Council of Western Australia was undertaken in January 2002. The results of the database search are provided in **Table 6-5** of **Section 6**.

9.10.1 Potential Impacts

Of the registered sites listed under the regions of Karratha, Dampier and the Burrup Peninsula, two registered places are relevant to the proposed methanol complex. These sites are:

- Dampier Archipelago – listed on the Register of National Estate; and
- Hearson Cove – listed on the register of the Heritage Council of WA.

Hearson Cove is located within one kilometre of the project site and is a popular recreational beach. The project will not impact the physical condition of Hearson Cove but will contribute to the cumulative impacts from industry on the amenity of the Cove. These impacts and the management strategies proposed by Methanex are described in further detail in **Section 9.11**.

There is the potential that the Dampier Archipelago may be impacted by the shipping of methanol product and the discharge of brine and treated process wastewater via the Water Corporation's proposed wastewater return line.

These impacts are specifically related to:

- Deterioration of water quality including contamination with TBT from antifouling on vessels, potential oil and methanol spills, discharge of wastewater or potentially contaminated stormwater;
- Inadvertent impacts on marine organisms; and
- Introduction of exotic marine organisms from ballast water.

These potential impacts are discussed in further detail in **Sections 8.3.1** and **8.3.2.**

9.10.2 Management Strategies

Management of the above potential impacts on the Dampier Archipelago has been previously discussed in **Sections 8.3.1 and 8.3.2**. Management strategies and commitments that will be adopted by Methanex are summarised below for ease of reference:

- Methanex will develop and implement a methanol toxicity program to determine a suitable methanol trigger value as no such value currently exists for Australian marine environments (ANZECC, 2000) (**Commitment 8.03**);
- Methanex will develop and implement a Whole Effluent Testing (WET) program to determine the impacts of the proposed wastewater discharge (**Commitment 8.06**);
- The methanol loading process will be carefully controlled, continuously supervised and monitored from the loading wharf and the plant site;

- In the unlikely event of a ship emergency, leak, blown line or failed connection with the vessel the pumping of methanol to the wharf will be terminated by activating automatic shut-off valves;
- A Methanol Spill Contingency Plan will be developed based upon Methanex's spill response procedures for existing operating plants (**Commitment 8.04**). A reactive monitoring program will also be established as part of the Spill Contingency Plan to document the impacts on water quality and marine organisms and monitor the recovery of the marine environment;
- Prior to commissioning, Methanex will offer to become an active participant in the committee and will assist, where necessary, in the co-ordinated planning of spill response at the Dampier Port (**Commitment 8.05**);
- The stormwater drainage system will be designed to separate clean and potentially contaminated stormwater;
- Methanex will ensure that process wastewater is treated prior to discharge to the Water Corporation's wastewater return line and that the quality will meet or exceed regulations (**Commitment 8.14**);
- All vessels carrying Methanex products will meet AQIS guidelines and ballast water requirements of the Dampier Port Authority as stipulated in the Port of Dampier Environmental Management Plan; and
- All vessels carrying Methanex products will comply with relevant legislation concerning anti-foulants (TBT).

Predicted Outcome - *It is likely that the project will have negligible impact on the heritage value of Hearson Cove and the Dampier Archipelago.*

9.11 Recreation Areas

Management Objective – *To ensure that recreational users of Hearson and Cowrie Coves are not compromised.*

The methanol complex will be located close to Hearson and Cowrie Coves which are both popular recreational areas used for swimming, fishing, boating and crabbing. Hearson Cove is located about 750m south west of the project site and Cowrie Cove is located approximately 1km north of the project site. Hearson Cove is accessible by two wheel drive vehicles via Hearson Cove Road, whereas Cowrie Cove is only accessible by four wheel drive vehicles via tracks that traverse the project site. Easy access to Hearson Cove makes this beach a more popular recreational area than Cowrie Cove.

9.11.1 Potential Impacts

The potential impacts on Hearson and Cowrie Coves that may result from the establishment of the methanol complex include:

- Impacts on visual amenity, including light spill during night-time operation (**Section 9.8**);
- Occurrence of nuisance odorous emissions (**Section 8.4.3**);
- Occurrence of nuisance noise emissions (**Section 8.4.3**);
- Increased risk to public safety and traffic (**Section 9.3**); and
- Relocation of access route to Cowrie Cove.

Many of the above potential impacts have been discussed in detail elsewhere in this document as referenced above. The potential impact on access routes is discussed within this section. Access to Hearson Cove will not be impacted by the proposed methanol complex however tracks providing access to Cowrie Cove will be removed and relocated.

9.11.2 Management Strategies

Management strategies nominated by Methanex to minimise potential impacts have been previously discussed in other sections but are summarised below for convenience. Management strategies in regard to providing alternate access to Cowrie Cove are also stated below.

Visual Amenity
The methanol complex will be visible from Hearson Cove (**Figures 9-8 and 9-9**), however it is expected that at the shoreline a large portion of the complex will be concealed by the sand dunes as there is a considerable drop in elevation from the beach to the shoreline. It is unlikely that the complex will be visible from Cowrie Cove as the large rockpiles adjacent to the Cove will conceal the complex.

Little can be done to conceal the plant however the complex can be coloured to blend in with the surrounding landscape. Methanex will also ensure that during operation a high standard of housekeeping will be maintained and items will be stored or disposed appropriately.

Odour
Potential odours from the complex may be generated from the domestic water treatment plant or from cooling tower blowdown. Appropriate measure will be adopted to minimise odour. Odorous emissions will have negligible impact on the amenity of Hearson or Cowrie Coves.

Noise
Noise modelling undertaken for the preliminary design of the complex has indicated that sensitive noise receptors at Hearson Cove will be exposed to noise levels of up to 62dB(A) from an unattenuated complex. On a cumulative basis, the noise emissions from the complex will overshadow those proposed by other industry. Considering potential noise attenuation strategies to reduce noise levels at the boundary from 75dB(A) to meet boundary criteria of 65dB(A), noise at Hearson Cove may be reduced to a maximum of 51dB(A) (**Table 8-20**).

The attenuated noise emission of 51dB(A) at Hearson Cove remains higher, in the order of 14dB(A), than other industrial plants proposed for the King Bay-Hearson Cove Industrial Area. No assigned noise criteria are specified in the Noise Regulations for recreational areas. OMP is currently undertaking an assessment to indicate an acceptable cumulative noise level for Hearson Cove. The results of this survey are expected to be available in April 2002.

Public Safety
Public safety at Hearson and Cowrie Coves will not be compromised by the proposed methanol complex. The Preliminary Risk Assessment (**Section 9.3**) indicates that the individual risk at Hearson and Cowrie Coves is well within the EPA acceptance criteria of 10 x 10^{-6} for non-industrial areas and active open spaces (**Section 9.3.6**).

Access
Access to Cowrie Cove is currently made via unsealed tracks that traverse through the project site. These tracks will need to be removed to construct the methanol complex. As part of the OMP's development plans for the King Bay – Hearson Cove Industrial Area alternative access routes to Cowrie Cove are being investigated. Methanex is assisting the Office of Major Projects in determining alternative access routes, where practicable.

Commitment 9.08: Methanex will ensure that any complaints received from the community are documented on a register and substantiated complaints will be investigated to the satisfaction of the DEP.

Predicted Outcome *- The project will result in the closure of the 4WD vehicle track to Cowrie Cove, however, Methanex will assist OMP in determining an alternative route. The plant layout will be optimised and noise attenuation measures implemented to minimise the loss of amenity to Hearson Cove users resulting from noise emissions from the complex.*

10. Decommissioning

10.1 Introduction

The methanal complex is being designed for an economic life of 25 years. Methanex' philosophy of Responsible Care® and its focus on long term reliability and maximum efficiency will ensure that the physical life of the plant extends many years past the designed economic life. The date when the complex could be decommissioned will be determined by the consideration of many commercial factors including:

- Availability of cost effective natural gas as the feedstock to produce methanol;
- The market demand of the product to be sold into the market and produce a profit for Methanex in the long term;
- The introduction of new technology; and
- Natural disaster or catastrophic incident which renders the complex not economic to restore.

Methanex' aim will be to ensure the complex operates well into the future and that when decommissioning takes place the site will be left in a safe condition and as near as practicable to the original environmental condition.

10.2 Preliminary Decommissioning Plan

Commitment 10.01: Prior to the start of construction Methanex will prepare a Preliminary Decommissioning Plan which provides a framework to ensure that the site is left in a suitable condition should decommissioning take place. The Preliminary Decommissioning Plan will be developed in consultation with DEP and MPR and include but not be limited to:

- The rationale for the siting and design of the complex and infrastructure;
- The conceptual plans for the removal of the complex;
- If appropriate the rationale for any plant, buildings or equipment that might be retained;
- The conceptual rehabilitation plans for all disturbed areas;
- A process to agree on end land use(s);
- Conceptual management plans to deal with any contamination issues; and
- A conceptual public consultation plan concerning the decommissioning.

10.3 Final Decommissioning Plan

Commitment 10.02: Six months prior to the last day of methanol production Methanex will prepare a final decommissioning plan in consultation with DEP and MPR designed to leave the site in a suitable condition. This plan will expand on the Preliminary Decommissioning Plan and provide details of:

- The plans for the removal of plant, buildings and equipment;
- The rational for the retention of any plant, buildings or equipment;
- The rehabilitation plans for the disturbed areas;
- An end land use(s) agreement;

- The management plans for dealing with contaminated areas; and
- A record of the public consultation undertaken to finalise the plan.

The plan will reflect regulations and guidelines that are in force at the time that the decommissioning is to take place.

11. Stakeholder and Public Consultation

11.1 Stakeholder Consultation

This PER represents a source of information from which individuals and groups may gain an understanding of the proposal, the need for the proposal, the alternatives, the environment that it would affect, the impacts that may occur and the measures taken to minimise those impacts. During its preparation, Methanex embarked on a stakeholder consultation exercise designed to:

- Brief stakeholders on the project;
- Gain feedback from stakeholders on the environmental, social and heritage aspects of the proposed project; and
- Present to stakeholders for their feedback, the key environmental issues associated with the project and the proposed management strategies to mitigate those impacts.

The overall strategy to achieve the objectives included three separate stages:

- Initial face to face meetings, including one on one briefings and meetings with stakeholder groups, phone conversations, exchanges of written information by letters and other correspondance;
- Interim group meetings coinciding with preliminary identification of potential impacts and formulation of appropriate management strategies; and
- Final group meetings on release of the PER for public review.

Methanex prepared various communication tools to assist with the information transfer during the consultation process, these included a project briefing pack, newsletters and presentation notes.

During the course of the PER preparation, Methanex undertook consultations with the following Government bodies and community groups based in Perth and Karratha:

- Conservation Council of Western Australia
- Dampier Port Authority
- Department of Conservation and Land Management
- Department of Environment, Water and Catchment Protection
- Department of Indigenous Affairs
- Department of Land Administration
- Department of Minerals and Petroleum Resources
- Department of Sport and Recreation
- Fire and Emergency Services Authority
- Karratha Chamber of Commerce and Industry
- Main Roads Western Australia
- Office of Major Projects
- Pilbara Development Commission
- Pilbara Native Title Service
- Roebourne Shire Council
- Water and Rivers Commission
- Water Corporation
- West Pilbara Health Service
- Western Australian Museum
- Western Power
- Ngaluma-Injibandi Native Title claimant group
- Yaburara and Coastal Mardudhunera Native Title claimant group

- Ministry for Planning and Infrastructure
- Nickel Bay Naturalists
- Wong-goo-tt-oo Native Title claimant group

The environmental and social issues that were raised by the government bodies and community groups during preliminary consultations are summarised in **Table 11-1**. **Table 11-1** also provides reference to the relevant section in the PER document where these issues are discussed in further detail. It is acknowledged that although some organisations may have focussed on a limited number of specific environmental issues during the preliminary consultations, they will likely be interested in many of the other environmental issues associated with the project.

The proponent will continue to consult with government authorities and community stakeholders throughout the formal public review process.

11.2 Community Consultation

Not only does this PER represent a source of information, but it is a basis for public consultation and informed comment on the proposal that will occur during the four-week public review period.

During the review period Methanex will conduct a community consultation program to ensure that local issues and concerns are addressed and to facilitate public participation in environmental and social impacts of the proposal.

Several public open days are planned for the Karratha and Dampier areas. These open days will take the form of manned public displays in local shopping centres and will be supplemented by a series of media releases and public communications. All activities will be well advertised and planned to ensure maximum public profile and access.

11.3 Indigenous Consultation

Methanex has embarked on a process of consultation with the indigenous people of the area to reach an agreed protocol for the handling of Cultural Heritage and Land tenure issues. The initial group discussions were conducted in December 2001 when Methanex provided a project description, proposed path forward on cultural issues and a comprehensive introduction to the environmental process underway.

As Methanex continues to develop relationships with the indigenous people through ongoing discussions, updates and outcomes of the environmental process will be provided. .

11.4 Operational Consultation

The Responsible Care® Code of Practice requires on going consultation with the community. Methanex has found that this is most effective through the establishment of a Community Advisory Panel (CAP). This CAP is a group of community members who act as a link between the company and the community. The company provides information about its business plans and how the business is functioning on a regular basis and the panel advises the company on how these plans effect the community and on what the community concerns are.

Commitment 11.01. Methanex will establish a Community Advisory Panel for its production facilities on the Burrup to enable ongoing consultation with the community prior to commissioning of the first plant.

■ **Table 11-1 Environmental Issues identified during Preliminary Consultations**

Environmental Issues Raised	Organisation																				
	Section in PER Document	Conservation Council	Department of Conservation and	Department of Environmental	Department of Indigenous Affairs	Department of Land Administration	Department of Minerals and	Department of Planning and	Department of Sports and Recreation	Fire and Emergency Services Authorities	Karratha Chamber of Industry and	Main Roads Western Australia	Ngaluma – Injibandi Claimant Group	Office of Major Projects	Pilbara Native Title Service	Roebourne Shire Council	Water and Rivers Commission	Water Corporation	West Pilbara Health Services	Wong-goo-tt-oo Claimant Group	Yaburara – Mardudhunera
BIOPHYSICAL ISSUES																					
Flora and Fauna	5.7, 5.8, 7.3.1, 7.3.2	✓	✓										✓			✓					
Landform, Drainage and Site Hydrology	5.4, 5.5, 7.3.3, 7.3.4		✓																		
Water Supply	4.3, 6.1.6, 8.4.7											✓					✓	✓		✓	
Marine Environment	5.9, 8.3.1		✓																		
Water Quality	8.3.1, 8.3.2																	✓		✓	
Flood, Storm/ Tide Levels	5.2.4, 5.2.5, 5.2.6		✓																		
EMS and Safety	7.1.3, 8.1.3, 12.1, 12.2				✓																
POLLUTION ISSUES																					
Atmospheric Emissions	7.4.1, 8.4.1		✓	✓	✓					✓			✓								
Greenhouse Gases	8.4.2		✓	✓	✓			✓					✓			✓			✓		
Noise	5.11, 7.4.2, 8.4.4, 9.11.2												✓			✓			✓		
Solid and Liquid Waste	7.4.3, 8.4.5, 8.4.6		✓										✓							✓	
Ballast Water	8.3.1.5																			✓	
Brine Return	8.3.1.4												✓					✓			
Hazardous Materials	8.4.6		✓																		
Waste Water Treatment	4.3.4, 4.3.5, 8.3.1.3, 8.3.1.4															✓					
SOCIAL ISSUES																					
Aboriginal/European Heritage	6.2, 6.3				✓								✓		✓	✓				✓	✓
Sport and Recreation (including Hearson and Cowrie Coves)	6.1.5.4, 9.11				✓				✓		✓								✓		
Workforce & Accommodation	4.7, 6.1.5.3, 9.6		✓		✓			✓							✓	✓			✓		✓
Stakeholder and Public Consultation	11							✓			✓				✓	✓	✓				
Community Benefits	3.4								✓		✓		✓		✓	✓				✓	✓
Public Safety	9.3		✓				✓			✓											
Road Transport	9.5											✓			✓						
Land Tenure	2.3				✓	✓										✓					
Project Funding	1															✓				✓	✓
INFRASTRUCTURE AND ENGINEERING ISSUES																					
Site Selection	3.5.1	✓	✓	✓																	
Service Corridors	3.5, 3.5.2		✓																		
Road Upgrades	9.5											✓									

- **Table 11-1 Environmental Issues identified during Preliminary Consultations (continued)**

Environmental Issues Raised	Organisation																				
	Section in PER Document	Conservation Council	Department of Conservation and	Department of Environmental	Department of Indigenous Affairs	Department of Land Administration	Department of Minerals and	Department of Planning and	Department of Sports and Recreation	Fire and Emergency Services Authorities	Karratha Chamber of Industry and	Main Roads Western Australia	Ngaluma – Injibandi Claimant Group	Office of Major Projects	Pilbara Native Title Service	Roebourne Shire Council	Water and Rivers Commission	Water Corporation	West Pilbara Health Services	Wong-goo-tt-oo Claimant Group	Yaburara – Mardudhunera
Pipeline Logistics	3.5.2,	✓	✓									✓									
Supply of Feedstock	4.4.2	✓	✓									✓					✓				
Port Loading Facilities	4.4.4		✓									✓									
Shipping	4.4.4		✓		✓															✓	
Landing Facility	4.5.2											✓				✓					
OTHER ISSUES																					
Co-ordinated Project Planning for Burrup	8.1.2		✓									✓				✓				✓	
Cumulative Impacts	8.1.2, 8.4.1.7,8.4.4.6, 9.3.7,		✓				✓							✓	✓	✓					✓

12. Environmental Management

12.1 Approach to Environmental Management

Methanex's excellent track record with respect to environmental management at its various manufacturing plants around the world has resulted from the adoption of the Responsible Care® ethic. As discussed in **Section 1.2.1** Responsible Care® is a philosophy and guiding principle set out by the Canadian Chemical Producers Association CCPA. The ethic involves a commitment to the responsible management of products and processes by which they are produced as well as continuous improvement in environmental, health and safety standards and its relationship with the communities in which it operates.

All Methanex manufacturing facilities have been verified by an independent auditing group as being compliant with the Responsible Care® Codes of Practice. This was the first time that an international chemical manufacturing company had a global verification of this nature completed. Furthermore, all Methanex facilities are ISO 9001 certified and the New Zealand facilities are accredited to ISO 14001.

The Responsible Care® ethic is the foundation of Methanex's multi-faceted approach to environmental management for the proposed Burrup methanol complex.

The Responsible Care® ethic will be inherent in all feasibility and design studies conducted for the Burrup methanol complex. This approach will enable Methanex to achieve or exceed a level of environmental management and performance consistent with national and international standards and statutory obligations.

Throughout the PER Methanex has nominated management and monitoring strategies to manage and reduce the level of risk of environmental impacts that may occur due to the construction, commissioning, operation and decommissioning of the methanol complex. Whilst these management and monitoring strategies are vital for the protection of the environment, management strategies also form an inherent part of the pre-construction planning process. This has taken the form of extensive and in-depth consultation with all key stakeholders including government and non-government organisations to ensure consideration during the feasibility and final design phases of all relevant environmental and social issues. This is consistent with Methanex' Responsible Care® approach to "*operate equipment, facilities and services in a manner that minimises risk, the impact on the environment and protects the health and safety of our employees, customers, contractors and the general public.*" (Methanex Corporation Responsible Care® Policy Statement **Figure 12-1**).

To ensure that construction management strategies are fulfilled and implemented a Construction Environmental Programme will be developed. The development and implementation of the CEMP will be undertaken by the EPC contractor and overseen by Methanex. The EPC contractor will be undertaking all construction works and will be responsible for ensuring the environmental impacts are minimised and construction proceeds with compliance to the management strategies and commitments nominated in the PER document. Environmental issues relevant to the EPC contractor will be managed through the EPC contractor selection process and the negotiated EPC contract. Each EPC contractor will be required to submit details on its Environmental Policy and Environmental Management System and provide a preliminary CEMP. The successful contractor will be required to develop and implement the CEMP in accordance with the commitments given in the PER document.

To ensure that management strategies and commitments relevant to the operation phase are fulfilled and implemented, they will be incorporated into an Environmental Management System (EMS) for the complex. Methanex already has a well-established EMS for their existing operating facilities in New Zealand. This system which is accredited to ISO 14001 and reflects Methanex's commitment to the Responsible Care® ethic, will be adopted for the proposed Burrup complex with relevant modification made to suit West Australian conditions, legislation and Australian Standards. The pivotal element of the EMS will be the Methanex Corporation Environmental Policy which is presented in **Figure 12-2**.

12.2 Environmental Management Programmes

Environmental aspects of the methanol project will be managed primarily through development and implementation of environmental management programmes for three phases of the development:

- Construction and Pre-commissioning;
- Commissioning and Operations; and
- Decommissioning.
- The environmental programmes will be developed following the completion of the environmental assessment and finalisation of project design.
- The programmes will be based on the ISO 14001 continuous cycle of improvement containing the five main principles of Policy, Planning, Implementation, Measurement and review (**Figure 12-3**).

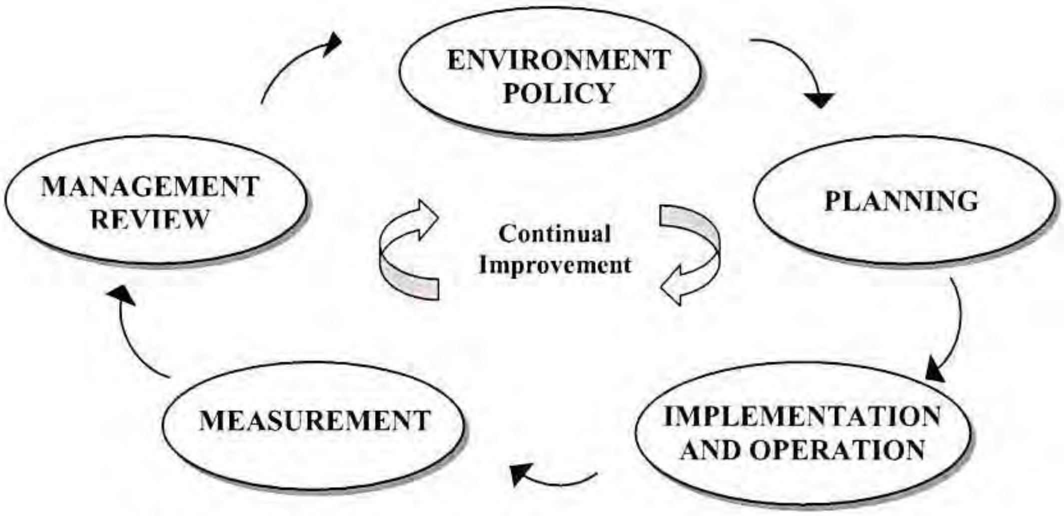

Figure 12-3 Environmental Management System Principles

An environmental program using the ISO 14001 standard consists of seventeen elements which are embodied with in the five main principles identified in **Figure 12-3**. The elements of an EMS are outlined in **Table 12-1**. The three environmental programmes will be developed using the elements as a guide.

METHANEX

A Responsible Care Company

METHANEX CORPORATE MANUAL

SECTION: Corporate Governance	SUB-SECTION: Corporate Policies
TITLE: RESPONSIBLE CARE	DOCUMENT #: CG1CP010

1.0 Scope

This document applies to all Methanex Corporation owned and operated facilities.

2.0 Purpose

This statement is intended to provide guidance to management regarding the implementation and management of Responsible Care® initiatives and systems within Methanex.

3.0 Responsibility

All staff are responsible for being aware of this policy, and applying it during the fulfilment of their responsibilities.

4.0 Policy

As a member of the Canadian Chemical Producers Association, Methanex Corporation is committed to the ethic of Responsible Care®. Methanex pledges to:

- Encourage and support Regional Management in the application of Responsible Care® in their respective countries.
- Recognize and respond to community concerns about the manufacture, storage, handling, transportation and disposal of chemical products.
- Give safety, health and environmental considerations priority in planning new facilities, products and the delivery of services involving the manufacture, storage, transportation, handling, recycling and disposal of chemical products.
- Operate equipment, facilities and services in a manner that minimizes risk, the impact on the environment, and protects the health and safety of employees, customers, contractors, and the general public.
- Increase knowledge by providing information concerning the distribution, storage, handling, use, the ultimate disposal and the effects on the environment of chemical products.
- Actively assist in the development of legislation and regulations that protect the workplace, the community and the environment.
- Cooperate with interested parties to resolve concerns arising from the handling, use, recycling and disposal of chemical products.

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- Promptly provide information concerning any potential health or environmental hazard to the appropriate authorities, employees and all stakeholders.
- Actively encourage and assist others to implement Responsible Care®.

5.0 References

METHANEX CORPORATE MANUAL

METHANEX
A Responsible Care Company

SECTION: Corporate Governance	SUB-SECTION: Corporate Policies
TITLE: ENVIRONMENT	DOCUMENT #: CG1CP012

1.0 Scope

All Methanex Corporation owned and operated facilities.

2.0 Purpose

To establish a broad policy for Methanex Corporation on environmental protection issues.

3.0 Responsibility

All employees are responsible for being aware of Methanex Corporation's Environment Policy and for applying it to their day-to-day activities.

4.0 Policy

4.1. Methanex's plants and product logistics systems have potential to adversely impact the environment. As a guiding principle, on a regional basis Methanex seeks to be among the leaders, with respect to environmental performance.

4.2. All appropriate employees shall have delegated authority to shut down a production unit or product logistics system should the environment be threatened or compromised.

4.3. Regional management shall ensure that their business unit(s) are in full compliance will all applicable environmental legislative requirements.

4.3.1. A process shall be maintained whereby legislative developments that have potential to negatively impact Methanex's business are followed.

4.4. Each operating facility, including terminals, shall undergo environmental audits on a frequency determined by Methanex Corporation.

4.5. Performance Standards

4.5.1. Each Methanex facility shall have equipment and procedures in place which will minimize the effects of spills and releases and, at a minimum, conform to local jurisdiction requirements.

4.5.2. All reportable environmental incidents and subsequent related actions shall be reported to Methanex Corporation.

4.5.3. All Methanex facilities shall set environmental key performance indicators and measure performance against them.

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4.5.4. All Methanex facilities shall demonstrate continuous improvement in environmental management system performance and pollution prevention.

4.5.5. Methanex Corporation shall maintain an environmental management system and organization that enables adherence to this Policy.

5.0 References

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Table 12-1 EMS Elements

Principle	Element
Policy	*Environmental Policy Statement:* A statement of the company's commitment to the environment. The policy provides the framework for the development of the EMS.
Planning	*Environmental Aspects:* Identify and evaluate the environmental 'attributes' of the company's activities, products and services.
	Legal and Other Requirements: Identify and ensure access to relevant environmental laws, regulations, and other requirements of statutory authorities.
	Environmental Objectives and Targets: Develop environmental objectives and targets, relative to the organisation's Environment Policy, environmental aspects and impacts, legal requirements, views of stakeholders etc.
	Environmental Management Plans: Prepare Environmental Management Plans, which specify actions, responsibilities and timeframes in which to implement the Environment Policy, and environmental objectives and targets.
Implementation	*Organisational Structure and Responsibility:* Define clear roles and responsibilities for environmental management within the organisation. Provide the necessary human, physical and financial resources for personnel to conduct their responsibilities effectively.
	Training and Awareness: Provide the necessary training and skills for personnel to manage their environmental responsibilities capably.
	Communication: Establish clearly defined internal and external communication and reporting pathways.
	EMS Documentation: Establish and maintain documented information on the EMS and establish links to related documents. EMS documentation includes the EMS Manual, procedures, environmental management plans, schedules etc.
	Document Control: Ensure the effective management of EMS documentation.
	Operational Control: Identify, plan and manage the organisation's operations and activities in accordance with the Environment Policy, as well as environmental objectives and targets.
	Emergency Preparedness and Response: Develop procedures for preparing for, and responding to, environmental incidents and emergencies.
Measurement and Evaluation	*Monitoring and Measurement:* Develop and maintain monitoring of activities which entail a significant environmental risk.
	Corrective and Preventative Action: Establish a method of identifying and correcting actual and potential deficiencies in the EMS.
	EMS Records: Establish and maintain records of the EMS to assess environmental performance.
	EMS Auditing: Periodically audit the EMS to assess the performance of the system.
Review and Improvement	*Management Review:* Periodic management review of the EMS is the vital concluding stage in the feedback loop of the EMS. The review is conducted with a view to setting new benchmarks in environmental performance and therefore establishing continual improvement in the EMS.

Environmental Management Plans will be an integral component of each environmental management programme and provide procedures and tasks that need to be completed to minimise the impact of the methanol complex on the surrounding environment.

In summary each EMP will contain, though may not be limited to, the following:

- Specific environmental objectives and commitments;
- Statutory and other legal requirements;

- Organisation Structure and management responsibilities;
- A brief description of the existing environment;
- A brief description of the proposed project or process;
- Environmental management activities including monitoring;
- Contingency plans;
- Emergency response procedures and emergency contact numbers;
- Auditing; and
- Reporting (including non-conformance and corrective action reporting, incident reporting, and compliance reporting).

Each EMP will flowchart major processes including the following:

- Organisation structure and management responsibilities;
- Project activities;
- Monitoring programmes;
- Contingency plans; and
- Emergency response procedures.

Flowcharting the major processes, provides an effective tool that is clear and simple to understand for all levels of personnel. These charts can be utilised on a stand-alone basis, separate from the EMP, as each chart will capture the major processes. The EMP will provide further guidance and information.

12.3 Summary of Management Commitments

Methanex is committed to achieving or exceeding a level of environmental management and performance consistent with national and international standards and statutory obligations. The most economically effective, environmentally sound technology and procedures will be incorporated into the design of the project in accordance with the ALARP (as low as reasonably practicable) principle.

The development of the methanol complex will be undertaken in a manner that will minimise impacts on the surrounding biophysical and social environments. Accordingly management commitments have been nominated throughout the PER document and are summarised in **Table 12-2**. There are a number of action items that have also been highlighted that need to be undertaken and completed for the EPA's assessment of the proposal. For the purposes of providing a summary of these action items, a separate listing is provided (**Table 12-3**). These action items will not be audited as they will be completed prior to the EPA's and the Minister's consideration of the proposal. It is important to note that the nominated commitments and actions will be implemented in addition to national and international standards and statutory obligations.

As the proposal advances through the design process and the EPA's approval process it will be possible to further refine the full list of these commitments.

- **Table 12-2 Summary of proposed draft management commitments (Assessment No. 1405)**

Commitment No.	Description	Objective	Timing	Advice from
Construction Environmental Management				
7.01	Develop a Construction and Pre-commissioning Environmental Management Programme. The CEMP will consist of a series of management plans that will include: ▪ Flora and Vegetation Management Plan (encompassing weed management); ▪ Landscaping Plan; ▪ Fauna Management Plan; ▪ Erosion and Sediment Control Plan; ▪ Dust Management Plan; ▪ Noise Management Plan; ▪ Solid Waste Management Plan; ▪ Liquid Waste Management Plan; ▪ Hazardous Materials Management Plan; ▪ Pre-commissioning Management Plan; ▪ Construction Safety Management Plan; ▪ Cultural Heritage Plan; ▪ Traffic Management Plan; and ▪ Cyclone Contingency Plan. Implement the Management Programme.	To manage all relevant environmental factors associated with the construction phase of the project.	Prior to construction Prior to construction	DEP ▪ CALM ▪ CALM ▪ CALM ▪ Commissioner of Soil and Land Conservation ▪ Department of Mineral and Petroleum Resources
7.02	A wet season vegetation survey will be undertaken provided sufficient rainfall is received prior to earthworks commencing on site.	To document additional flora species that may occur on the project site and provide suitable management where appropriate to minimising potential impacts.	Prior to construction	

- **Table 12-2 Summary of proposed draft management commitments (Assessment No. 1405) (continued)**

Commitment No.	Description	Objective	Timing	Advice from
7.03	CALM will be consulted in the development of suitable management procedures, as part of the CEMP, for managing impacts to Priority flora.	To manage impacts on vegetation, flora and particularly Priority flora.	Prior to construction	CALM
7.04	Contribute to taxonomic research programs investigating *Rhagada* sp., *Planigale* sp. and *Delma pax.*	To expand the current knowledge base of fauna and their distribution on the Burrup Peninsula and the Pilbara.	Prior to construction	WA Museum
7.05	All temporary excavations and pits will be backfilled and levelled.	To ensure that no adverse impacts occur from the establishment of excavations and pits.	Following construction	
7.06	Fill will be sourced from the project site where possible. Additional fill will be required and approval from the Shire of Roebourne will be obtained to extract fill from an alternative source.	To ensure that no potential adverse impacts occur as a result of the introduction of unsuitable fill and gravel.	Prior to construction	Shire of Roebourne CALM
Operation Environmental Management				
8.01	Seek to establish and participate with the Burrup Industrial Council in managing industry requirements for the Burrup Peninsula. Methanex will contribute to mutually agreed studies or investigations of cumulative impacts and will implement practicable and feasible actions where appropriate to the methanol complex operation.	▪ Minimise the impact of industry on the environment including: ▪ Social environment; ▪ Recreational areas; ▪ Flora and fauna; ▪ Aboriginal sites; ▪ Aquatic environment; and ▪ Mutual aid.	Operation	

- **Table 12-2 Summary of proposed draft management commitments (Assessment No. 1405) (continued)**

Commitment No.	Description	Objective	Timing	Advice from
8.02	Develop an Operation Environmental Management Programme (OEMP). The OEMP will consist of a series of management plans and will include: ▪ Flora and Vegetation Management Plan; ▪ Landscaping Plan; ▪ Fauna Management Plan; ▪ Erosion and Sediment Control Plan; ▪ Methanol Spill Contingency Plan; ▪ Water Quality Management Plan; ▪ Dust Management Plan; ▪ Noise Management Plan; ▪ Solid Waste Management Plan ▪ Liquid Waste Management Plan; and ▪ Hazardous Materials Management Plan. ▪ ▪ Implement the Programme.	To manage all relevant environmental factors associated with the operation phase of the project.	Prior to commissioning Operation	DEP ▪ CALM ▪ CALM ▪ Commissioner of Soil and Land Conservation

- **Table 12-2 Summary of proposed draft management commitments (Assessment No. 1405) (continued)**

Commitment No.	Description	Objective	Timing	Advice from
		Marine Environment		
8.03	Undertake a methanol toxicity testing programme to determine the impacts of methanol toxicity on typical Australian tropical marine species.	To determine a methanol toxicity trigger value.	Prior to construction	DEP
8.04	Prepare a Methanol Spill Contingency Plan. Implement the Plan.	To minimise the potential for contamination and adverse affects on the marine environment.	Prior to commissioning Operation	DEP
8.05	Offer to become an active participant in the committee of Terminal Operators and assist, where necessary, in the co-ordinated planning of spill response at the Dampier Port.	To minimise the potential occurrence of spill and to minimise the impacts of spills on the marine environment.	Prior to commissioning	Dampier Port Authority
8.06	Undertake 'Whole Effluent Testing ' of the proposed brine and wastewater stream. Undertake testing subsequent to plant start up and the availability of actual brine and return wastewater.	To determine the impacts of wastewater discharge on the marine environment.	Prior to construction Operation	DEP
8.07	Adopt AQIS guidelines, requirements of the Dampier Port Authority and appropriate ballast water management procedures.	To minimise the impact of shipping on the marine environment.	Operation	Dampier Port Authority AQIS
8.08	Inform vessel masters that no vessel hull scraping or antifoulant painting may take place in the Port of Dampier.	Prevent the contamination of the marine environment from antifouling.	Operation	
		Atmospheric Emissions		
8.09	Continue to investigate the optimum solution for the fuel and energy balance of the plant and minimise the emissions from the complex in accordance with EPA requirements that "all reasonable and practicable measures should be taken to minimise the discharge…" Continue these studies and implement the latest techniques to establish optimum emissions levels.	Minimise atmospheric emissions where practicable and comply with relevant guidelines.	Operation	DEP

- **Table 12-2 Summary of proposed draft management commitments (Assessment No. 1405) (continued)**

Commitment No.	Description	Objective	Timing	Advice from
		Greenhouse Gas		
8.10	Develop a framework agreement as part of joining the Greenhouse Challenge and implement the agreement.	To participate in the national programme of managing greenhouse gas emissions with the aim of minimising emissions where practicable.	Prior to commissioning	DEP
8.11	As part of managing greenhouse gas emissions, Methanex will: ▪ Continue to research and develop the methanol process in order to improve efficiency and reduce gas usage and implement plant improvements where practicable; ▪ Become a member of the Australian Industry Greenhouse Network; ▪ As a member of the Burrup Industrial Council, Methanex will participate and assist in agreed studies and investigation into the effects and remedies, such as alternative fuel technology, other technology advances and off-set measures for greenhouse gas emissions. Where practicable and feasible to the operation of the methanol complex, actions will be adopted and implemented; and ▪ Adopt and implement practicable and feasible actions where appropriate to the methanol complex operation.	To participate in the national programme of managing greenhouse gas emissions with the aim of minimising emissions where practicable.	Operation	DEP

- **Table 12-2 Summary of proposed draft management commitments (Assessment No. 1405) (continued)**

Commitment No.	Description	Objective	Timing	Advice from
Noise				
8.12	Following the design process of optimising the plant layout, noise emissions from the complex will be re-evaluated to confirm compliance with boundary noise criteria and to determine the contribution of noise at Hearson Cove.	To confirm compliance with boundary noise criteria and to determine the contribution to noise at Hearson Cove.	Prior to construction	DEP
8.13	Compliance noise monitoring will be undertaken by suitably qualified personnel to distinguish between noise levels from local environmental sources and other nearby operating industries.	To identify areas of potential exceedance or confirm compliance with statutory guidelines.	Operation	DEP
Waste Management				
8.14	Treat process wastewater prior to discharge to the brine return line such that the quality of water will meet or exceed regulations.	Comply with relevant guidelines and conditions.	Operation	DEP
Public Safety				
9.01	Inform the EPC contractor that they are required to prepare and implement a Construction Safety Management Plan that will address all emergency response procedures required during construction. In general, the Construction Safety Management will address: ▪ Provision of fire fighting equipment; ▪ Reporting of fires; ▪ Alarms and communication signals; ▪ Muster points; ▪ Evacuation procedures; and ▪ Preparedness and procedures for the three different cyclone warning stages (blue, yellow and red).	To minimise the risk to public safety and the potential creation of hazardous working environments.	Prior to construction	DEP Department of Mineral and Petroleum Resources

- **Table 12-2 Summary of proposed draft management commitments (Assessment No. 1405) (continued)**

Commitment No.	Description	Objective	Timing	Advice from
9.02	Prepare an Operation Safety Report that encompasses a Safety Management System, a Safety Management Plan and a Safety Emergency Response Plan. Implement the Operation Safety Report.	To minimise the risk to public safety and the potential creation of hazardous working environments.	Prior to commissioning Commissioning	DEP Fire and Emergency Services Authority
9.03	Develop a Traffic Management Plan that will focus on: ▪ Traffic flow patterns and scheduling of traffic movements such that impacts on road thoroughfare and the general public is minimised; ▪ Public safety, awareness and signage during construction; ▪ The capacity of existing road conditions to support proposed heavy loads and road usage; ▪ Monitoring the transportation of oversized loads; ▪ Design and construction of a one-way loop road around the plant footprint; and ▪ Restricting vehicle access to designated routes such that unnecessary disturbance to the surrounding environment is prevented. ▪ ▪ Implement the Plan.	To minimise potential traffic impacts and ensure safety of public during construction.	Prior to construction Construction	DEP Main Roads Wester Australia Shire of Roebourne Fire and Emergency Service Authority

■ Table 12-2 Summary of proposed draft management commitments (Assessment No. 1405) (continued)

Commitment No.	Description	Objective	Timing	Advice from
9.04	Develop a workforce profile that will detail the demographics of the expected workforce, a timeline, the required accommodation, and likely education and recreational requirements. Forward the workforce profile to : ▪ Education Department of Western Australia; and ▪ Shire of Roebourne	To provide information to key planning stakeholders such that appropriate provisions can be made in the planning of social infrastructure of Karratha and Dampier.	Prior to construction and commissioning	DEP
		Heritage		
9.05	Undertake archaeological and ethnographical surveys of the project site with relevant Aboriginal groups.	To minimise impacts on areas considered to be of Aboriginal heritage and cultural significance.	Prior to construction	DEP Department of Indigenous Affairs
9.06	Develop a cultural heritage protocol which will include heritage surveys and ongoing consultations with Aboriginal groups. Implement the protocol.	To minimise impacts on areas considered to be of Aboriginal heritage and cultural significance.	Prior to construction Construction	DEP Department of Indigenous Affairs
9.07	Develop an Aboriginal Awareness Program in consultation with Aboriginal groups for the construction and operation workforces. Implement the Program.	To minimise impacts on areas considered to be of Aboriginal heritage and cultural significance.	Prior to construction Construction and Operation	DEP Department of Indigenous Affairs
9.08	Document any complaints received from the community on a register and investigate substantiated complaints.	To ensure that environmental impacts are minimised.	Construction and operation.	DEP

- **Table 12-2 Summary of proposed draft management commitments (Assessment No. 1405) (continued)**

Commitment No.	Description	Objective	Timing	Advice from
		Decommissioning		
10.01	Prepare a Preliminary Decommissioning Plan which provides a framework to ensure that the site is left in a suitable condition should decommissioning take place: the plan will include: ▪ The rationale for the siting and design of the complex and infrastructure; ▪ The conceptual plans for the removal of the complex and infrastructure; ▪ If appropriate the rationale for any plant, buildings or equipment that might be retained; ▪ The conceptual rehabilitation plans for all disturbed areas; ▪ A process to agree on end land use(s); ▪ Conceptual management plans to deal with any contamination issues; and ▪ A conceptual public consultation plan concerning the decommissioning.	To restore the project lease as near as practicable to its 'as found' condition and leave it in a safe condition.	Prior to commissioning.	DEP Department of Mineral and Petroleum Resources.
10.02	Prepare a final decommissioning plan designed to leave the site in a suitable condition. This plan will expand on the Preliminary Decommissioning Plan and provide details of: ▪ The plans for the removal of plant, buildings and equipment; ▪ The rational for the retention of any plant, buildings or equipment; ▪ The rehabilitation plans for the disturbed areas; ▪ An end land use(s) agreement; ▪ The management plans for dealing with contaminated areas; and ▪ A record of the public consultation undertaken to finalise the plan.	To restore the project lease as near as practicable to its 'as found' condition and leave it in a safe condition.	Six months prior to last day of methanol production	DEP Department of Mineral and Petroleum Resources.

■ Table 12-2 Summary of proposed draft management commitments (Assessment No. 1405) (continued)

Commitment No.	Description	Objective	Timing	Advice from
Community Consultation				
11.01	Establish a Community Advisory Panel for its production facilities on the Burrup to enable ongoing consultation with the community.	To establish a working relationship with community members such that environmental and social impacts from the complex are minimised.	Prior to commissioning	DEP

Abbreviations:

AQIS – Australian Quarantine and Inspection Service
CALM – Department of Conservation and Land Management
DEP – Department of Environmental Protection
EPA – Environmental Protection authority
EPC – Engineering, Procurement and Construction

■ Table 12-3 Summary of proposed draft actions items

Action Item No.	Description	Objective	Timing	Advice from
1	Complete a desktop assessment of flora encompassing a regional assessment of impact and make this available to the public upon request and the EPA during the assessment of the proposal.	To assess the regional impact of clearing requirements for the proposal and to document potential wet season flora species in the absence of sufficient rainfall to date.	April/May 2002	DEP
2	Forward the results of the methanol toxicity testing programme to the EPA for their consideration during the assessment of the proposal.	Provide the EPA with methanol toxicity information.	May 2002	DEP
3	Provide the EPA the results of the Whole Effluent Testing programme for their consideration during the assessment of the proposal.	Provide the EPA with methanol toxicity information.	May 2002	DEP
4	Notify the EPA of any additional commitments related to Aboriginal heritage that may be made prior to the assessment of the proposal	To minimise impacts on areas considered to be of Aboriginal heritage and cultural significance.	May 2002	DEP

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14. Abbreviations

AEC	Australian Environment Council
AHD	Australian Height Datum
ALARP	As Low As Reasonably Practicable
AMSA	Australian Maritime Safety Authority
ANOVA	Analysis of Variance
ANZECC	Australian and New Zealand Environment and Conservation Council
ARMCANZ	Agriculture and Resource Management Council of Australia and New Zealand
AQIS	Australian Quarantine Inspection Service
AS	Australian Standard
ASU	Air Separation Unit
AUD	Australian Dollars
BFW	Boiler Feed Water
BOD	Biochemical Oxygen Demand
CAAA	Clean Air Act Amendments
CALM	Department of Conservation and Land Management
CCPA	Canadian Chemical Producers Association
CEMP	Construction Environmental Management Program
CO_2	Carbon Dioxide
COD	Chemical Oxygen Demand
CoMo	Cobalt Molybdenum
CONCAWE	Conservation of Clean Air and Water in Europe
CSIRO	Commonwealth Science and Industrial Research Organisation
CW	Cooling Water
DAS	Department of Aboriginal Sites
DBNG	Dampier to Bunbury Natural Gas Pipeline
DEP	Department of Environmental Protection
DME	Di-Methyl-Ether
DMW	Demineralised Water
DOLA	Department of Land and Administration
DOMGAS	Domestic Gas
DPA	Dampier Port Authority
DRD	Department of Resources Development
DRF	Declared Rare Flora
DSS	Decision Support System
DWT	Deadweight tonnage
EIA	Environmental Impact Assessment
EMP	Environmental Management Plan
EMS	Environmental Management System
ENM	Environmental Noise Model
EPA	Environmental Protection Authority
EPBC Act	Environment Protection and Biodiversity Conservation Act
EPC	Engineering, Procurement and Construction
EPBC	Environmental Protection and Biodiversity Conservation Act
ESD	Emergency Shut Down
FEED	Front End Engineering Design
FESA	Fire and Emergency Services Authority
GDP	Gross Domestic Product
GHG	Greenhouse Gas
GP	General Practitioner
GPS	Global Positioning System
GSP	Gross State Product
GT	Gas Turbine

GTL	Gas to Liquid
H_2	Hydrogen gas
HAT	Highest Astronomical Tide
HHV	High Heating Value
HSDB	Hazardous Substances Databank
IFRAO	International Federation of Rock Art Organisation
IMO	International Maritime Organisation
IRPA	Individual Risk Per Annum
KDCCI	Karratha and Districts Chamber of Commerce and Industry
LAT	Lowest Astronomical Tide
LCM	Leading Concept Methanol
LHV	Low Heating Value
LNG	Liquefied Natural Gas
LoP	Level of Protection
LPG	Liquefied Petroleum Gas
MARPOL	Maritime Pollution Convention
MATES	Men Assessing Training and Employment Skills
MCI	Mound Condition Index
MIC	Maximum Instantaneous Charge
MP	Medium Pressure
MPR	Department of Mineral and Petroleum Resources (formerly Department of Minerals and Energy)
MTBE	Methyl Tertiary Butyl Ether
MTO	Methanol to Olefins
NEPC	National Environmental Protection Council
NEPM	National Environmental Protection Measure
NH_3	Ammonia
NHMRC	National Health and Medical Research Council
NiMo	Nickel Molybdenum
NO	Nitric Oxide
NO_2	Nitrogen Dioxide
NPI	National Pollutant Inventory
NO_x	Oxides of Nitrogen
NOW	New Opportunities for Women
NTT	Native Title Tribunal
NWSG	North West Shelf Gas
NWSG-JV	North West Shelf Gas Joint Venture
NZ	New Zealand
OEMP	Operational Environmental Management Plan
OMP	Office of Major Projects (formerly Department of Resources Development)
OSC	On Scene Coordinator
PAT	Patient Assisted Travel
PCB	Polychlorinated Biphenyls
PDC	Pilbara Development Commission
PER	Public Environmental Review
PM	Particulate Matter (PM_{50} particles, 50µm diameter. PM_{10} particles, 10µm)
PRA	Preliminary Risk Assessment
SES	State Emergency Service
SO_2	Sulphur Dioxide
SO_x	Oxides of Sulphur
SOP	Standard Operating Procedure
SS	Suspended Solids
TBT	Tributyl Tin
TDS	Total Dissolved Solids
TSS	Total Suspended Solids
USDOE	United States Department of Environment

USEPA	United States Environment Protection Agency
VOC	Volatile Organic Compound
VCL	Vacant Crown Land
WAM	Western Australian Museum
WAPC	Western Australian Planning Commission
WET	Whole Effluent Testing

UNITS

%	Percent
‰	Parts per thousand
°C	degrees Celsius
bar	absolute pressure in bar
bara	bar absolute
barg	bar gauge
bbl	barrel
cm	centimetre
cm/s	centimetre per second
dB	decibels
dB(A)	A weighted decibels
dB(lin)	unweighted decibels
GJ/t	gigajoules per tonne
g/s	grams per second
ha	hectares
Hz	Hertz
kg	kilogram
kg/hr	kilogram per hour
kJ/h	kilojoule per hour
kPa	kilopascal
kL	kilolitre
kL/d	kilolitre per day
km	kilometre
km^2	square kilometre
km/hr	kilometre per hour
kt	kilotonne
ktpd	kilotonne per day
kV	kilovolt
m	metre
mm	millimetre
m/s	metre per second
mg/Nm^3	milligrams per Normal metre cubed
mg/L	milligram per litre
m^3	cubic metre
mS/cm	millisiemens per centimetre
mL	millilitre
ML/d	megalitre per day
MMbbl	million barrels
MMscf/d	million standard cubic feet per day
Mtpa	megatonne per annum
MW	megawatt
$\mu g/m^3$	microgram per cubic metre
ppm	part per million
ppb	parts per billion
scf	standard cubic feet
t	tonne
tpa	tonne per annum
tpd	tonne per day

tph or t/h	tonne per hour
Tcf	trillion cubic feet
TJ/d	terajoule per day
W/m^2	watts per square metre

UNIT CONVERSION

1 tonne	= 1000kg
1 kg	= 1000g
	= 1000 000mg
	= 1000 000 000µg
1 day	= 86 400s
	= 3 600 min
	= 24h
1 litre	= 1000mL
	= $10^{-3}m^3$
1 barrel	= 159L

Prefix	Symbol	Conversion
tera	T	10^{12}
giga	G	10^{9}
mega	M	10^{6}
kilo	k	10^{3}
centi	C	10^{-2}
milli	m	10^{-3}
micro	µ	10^{-6}

15 Glossary

Aliphatic	Organic compound with an open chain structure
Alluvial	Deposited by a river or stream.
Anhydrous	Liquid.
Anoxic	Lacking oxygen.
Aquifer	A geological formation or group of formations capable of receiving, storing and transmitting significant quantities of water that can be pumped.
Australian Standard (AS)	An Australian Standard which provides criteria and guidance on design, materials, fabrication, installation, testing, commissioning, operation, maintenance, re-qualification and abandonment.
A-weighting	A standardised frequency response used in sound measuring instruments which approximates the response of the human ear.
Benthic	Bottom dwelling.
Benthos	All biota living upon or in the sediment of an aquatic habitat.
Best Practice	Designed using best practicable engineering design, and operated using best industry practice management systems.
Bioaccumulation	The accumulation of contaminants in organisms at levels above that of the ambient environment.
Bioavailability	A substance in a chemical and physical form that allows it to affect organisms or be accumulated by them.
Biodiversity	The variability among living organisms on the earth, including the variability within and between species and within and between ecosystems.
Biota	The plants, animals and micro-organisms of a region.
Blowdown	Waste
Brine	Water containing large amounts of salt
Catalyst	An agent that provokes or speeds significant change or action.
Colluvial	Transported by gravel, usually at the foot of a slope.
Contaminant	Any physical, chemical or biological substance or property which is introduced into the environment.
Conventional Technology	Methanol production technique that incorporates only one reformer.
Cryptic	Hidden or camouflaged
Decibel	A logarithmic unit which represents the ratio of a measured quantity to a defined reference level.
Declared Rare Flora	Under the Wildlife Conservation Act 1950, the Minister for the Environment may declare species of protected flora to be "Rare Flora" if they are considered to be in danger of extinction, rare or otherwise in need of special protection. Such species receive special management attention by CALM.
Demineralisation	The process of removing dissolved mineral ions from water.
Desalination	The process of converting salt water into freshwater.
Desulphurisation	The process of removing sulphur dioxide from the natural gas stream.
Dextral	A snail shell that coils clockwise and has its aperture to the right when facing the observer with the apex upward.
Distillation	The process in which a liquid or vapour mixture of two or more substances is separated into its component fractions of desired purity, by the application and removal of heat.
Dyke	Tabular igneous rock intrusion cutting across the bedding or other planar structures of adjacent rock.
EC_{50}	Estimated concentration that is expected to cause an affect other than death to 50% of the test organisms.

Echolocation	A sensory system in certain animals, such as bats, in which usually high-pitched sounds are emitted and their echoes interpreted to determine the direction and distance of objects.
Emissions	Gases, particulates or liquids being released into the environment by either natural or human means. Some emissions are of concern to human and/or environmental health.
Endemic	Confined to a certain region.
Endothermic	Heat requiring.
Environment	The surroundings of an organism including the other biota with which it interacts.
Environmental Management Plan	A procedure that identifies potential impacts and methodologies necessary to prevent or mitigate them.
Environmental Management System	A set of procedures incorporated into a documented framework that defines the environmental policy and organisational responsibility for planning, recording, auditing, and resolving non-conformances through a process of review leading to continual improvement of an organisations environmental management.
Eluvial	Soil material moved from one soil horizon to another in solution or suspension.
Ephemeral	Intermittent stream flow.
Epifauna	Benthic animals that move about on the seabed or are firmly attached to it.
Exothermic	Heat producing.
Fauna	Collectively, the animal life of any particular region.
Flora	Collectively, the plant life of any particular region.
Formation	A rock deposit or structure of homogeneous origin and appearance.
Frequency	The rate of vibration in cycles per second (Hertz) commonly associated with the pitch of a sound. Low frequencies produce treble sounds. The frequency range of the human ear is nominally 20 Hz to 20,000 Hz.
Granophyre	A fine grained granitic rock in which irregular crystals of quartz and feldspar are embedded.
Greenhouse Gas	Gaseous constituents of the atmosphere, both natural and anthropogenic, that absorb and re-emit infrared radiation, including water vapor (H_2O), carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and sulphur hexafluoride (SF_6).
Habitat	The specific place where a particular organism lives.
Half life	The time required for half of the amount originally present to react.
Hydrocarbon	Organic compound made up of carbon and hydrogen.
Hydrogenation	To combine or treat with or expose to hydrogen.
Igneous	A rock or mineral formed by solidification of molten material of volcanic origin.
Infauna	Animals that live within the sediments of aquatic environments.
Invertebrate	Collective term for all animals which do not have a backbone or spinal column.
ISO 9001	Quality management system to meet customer and applicable regulatory requirements and thereby address customer satisfaction.
ISO 14001	Environmental management system standards
Latest Generation Technology	Methanol production technique that incorporates a primary and secondary reformer.
L_{A1}	Assigned noise level which is not to be exceeded for more that 1% of the time.

L_{A10}	Assigned noise level which is not to be exceeded for more than 10% of the time.
L_{Amax}	Assigned noise level which is not to be exceeded at any time.
LC_{50}	Estimated concentration that is expected to be lethal to 50% of the test organisms.
Lin	Abbreviation for linear.
Macrofauna	Animals whose shortest dimension is greater than or equal to 0.5mm.
Macrophyte	An individual alga large enough to be seen easily with the unaided eye.
Methanol	A colourless, flammable alcohol, with chemical formula CH_3OH.
Miscible	Capable of being mixed without separation.
Modulating noise	Noise whose amplitude and/or frequency content varies periodically in time. For example, a siren.
Monitoring	Periodic or continuous surveillance or testing to determine the level of compliance with statutory requirements and/or pollutant levels.
Mutagenic	A compound that causes mutation.
National Environmental Protection Council (NEPC)	A Ministerial Council with statutory powers to make national environmental protection measures on a co-operative basis. The Inter-governmental Agreement of the Environment provided for the establishment.
National Environment Protection Measure (NEPM)	A legal instrument which sets agreed national objectives for protecting particular aspects of the environment. NEPM are made by the NEPC.
Octant band	A range of frequencies where the highest frequency is greater than the lowest frequency by a factor of two.
Organism	Any living entity.
Pelagic	Pertaining to marine organisms which belong to the open seas living free from direct dependence on the bottom of the shore.
Phytoplankton	The planktonic organisms capable of photosynthesis
Pollution	Degradation or impairment of the purity of the environment by causing a condition that is hazardous to public health, safety aesthetics or welfare, or to biota.
Polychaete	Segmented marine worms of the class Polychaeta.
Priority Listed Flora	Flora that have not been adequately surveyed but may be rare or endangered.
Reformer	Unit which heats natural gas and converts it into carbon monoxide, carbon dioxide and hydrogen.
Responsible Care®	An accreditation given to companies who adopt the philosophy and guiding principles of the Responsible Care Codes of Practice.
Sinistral	A snail shell that has its aperture to the left when facing the observer with the apex upward.
Storm surge	Elevation of the sea caused by the effects of surface wind stress and surface pressure.
Tonal noise	Noise containing one or more frequencies which dominate the spectrum. Typically whining or droning noises.
Toxicity	The quality or degree of becoming poisonous, or harmful, to humans or biota.
Turbidity	Measure of the clarity of a water body.
Wastewater	Domestic, industrial or municipal effluent.
Zooplankton	Animal members of the plankton.

16 Study Team

Project Team

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Environmental Protection Authority Guidelines for the Preparation of the Public Environmental Review Document

Appendix A

Environmental Protection Authority
Guidelines for preparation of PER

METHANEX METHANOL COMPLEX

BURRUP PENINSULA
(Assessment Number 1405)

These guidelines are provided for the preparation of the proponent's environmental review document. The specific environmental factors to be addressed are identified in Section 4.2.

The environmental review document <u>must</u> address all elements of these guidelines prior to approval being given to commence the public review. The environmental review document must also be aware of any requirements of the Commonwealth Government under the *Environment Protection and Biodiversity Conservation Act 1999.*The EPA expects the proponent to fully consult with interested members of the public and relevant stakeholders, and to take due care in ensuring any other relevant environmental factors, which may be of interest to the public and stakeholders, are addressed. The environmental review should document the results of all consultation undertaken.

Guidelines for the preparation of the PER document

1. Overview

All environmental reviews have the objective of protecting the environment. Environmental impact assessment is deliberately a public process in order to obtain broad ranging advice. The review requires the proponent to:

- describe the proposal;
- describe the receiving environment;
- outline the potential impacts of the proposal on factors of the environment;
- identify the proposed management strategies to ensure those environmental factors are appropriately protected; and
- demonstrate that the proposal should be judged by the EPA to be environmentally acceptable.

Throughout the assessment process it is the objective of the Environmental Protection Authority (EPA) to help the proponent to design the proposal to improve the protection to the environment.

The primary purpose of the environmental review is to provide information to the EPA on the proposal within the local and regional framework, with the aim of emphasising how the proposal may impact the relevant environmental factors and how those impacts may be mitigated and managed so as to be environmentally acceptable.

The language used in the body of the environmental review should be kept simple and concise, considering the audience includes non-technical people, and any extensive, technical detail should either be referenced or appended to the environmental review. The environmental review will form the legal basis of the Minister for the Environment and Heritage's approval of the proposal and therefore the environmental review should include a description of all the main and ancillary components of the proposal.

Information used to reach conclusions should be properly referenced, including personal communications. Such information should not be misleading or presented in a way that could be construed to mislead readers. Assessments of the significance of an impact should be soundly based rather than unsubstantiated opinion, and each assessment should lead to a discussion of the management of the environmental factor.

2. Objectives of the environmental review

The objectives of the environmental review are to:

- place this proposal in the context of the local and regional environment;
- adequately describe all components of the proposal, so that the Minister for the Environment and Heritage can consider approval of a well-defined project;
- provide the basis of the proponent's environmental management program, which shows that the environmental impacts resulting from the proposal, including cumulative impact, can be acceptably managed;
- communicate clearly with the public (including government agencies), so that the EPA can obtain informed public comment to assist in providing advice to government; and
- provide a document which clearly sets out the reasons why the proposal should be judged by the EPA to be environmentally acceptable.

3. Preparation of the environmental review document

Proponents are encouraged to maintain close contact with the EPA officer during the preparation of the environmental review. The environmental review should be provided to the EPA officer for comment. At this stage the document should have all figures produced in the final format and colours.

The proponent and EPA officer/Manager should agree on the time to be taken to review the draft, taking into account the level of consultation during the environmental review preparation, EPA officer's availability and the need for external review. Revision of the document may be requested to ensure that it addresses all topics and issues in these guidelines, can be read by the educated lay-person, contains no significant error of science and meets the required format.

When the EPA is satisfied with the standard of the environmental review document it will provide a written sign-off to the proponent, giving approval to advertise the document for public review. The review document may not be advertised for release before written approval is received.

Following approval to release the review for public comment, the final environmental review document should also be provided to the EPA project officer as an electronic copy, in PC Microsoft Word 2000 format, and any scanned figures. Where possible, these figures should be legible and meaningful in a black and white format.

4. Contents of the environmental review document

The environmental review document should include an executive summary, introduction and at least the following:

4.1 The proposal

General requirements

The environmental review document should provide a comprehensive description of the proposal including its location (address and certificate of title details where relevant). Specific matters requiring attention are:

- justification and objectives for the proposed development;
- the legal framework, including existing zoning and environmental approvals, decision-making authorities and involved agencies; and
- consideration of alternative options.
-

Brief description of the proposal which is the subject of these guidelines

Methanex Australia P/L (the proponent} proposes to build a methanol complex on industrial zoned land at Hearson Cove on the Burrup Peninsula. The proposal involves:

- materials offloading facility / marine base;
- two methanol plants;
- natural gas supply pipeline; product pipelines to Dampier Port;
- water and wastewater treatment and disposal facilities;
- methanol product storage tanks;
- product loading facilities at Dampier Port; and
- ships for transport of the product.

The proposal location is indicated on the attached plan (Attachment 1).

Key characteristics of the proposal
The Minister's statement will bind the proponent to implementing the proposal in accordance with any technical specifications and key characteristics[1] in the environmental review document. It is important therefore, that the level of technical detail in the environmental review, while sufficient for environmental assessment, does not bind the proponent in areas where the project is likely to change in ways that have no environmental significance.
Include a description of the components of the proposal, including the nature and extent of works proposed. This information must be summarised in the form of a table, an example of which follows:

Table 1: Key characteristics (generic example only)

Element	Description
Life of project (mine production)	< 5 yrs (continual operation)
Size of ore body	682 000 tonnes (upper limit)
Depth of mine pit	less than 30m
Water table depth	50m below ground surface
Area of disturbance (including access)	100 hectares
Mine operation	Daylight hours only, Monday to Friday
List of major components • pit • waste dump • infrastructure (water supply, roads, etc)	refer 'Plans, specifications, charts' section immediately below for details of map requirements
Ore mining rate • maximum	 • 200,000 tonnes per year
Solid waste materials • maximum	 • 800,000 tonnes per year
Water supply • source • maximum hourly requirement • maximum annual requirement	 • XYZ borefield, ABC aquifer • 180 cubic metres • 1 000 000 cubic metres
Fuel storage capacity and quantity used	litres; litres per year

Plans, specifications, charts
Provide adequately dimensioned plans showing clearly the location and elements of the proposal which are significant from the point of view of environmental protection. Locate and show dimensions (for progressive stages of development, if relevant) of plant, amenities buildings, access ways, stockpile areas, dredge areas, waste product disposal and treatment areas, all dams and water storage areas, mining areas, storage areas including fuel storage, landscaped areas etc.
Only those elements of plans, specifications and charts that are significant from the point of view of environmental protection are of relevance here.

[1] Changes to the key characteristics of the proposal following final approval would require assessment of the change and can be treated as non-substantial and approved by the Minister, if the environmental impacts are not significant. If the change is significant, it would require assessment under section 38 or section 46. Changes to other aspects of the proposal are generally inconsequential and can be implemented without further assessment. It is prudent to consult with the Department of Environmental Protection about changes to the proposal.

Always include:
- a map showing the proposal in the local context - an overlay of the proposal on a base map of the main environmental constraints;
- a map showing the proposal in the regional context; and, if appropriate,
- a process chart / mass balance diagram showing inputs, outputs and waste streams.

The plan/s should include contours, north arrow, scale bar, legend, grid coordinates, the source of the data, and a title. The dates of any aerial photos should be shown.

Other logistics
- timing and staging of project; and
- ownership and liability for waste during transport, disposal operations and long-term disposal (where appropriate to the proposal).

4.2 The environment

Provide a description of the existing environment in a local and regional context which includes, if appropriate:
- ecosystem processes;
- biodiversity;
- existing site contamination (soil and groundwater); and
- other environmental factors / constraints that may be fatal flaws to the proposal.

4.3 Environmental factors

The environmental review should focus on the relevant environmental factors for the proposal, and these should be agreed in consultation with the EPA and relevant public and government agencies.

At this preliminary stage, the EPA believes the specific relevant environmental factors, objectives and work required for this proposal are as detailed in the table below. Please note the importance of considering the cumulative effects of the proposal as they relate to many of the environmental factors, especially with regard to air quality, noise and risks and hazards.

CONTENT		SCOPE OF WORK	
Factor	**Site specific factor**	**EPA objective**	**Work required for the environmental review**
BIOPHYSICAL			
Biological diversity	Terrestrial flora - vegetation communities	Maintain the abundance, species diversity, geographic distribution and productivity of vegetation communities	Baseline studies to identify existing vegetation communities. Assess the vegetation and flora conservation significance of the site with respect to the local and regional contexts (See Interim Terrestrial Biota Survey Guidelines and Preliminary EPA Position Statement #3 – General Requirements for Terrestrial Biological Surveys). Assess potential direct and indirect impacts on vegetation communities from the proposal. On the basis of information available on vegetation communities as defined at a local and regional scale provide detailed measures to minimise impacts during plant layout, design, construction and operation of the project. Show that any impacts on vegetation communities will not be environmentally significant or will be environmentally acceptable in a regional context. Include details of weed management.
	Declared Rare and Priority Flora; Flora of Conservation Significance	Protect Declared Rare and Priority Flora, consistent with the provisions of the *Wildlife Conservation Act 1950.* Protect flora listed in the Schedules of the *Environment Protection Biodiversity Conservation Act 1999.* Protect other flora species of conservation significance	Baseline studies to identify any Declared Rare Flora, Priority Flora or other species of conservation significance (including species listed on the Schedules of the *Environment Protection Biodiversity Conservation Act 1999)* the flora section should include comment on species of interest (DRF and Priority Flora) for which suitable habitat is present but which could not be searched for if the survey is carried out before spring and any other flora of conservation significance recorded during the survey. (See comments in the attached "Terrestrial Biota Survey Guidelines"). Assess potential impacts (direct and indirect) on vegetation communities as a result of the project's activities and infrastructure. Propose measures to manage impacts.
	Terrestrial Fauna	Maintain the abundance, species diversity and geographical distribution of terrestrial fauna.	Baseline studies to identify existing terrestrial fauna throughout the areas to be affected by the proposal. (See comments in the attached "Terrestrial Biota Survey Guidelines"). Also Position Statement #3; General requirements for biological surveys for EIA in WA Assess potential impacts (direct and indirect) on terrestrial fauna as a result of the project and associated activities. Propose measures to manage impacts.

Factor	Site specific factor	EPA objective	Work required for the environmental review
	Specially protected (Threatened) fauna	Protect Specially Protected (Threatened) Fauna, consistent with the provisions of the *Wildlife Conservation Act 1950*. Protect fauna listed on the Schedules of the *Environment Protection Biodiversity Conservation Act 1999*	Baseline studies to identify Specially Protected (Threatened) Fauna which may be found within the areas to be affected by the proposal (including species listed on the Schedules of the *Environment Protection Biodiversity Conservation Act 1999*). Assess potential direct and indirect impacts from the proposal, and how they will be addressed. Propose measures to manage impacts.
Landform, drainage and site hydrology		Maintain the integrity, functions and environmental values of landforms and natural surface water drainage.	Provide details of potential impacts from proposal and pipeline corridors on landform, natural surface water drainage, sediment transport and how they will be addressed. (Draft Guidance No.26 'Management of Surface Run-Off from Industrial and Commercial Sites) Include details of requirements for and sourcing of raw materials for fill in levelling of the site for construction. Propose measures to manage impacts.
	Impact of high tide flow events	To protect the hydrological role of the flood plain so that any changes do not result in unacceptable environmental impact.	Provide details of potential impacts from flood events and how these will be addressed.
Water supply			Provide details of water quantity required, sources of supply and method and routes of conveyance. Identify potential impacts and proposed measures to manage impacts.
Surface water	Water-courses	Maintain the integrity, functions and environmental values of watercourses and sheetflow.	Identify watercourses, and types of surface water flow including sheetflow throughout the areas to be affected by the proposal. . Assess the potential impacts on surface water flow rates, drainage patterns, sediment transport, riparian vegetation, pools and dependent vegetation, as a result of the industrial plant, roads, pipelines and associated activities. Propose measures to manage impacts.
Water quality	Surface water	Maintain or improve the quality of surface water to ensure that existing and potential uses, including ecosystem maintenance are protected, consistent with the National Water Quality Management Strategy-Australian and New Zealand Guidelines for Fresh and Marine Water Quality (*draft* October 2000).	Provide a detailed explanation of wastewater discharge from the site, options considered, assessment of options and steps taken to avoid or minimise impacts on the environment. Provide details of potential impacts on surface water quality and how they will be addressed with a specific emphasis on management of downstream impacts. Details of chemical storage and management on site should be included. (Refer to EPA Draft Guidance for the Assessment of Environmental Factors No. 26, *Management of Surface Run-off from Industrial and Commercial Sites*.)

Factor	Site specific factor	EPA objective	Work required for the environmental review
	Increased shipping	Minimise the risk of introduction of unwanted marine organisms consistent with the AQIS guidelines for ballast water management and ANZECC Code of Practice for Antifouling and In-water Hull Cleaning and Maintenance.	Assess and describe any likely contaminants resulting from increased shipping movements including the potential for accumulation of TBT and heavy metals. Develop strategies for the management of potential exotic organism introduction associated with ballast water and in-water hull cleaning and demonstrate how these are consistent with the AQIS guidelines for ballast water management and ANZECC Code of Practice for Antifouling and In-water Hull Cleaning and Maintenance.
POLLUTION MANAGEMENT			
Atmos-pheric emiss-ions	General	(i) Ensure that gaseous emissions, from this proposal in isolation and in combination with emissions from neighbouring sources and background concentrations, do not cause ambient ground level concentrations to exceed appropriate criteria, (including the NEPM for Ambient Air Quality, with advice sought from the DEP on specific pollutants as necessary), or cause an environmental or human health/ amenity problem; and (ii) Use all reasonable and practicable measures to minimise the discharge of significant atmospheric wastes such as NOx, SOx, greenhouse gases, toxic gases, particulates and smoke.	Identify and quantify all emissions (not limited to those below) to atmosphere from the proposal with a potential to have non-trivial impact on the environment (including impact on human health, nuisance, amenity, vegetation or fauna). Note: The proponent should refer to the Air Quality and Air Pollution Modelling Guidelines in Attachment 4 for a discussion of identification and modelling required. Provide details of any potential impacts (including cumulative impacts) and how they will be minimised and managed.
	NOx	Ambient NOx levels from the proposal should be compared with the NEPM for Ambient Air Quality, and may be compared to other standards recognised in Australia. If gas turbines are to be used then the EPA's Guidance for the Assessment of Environmental Factors relating to oxides of nitrogen should be met.	Provide a detailed explanation of NOx emissions and steps taken to minimise emissions of NOx. Provide justification of the ratio of NO to NO_2 used in modelling (as outlined in Attachment 4). Compare levels of NOx emitted from the proposed plant with levels from other methanol plants. Provide details of any impacts (including cumulative impacts) and how they will be addressed and managed. (Refer to EPA Draft Guidance for the Assessment of Environmental Factors No. 15, *Emissions of Oxides of Nitrogen from Gas Turbines*.)

	SOx		The modelled ambient SOx levels should be compared with the NEPM for Ambient Air Quality. Provide a detailed explanation of the SOx emissions and steps taken to minimise emissions of SOx to best practice levels. Provide details of any potential impacts and how they will be managed.

Factor	Site specific factor	EPA objective	Work required for the environmental review
	Photo-chemical smog	Predicted ambient ozone levels from the proposal should be compared with the NEPM for Ambient Air Quality.	Provide details of any impacts (including cumulative impacts) and how they will be addressed.
	Odour	No unreasonable impacts at boundary of the plant and Hearson Cove.	Provide details of odorous emissions and how these will be controlled. If necessary and appropriate, undertake an odour assessment in accordance with the EPA draft Guidance No.47 'Assessment of Odour Impacts'. Propose measures to manage impacts.
	Dust	(i) Ensure that dust generated during construction and operation does not cause any environmental or human health problem or significantly impact on amenity; and (ii) Use all reasonable and practicable measures to minimise airborne dust.	Provide details of dust emission sources during construction and operation and how these will be managed. Provide details of any potential impacts and measures to minimise impacts of dust.
	Green-house gases	To minimise greenhouse gas emissions in absolute terms and reduce emissions per unit product to as low as reasonably practicable. Mitigate greenhouse gas emissions in accordance with the Framework Convention on Climate Change 1992, and in accordance with established Commonwealth and State policies.	Provide details of greenhouse gas emissions, and using annual CO_2 equivalent quantities, provide a comparison with other plants producing similar products (considering the full life cycle). Provide details of the measures to be taken during design, construction and operation to reduce greenhouse gas emissions to best practice levels. Provide details of investigation and research into sink enhancement / storage measures (and other measures such as those included in the Kyoto Protocol) to further offset greenhouse gas emissions. Provide details of any Greenhouse management agreements to be adopted, such as the Commonwealth Government's voluntary Greenhouse Challenge.
Waste	Liquid and solid waste disposal	Where possible, waste should be minimised, reused or recycled. Liquid and solid wastes should be treated on site or disposed of off site at an appropriate landfill facility. Where this is not feasible, contaminated material should be managed on site to prevent groundwater and surface water contamination or risk to public health.	Provide details of all liquid and solid wastes that will be produced by the proposal and how they will be disposed of, and rationale for chosen options, any potential impacts and how they will be addressed and managed.

Factor	Site specific factor	EPA objective	Work required for the environmental review
Other emiss-ions	Noise	Ensure that noise impacts emanating from the proposed plant comply with statutory requirements specified in the Environmental Protection (Noise) Regulations 1997. Protect the amenity of nearby Hearson Cove from noise impacts resulting from activities associated with the proposal by ensuring that noise levels meet statutory requirements and acceptable standards.	Provide details of noise emissions. Determine existing background noise levels and quality at Hearson's Cove. Undertake modelling to determine impacts from the plant to Hearson Cove, including cumulative impacts from other existing or proposed plants, as to both noise levels and quality. Provide details of any potential impacts and how they will be managed, including community consultation.
	Light	Manage potential impacts from plant light overspill to visitors at Hearson Cove, and offshore fauna such as turtles, if applicable.	Provide details of any potential impacts of light spill and how they will be addressed.
SOCIAL SURROUNDINGS			
Public health and safety		Ensure that risk is managed to meet the Pea's criteria for individual facility risk off site and the MPR's requirement in respect to public safety.	Assess and describe the on-site and off-site risks associated with the various aspects of the proposal. (Refer to EPA Draft Guidance for the Assessment of Environmental Factors No. 2, *Risk Assessment and Management: offsite individual Risk from Hazardous industrial plant.*)
	Risk and hazard	Ensure that risk is managed to meet the EPA's criteria for off-site individual fatality risk (Interim Guidance Statement No.2), and that ALARP is demonstrated, and the DME's requirements in respect of public safety are met.	Undertake a preliminary risk assessment in accordance with the attached scope of works, to provide details of any potential risks and hazards associated with the proposal, associated pipelines and shipping. Include cumulative risks due to other existing or proposed hazardous facilities, and how they will be managed to meet the EPA's criteria. Demonstrate compliance with the Worksafe Australia Standard for the Control of Major Hazard Facilities.
	Road transport and traffic impacts	Ensure that roads are maintained or improved and road traffic managed to meet an adequate standard of level of service and safety and DfPI requirements.	Provide details of how road traffic will be managed and construction materials transported during construction, and future maintenance of proposed pipelines and roads to prevent potential impacts on existing levels of service, safety and public amenity.

Factor	Site specific factor	EPA objective	Work required for the environmental review
Culture and heritage	Aborig-inal culture and heritage	(i) Ensure that the proposal complies with the requirements of the Aboriginal Heritage Act 1972; and (ii) Ensure that changes to the biological and physical environment resulting from the project do not adversely affect cultural associations with the area.	Develop a clear understanding of relevant archaeological and ethnographic / landform utilisation issues. Provide details of archaeological and ethnographic surveys and consultations with Aboriginal communities and the Department of Indigenous Affairs, and of any potential impacts on Aboriginal culture, heritage and archaeological sites. Provide details of how impacts will be addressed and managed both during construction and operation.
	Register of the National Estate	Identify any areas which are close to the proposal that are listed on the Register of the National Estate or those areas on the Interim List, under the Australian Heritage Commission Act 1975.	Provide details of potential impacts on any such areas and how the impacts will be addressed and managed both during construction and operation.
Aesthetic	Visual amenity and recreation	Visual amenity of the plant and facilities from adjacent public areas should not be unduly adverse. Not to compromise recreational uses of the Hearson Cove area, as developed by local authority and planning agencies.	Provide details of any potential impacts on visual amenity resulting from the construction and operation of the plant and required infrastructure, possibly through the use of two dimensional silhouette images, overlay on ground level photographs or drawings. Demonstrate how these impacts will be minimised. Provide views of impacts on the users of the Burrup Access Road and Hearson Cove beach area. Include cumulative impacts from other existing or proposed plants.

These factors should be addressed within the PER document for the public to consider and make comment to the EPA. In addition, issues related to the impacts of infrastructure such as pipeline corridors and fire management need to be considered. The EPA expects to address all of these factors in its report to the Minister for the Environment and Heritage.

The EPA expects the proponent to fully consult with interested members of the public and take due care in ensuring all other relevant environmental factors, which may be of interest to the public, are addressed.

Further environmental factors may be identified during the preparation of the environmental review, therefore on-going consultation with the EPA and other relevant agencies is recommended. The EPA can advise on the recommended EPA objective for any new environmental factors raised. Minor matters which can be readily managed as part of normal operations for the existing operations or similar projects may be briefly described.

For discussion under each environmental factor:

- a description of where this factor fits into the broader environmental / ecological context (only if relevant - may not be applicable to all factors);
- a clear definition of the area of assessment for this factor;
- the EPA objective for this factor;
- a description of what is being affected - why this factor is relevant to the proposal;
- a description of how this factor is being affected by the proposal - the predicted extent of impact;
- a straightforward description or explanation of any relevant standards / regulations / policy;
- environmental evaluation - does the proposal meet the EPA's objective as defined above;
- if not, environmental management proposed to ensure the EPA's objective is met; and
- predicted outcome.

The proponent should provide a summary table of the above information for all environmental factors, under the three categories of biophysical, pollution management and social surroundings as shown below.

Table 2: Environmental factors and management (generic example only)

Environ-mental Factor	EPA Objective	Existing environment	Potential impact	Environmental management	Predicted outcome
BIOPHYSICAL					
vegetation community types 3b and 20b	Maintain the abundance, species diversity, geographic distribution and productivity of vegetation community types 3b and 20b	Reserve 34587 contains 45 ha of community type 20b and 34 ha of community type 3b	Proposal avoids all areas of community types 20b and 3b	Surrounding area will be fully rehabilitated following construction	Community types 20b and 3b will remain untouched Area surrounding will be revegetated with seed stock of 20b and 3b community types
POLLUTION MANAGEMENT					
Dust	Ensure that the dust levels generated by the proposal do not adversely impact upon welfare and amenity or cause health problems by meeting statutory requirements and acceptable standards	Light industrial area - three other dust producing industries in close vicinity Nearest residential area is 800 metres	Proposal may generate dust on two days of each working week.	Dust Control Plan will be implemented	Dust can be managed to meet EPA's objective
SOCIAL SURROUNDINGS					
Visual amenity	Visual amenity of the area adjacent to the project should not be unduly affected by the proposal	Area already built-up	This proposal will contribute negligibly to the overall visual amenity of the area	Main building will be in 'forest colours' and screening trees will be planted on road	Proposal will blend well with existing visual amenity and the EPA's objective can be met

4.3. Environmental management

The EPA expects the proponent to have in place an environmental management system (EMS) appropriate to the scale and impacts of the proposal, including provisions for performance review and a commitment to continuous improvement.
The system may be integrated with quality and health and safety systems and should include the following elements:

- environmental policy and commitment;
- planning of environmental requirements;
- implementation of environmental requirements;
- measurement and evaluation of environmental performance; and
- review and improvement of environmental outcomes.

A description of the environmental management system should be included in the environmental review documentation. If appropriate, the documentation can be incorporated into a formal environmental management system (such as AS/NZS ISO 14001). Public accountability should be incorporated into the approach on environmental management. The environmental management program (EMP) is the key document of an environmental management system. The EMP should provide plans to manage the relevant environmental factors, define the performance objectives, describe the resources to be used, outline the operational procedures and outline the monitoring and reporting procedures which would demonstrate the achievement of the objectives.

4.4. Environmental management commitments

The final stage of the Environmental Impact Assessment (EIA) process is reached when the Minister for the Environment and Heritage issues the Ministerial Statement for the project, which is a set of legally enforceable conditions and procedures for the implementation of the project. One of the standard procedural conditions is a requirement for the proponent to implement the key commitments which have been made during the EIA process and which the EPA and the proponent wish to become legally enforceable.

It is accepted practice for a list of the proponent's key commitments to be attached to the Minister's statement, however, it is not compulsory for the proponent to make any legally enforceable commitments. The EPA will recommend conditions to address environmental matters that the implementation of the proposal should be subject to. The EPA expects proponents to implement all the commitments, which are made as part of the public review of the proposal, as part of their commitment to good environmental management.

Commitments that are to be made legally enforceable should not be made lightly and should focus on the important, on-going, high risk issues that will need a higher level of environmental management in terms of achieving a satisfactory outcome. They would be key components within the proponent's environmental management system and would be subject to both internal (company) and external (regulator) audit processes to ensure both compliance as well as outcome.

Smaller-scale, generalised, overly-specific and/or non-controversial management actions, objectives and policies that the proponent intends to undertake in implementing the proposal (eg. return 150mm of topsoil, avoid coral reefs, minimise clearing of vegetation) do not need to be included in the list of legally enforceable commitments.

Ideally, management actions, etc, should be separated from the commitments in the public review document and they would not become specifically legally binding as would the commitments. However, the proponent would still be expected to implement these management actions as part of responsible environmental management as this is what the EPA will base its recommendations of acceptability upon.

It is important to ensure the commitments are auditable and, therefore, proponents are advised to follow a tabular format as explained below.

4.4.1. Commitment components

The commitments need to be framed in a format similar to that of the environmental conditions so that they have clarity and enforceability and, therefore, can be readily implemented by the proponent and audited efficiently by the DEP. The required standard format for all commitments comprises a number of components as follows:
The proponent will, for a specific topic (environmental issue), undertake an action (**what, how, where**) to meet an environmental objective (**why**) to a time frame (**when**), and on advice from a relevant advisory agency (**from whom**, eg. government agencies such as Department of CALM, Department of Mineral and Petroleum Resources, Shire Council).
With regard to 'advice from whom', this need only be included if the expertise and/or statutory responsibilities of the third party is relevant to implementing the commitment.
It is important for the consolidated list of commitments to be numbered correctly for easy reference in the implementation and auditing stages of the project. Accordingly, number these 1, 2, 3, ... without use of subgroups such as 1.1, 1.2 or -2(i) or 2(a), 2(b).

4.4.2. Paragraph format

In applying the standard components (topic what, why, when, from whom) an example of a commitment in paragraph form is as follows:
Prepare and implement a Dust Control Plan that will minimise dust generation on-site and aim to prevent dust emission from construction of the foreshore extension in order to protect the amenity of nearby land users. The Plan will be prepared during the design (project planning) phase and will include measures that ensure dust levels do not exceed EPA dust control criteria (EPA, 1996). The Plan will be prepared and implemented on advice from the Shire of Widgie. The approved Plan will be implemented during the construction phase.

However, writing the commitment in paragraph form can result in a confusing or clumsy sentence structure that may be difficult to interpret for future auditing purposes. Hence, a paragraph format is not acceptable and a tabular format is now required.

4.4.3. Tabular format

It is recommended that the table column headings be titled: 'commitment number', 'topic', 'actions', 'objectives', 'timing' and 'advice from'. The example in paragraph format above can be written in tabular form as per example 1 below. Note that the tabular format also overcomes the sometimes long-winded sentence structure where there are multiple specific actions for the plan to address. Also, it is desirable to create a separate commitment for the preparation and implementation parts of the commitment. Finally, the tabular format provides an immediate audit framework for use both by the proponent and the DEP, which enables efficient administration of environmental approvals. An example of the three most common formats is given below and Example 4 shows how to rewrite a management strategy into a commitment.

Example 1. Prepare and Implement format

This is the most common format and will apply most of the time where there is an on-going need to address the issue.

No.	Topic	Actions	Objectives	Timing	Advice from*
1.	Dust management	Prepare a Dust Control Plan for the foreshore construction site which addresses: 1) prevention of dust generation; 2) prevention of dust emissions off-site; and 3) monitoring and compensatory measures to address accidental emissions off-site.	1) Maintain the amenity of nearby residents. 2) Dust levels at nearest critical premise are within EPA dust control criteria (EPA, 1996).	Design phase (prior to the start of construct-ion)	Shire of Widgie
2.	Dust management	Implement the approved Dust Control Plan referred to in commitment 1.	Achieve the objectives of Commitment 1.	During constructi on	Shire of Widgie

* this may be left blank if no advisory local or state government agency is relevant; note that the DEP or the EPA or the Minister for the Environment and Heritage are never noted in this column. They are the regulators and the commitments are to their requirements, not advice.

Example 2. Once-off Action format

This format is for actions that have a clear completion time.

No.	Topic	Action	Objectives	Timing	Advice from
3.	Fauna protection	Undertake a trapping programme, approved by CALM, for capturing and relocating the Southern Brown Bandicoots from the area to be cleared.	Relocate the Southern Brown bandicoots to an area and in a manner where the population will be protected	Design (prior to the start of ground disturbance)	CALM

Example 3. Prepare, Implement and Upgrade format

This format is for circumstances when there is a clear need to modify a plan based on a study that is yet to be completed.

No.	Topic	Action	Objectives	Timing	Advice from
4.	Waste Rock Dump	Prepare a Waste Rock Dump Management Plan that: 1) ensures natural drainage is reinstated; 2) identifies rehabilitation options and techniques; 3) achieves a visual quality objective of level 3; 4) etc.	Construct a waste rock dump that: 1) blends with local landscape; 2) is stable in the long-term; and 3) will not produce leachate that would pollute the nearby wetlands.	Prior to the start of construction of the mine	Dept. Minerals and Petroleum Resources
5.	Waste Rock Dump	Implement the WRDM Plan referred to in commitments 4 and 6.	As for commitment 4.	During construction and operations	MPR

6.	Waste Rock Dump	Modify the WRDM Plan referred to in commitment 4 after the Acid Mine Drainage study referred to in commitment 9 is completed and the study findings approved by the EPA.	Ensure that drainage, including subsurface leachate, does not exceed water quality criteria (NHMRC, 1999).	During operations	MPR

Example 4. How to rewrite a management action, etc, into a commitment

No.	Topic	Action	Objectives	Timing	Advice from
1.	Waste material	Remove waste material which cannot be accommodated on-site due to potential changes in final design levels to an acceptable landfill. **this is a management action and is rewritten below**	To prevent contaminated material removed from the western part of the site being relocated inconsistent with the final plans for the development.	During remedial works	Shire of Widgie
1.	Excess waste material	Prepare a Waste Material Plan for any excess contaminated material that: 1) identifies the quantity and location of the material; 2) specifies the methods of removal and transport of the material; and 3) identifies the landfill site for disposal and the monitoring methods for the landfill disposal operation.	Ensure that contaminated material that cannot be contained on-site is disposed of at an acceptable landfill site.	During the remedial stage (prior to the validation stage)	Shire of Widgie
2.	Excess waste material	Implement the approved Waste Material Plan referred to in commitment 1.	Achieve the objectives of commitment 1.	After plan is approved by the DEP (during remedial stage)	Shire of Widgie

5. Public consultation

A description of the public participation and consultation activities undertaken by the proponent in preparing the environmental review should be provided. It should describe the activities undertaken, the dates, the groups/individuals involved and the objectives of the activities. Cross reference should be made with the description of environmental management of the factors which should clearly indicate how community concerns have been addressed. Those concerns which are dealt with outside the EPA process can be noted and referenced.

5.1. Availability of the environmental review

Copies for distribution free of charge

	• DEP Library/Information Centre 9
	• EPA members..6
	• Officers of DEP/EPA (Perth & Karratha) 6
Distributed by the proponent to:	
Government departments	• Department of Environmental Protection (Pollution Prevention Division, Pilbara Regional Office).................2
	• Department of Mineral and Petroleum Resources 2
	• Department of Conservation and Land Management 2
	• Department of Indigenous Affairs 1
	• Office of Major Projects 1
	• Pilbara Development Commission 1
	• Department for Planning and Infrastructure (Lands).........1
	• Department for Planning and Infrastructure (Maritime) ..1
	• Dampier Port Authority 1
	• Ministry for Planning...1
	• Water Corporation 1
	• Fire and Emergency Services Authority of WA...............1
	• Commissioner for Soil and Land Conservation` 1
	• Environment Australia...1
Local government authority	• Shire of Roebourne 2
Libraries	• J S Battye Library 3
	• The Environment Centre 2
	• Karratha Community Library 2
	• Wickham Community Library...2
	• Roebourne Library...2
Others	• Conservation Council of WA..1
	• Nickol Bay Naturalists..1
	• Dampier Archipelago Preservation Association...............1

Available for public viewing

- Department of Environmental Protection Library, Perth;
- Department of Environmental Protection Library, Karratha;
- Shire of Roebourne Library;
- Karratha Community Library
- Wickham Community Library,
- J S Battye Library, Perth; and
- [anywhere else, for example on your website]

6. Other information

Additional detail and description of the proposal, if provided, should go in a separate section.

Correspondence from the Commonwealth Minister for Environment and Heritage

Appendix B

Russell

Environment Australia

Department of the Environment and Heritage

Mr Bruce Aitken
Managing Director
Methanex Australia Pty Ltd
PO Box 4299
AUCKLAND NEW ZEALAND

Dear Mr Aitken

Methanex Australia Pty Ltd/Industry/King Bay-Hearson Cove, Burrup Peninsula/WA/Methanol manufacturing (Our Reference: 2001/528)

The above action was referred by Methanex Australia Pty Ltd, and received on 13 December 2001, for decision whether or not approval is needed under Chapter 4 of the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). The referral documentation nominated yourself as the person proposing to undertake the action.

The referral has now been considered under the EPBC Act and I have decided that the action is not a controlled action. Approval is therefore not needed under Part 9 of the Act before the action can proceed.

A copy of the document recording my decision is attached for your information.

Yours sincerely

W. Fletcher

Wayne Fletcher
A/g Assistant Secretary
Policy & Compliance Branch

8 January 2002

COMMONWEALTH OF AUSTRALIA

ENVIRONMENT PROTECTION AND BIODIVERSITY CONSERVATION ACT 1999

DECISION THAT ACTION IS NOT A CONTROLLED ACTION

Pursuant to section 75 of the *Environment Protection and Biodiversity Conservation Act 1999*, I, WAYNE WILLIAM FLETCHER, Acting Assistant Secretary, Policy and Compliance Branch, Environment Australia decide that the proposed action, set out in the Schedule, is not a controlled action.

SCHEDULE

The proposed action by Methanex Australia Pty Ltd to construct and operate a methanol complex, on the Burrup Peninsula of Western Australia, and as described in the referral received under the Act on 13 December 2001 (EPBC 2001/528).

Dated this 8th day of January 2002

W. Fletcher
....
ACTING ASSISTANT SECRETARY
POLICY AND COMPLIANCE BRANCH
ENVIRONMENT AUSTRALIA

Flora and Fauna Species List

Appendix C

Appendix C1

Vascular Flora Recorded from the Methanex Study Area

NB. * denotes flora introduced to Western Australia
† denotes flora that are probably introduced to the Burrup Peninsula

Correspondence of *Cassia / Senna* nomenclature

Cassia glutinosa	*Senna glutinosa* subsp. *glutinosa*
Cassia helmsii	*Senna artemisioides* subsp. *helmsii*
Cassia luerssenii	*Senna glutinosa* subsp. x *luerssenii*
Cassia notabilis	*Senna notabilis*
Cassia oligophylla x *helmsii*	*Senna artemisioides* subsp. *oligophylla* x *helmsii*
Cassia pruinosa	*Senna glutinosa* subsp. *pruinosa*

FAMILY / Species	# Collections
031: POACEAE	
Aristida holathera var. *holathera*	1
**Cenchrus ciliaris*	5
Cymbopogon ambiguus	9
Eriachne mucronata	1
Eriachne tenuiculmis (Priority 3)	2
Paspalidium tabulatum (Burrup Form)	2
Triodia angusta (Burrup Form)	3
Triodia epactia (Burrup Form)	12
Triodia wiseana (Burrup Form)	5
032: CYPERACEAE	
Cyperus vaginatus	3
056B: AGAVACEAE	
**Agave americana*	1
087: MORACEAE	
Ficus brachypoda (hirsute and glabrous forms)	2
Ficus opposita var. *aculeata*	1
Ficus opposita var. *indecora*	1
090: PROTEACEAE	
Grevillea pyramidalis subsp. *pyramidalis*	11
Hakea chordophylla	4
092: SANTALACEAE	
Santalum lanceolatum	2
105: CHENOPODIACEAE	
Enchylaena tomentosa	1
Rhagodia eremaea	7
106: AMARANTHACEAE	
**Aerva javanica*	6
Ptilotus exaltatus var. *exaltatus*	2
Ptilotus obovatus var. *obovatus*	1
107: NYCTAGINACEAE	
Boerhavia gardneri	3
113: CARYOPHYLLACEAE	
Polycarpaea longiflora (dead)	4
122: MENISPERMACEAE	
Tinospora smilacina	3
131: LAURACEAE	
Cassytha capillaris	7
137A: CAPPARACEAE	
Capparis spinosa var. *nummularia*	3
Cleome viscosa	1
152: PITTOSPORACEAE	
Pittosporum phylliraeoides var. *phylliraeoides*	3
163: MIMOSACEAE	
†*Acacia ancistrocarpa*	1
Acacia arida	2
Acacia bivenosa	10
Acacia colei var. *colei*	9
Acacia coriacea subsp. *coriacea*	7
Acacia coriacea subsp. *pendens*	2
†*Acacia gregorii*	1
Acacia inaequilatera	5
Acacia pyrifolia (green form)	5
Acacia pyrifolia (slender, white form)	6

FAMILY / Species	# Collections
163: MIMOSACEAE (continued)	
Acacia stellaticeps	1
Acacia synchronicia	1
†*Acacia trachycarpa*	1
†*Acacia tumida*	1
†*Acacia* sp.	1
Dichrostachys spicata	5
164: CAESALPINIACEAE	
Cassia glutinosa	4
†*Cassia helmsii*	1
†*Cassia luerssenii*	1
Cassia notabilis	1
†*Cassia oligophylla* x *helmsii*	1
†*Cassia pruinosa*	2
165: PAPILIONACEAE	
Cajanus cinereus	2
Crotalaria cunninghamii	1
Crotalaria medicaginea (Burrup form; B65-11)	2
Crotalaria novae-hollandiae subsp. *novae-hollandiae*	2
Cullen leucochaites	1
Erythrina vespertilio	1
Indigofera monophylla (Burrup form)	7
Rhynchosia cf. *minima*	2
Rhynchosia sp. Burrup (82-1C)	3
Swainsona formosa	2
Tephrosia aff. *supina* (MET 12,357)	2
Tephrosia rosea var. *clementii*	2
185: EUPHORBIACEAE	
Adriana tomentosa var. *tomentosa*	4
Euphorbia tannensis subsp. *eremophila* (Burrup form)	1
Flueggea virosa subsp. *melanthesoides*	6
Phyllanthus maderaspatensis var. *angustifolius*	1
207: SAPINDACEAE	
Alectryon oleifolius subsp. *oleifolius*	6
Diplopeltis eriocarpa	1
220: TILIACEAE	
Corchorus walcottii	7
Triumfetta appendiculata (Burrup form)	2
Triumfetta clementii	6
221: MALVACEAE	
Abutilon sp. (resprouting, sterile)	1
Gossypium australe (Burrup Peninsula form)	4
**Malvastrum americanum*	1
223: STERCULIACEAE	
Brachychiton acuminatus	4
243: VIOLACEAE	
Hybanthus aurantiacus	2
272: COMBRETACEAE	
Terminalia canescens	1
Terminalia supranitifolia (Priority 1)	4

FAMILY / Species	# Collections
273: MYRTACEAE	
Corymbia hamersleyana	4
Eucalyptus victrix	2
294: PLUMBAGINACEAE	
Plumbago zeylanica	2
301: OLEACEAE	
Jasminum didymum subsp. *lineare*	4
305: ASCLEPIADACEAE	
Cynanchum floribundum	3
307: CONVOLVULACEAE	
Bonamia media var. *villosa*	2
Evolvulus alsinoides var. *villosicalyx*	2
Ipomoea costata	4
Operculina aequisepala	1
310: BORAGINACEAE	
Ehretia saligna var. *saligna*	3
Trichodesma zeylanicum var. *zeylanicum*	6

FAMILY / Species	# Collections
315: SOLANACEAE	
Solanum horridum	3
Solanum phlomoides	2
316: SCROPHULARIACEAE	
Stemodia grossa	2
325: ACANTHACEAE	
Dicliptera armata	4
337: CUCURBITACEAE	
Mukia maderaspatana	8
341: GOODENIACEAE	
Goodenia microptera	1
Scaevola spinescens (broad form)	9
345: ASTERACEAE	
Pentalepis trichodesmoides	2
Pluchea ferdinandi-muelleri	2
Pterocaulon sphacelatum	7
Streptoglossa sp. (dead)	1

Appendix C2

Fauna Recorded Previously from the Burrup Peninsula

Appendix C1: **Records of mammals sourced from the Western Australian Museum mammal database for the Burrup Peninsula** (Latitude: 20°30'0"S to 20°43'0"S, Longitude: 116°36'0"E to 116°55'0"E). Names follow How *et al.* (2001). Additional observations from Butler and Butler (1983) and Butler (1994) are also included (marked with * and # respectively).

Family	*Genus species*	Common name
TACHYGLOSSIDAE	*Tachyglossus aculeatus*	Echidna
DASYURIDAE	*Dasykaluta rosamondae*	Little Red Kaluta
	Dasyurus hallucatus	Northern Quoll*#
	Pseudantechinus roryi	Rory's Pseudantechinus
	Planigale maculata	Common Planigale
	Ningaui timealyi	Pilbara Ningaui
MACROPODIDAE	*Macropus robustus*	Euro
	M. rufus	Red Kangaroo#
	Petrogale rothschildi[1]	Rothschild's Rock-wallaby
PTEROPODIDAE	*Pteropus scapulatus*	Little Red Flying-fox#
EMBALLONURIDAE	*Taphozous georgianus*	Common Sheathtail-bat*#
VESPERTILIONIDAE	*Vespadelus finlaysoni*[2]	Finlayson's Cave Bat
MURIDAE	*Pseudomys delicatulus*	Delicate Mouse
	P. hermannsburgensis	Sandy Inland Mouse
	Zyzomys argurus	Common Rock-rat
	Mus musculus	House Mouse
	Rattus rattus	Black Rat
	R. tunneyi	Pale Field-rat
	Hydromys chrysogaster	Water-rat*#
CANIDAE	*Canis familiaris*	Dog*#
	Vulpes vulpes	Fox*#
FELIDAE	*Felis catus*	Cat*#
BOVIDAE	*Ovis aries*	Sheep

[1] Butler (1994) lists *Petrogale lateralis.*
[2] As *V. pumilis* on WAM database.

Appendix C2: **Records of amphibians and reptiles sourced from the Western Australian Museum herpetofauna database for the Burrup Peninsula** (Latitude: 20°30'0"S to 20°43'0"S, Longitude: 116°36'0"E to 116°55'0"E). The Pilbara Olive Python *Liasis olivaceus barroni* is not included on this list but is known to occur on the Burrup Peninsula (see Section 5.5).

Family	*Genus species*
HYLIDAE	*Cyclorana maini*
	Litoria rubella
MYOBATRACHIDAE	*Notaden nichollsi*
AGAMIDAE	*Ctenophorus caudicinctus caudicinctus*
	C. isolepis isolepis
	Lophognathus gilberti gilberti
GEKKONIDAE	*Crenadactylus ocellatus horni*
	Diplodactylus conspicillatus
	D. savagei
	D. stenodactylus
	Gehyra pilbara
	G. punctata
	G. variegata
	Heteronotia binoei
	Oedura marmorata
	Strophurus ciliaris aberrans
	S. elderi
PYGOPODIDAE	*Delma borea*
	D. pax
	D. tincta
	Lialis burtonis
SCINCIDAE	*Carlia triacantha*
	Cryptoblepharus carnabyi
	C. plagiocephalus
	Ctenotus pantherinus ocellifer
	C. rubicundus
	C. saxatilis
	C. serventyi
	Cycladomorphus melanops melanops
	Egernia pilbarensis
	Glaphyromorphus isolepis
	Lerista bipes
	L. muelleri
	Menetia greyii
	M. surda surda
	Morethia ruficauda exquisita
	Notoscincus ornatus ornatus

Appendix C2: Records of reptiles and amphibians – continued.

Family	*Genus species*
VARANIDAE	*Varanus acanthurus*
	V. eremius
	V. pilbarensis
	V. tristis tristis
BOIDAE	*Antaresia perthensis*
	A. stimsoni stimsoni
	Aspidites melanocephalus
COLUBRIDAE	*Fordonia leucobalia*
ELAPIDAE	*Acanthophis wellsi*
	Demansia psammophis cupreiceps
	D. rufescens
	Furina ornata
	Pseudechis australis
	P. nuchalis
	Suta punctata
TYPHLOPIDAE	*Ramphotyphlops ammodytes*
	R. australis
	R. grypus
HYDROPHIIDAE	*Aipysurus laevis*
	Ephalophis grayae
	Hydrelaps darwiniensis

Appendix C3: Annotated list of birds recorded on the Burrup Peninsula.

Data sourced from the Storr-Johnstone Bird Data Bank, including data compiled by D. Hembree between February 1973 and June 1974; visit to the area by R. E. Johnstone in October 1980; Butler (1987); Astron Environmental (1999, 2000); and a visit by C. Davis in October 2001. Nomenclature and sequence follows Johnstone (2001).

Family	*Genus species*	Common name	Comments
CASUARIIDAE	*Dromaius novaehollandiae*	Emu	Scarce nomad. Recorded just outside the area.
PHASIANIDAE	*Coturnix pectoralis*	Stubble Quail	Uncommon. Recorded just outside the area.
	Coturnix ypsilophora	Brown Quail	Uncommon. Coastal spinifex flats (including *Spinifex longifolius* and *Triodia*).
ANATIDAE	*Cygnus atratus*	Black Swan	Scarce visitor. Small flocks (up to 30) reported at base of peninsula and at Dampier Salt.
	Tadorna tadornoides	Australian Shelduck	Scarce.
	Anas gracilis	Grey Teal	Scarce at tidal creeks and saltwork ponds.
SULIDAE	*Sula leucogaster plotus*	Brown Booby	Moderately common in enclosed waters (Nickol Bay, Withnell Bay and Mermaid Sound).
PHALACROCORACIDAE	*Phalacrocorax varius*	Pied Cormorant	Moderately common. Mainly sheltered seas, tidal creeks and saltwork ponds.
PELECANIDAE	*Pelecanus conspicillatus*	Australian Pelican	Common in small groups (up to 50). Nomadic. Sheltered seas, tidal creeks, samphire flats and saltwork ponds.
FREGATIDAE	*Fregata ariel*	Lesser Frigatebird	Scarce. Seas on both sides of the peninsula.
ARDEIDAE	*Ardea novaehollandiae*	White-faced Heron.	Uncommon. Recorded in tidal creeks, sheltered reef flats, beaches and saltwork ponds.
	Ardea alba	Great Egret	Scarce or uncommon. Recorded in mangrove creeks and saltwork ponds.
	Ardea garzetta	Little Egret	Uncommon. Tidal flats and saltwork ponds.
	Ardea sacra	Eastern Reef Heron	Common. Tidal mud, reef flats and mangal, also rocky shores and saltwork ponds.
	Butorides striatus	Striated Heron	Moderately common. Mangal (e.g. King Bay) also tidal flats.
	Nycticorax caledonicus	Rufous Night Heron	Uncommon. Mangrove creeks and saltwork ponds.
CICONIIDAE	*Ephippiorhynchus asiaticus australis*	Black-necked Stork	Uncommon. Mainly tidal creeks and mudflats also saltwork ponds.
ACCIPITRIDAE	*Pandion haliaetus*	Osprey	Uncommon in ones and twos. Sheltered seas, tidal creeks and saltwork ponds.
	Elanus caeruleus axillaris	Black-shouldered Kite	Uncommon visitor.
	Hamirostra melanosternon	Black-breasted Buzzard	Uncommon in ones and twos. Mainly over coast.

Appendix C3: Annotated list of birds – continued.

Family	*Genus species*	Common name	Comments
	Milvus migrans	Black Kite	Uncommon visitor. Single birds and small flocks (up to 10) over the area in October 1980.
	Haliastur sphenurus	Whistling Kite	Common or moderately common, in ones, twos or small parties. Wooded habitats including mangroves.
	Haliastur indus girrenera	Brahminy Kite	Moderately common in ones and twos. Mainly near mangroves.
	Accipiter fasciatus fasciatus	Brown Goshawk	Mainly a non-breeding visitor. Uncommon to moderately common in autumn and winter, scarce in spring and summer. Usually in ones and twos. Reported in mangroves.
	Accipiter cirrocephalus cirrocephalus	Collared Sparrowhawk	Reported just outside the area.
	Aquila morphnoides	Little Eagle	Scarce or uncommon.
	Aquila audax	Wedge-tailed Eagle	Scarce.
	Haliaeetus leucogaster	White-bellied Sea-Eagle	Moderately common over coasts (e.g. King Bay and Withnell Bay). Favours sheltered seas, tidal creeks and saltwork ponds. Breeding reported on offshore islands.
	Circus assimilis	Spotted Harrier	Moderately common usually in ones and twos. Favours sparsely wooded country. Breeding recorded.
	Circus approximans	Swamp Harrier	Recorded by Astron but would be a rare non-breeding visitor (February - September) to coastal plains.
FALCONIDAE	*Falco berigora berigora*	Brown Falcon	Moderately common resident. Usually single birds. Throughout the peninsula.
	Falco cenchroides cenchroides	Australian Kestrel	Common to moderately common resident and autumn - winter visitor; in ones, twos and small parties. Throughout the peninsula.
	Falco longipennis longipennis	Australian Hobby	Uncommon, recorded at Withnell Bay in 1987.
OTIDIDAE	*Ardeotis australis*	Australian Bustard	Uncommon in ones, twos and threes. Observed in low scrub and spinifex at base of peninsula in 1973 - 74.
TURNICIDAE	*Turnix velox*	Little Button-quail	Moderately common in good seasons in ones, twos and small parties. Mainly spinifex flats near coast.
SCOLOPACIDAE	*Limosa limosa melanuroides*	Black-tailed Godwit	Scarce to moderately common visitor from northern hemisphere. Recorded at Nickol Bay, Dampier Salt and Withnell Bay. Favours rocky and muddy coasts.

Appendix C3: Annotated list of birds – continued.

Family	*Genus species*	Common name	Comments
	Limosa lapponica menzbieri	Bar-tailed Godwit	Scarce to moderately common visitor from northern hemisphere. Recorded at Nickol Bay, Withnell Bay and Dampier Salt. Mainly tidal mudflats, beaches and saltwork ponds.
	Numenius minutus	Little Curlew	Scarce summer visitor from northern hemisphere. Recorded at Nickol Bay. Favours tidal flats and near-coastal samphire flats.
	Numenius phaeopus variegatus	Whimbrel	Common or moderately common visitor from northern hemisphere. Ones, twos and small flocks. Mainly tidal flats, beaches and saltwork ponds.
	Numenius madagascariensis	Eastern Curlew	Moderately common visitor from northern hemisphere. One, twos and small parties. Mainly tidal flats and saltwork ponds.
	Tringa stagnatilis	Marsh Sandpiper	Uncommon visitor from northern hemisphere. Recorded at Dampier Saltponds.
	Tringa nebularia	Common Greenshank	Moderately common visitor from northern hemisphere. Usually in ones, twos or small parties, occasionally flocks. Mainly tidal mudflats, mangrove creeks and saltwork ponds. Recorded at Nickol Bay, Dampier Salt ponds and Withnell Bay.
	Tringa cinerea	Terek Sandpiper	Uncommon visitor from northern hemisphere. Several observed at Dampier Salt ponds.
	Tringa hypoleucos	Common Sandpiper	Moderately common visitor from northern hemisphere; mainly in ones and twos. Sheltered salt waters, tidal flats and reef flats. Recorded at Nickol Bay, Dampier Salt and Withnell Bay.
	Tringa brevipes	Grey-tailed Tattler	Common to moderately common visitor from northern hemisphere; in ones, twos and occasionally flocks (up to 20). Tidal mud and reef flats, mangrove creeks, beaches and saltwork ponds. Recorded at Nickol Bay, Dampier Salt and Withnell Bay.
	Arenaria interpres interpres	Ruddy Turnstone	Common visitor from northern hemisphere; in ones, twos and small flocks. Tidal mudflats and reef flats, beaches and saltwork ponds. Recorded at Nickol Bay, Dampier Salt (more than 200 in 1987) and Withnell Bay.

Appendix C3: Annotated list of birds – continued.

Family	Genus species	Common name	Comments
	Calidris canutus rogersi	Red Knot	Uncommon to moderately common visitor from northern hemisphere; ones, twos or small parties. Tidal mud and sand flats, also saltwork ponds.
	Calidris tenuirostris	Great Knot	Uncommon visitor from northern hemisphere; in ones, twos or small flocks. Reported from Dampier Salt in October 2001.
	Calidris alba	Sanderling	Uncommon visitor from northern hemisphere; usually in small flocks. Mainly beaches, sandy inlets and saltwork ponds.
	Calidris ruficollis	Red-necked Stint	Common visitor from northern hemisphere; mainly small flocks, occasionally large flocks (hundreds or thousands). Tidal flats, beaches and saltwork ponds. Flocks recorded at Nickol Bay, Dampier Salt and Withnell Bay.
	Calidris acuminata	Sharp-tailed Sandpiper	Common visitor from northern hemisphere; usually in small flocks, occasionally large flocks (over 100). Mangrove creeks and saltwork ponds.
	Calidris ferruginea	Curlew Sandpiper	Moderately common visitor from northern hemisphere; in ones, twos, small flocks and on migration large aggregations (hundreds or thousands). Tidal flats and saltwork ponds.
	Limicola falcinellus	Broad-billed Sandpiper	Uncommon visitor from northern hemisphere; mainly in small flocks. Reported at Dampier Salt in October 2001.
	Phalaropus lobatus	Red-necked Phalarope	Uncommon visitor from northern hemisphere; in small flocks. Recorded at Dampier Salt ponds in October 2001.
BURHINIDAE	*Burhinus grallarius*	Bush Stone-curlew	Uncommon. In ones or twos. Recorded at Withnell Bay.
	Esacus neglectus	Beach Stone-curlew	Uncommon. Mainly sandy beaches, also tidal flats. Recorded at Withnell Bay.
HAEMATOPODIDAE	*Haematopus longirostris*	Pied Oystercatcher	Moderately common in pairs or small flocks. Tidal mud and reef flats and beaches.
	Haematopus fuliginosus opthalmicus	Sooty Oystercatcher	Uncommon in pairs or small groups. Tidal reef and mud flats and sandy beaches.
RECURVIROSTRIDAE	*Himantopus himantopus leucocephalus*	Black-winged Stilt	Scarce to common in ones, twos or flocks (up to 100). Mainly saltwork ponds.
	Recurvirostra novaehollandiae	Red-necked Avocet	Nomadic. Common on Dampier Salt ponds in flocks (up to 400).

Appendix C3: Annotated list of birds – continued.

Family	*Genus species*	Common name	Comments
CHARADRIIDAE	*Pluvialis squatarola*	Grey Plover	Uncommon summer visitor from northern hemisphere; in ones, twos or small parties. Mainly tidal mudflats, beaches and saltwork ponds. Recorded at Nickol Bay, Dampier Salt and Withnell Bay.
	Pluvialis fulva	Pacific Golden Plover	Scarce visitor from northern hemisphere; usually single. Recorded at Dampier Salt ponds in October 2001.
	Charadrius ruficapillus	Red-capped Plover	Common resident, in ones, twos, small flocks and aggregations (up to 200). Mudflats, beaches and saltwork ponds.
	Charadrius mongolus	Lesser Sand Plover	Uncommon visitor from northern hemisphere; ones, twos and small parties. Tidal flats, beaches and saltwork ponds.
	Charadrius leschenaultii leschenaultii	Great Sand Plover	Common to moderately common visitor from northern hemisphere; in ones, twos or small parties. Tidal mudflats, beaches, reef flats and saltwork ponds. Recorded from Nickol Bay, Dampier Salt and Withnell Bay.
	Charadrius melanops	Black-fronted Dotterel	Moderately common, usually in ones, twos or threes. Mainly margins of fresh water.
GLAREOLIDAE	*Stiltia isabella*	Australian Pratincole	Scarce or rare. Listed by Astron. Favours samphire and grass flats.
	Glareola maldivarum	Oriental Pratincole	Not so far recorded on the Burrup but probably an irregular visitor from the northern hemisphere. Recorded in large numbers on adjacent coastal plains.
LARIDAE	*Larus novaehollandiae novaehollandia*	Silver Gull	Uncommon to moderately common. Coasts, sheltered seas and saltwork ponds.
	Sterna nilotica macrotarsa	Gull-billed Tern	Uncommon to moderately common; usually in small flocks. Recorded at Dampier Salt and Withnell Bay.
	Sterna caspia	Caspian Tern	Moderately common in ones and twos. Sheltered seas, tidal creeks and saltwork ponds.
	Sterna bengalensis	Lesser Crested Tern	Moderately common in small flocks. Mainly sheltered seas.
	Sterna bergii	Crested Tern	Moderately common. Sheltered seas and saltwork ponds.
	Sterna nereis	Fairy Tern	Uncommon. Listed by Astron but scarce close to mainland; favours offshore islands.
	Sterna leucoptera	White-winged Black Tern	Uncommon to common visitor in ones, twos and small flocks from Asia. Mainly sheltered seas and Dampier saltponds.

Appendix C3: Annotated list of birds – continued.

Family	*Genus species*	Common name	Comments
COLUMBIDAE	*Columba livia*	Domestic Pigeon	Introduced species. Listed by Astron.
	Phaps chalcoptera	Common Bronzewing	Uncommon, in ones and twos. Mainly low shrubbery near water.
	Ocyphaps lophotes	Crested Pigeon	Common to moderately common throughout the area, in ones, twos and flocks (up to 50).
	Geophaps plumifera	Spinifex Pigeon	Moderately common to common, in ones, twos or small parties. Lightly wooded areas, also rocky country.
	Geopelia cuneata	Diamond Dove	Partly nomadic, attracted to permanent fresh water and seeding *Triodia*.
	Geopelia striata placida	Peaceful Dove	Scarce or uncommon in pairs and small parties. Attracted to permanent fresh water, rock pools etc.
	Geopelia humeralis	Bar-shouldered Dove	Moderately common, in ones, twos or small parties. Favours mangroves and their vicinity (e.g. Withnell Bay) and coastal acacia scrubs.
PSITTACIDAE	*Cacatua roseicapilla assimilis*	Galah	Uncommon to moderately common in pairs and small groups. Recorded feeding on seeds of curly-leaf wattle at Withnell Bay in October 1980.
	Cacatua sanguinea westralensis	Little Corella	Common in pairs and small flocks, occasionally large flocks (several hundred). Flocks of up to 50 at Dampier Salt in 1973 – 74 and small flocks feeding on seeds of curly-leaf wattle at Withnell Bay in October 1980.
	Nymphicus hollandicus	Cockatiel	Possibly a scarce visitor, recorded just outside the area.
	Platycercus zonarius zonarius	Ring-necked Parrot	Uncommon, usually in pairs or small parties. Pairs recorded feeding on river gum blossom on Dampier Peninsula in 1987 (Butler).
	Melopsittacus undulatus	Budgerigar	Scarce to moderately common, usually in small flocks. Abundance variable depending on season.
CUCULIDAE	*Cuculus saturatus optatus*	Oriental Cuckoo	Rare summer visitor from northern Asia. Recorded at Dampier.
	Cuculus pallidus	Pallid Cuckoo	Uncommon to moderately common visitor and passage migrant to the peninsula. Usually single, occasionally in twos. All wooded habitats.
	Chrysococcyx osculans	Black-eared Cuckoo	Scarce visitor, usually single birds.
	Chrysococcyx basalis	Horsfield's Bronze Cuckoo	Uncommon breeding visitor, usually in ones and twos. Favours acacia thickets and mangroves.

Appendix C3: Annotated list of birds – continued.

Family	*Genus species*	Common name	Comments
STRIGIDAE	*Ninox novaeseelandiae boobook*	Boobook Owl	Scarce or uncommon resident and winter visitor.
TYTONIDAE	*Tyto alba delicatula*	Barn Owl	Uncommon, probably mainly autumn – winter visitor. Recorded at Withnell Bay.
PODARGIDAE	*Podargus strigoides*	Tawny Frogmouth	Uncommon, in most wooded habitats.
CAPRIMULGIDAE	*Eurostopodus argus*	Spotted Nightjar	Scarce, favours sparsely wooded stony country.
AEGOTHELIDAE	*Aegotheles cristatus*	Australian Owlet-nightjar	Uncommon, favours wooded habitats.
APODIDAE	*Apus pacificus pacificus*	Fork-tailed Swift	Irregular visitor from north-east Asia, mainly in small flocks from November to early April.
HALCYONIDAE	*Dacelo leachii leachii*	Blue-winged Kookaburra	Scarce. Recorded for the peninsula but favours river gums on watercourses.
	Todiramphus pyrrhopygia	Red-backed Kingfisher	Moderately common, usually single birds. Favours lightly wooded habitats.
	Todiramphus sanctus sanctus	Sacred Kingfisher	Moderately common, breeding visitor, winter visitor and passage migrant. Usually in ones and twos. Mangroves and other well-wooded habitats.
	Todiramphus chloris pilbara	Collared Kingfisher	Locally common (e.g. Dampier Salt) but generally uncommon in mangal on peninsula. Resident, breeding in September – October. Favours mangal with large trees of *Avicennia*. This subspecies endemic to Pilbara.
MEROPIDAE	*Merops ornatus*	Rainbow Bee-eater	Moderately common to common, resident, winter visitor and passage migrant, in ones, twos or small parties, occasionally small flocks. Favours lightly wooded areas near water.
MALURIDAE	*Malurus lamberti assimilis*	Variegated Fairy-wren	Uncommon, usually in family parties. Thickets and scrub, including mangroves.
	Malurus leucopterus leuconotus	White-winged Fairy-wren	Moderately common throughout the region in pairs or family parties. Mainly *Triodia* and other low vegetation.
PARDALOTIDAE	*Pardalotus rubricatus*	Red-browed Pardalote	Uncommon, in ones and twos. Favours areas with river gums or other eucalypts near water.
	Pardalotus striatus murchisoni	Striated Pardalote	Scarce or uncommon, listed for the peninsula by Astron. Favours areas with eucalypts.
ACANTHIZIDAE	*Smicrornis brevirostris*	Weebill	Scarce or rare. Listed by Astron for the peninsula. Favours river gums and other eucalypts.

Appendix C3: Annotated list of birds – continued.

Family	Genus species	Common name	Comments
	Gerygone tenebrosa	Dusky Gerygone	Common to moderately common, usually in ones and twos. Confined to mangroves.
MELIPHAGIDAE	*Lichmera indistincta indistincta*	Brown Honeyeater	Moderately common to common; in ones, twos or small groups. Most frequent in mangroves but reported in all wooded habitats.
	Lichenostomus virescens	Singing Honeyeater	Common, usually in ones and twos. All wooded habitats including mangroves.
	Lichenostomus keartlandi	Grey-headed Honeyeater	Uncommon to moderately common and patchily distributed. Usually in ones and twos. Recorded in rocky areas on the peninsula, also Withnell Bay.
	Lichenostomus penicillatus	White-plumed Honeyeater	Uncommon to moderately common in ones, twos or small groups. Favours areas with river gums and flowering eucalypts and hakeas.
	Manorina flavigula	Yellow-throated Miner	Moderately common in pairs or small parties. Recorded in most wooded habitats.
	Acanthagenys rufogularis	Spiny-cheeked Honeyeater	Locally moderately common; in ones, twos or small flocks. Mainly wattle scrubs and mangroves.
	Epthianura aurifrons	Orange Chat	Probably occurs in area, reported near Dampier Salt.
	Epthianura tricolor	Crimson Chat	Uncommon to common irregular visitor; usually in small flocks. Sparsely wooded country especially *Triodia* flats and areas regenerating after fire.
PETROICIDAE	*Eopsaltria pulverulenta*	Mangrove Robin	Common to moderately common; usually in pairs. Confined to mangroves.
PACHYCEPHALIDAE	*Pachycephala melanura melanura*	Mangrove Golden Whistler	Uncommon to moderately common; usually in ones and twos. Confined to mangroves.
	Pachycephala rufiventris	Rufous Whistler	Scarce or uncommon; in ones and twos. Possibly only an autumn – winter visitor to this area. All wooded habitats.
	Pachycephala lanioides	White-breasted Whistler	Moderately common, in ones and twos. Confined to mangroves.
DICRURIDAE	*Rhipidura phasiana*	Mangrove Grey Fantail	Common; in ones and twos. Confined to mangroves.
	Rhipidura leucophrys	Willie Wagtail	Uncommon to moderately common; mainly in pairs. Most birds are probably winter visitors and passage migrants from the south. Favours lightly wooded areas near water.
	Grallina cyanoleuca	Magpie Lark	Uncommon to moderately common; in ones, twos or small parties. Mainly autumn – winter visitor. Favours sparsely vegetated flats in vicinity of tall trees and water.

Appendix C3: Annotated list of birds – continued.

Family	*Genus species*	Common name	Comments
CAMPEPHAGIDAE	*Coracina novaehollandiae*	Black-faced Cuckoo-shrike	Moderately common; usually in ones and twos. Recorded in all wooded habitats. The resident population *C. n. subpallida* is augmented in winter by passage migrants of the nominate subspecies *C. n. novaehollandiae* from south of state.
	Lalage tricolor	White-winged Triller	Locally common in some winters but generally uncommon; in pairs and small flocks. Breeding visitor and passage migrant. Favours lightly wooded areas.
ARTAMIDAE	*Artamus leucorynchus leucopygialis*	White-breasted Woodswallow	Moderately common; in ones, twos and family parties (up to 8). Mainly in and near mangroves.
	Artamus personatus	Masked Woodswallow	Nomadic visitor; locally and seasonally uncommon to common in small to large flocks. Lightly wooded areas with flowering trees and shrubs.
	Artamus cinereus melanops	Black-faced Woodswallow	Common; in ones, twos or small parties throughout the peninsula. Favours lightly wooded country.
	Artamus minor	Little Woodswallow	Moderately common; in ones, twos or small parties. Usually about rocky coasts.
CRACTICIDAE	*Cracticus nigrogularis*	Pied Butcherbird	Scarce or uncommon; in ones or twos. Lightly wooded areas.
	Cracticus tibicen tibicen	Australian Magpie	Scarce; in pairs or family parties.
CORVIDAE	*Corvus orru cecilae*	Western Crow (Torresian Crow)	Scarce in ones or twos. Favours habitats with tall trees and water, also attracted to road kills.
	Corvus bennetti	Little Crow	Nomadic. Common in ones, twos and small flocks. Attracted to habitation and road kills.
PTILONORHYNCHIDAE	*Ptilonorhynchus maculatus guttatus*	Western Bowerbird	Uncommon; in ones and twos. Recorded for Withnell Bay. Favours rocky country with *Ficus* in vicinity of water.
HIRUNDINIDAE	*Hirundo rustica gutturalis*	Barn Swallow	Not reported for peninsula but uncommon to moderately common visitor from north-east Asia to coastal plains of Pilbara from Cape Keraudren to Exmouth.
	Hirundo neoxena	Welcome Swallow	Moderately common in ones, twos and small parties over mangroves and beaches. Probably mainly winter visitor from south.
	Hirundo nigricans nigricans	Tree Martin	Common resident, winter visitor and passage migrant. Usually in small flocks. Often observed hawking over mangroves and mudflats.

Appendix C3: Annotated list of birds – continued.

Family	*Genus species*	Common name	Comments
	Hirundo ariel	Fairy Martin	Uncommon to moderately common; usually in small flocks. Mainly near rock piles, buildings and vicinity of fresh water.
ZOSTEROPIDAE	*Zosterops luteus*	Yellow White-eye	Common; in ones, twos or flocks (up to 20) in mangroves and near coastal scrub.
SYLVIIDAE	*Eremiornis carteri*	Spinifex-bird	Recorded by Astron for the peninsula but coastal records need confirmation.
	Cincloramphus mathewsi	Rufous Songlark	Uncommon visitor; in ones and twos. Favours lightly wooded areas with *Triodia*, especially near watercourses.
	Cincloramphus cruralis	Brown Songlark	Status uncertain, probably an uncommon visitor. Ones and twos recorded near Dampier Salt.
ALAUDIDAE	*Mirafra javanica horsfieldii*	Singing Bushlark	
DICAEIDAE	*Dicaeum hirundinaceum hirundinaceum*	Mistletoebird	Moderately common; in ones and twos. Most wooded habitats including mangroves.
PASSERIDAE	*Taeniopygia guttata castanotis*	Zebra Finch	Common; in pairs or small flocks (up to 30). Lightly wooded areas in vicinity of water.
	Emblema pictum	Painted Finch	Uncommon to common; usually in pairs or flocks. Mainly rocky hills with *Triodia*.

Appendix C4: List of birds previously recorded on the Burrup Peninsula (please refer to Appendix E3) that are specially protected.

Family	*Genus species*	Common name	Conservation Status[1]
ANATIDAE	*Cygnus atratus*	Black Swan	E
	Tadorna tadornoides	Australian Shelduck	E
	Anas gracilis	Grey Teal	E
SULIDAE	*Sula leucogaster plotus*	Brown Booby	E
FREGATIDAE	*Fregata ariel*	Lesser Frigatebird	E
ACCIPITRIDAE	*Pandion haliaetus*	Osprey	E
	Elanus caeruleus axillaris	Black-shouldered Kite	E
	Hamirostra melanosternon	Black-breasted Buzzard	E
	Milvus migrans	Black Kite	E
	Haliastur sphenurus	Whistling Kite	E
	Haliastur indus girrenera	Brahminy Kite	E
	Accipiter fasciatus fasciatus	Brown Goshawk	E
	Accipiter cirrocephalus cirrocephalus	Collared Sparrowhawk	E
	Aquila morphnoides	Little Eagle	E
	Aquila audax	Wedge-tailed Eagle	E
	Haliaeetus leucogaster	White-bellied Sea-Eagle	E
	Circus assimilis	Spotted Harrier	E
	Circus approximans	Swamp Harrier	E
FALCONIDAE	*Falco berigora berigora*	Brown Falcon	E
	Falco cenchroides cenchroides	Australian Kestrel	E
	Falco longipennis longipennis	Australian Hobby	E
OTIDIDAE	*Ardeotis australis*	Australian Bustard	P4
SCOLOPACIDAE	*Limosa limosa melanuroides*	Black-tailed Godwit	E
	Limosa lapponica menzbieri	Bar-tailed Godwit	E
	Numenius minutus	Little Curlew	E
	Numenius phaeopus variegatus	Whimbrel	E
	Numenius madagascariensis	Eastern Curlew	E, P4
	Tringa stagnatilis	Marsh Sandpiper	E
	Tringa nebularia	Common Greenshank	E
	Tringa cinerea	Terek Sandpiper	E
	Tringa hypoleucos	Common Sandpiper	E
	Tringa brevipes	Grey-tailed Tattler	E
	Arenaria interpres interpres	Ruddy Turnstone	E
	Calidris canutus rogersi	Red Knot	E
	Calidris tenuirostris	Great Knot	E
	Calidris alba	Sanderling	E
	Calidris ruficollis	Red-necked Stint	E
	Calidris acuminata	Sharp-tailed Sandpiper	E
	Calidris ferruginea	Curlew Sandpiper	E
	Limicola falcinellus	Broad-billed Sandpiper	E
	Phalaropus lobatus	Red-necked Phalarope	E
BURHINIDAE	*Burhinus grallarius*	Bush Stone-curlew	P4
RECURVIROSTRIDAE	*Himantopus himantopus leucocephalus*	Black-winged Stilt	E
	Recurvirostra novaehollandiae	Red-necked Avocet	E

Appendix C4: List of specially protected birds – continued.

Family	*Genus species*	Common name	Conservation Status[1]
CHARADRIIDAE	*Pluvialis squatarola*	Grey Plover	E
	Pluvialis fulva	Pacific Golden Plover	E
	Charadrius ruficapillus	Red-capped Plover	E
	Charadrius mongolus	Lesser Sand Plover	E
	Charadrius leschenaultii leschenaultii	Great Sand Plover	E
	Charadrius melanops	Black-fronted Dotterel	E
	Glareola maldivarum	Oriental Pratincole	E
CUCULIDAE	*Cuculus saturatus optatus*	Oriental Cuckoo	E
APODIDAE	*Apus pacificus pacificus*	Fork-tailed Swift	E
MEROPIDAE	*Merops ornatus*	Rainbow Bee-eater	E
HIRUNDINIDAE	*Hirundo rustica gutturalis*	Barn Swallow	E

[1] E: List of Migratory Species under the *Environmental Protection and Biodiversity Conservation Act 1999*. This national list of Migratory Species consists of those species listed under the following international conventions: Japan-Australia Migratory Bird Agreement (JAMBA), China-Australia Migratory Bird Agreement (CAMBA), Convention on the Conservation of Migratory Species of Wild Animals (BonnConvention).

No species listed on Schedules 1, 3 or 4 under the Wildlife Conservation (Specially Protected Fauna) Notice 2001 have been recorded previously on the Burrup Peninsula.

P4: Species included under Priority 4 on the Department of Conservation and Land Management Priority Fauna Listing (October 2001). This includes taxa which are considered to have been adequately surveyed, or for which sufficient knowledge is available, and which are considered not currently threatened or in need of special protection, but could be if present circumstances change. These taxa are usually represented on conservation lands.

Correspondence from the Department of Indigenous Affairs

Appendix D

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BRWO

ABORIGINAL AFFAIRS DEPARTMENT

ALBANY BROOME FREMANTLE GERALDTON KALGOORLIE MIDLAND PORT HEDLAND PERTH

ENQUIRIES: Denis Callaghan 9235 8135

OUR REF: l:\idms\open\djc\djc06181.doc

YOUR REF: R0193/01

Mr Brian Wood
Project Manager
Mineral and Petroleum Resources
SGIO Atrium 168-170 St George's Terrace
PERTH WA 6000

Dear Brian

METHANEX PROJECT - ENVIRONMENTAL APPROVAL

Thank you for your facsimile of 1 Feb 2002.

I confirm that the 1997 heritage survey report by Dr Patricia Vinnicombe will be an adequate basis to address the PER guidelines on cultural and heritage issues pending the completion of further work to satisfy the provisions of the Aboriginal Heritage Act.

Yours sincerely

Stuart Reid

Stuart Reid
ASSISTANT DIRECTOR, HERITAGE AND CULTURE
4/02/02

Department of Indigenous Affairs
Government of Western Australia

FAXED

ENQUIRIES: Denis Callaghan 9235 8135
OUR REF: 01/0826 I:\idm\open\djc\dje0082].doc
YOUR REF:

Mr Brian Wood
Project Manager
Mineral and Petroleum Resources
SGIO Atrium 168-170 St George's Terrace
PERTH WA 6000

FOR THE
INFORMATION OF
Methanex
3/4/2002

Dear Brian

METHANEX PROJECT – PUBLIC ENVIRONMENTAL REVIEW

Thank you for allowing me a preview of this document.

I have no concerns about any of the details incorporated from Dr Vinnicombe's work in the document.

I wish to point out that Page 1-7 Table 1-2 incorrectly identifies the Department of Indigenous Affairs as administering the *Native Title Act 1993*.

A typographical error occurs on page 4 of Appendix G.'Nampier' on the penultimate line should read Napier.

Yours sincerely

Stuart Reid

Stuart Reid
A/ASSISTANT DIRECTOR, HERITAGE AND CULTURE
3 April 2002

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Ballast Water Risk Assessment

Appendix E

E.1 Risk Assessment

Preliminary investigations, based on biogeographic and environmental similarities, indicate that the risk of marine pest species introduction to the Port of Dampier varies as per **Table E1** (in the event that mandatory AQIS regulations are not complied with).

Ships that will be coming into the Port of Dampier to transport methanol product to Methanex' customers will have the potential to introduce marine pest species from various countries. Vessels coming into Dampier are likely to be from various origins as listed in **Table E1.** An indication of the frequency of vessel origins is also given in the table below.

The threat of marine pest species introductions, and their subsequent survival and establishment in the Port of Dampier, from each port of origin has been assigned to one of the following categories:

A Highest threat
B Substantial threat
C Moderate threat
D Low threat
E Negligible threat

- **Table E1 Risk of marine species introduction to the Port of Dampier**

Vessel Origin		Frequency of Visits	Risk
Country	**Port**		
Australia	Brisbane	Low	A
	Bunbury	Low	E
	Darwin	Low	A
	Melbourne	Low	E
	Port Botany	Low	C
	Sydney	Low	C
Brazil	Sao Sebastiao	Low	D
Canada	Kitimat	Low	E
	Vancouver	Low	E
Chile	Punta Arenas	Low	E
China	Aoshan	High	D
	Dalian	High	D
	Guangzhou	High	D
	Huangpu	High	D
	Jiangyin	High	D
	Lanshan	High	D
	Nanshan	High	D
	Nantong	High	D
	Ningbo	High	D
	Panyu	High	D
	Rizhao	High	D
	Shanghai	High	D
	Shekou	High	D
	Taicang	High	D
	Tianjin	High	D
	Weihai	High	D
	Wenzhou	High	D
	Xiamen	High	D
	Yingkou	High	D
	Zhan Jiagang	High	D
	Zhenjiang	High	D

■ **Table E1 Risk of marine species introduction to the Port of Dampier (continued)**

Vessel Origin		Frequency of Visits	Risk
Country	Port		
Hong Kong	Hong Kong	Moderate	A
India	Mumbai (Bombay)	Moderate	A
	Calcutta	Moderate	A
	Kandla	Moderate	A
	Vishakhapatnam	Moderate	A
Indonesia	Balikpapan	Moderate	D
	Batam	Moderate	D
	Bunyu	Moderate	D
	Jambi	Moderate	D
	Kijang	Moderate	D
	Medan	Moderate	D
	Merak	Moderate	D
	Pontianak	Moderate	D
	Samarinda	Moderate	D
	Semarang	Moderate	D
	Sorong	Moderate	D
Iran	Bushire	Low	B
	Kharg Island	Low	B
Japan	Chiba	High	D
	Hirohata	High	D
	Kawasaki	High	D
	Kinoe	High	D
	Kobe	High	D
	Mizushima	High	D
	Namikata	High	D
	Naoetsu	High	D
	Niigata	High	D
	Onahama	High	D
	Osaka	High	D
	Sakai	High	D
	Sakurajima	High	D
	Shimizu	High	D
	Tsurumi	High	D
	Yokohama	High	D
Korea	Daesan	High	D
	Inchon	High	D
	Kunsan	High	D
	Pusan	High	D
	Pyeong Taek	High	D
	Ulsan	High	D
	Yeochun	High	D
	Yeosu	High	D
Kuwait	Kuwait	Low	B
Malaysia	Bintulu	Moderate	D
	Bontang	Moderate	D
	Kertih	Moderate	D
	Kota Kinabalu	Moderate	D
	Kuantan	Moderate	D
	Labuan	Moderate	D
	Port Kelang	Moderate	D
	Sabah	Moderate	D

Table E1 Risk of marine species introduction to the Port of Dampier (continued)

Vessel Origin		Frequency of Visits	Risk
Country	Port		
	Sandakan	Moderate	D
Mexico	Altameria	Low	A
New Zealand	Auckland	Low	D
	Lyttelton	Low	E
	Mount Maunganui	Low	D
	Nelson	Low	E
	New Plymouth	Low	E
	Picton	Low	E
	Wellington	Low	E
Panama	Colon	Low	B
Philippines	Batangas	Low	C
	Jasaan	Low	C
	Manila	Low	C
	Zamboanga	Low	C
Qatar	Doha	Low	A
	Mesaieed	Low	A
Saudi Arabia	Jubail	Low	A
Singapore	Singapore	Moderate	D
South Africa	Durban	Low	D
Taiwan	Kaohsiung	High	B
	Keelung	High	B
	Mai-Laio	High	B
	Suao	High	B
	Taichung	High	B
Thailand	Bangkok	Moderate	C
	Map Ta Phut	Moderate	C
Trinidad	Trinidad	Low	B
UAE – Dubai	Jebel Ali, Dubai	Low	A
USA	Honolulu	Low	B
	Houston	Low	A
	Los Angeles	Low	D
	Portland	Low	D
	Richmond	Low	E
	Salina Cruz	Low	B
	San Francisco	Low	D
	St. Rose	Low	E
	Tampico	Low	A
Venezuela	Puerto La Cruz	Low	C

E.2 References

Hilliard, R.W. and Raaymakers, S. December 1997. Ballast Water Risk Assessment, 12 Queensland Ports. Stage 5 Report. Executive Summary and Synthesis of Stages 1 – 4. EcoPorts Monograph Series No.14.

Aquatic Toxicity of Methanol on Organisms

Appendix F

F.1 Introduction

Appendix E provides toxicology data for freshwater and marine water organisms as investigated in May 2001 by BC Research for Methanex Corporation. The organisms subject to toxicology tests are those commonly found in the United States. Although, the Proponent will be undertaking eco-toxicology tests for Australian marine species, the data collected by BC Research provides an interim indication of the acute toxicity of methanol. The toxicity of gasoline is also specified as a comparison.

Toxicity endpoint values are compared to the USEPA toxicity rating scheme (**Table F1**) to determine the level of toxicity.

- **Table F-1 USEPA Ecological Toxicity rating Chart**

Toxicity Rating	Effect	Concentration
High	50% mortality	≤ 1 mg/L
Moderate	50% mortality	> 1 mg/L < 100 mg/L
Low	50% mortality	> 100 mg/L

Source: USEPA (1996) as cited in BC Research (2001)

F.2 Acute Toxicity of Methanol and Gasoline to Freshwater Fish Species

The toxicity endpoint values which describe the acute toxicity of methanol and gasoline to freshwater fish is presented in **Table F2**.

The data indicate that methanol has general low acute toxicity to aquatic organisms and gasoline is in three orders of magnitude more toxic to fish species than methanol.

Table F-2 Acute Aquatic Toxicity Endpoint Values for Freshwater Fish

Test Organism Common name, scientific name	Test Endpoint	Methanol (g/L)	Gasoline (mg/L)	Ref. # M/G
Rainbow trout, *Oncorhynchus mykiss*	<1.2 hr LOEC	120	N/A	25/-
Rainbow trout, *Oncorhynchus mykiss*	24 hr EC50	13.2	N/A	20/-
Rainbow trout, *Oncorhynchus mykiss*	48 hr EC50	13.2	N/A	20/
Rainbow trout, *Oncorhynchus mykiss*	96 hr EC50	13.0 (12.8-13.4)	2.7 - 5.1	20/53
Rainbow trout, *Oncorhynchus mykiss*	24 hr LC50	20.3 (19.8-20.7)	N/A	20/-
Rainbow trout, *Oncorhynchus mykiss*	48 hr LC50	20.1 (19.5-20.7)	5.4 – 6.8	20/53
Rainbow trout, *Oncorhynchus mykiss*	96 hr LC50	20.1 (19.5-20.7)	N/A	20/-
Rainbow trout, *Oncorhynchus mykiss*	96 hr LC50	19.0 (12.8-20.0)	2.7	24/17
Rainbow trout, *Oncorhynchus mykiss*	96 hr LC50	10.8	125 - 182	49/53
Rainbow trout, *Oncorhynchus mykiss*	96 hr NOEC	8.53	N/A	49/-
Fathead minnow, *Pimephales promelas*	24 hr EC50	29.7 (29.0-30.5)	N/A	20/-
Fathead minnow, *Pimephales promelas*	48 hr EC50	29.7 (29.0-30.5)	N/A	20/-
Fathead minnow, *Pimephales promelas*	96 hr EC50	28.9 (27.0-30.5)	N/A	20/-
Fathead minnow, *Pimephales promelas*	24 hr LC50	>1	N/A	6/-
Fathead minnow, *Pimephales promelas*	24 hr LC50	29.7 (29.0-30.5)	N/A	20/-
Fathead minnow, *Pimephales promelas*	48 hr LC50	29.7 (29.0-30.5)	N/A	20/-
Fathead minnow, *Pimephales promelas*	72 hr LC50	28.4 (27.6-30.5)	N/A	21/-
Fathead minnow, *Pimephales promelas*	96 hr LC50	29.4 (28.5-30.4)	N/A	20/-
Fathead minnow, *Pimephales promelas*	96 hr LC50	28.2	N/A	27/-
Creek chub, *Semotilus atromaculatus*	24 hr LC0	8	N/A	29/-
Creek chub, *Semotilus atromaculatus*	24 hr LC100	17	N/A	29/-
Creek chub, *Semotilus atromaculatus*	24 hr TD	6.32	N/A	49/-
Creek chub, *Semotilus atromaculatus*	24 hr NOEC	<8	N/A	49/-
Creek chub, *Semotilus atromaculatus*	24 hr EC	≥8 - 17	N/A	49/-
Carp, *Cyprinus carpio*	48 hr LC50	28.4	N/A	1/-
Carp, *Cyprinus carpio*	TLm*	28.4	N/A	49/-*
Bluegill, *Lepomis macrochirus*	24 hr EC50	16.1 (14.5-18.0)	N/A	20/-
Bluegill, *Lepomis macrochirus*	48 hr EC50	16.0 (14.4-17.9)	N/A	20/-
Bluegill, *Lepomis macrochirus*	96 hr EC50	12.7 (11.8-13.7)	6.3 – 6.4	20/53
Bluegill, *Lepomis macrochirus*	72 hr LC50	17.7 (15.5-20.2)	N/A	21/-
Bluegill, *Lepomis macrochirus*	24 hr LC50	19.1 (17.4-21.0)	N/A	20/-
Bluegill, *Lepomis macrochirus*	48 hr LC50	19.1 (17.3-21.1)	N/A	20/-
Bluegill, *Lepomis macrochirus*	96 hr LC50	15.4 (13.5-17.6)	N/A	20/-
Goldfish, *Carassius auratus*	48 hr LC50	1.66	N/A	1/-
Goldfish, *Carassius auratus*	11 hr LC100	0.198	N/A	49/-
Goldfish, *Cyprinus auratus*	TLm*	1.66	N/A	49/-
Guppy, *Poecilia reticulata*	7 day LC50	10.86	N/A	49/-
Golden ide, *Leuciscus idus melanotus*	48 hr LC0	7.9	N/A	49/-
Golden ide, *Leuciscus idus melanotus*	48 hr LC50	>10	N/A	49/-
Golden ide, *Leuciscus idus melanotus*	48 hr LC100	>10	N/A	49/-
Ide, *Leuciscus idus*	48 hr LC0	>1.00	N/A	49/-
Bleak, *Alburnus alburnus*	96 hr LC50	28	N/A	23/-
Bleak, *Alburnus alburnus*	24 hr LC50	>28	47 (41- 54)	47/47
Medaka, high eyes, *Oryzias latipes*	48 hr LC50	1.4	N/A	26/-

Source: BC Research (2001)
*No time duration available for these endpoint values.

F.3 Acute Toxicity of Methanol to Anadromous, Estuarine and Marine Fish Species

The toxicity data which describe the acute toxicity of methanol to anadromous, estuarine and marine fish is provided in **Table F3**. There is currently very limited data available for fish in coastal or ocean waters than for freshwater species.

- **Table F-3 Acute Aquatic Toxicity Data for Anadromous, Estuarine and Marine Fish Species**

Test Organism Common name, scientific name	Test Endpoint	Methanol (g/L)
Salmonid, *Salmo sp*	TLm*	8
Armed bullhead, *Agonus cataphractus*	96 hr LC50	10 - 33
Armed bullhead, *Agonus cataphractus*	96 hr LC50	7.9 – 27.7
Armed bullhead, *Agonus cataphractus*	96 hr LC50	7.9 – 26.1

Source: BC Research (2001)
* No time duration available for these endpoint values.

The endpoint values above, suggests that methanol toxicity to anadromous, estuarine and marine fish is low and similar to that for freshwater species.

F.4 Acute Toxicity of Methanol and Gasoline to Freshwater Invertebrates

The toxicity data which describe the acute toxicity of methanol and gasoline to freshwater invertebrates is provided in **Table F4**.

- **Table E-4 Acute Aquatic Toxicity Endpoint Values for Freshwater Invertebrates**

Test Organism Common name, scientific name	Test Endpoint	Methanol (g/L)	Gasoline (mg/L)	Ref. # M/G
Water flea, *Daphnia magna*	24 hr EC100	10	N/A	14/-
Water flea, *Daphnia magna*	24 hr EC50	21.4	260 - 345	4/53
Water flea, *Daphnia magna*	24 hr EC50	20.8	N/A	15/-
Water flea, *Daphnia magna*	48 hr EC50	3.83 E-4	1.2 – 3.0	28/53
Water flea, *Daphnia magna*	24 hr LC50	>10	N/A	16/-
Water flea, *Daphnia magna*	96 hr LC50	>0.1	N/A	6/-
Water flea, *Daphnia pulex*	2.88 hr LC50	37.9	N/A	1/-
Water flea, *Daphnia pulex*	18 hr LC50	19.5 (17.8-21.8)	N/A	13/-
Water flea, *Daphnia obtusa*	24 hr EC50	23.5 (22.8-24.4)	N/A	18/-
Water flea, *Daphnia obtusa*	48 hr EC50	22.2 (21.1-23.4)	N/A	18/-
Water flea, *Moina macrocopa*	2.88 hr LC50	41.1	N/A	1/-
Water flea, *Chydorus ovalis*	96 hr LC50	>2	N/A	12/-
Water flea, *Ceriodaphnia dubia*	48 hr LC50	0.011	N/A	49/-
Amphipod, *Hyalella azteca*	18 hr LC50	19.4 (15.1-22.4)	N/A	13/-
Amphipod, *Gammarus fasciatus*	96 hr LC50	>0.1	N/A	6/-
Aquatic sowbug, *Asellus intermedius*	96 hr LC50	>0.1	N/A	6/-
Midge, *Chironomus thummi*	96 hr NOEC	10.3	N/A	9/-
White dotted mosquito, *Culex restuans*	18 hr LC50	20.0 (17.7-22.3)	N/A	13/-

Oligochaete worm, *Lumbriculus variegatus*	96 hr LC50	>0.1	N/A	6/-
Brown flatworm, *Dugesia tigrina*	96 hr LC50	>0.1	N/A	6/-

Source: BC Research (2001)

Methanol has a moderate to low toxicity to freshwater invertebrates as demonstrated by the range of endpoints between 0.011 to 37.9 g/L. Similarly gasoline is also considered by BC Research (2001) to have moderate to low toxicity with endpoints ranging from 1.2 to 345 mg/L.

F.5 Acute Toxicity of Methanol and Gasoline to Marine and Estuarine Invertebrates

The toxicity data which describe the acute toxicity of methanol and gasoline to marine and estuarine invertebrates is provided in **Table F5**.

- **Table F-5 Acute Aquatic Toxicity Endpoint Values for Marine and Estuarine Invertebrates**

Test Organism Common name, scientific name	Test Endpoint	Methanol (g/L)	Gasoline (mg/L)	Ref. # M/G
Harpacticoid copepod, *Nitocra spinipes*	96 hr LC50	12.0 (11.5-12.5)	N/A	23/-
Harpacticoid copepod, *Nitocra spinipes*	96 hr LC50	12.6 (10.9-14.4)	171 (152-192)	47/47
Blue mussel, *Mytilus edulis*	96 hr LC50	15.2 (13.4-17.3)	N/A	22/-
Blue mussel, *Mytilus edulis*	96 hr LC50	16.7 (15.9-17.3)	N/A	22/-
Blue mussel, *Mytilus edulis*	96 hr NOEC	7.96	N/A	22/-
Mussel, *Anodonta imbecillis*	48 hr LC50	0.037	N/A	3/-
Cockle, *Cerastoderma edule*	48 hr LC50	1.00	N/A	8/-
Cockle, *Cerastoderma edule*	96 hr LC50	3.3 – 10	N/A	8/-
Ramshorn snail, *Helisoma trivolvis*	96 hr LC50	>0.1	N/A	6/-
Brine shrimp, *Artemia salina*	24 hr LC50	43.6	N/A	4/-
Brine shrimp, *Artemia salina*	24 hr LC50	50.6 (46.9 – 54.6)	N/A	5/-
Brine shrimp, *Artemia salina*	24 hr LC50	35.3 (22.6 – 55.3)	N/A	5/-
Brine shrimp, *Artemia salina*	24 hr LC50	28.9 (25.5 – 32.7)	N/A	5/-
Fairy shrimp, *Streptocephalus probosiceus*	24 hr LC50	32.7	N/A	4/-
Grass shrimp, *Palaemonetes kadiakensis*	18 hr LC50	21.8 (18.5-23.9)	N/A	13/-
Sand shrimp, *Crangon crangon*	48 hr LC50	2.5	N/A	8/-
Sand shrimp, *Crangon crangon*	96 hr LC50	1.7	15	8/53

Source: BC Research (2001)

Methanol has a moderate to low toxicity to marine and estuarine invertebrates as demonstrated by the range of endpoints between 0.037 to 50.6 g/L. However, gasoline is considered to have high to low by BC Research (2001) to have moderate to low toxicity as per the USEPA's ecological toxicity rating chart (**Table F1**).

F.6 Acute Toxicity of Methanol to Aquatic Plants

The toxicity data which describe the acute toxicity of methanol to aquatic plants is provided in **Table F6**.

The data indicate that methanol toxicity is high for some aquatic plants and algal species and low in others. High toxicity is demonstrated for eelgrass, algal mat and green algae (*C. vacuolata*).

- **Table F-6 Acute Aquatic Toxicity Endpoint Values for Aquatic Plant Species**

Test Organism Common name, scientific name	Test Endpoint	Methanol (g/L)
Eelgrass, *Zostera marina*	21 week biochemical	1.0 E-7
Algae, Algal mat	8 hr population	2.0 E-4 - 4.8 E-4
Algae, *Scenedesmus sp.*	LD0*	10
Algae, planktonalgen	24 hr EC10	1.6
Algae, planktonalgen	24 hr EC50	12
Green algae, *Chlorella vacuolata*	24 hr BCF	5.0 E-5
Green algae, *Chlorella pyrenoidosa*	10-14 d EC50	28.4 (27.3 – 29.6)
Green algae, *Chlorella pyrenoidosa*	EC50*	31.1
Green algae, *Chlorella vulgaris*	96 hr IC50	1.58
Green algae, *Chlorella vulgaris*	96 hr IC50	0.79
Blue green algae, *Anabaena sp.*	10-14 d EC50	24.6 (20.5-28.8)
Blue green algae, *Anabaena cylindrica*	10-14 d EC50	20.3 (18.4-22.2)
Blue green algae, *Anabaena inaequalis*	10-14 d EC50	21.2 (19.1-23.2)
Blue green algae, *Anabaena variabilis*	10-14 d EC50	24.7 (16.9-32.5)
Blue green algae, *Nostoc sp.*	10-14 d EC50	43.3 (35.6-51.0)

* No time duration available for these LC50 values; † IL50 based on average specific growth rate (SGR)
‡ IL50 based on area under the growth curve (AUC)

F.7 References

BC Research. May 2001. Compilation of Acute Toxicological Data for Methanol and Gasoline. Prepared for Methanex Corporation.

US EPA, 1996. Aqueous and Semi-Aqueous Solvent Chemicals: Environmentally Preferable Choices, Guide and Wall Chart. Cited in: BC Research, May 2001. *Complication of acute Toxicological Data for Methanol and Gasoline.* Prepared for Methanex Corporation.

Correspondence from GE Power Systems

Appendix G

g

GE Power Systems

John M Wainwright, Manager
Process Power Plant Product Development

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Aubry Nugara
KBR Halliburton

March 25, 2002

Subject: GE PG7121(EA) Emissions and Performance
Reference: e-mail Request from A. Nugara, Friday, March 22, 2002

Dear Aubry,

This is in response to your request to clarify performance and, in particular, emissions capabilities of the GE Fr 7EA Heavy Duty Gas Turbine which is being considered for application in the Methanex Australia Methanol Plant. Two types of combustion systems are available for the Fr 7EA gas turbine, 1) Dry Low NOx (DLN) and 2) Standard Diffusion Flame. The DLN system is suitable for Natural Gas fuels that meet the requirements of GEI41040. You will note that no hydrogen is allowed in fuel for DLN combustors, therefore fuels that contain hydrogen require use of a Diffusion Flame Combustion System. The Diffusion Flame system has been used successfully in several models of heavy duty gas turbines to integrate with processes that produce syngas wherein the syngas or other process gas is used as fuel for the gas turbine. This combustion system type is the basis for all similar GE Applications.

With DLN combustors, the fuel is staged such that premixing of fuel with air occurs in the combustor before combustion. Therefore flame temperature and NOx is reduced without the need for steam or nitrogen diluent. With Diffusion Flame combustors, if NOx emission mitigation is required, this must be done either 1) during combustion via introduction of a diluent, such as steam or nitrogen, or 2) post-combustion via use of an SCR in the gas turbine exhaust stream.

GE does not currently have a commercially available DLN combustor design for use of gaseous fuels that contain hydrogen. Therefore, the use of fuels apart from natural gas with no H2, such as the natural gas and the process gas in the referenced project requires the use of a Diffusion Flame combustion system. With this system, three options can be considered, 1) NOx mitigation with steam or nitrogen, 2) NOx mitigation with post treatment (SCR), or 3) no NOx mitigation.

No performance has been calculated for Case 1, since the hydrogen content of 2% exceeds the allowable for a DLN system.

Below, please find table of estimated performance and emissions for the other two cases, Case 2) 7EA with Diffusion Combustor operating on NG fuel as defined by Kvaerner, and Case 3) 7EA with Diffusion Combustor operating on cofired Process Gas and NG fuel as defined by Kvaerner. These cases do not utilize steam or nitrogen injection and have estimated NOx emissions of 130 and 101 ppm @15% O2, respectively. Steam injection is not used due to lack of required large quantities of demineralized water at the site. Nitrogen diluent has not yet been fully evaluated as to what NOx levels could be expected.

ESTIMATED PERFORMANCE - PG7121(EA)

		Case 2, Fuel A	Case 3, Fuels A + D
Load Condition		Base	Base
Ambient Temp.	Deg F.	100.4	100.4
Ambient Relative Humid.	%	65.0	65.0
Output	kW	70,690.	72,330.
Heat Rate (LHV)	Btu/kWh	11,090.	11,000.
Heat Cons. (LHV) X 10^6	Btu/h	783.8	795.5
Exhaust Flow X 10^3	lb/h	2134.	2160
Exhaust Temp.	Deg F.	1032.	1028
EMISSIONS			
NOx	ppmvd @ 15% O2	130.	101.
NOx as NO_2	lb/h	411.	325.
CO	ppmvd	25.	25.
CO	lb/h	48.	48.
UHC	ppmvw	7.	7.
UHC	lb/h	8.	9.
Particulates	lb/h	10.4	10.5

As you can see, the NOx emissions for Case 3 are lower than Case 2 due to the presence of process gas, which reduces the heating value of the overall fuel and therefore lowers the flame temperature and production of thermal NOx. Power output is increased for Case 3, also due to the process gas, which requires a greater flow rate and therefore higher turbine output.

If you have any additional questions or comments, please contact the undersigned.

Sincerely,

John M. Wainwright
Manager, Process Power Plant Product Development

Atmospheric Deposition and Impacts on the Environment

Appendix H

H.1 Background

The Burrup Peninsula has been subject to recent attention as a result of several proposals for the King Bay – Hearson Cove Industrial Area and more recently a development proposal for Withnell East industrial area. All of these proposals aim to tap into Western Australia's expansive gas reserves for downstream processing. Products that will be produced include granulated urea, liquid ammonia, synthetic hydrocarbons, methanol and di-methyl ether.

A common factor between all downstream processing industries is that they produce a variety of waste products including NO_x and SO_x as a result of the combustion of natural gas. Natural gas is the primary feedstock for all of the proposed industries.

During preliminary stakeholder consultations the issues of atmospheric deposition (predominantly NO_x and SO_x) and the potential impacts on Aboriginal art, flora and aquatic (freshwater and marine) environments were raised. These issues were also highlighted in previous proposals for other developments, however Methanex is not aware whether these issues have been further investigated and specifically addressed by other developers.

Methanex recognises that the proposed methanol complex will not be the sole contributor to NO_x and SO_x in the airshed. Numerous other industries will be making a contribution, both in smaller and larger quantities. On this basis, Methanex encourages that such a cumulative issue be further investigated in detail through an 'Industrial Council' developed for the Burrup Peninsula. Methanex will be prepared to proportionally contribute jointly with other industry and government towards such an investigation. The development of the Industrial Council and Methanex' commitment to participate is discussed in **Section 8.1** of the PER document.

As an impetus for the recommended investigation, Methanex has undertaken a preliminary assessment of the likely impacts that may occur based upon readily available published information.

The following sections describe the results of this preliminary assessment.

H.2 Atmospheric Deposition

The deposition of atmospheric pollutants can occur through two mechanisms, these being wet deposition and dry deposition:

- **Wet deposition** describes the deposition of acidic pollutants through rainfall, and is commonly referred to as 'acid rain'. This form of deposition is dominant during periods of high rainfall and can cause pollutants to be distributed over a wide area. Acid rain would typically be comprised of carbonic acid (formed from CO_2), nitric acid (formed from NO_x) and sulphuric acid (formed from SO_x). It has been demonstrated that nitric acid contributes considerably less to the acidification of ecosystems compared to sulphuric acids (McLean, 1981), with an estimated ratio of 0.8 to 1 respectively (Galloway *et al*, 1982).
- **Dry deposition** refers to the fall-out of gases and particulates on the ground surface without any interaction with water. Dry deposition tends to occur close to the source of pollution, depending upon prevailing weather conditions, and dominates in dry climates (EPA, 2001).

Dry deposition is expected to be the dominant mechanism on the Burrup Peninsula by which atmospheric pollutants are deposited on terrestrial and aquatic environments. The Burrup Peninsula receives a very limited amount of rainfall, an annual average of 261mm over some 30 rain days (Bureau of Meteorology, 2002). The rate at which NO_X and SO_X may be deposited on the Burrup Peninsula is unknown at this stage, however studies undertaken in other arid areas of Australia, such as Kalgoorlie and Mt. Isa, indicate deposition rates are low. It has been predicted that annual deposition rates in arid areas are in the order of 0.2 to $0.5g/m^2$ representing 5% of total emissions (Carras *et al* 1992). It is important to note that these rates are above the advised annual deposition target loads of approximately $0.3g/m^2$ proposed for sensitive areas in Scandinavia and Northern Europe (Roser, 1995).

In the absence of site specific information, it would be conservative to assume that a similar deposition rate of up to 5% of total emissions would be expected on the Burrup Peninsula. Not withstanding this, the deposition rate is likely to be much less as the Burrup is strongly influenced by prevailing sea breezes that would be expected to transport the majority of emissions offshore. The likely deposition rates for the Burrup are estimated in **Section H.3**.

Rainfall that is received on the Burrup is usually generated from thunderstorm and cyclonic activity. It is typically heavy and received over very short durations under these conditions. In addition to rainfall, wet deposition may occur through the development of low level fog and dew comes into direct contact with the ground surface. Here the atmospheric pollutants occurring on the ground surface from dry deposition may enter the liquid phase from the formation of fog and dew. However, the development of fog and dew are unlikely to occur on the Burrup Peninsula.

Acid rain is typically considered as precipitation with a pH of less than 5 (EPA, 2001). The typical pH of rain in the Kimberley regions of Western Australia is approximately 4.5 to 5, whilst in the Pilbara it is more alkaline at a pH of about 6.5 (pers comm. WA Musuem). The lower pH of rainfall over the Kimberley's is attributed to the absorption and accumulation of pollutants from Indonesia as cloud bands travel from the tropics to northern Australia. It is important to note that a drop in one pH unit indicates a ten-fold increase in acidity.

H.3 Proposed Ambient Concentrations of NOx and SOx

Considering the Burrup Peninsula on a whole, the estimated contributions of NO_x and SO_x to the atmosphere from existing and proposed major industries are listed in descending order of emissions in **Table H1**.

- **Table H1 Existing and Proposed Emissions of NO_X and SO_X from Major Industry on the Burrup Peninsula**

Industry	NOx t/yr	SOx* t/yr	Source and Comments
Woodside LNG Plant (with Trains 4 and 5)	8460	120	National Pollutant Inventory Woodside, 1998. SO_x load without Trains 4 & 5.
Methanex Methanol Complex	3140	1.3	
Syntroleum Gas to Liquids Plant	1470	98	DEP, 2002.
Plenty River Ammonia/ Urea Plant	684	6.3	Woodward Clyde, 1998.
Hamersley Iron Dampier Power Station	560	Not available	Calculated based on 17.8 g/s as stated in HLA-Envirosciences for 365 days.
Burrup Fertilisers Liquid Ammonia Plant	503	0.6	Sinclair Knight Merz, 2001.
TOTAL	**14,817**	**226.2**	

* - SO_2 is emitted by industry generally during upset conditions when emergency diesel generators are used.

Note: 1. Emission data for the plants proposed by GTL Resources and Japan DME are not publicly available.

It is important to note that there are several natural emission sources such as lightning, bushfires and vegetation, which have the potential to contribute to a large portion of ambient NO_x and SO_x in the air shed. In some tropical areas, organic sources can contribute up to 41% acidity in rainwater (Bridgman, 1989).

Considering that dry deposition is likely to be the dominant mechanism on the Burrup Peninsula by which atmospheric pollutants impact on terrestrial and aquatic environments, it would be conservative to estimate that 5% of total emissions are likely to be deposited, as demonstrated in Mt Isa and Kalgoorlie. Hence, approximately 741t/NO_x and 11.3t/SO_x would be deposited annually from industry on the Burrup. Assuming deposition occurs over a 7 kilometre radius (154km^2; an approximate distance where cumulative emission return to existing ambient levels), a deposition rate of 4.8gNO_x/m^2 and 0.07gSO_x/m^2 would occur. Not withstanding the above, it is more likely that deposition rates will be greatest adjacent to the source of emissions with a gradual decreasing trend with further distance from the source.

It is expected that annual NO_x and SO_x loads will marginally contribute to the acidification of rainfall. Considerable effort has been made to determine the likely change in pH of rainfall. However due to the complexity of reactions that take place in the atmosphere and the consequent effects of these reactions on pH, it is difficult to estimate the resultant pH of rainfall following the establishment of industry. Discussions with Robert Bednarik of the International Federation of Rock Art Organisation (IFRAO) indicate that the pH of rainfall on the Burrup was in the order of 7.0 or above in the 1960s prior to industry becoming established. Being conservative, one could assume that the pH has reduced by a maximum of 1 pH unit since the introduction of Woodside and Hamersley Iron. The quantity of NO_x and SO_x emissions that are likely to have contributed to this reduction are estimated at:

- About 4,790tNO_x/yr (contribution of Hamersley Iron power station and 50% of the proposed Woodside plant as per **Table H1**); and
- About 120tSO_x/yr (known emissions of Woodside prior to Train 4 and 5 coming on line; No information for Hamersley Iron).

By increasing emissions to total loads estimated in **Table H1**, (ie an increase of 32% and 53% for NO_x and SO_x respectively), it can be assumed that the pH of rainfall may be reduced by an order of 0.7 of a pH unit from 6.5 to 5.8 following the establishment of all proposed industry.

Further comparisons can be made between the Pilbara's estimated pH of rainfall of 6.5, to other industrial areas of Australia investigated by Bridgman (1989). The Latrobe Valley in Victoria contributes 44,000tSO_x/yr and 45,000tNO_x/yr, resulting in an average pH of rainfall of 5.8 with seasonal variations fluctuating between pH 5.4 to 6.4. These emissions are at least four times greater than those proposed for the Burrup resulting in a similar pH. This indicates the possibility that the estimated pH change for the Burrup may be an overestimate.

Additional information collected by Bridgman (1989) also notes that the Hunter Valley in New South Wales is known to contribute 130,000tSO_x/yr and 111,000tNO_x/yr, resulting in an average pH of rainfall of 5.0 with seasonal variations between pH 4.9 to 5.2.

H.4 Impacts on Petroglyphs, Aboriginal Rock Art and Engravings

Surface erosion, soiling, black crust formation and discolouration are common problems that develop on building stone and paintwork due to pollution of SO_x, H_2S and other acid gases (USEPA, 2001). In the same way, both the rocks and the paintings of petroglyphs are susceptible to deterioration from a combination of factors such as:

- **Weathering of rock surfaces.** Rocks typical on the Burrup are igneous rocks (of various types) high in iron and manganese and with similar properties to granite. They are generally resistant to weathering and provide no acid neutralising capacity.
- **Microbial activity on rock surfaces** result in acidity changes of the surface which aid the process of weathering and mineral decomposition. The granophyre rocks on the Burrup are typically black but are coated by a weathered surface having a red varnish appearance.
- **Deposition of atmospheric pollutants** will result in acidity changes of rock surfaces, thus aiding the process of weathering.

On the Burrup, Aboriginal sites have been recorded to contain engravings (Vinnicombe, 1997) and percussion petroglyphs (pers.comm. R Bednarik, IFRAO). Petroglyphs on the Burrup occur in two forms, these being shallow ones or deep one. Shallow ones (also known as sgraffito) represent about 60% of petroglyphs whilst the remainder are deep ones. IFRAO describe sgraffito as forms that depend on the colour difference between an accretionary crust, a weathering zone and an unweathered core. These sites depend entirely on the colour contrast caused by the removal of the dark crust. Deep ones depend on a combination of relief and colour differences and remain visible after the complete removal of the crust, but are often difficult to detect visually.

The weathering of the surface of these rocks will first have the greatest impact on shallow percussion petroglyphs, whilst long-term weathering will impact the deeper petroglyphs. It has been noted that a reduction of one pH unit (ten-fold increase in acidity) on the rock surface will impact the condition of the petroglyph or rock art due to variations in the rock solubility (pers. comm. I. MacLeod, Western Australian Museum). A change in rock pH of 2.2 units between summer and winter at one study site in the Napier Range (Western Australia) has been shown to increase rock solubility by 230% (MacLeod et al., 1995).

Although it is uncertain over what period of time this may occur or the magnitude of change, an impact although initially low in magnitude, is likely to occur once all industries are operating.

Photographic records of the IFRAO taken in the 1960s, 1988 and 1990s followed by an inspection in 2000 of the rock art on the Burrup, indicate that colour variations were first detectable in the 1990s and that by 2000 a distinct deterioration of the accretionary crust was noted (pers.comm. R. Bednarik). Based upon this trend, it is assumed that the process of deterioration will continue and be potentially accelerated by the contribution of NO_x and SO_x from proposed industry.

Further to the above work undertaken on petroglyphs, MacLeod et al (1995) has investigated rock paintings in the Kimberley. Deterioration of paint pigment is particularly dependent on the impact of microflora on the rock surface, which can vary significantly across a site). High levels of microbial activity are strongly correlated with high acidity (low pH), and it is the reduction of the pH that results in the deterioration of the paint pigment. This is most likely to occur during the wet season when the availability of moisture, compared to the dry season, provides the impetus for microbial activity (Ford, 1994). Not withstanding the above, there is evidence that during the dry season microbial activity can be high, depending on the nature of the substrate (pers. comm. I. MacLeod, Western Australian Museum).

Studies of rock art in the West Kimberley region of Western Australia found that the presence of a bat colony caused the pH of the rock art to be very low (MacLeod et al., 1995). Bat urine contains high levels of nitrogenous compounds, and upon oxidation has been reported to react with the pigments in paintings on the walls of English churches, leading to staining and colour changes (Paine, 1993). The nutrients provided by the urine also facilitate microbial activity, thus leading to elevated acidity levels. A similar impact, although perhaps not in magnitude, from NO_x in the atmosphere would be expected on sensitive materials. It has been recognised that nitrate deposited on outdoor surfaces can enhance microbial activity and algal growth (European Commission, 1997).

Deteriorated rock minerals have been shown to contain sulphate ions on the rock surface, confirming that SO_x does in fact have the potential to adversely impact the condition of rock art (MacLeod, 2000). The acidic surfaces associated with weathered rocks tend to promote the deterioration of rock art, as the paint pigment is dissolved in the acidic environment. Although this deterioration may occur quite rapidly on calcareous and sandstone type rocks, it is expected to occur at a much slower rate on the granophyre rocks of the Burrup.

From the numerous studies that have been undertaken to date, it is likely that Aboriginal art, whether it be petroglyphs, rock paintings and engravings will show some form of impact over a long period of time from proposed industry on the Burrup Peninsula. It is important to note that industry has already been operating on the Burrup for some time and this existing source of atmospheric pollutants is likely to be the largest (**Table H1**) and it has been noted by IFRAO that the process of deterioration has already commenced to some degree. The very gradual deterioration of rock art is most likely to have already commenced and with the establishment of further industry the rate of deterioration may increase marginally.

Although the proposed methanol complex will be a relatively small contributor of SO_x and NO_x to the airshed (**Table H1**), Methanex recognises that on a cumulative basis, impacts will occur on Aboriginal rock art and it is necessary that this issue be addressed and resolved as far as practicable. This can be addressed by encouraging the Industry Group to undertake baseline surveys for rock art as soon as possible, or prior to the operation of proposed industries, and to continue ongoing monitoring. Methanex' commitment to this industry Group is discussed in **Section 1.8** of the PER document.

H.5 Impacts on Vegetation and Flora

Currently, the information detailing the effects of air pollution on Australian vegetation is limited due to the relatively small amount of sulphur and nitrogen oxides emitted compared to the emission rates in Europe, USA and Japan. Due to the limited amount of information regarding the impact of atmospheric deposition on Australian flora in arid conditions, a large proportion of the following assessment discusses the impacts that have occurred in other parts of the world.

Not withstanding the above, several generalisations can be made based on the results of laboratory experiments undertaken in Australia and overseas that have investigated the response of plants to SO_2 emissions. Under controlled conditions, the concentration, duration and pattern of exposure influences the response of plants (Murray, 1984). The light, temperature, relative humidity, soil moisture, mineral nutrition of the soil and plant age also affects the plant response to SO_2 emissions (Lacasse and Treshow, 1978). The long term dosage of sulphur influences the plant response, with plants in regions of high sulphur concentrations tending to be more sensitive to additional SO_2 fumigations than plants in low SO_2 environments (Lacasse and Treshow, 1978). Further to this, the combination of SO_2 with other pollutants can increase plant damage by lowering plant tolerance levels.

More specific investigations into the effects of SO_2 on Australian species indicate that plants belonging to the *Eucalyptus* species vary in sensitivity (O'Connor *et al.*, 1974). Some species have shown no affect to SO_2 whilst others are very sensitive. To date, it is unknown whether any investigations have been undertaken on *Eucalyptus* species that occur on the Burrup. For comparison, *Eucalyptus camaldulensis* (River Red Gum), which occurs widespread in the Pilbara, was shown to be very sensitive with reduced root growth and leaf abscission. Depending on the exposure time and concentration, plant responses can include desiccation, altered leaf colour, a reduced photosynthetic rate and eventual death. Of the *Eucalyptus* plants tested, the most sensitive were severely injured by 3-6 hours exposure of 2620 $\mu g/m^3$ (1ppm) SO_2 (O'Connor *et al.*, 1974). Fumigation tests were also undertaken on *Brachychiton populneus* which was found to show little effect to SO_2. Although this species does not occur on the Burrup, the closely related *Brachychiton acuminatus* is scattered throughout the Burrup. To date, no experimental fumigation tests have been undertaken on mangrove species (pers. comm. E. Paling, Murdoch University).

Based on the predicted emissions from the methanol complex, in isolation, very small quantities of SO_2 will only be released at 7.5g/s during emergency situations only (2 days/yr). The dispersion of SO_2 emissions over the 2 days is unlikely to result in an ambient concentration that will adversely impact vegetation. However, in the very rare event that all industry experience emergency situations at the same time and emit SO_2 from the use of generators, it remains unlikely that such a short duration of emissions will result in high ground level concentrations of SOx that will adversely impact vegetation. Ground level concentrations will need to reach in the order of 2620 $\mu g/m^3$ (1ppm) to impact sensitive plant species as demonstrated by (O'Connor *et al.*, 1974). It is important to note that the majority of industry proposed for the Burrup will have negligible SO_2 emissions.

Similar responses to that found by O'Connor *et al.* (1974) were observed in lichens located close to an alumina refinery in South-Western Australia (Kaeding and Kidby, 1987). In general, young plants tend to be less sensitive than older plants, although once injured, the condition of young plants deteriorates very rapidly (O'Connor *et al.*, 1974). Other Australian natives, including *Casuarina, Acacia, Hakea, Kunzea* and *Melaleuca* are not as sensitive as plants belonging to the *Eucalyptus* species (O'Connor *et al.*, 1974). Leguminous species tend to be more sensitive than grasses (Murray, 1984b).

Decreased sensitivity to emissions during times of water stress is commonly observed. It is thought that the hot temperatures associated with Australia's outback areas reduce the impact of SO_2 emissions on plants (Roser and Gilmour, 1995). This occurs due to the closure of stomata to prevent water loss, which has the added benefit of restricting gas transfer. This has been observed in Kalgoorlie, where the impact from emission stacks is limited to within a radius of 1.5km (Roser and Gilmour, 1995). In contrast, the presence of the sulphate ion in air pollution has been noted to disrupt the ability of plants to regulate water content, which would make plants more susceptible during drought periods (Roser and Gilmour, 1995). These contradictory findings remain to be further investigated.

Although it is difficult to determine the likely impacts on vegetation from predicted deposition rates on the Burrup, $4.8gNO_x/m^2$ and $0.07gSO_x/m^2$, **Table H2** provides a summary of the deposition rates that have occurred in Asian and European countries and corresponding effects that have occurred. Critical loads for Europe and conditions in Mt Isa, Queensland are also stated for comparison.

- **Table G2 Deposition Rates and Observed Impacts in Asia and Europe**

Region	Deposition Rate		Impact
	NOx	SOx	
China	-	1.2 to 83 g m^2/ yr	Decline of pine forests subject to SO_2 concentrations of 90 to 350 µg/m^3 (Roser, 1995).
China (Sichuan Basin)	-	3.87 g m^2/ yr	A critical load of 4.2 g m^2/ yr has been determined for this region based upon acidification of soil types rather than vegetation impacts (Roser, 1995).
Japan	1.62 g m^2/ yr	3.4 g m^2/ yr	Levels in 1987. Acidic rainwater pH 4.4 to 4.9. Impacts on vegetation not document (Roser, 1995).
Netherlands	3.0 to 4.5 g m^2/ yr	2.7 to 3.3 g m^2/ yr	Dry inland heath vegetation (dominated by *Calluna vulgaris*) shown to be deficient in K, Mg and Ca (Bobbink *et al*, 1992).
West Germany	-	1.9 g m^2/ yr	Not documented (Bobbink *et al*, 1992).
Europe	0.5 to 3.5 g m^2/ yr 1.0 to 3.5 g m^2/ yr 0.5 to 2.2 g m^2/ yr 0.5 to 3.0 g m^2/ yr	-	Critical loads for: Wetlands Grasslands Heathlands Forests (WHO, 2000).
Mt Isa, Qld	-	> 0.2 g m^2/ yr	Occurs 10,000 km^2 downwind of Mt Isa with some vegetation damage reported up to 10 km downwind of smelter (Teague, 1992).

The estimated deposition of $4.8gNO_x/m^2$ exceeds the critical loads determined for European vegetation types and is near the upper limit of the Netherlands criteria where it has been shown that dry inland heath vegetation become deficient in potassium, magnesium and calcium at such concentrations.

The estimated deposition of $0.07gSO_x/m^2$ is very small and well below the critical loads specified for European vegetation types. At these concentrations, it is unlikely that SO_x emissions will have an impact on vegetation.

Further comparisons between recommended SO_x and NO_x emission levels and the proposed emissions at Burrup are detailed in **Table H3**. These figures provide the best indication of the likely effects and magnitude of atmospheric pollution on the Burrup.

- **Table H3 Proposed emissions from industry and recommended critical loads and guidelines**

Source	SO_2	NOx	Notes
Industry			
Methanex Methanol Complex	-	45μg/m^3 24 hour mean 26.8μg/m^3 annual mean	Using TAPM
Burrup Fertilisers Liquid Ammonia Plant	-	13.2μg/m^3 24 hour mean 1.4μg/m^3 annual mean	EPA(2001) Bulletin 1036 Using DISPMOD
Guidelines and Impacts			
Air quality guidelines for Europe World Health Organisation	30 μg/m^3 for crops (annual mean) 20 μg/m^3 for forests	75μg/m^3 24 hour mean 30μg/m^3 annual mean	Guidelines determined based on European vegetation and conditions
Austria (1988)	-	10μg/m^3 annual mean	To protect highly sensitive plants
O'Connor, Parbery and Strauss, 1974	2620 μg/m^3 caused severe damage after 3-6 hours exposure	-	Tested in controlled laboratory conditions for Australian native flora
Roser, 1995	20 μg/m^3 annual mean	-	No impacts observed – Kalgoorlie WA.

Critical loads for Australian conditions have yet to be determined. Considerable investigations have been undertaken in Kalgoorlie in regard to vegetation impacts from SO_x. These reports are not publicly available, however Roser (1995) indicates that discernible impacts have not been observed beyond 1.5km from emission stacks in Kalgoorlie where ground level concentrations of 5μg/m^3 per year within 50km and 20μg/m^3 per year within 12km prevail.

Although American, Asian and European experience is important in enabling the prediction of effects of acid deposition in Australia, the significantly different climate (particularly in northern Australia) makes such predictions difficult. Based on the limited work that has been undertaken, considerations that are relevant to the Burrup include (Roser and Gilmour, 1995):

1. The high temperatures favour high reaction rates as well as influencing solid and gas solubilities. This may influence the rates of acid production, rock destruction, and gas transfer through plant and animal membranes.
2. Compared to the temperate regions of the world, northern Australia is likely to experience greater vertical mixing, allowing pollutants to be transported further from the source.
3. As tropical plants, including mangroves, often have roots confined to a limited depth range, less leaching of nutrients from the soil would be required before plants are affected when compared to temperate environments.

Although it is expected that dry deposition of atmospheric pollutants will occur to a greater extent than wet deposition, it remains worthwhile to discuss the potential impacts of acid rain.

The effect of acid rain on forests has been extensively investigated in Europe and America. In these areas, the acid content in the precipitation damages the leaves of trees, making them more susceptible to other environmental factors (USEPA, 2001). Generally, visible plant damage occurs at pH levels between 2 and 4, while significant growth reductions can occur at less acidic pH levels (Roser and Gilmour, 1995). In addition, over long periods, small excess hydrogen ion inputs through acid rain can have a significant effect on soil pH, although it can take many years for the acidification problem to become noticeable (Roser, 1995). The buffering capacity of soils can neutralise the acidity in the rainfall, however this ability depends on the soil type and location. In Australia, most soils are relatively insensitive to acidification, and the additional sulphate and nitrate in rainwater tends to be beneficial (Bridgman, 1989). The marine sediments of the King Bay-Hearson Cove valley would be expected to have a considerable neutralising capacity. However, where soil depths are very shallow on the Burrup (ie. colluvial slopes), the neutralising capacity would be very limited. Investigations in Latrobe Valley, have indicated that in the absence of neutralising capacity, soil pH may decrease by up to 0.015 pH unit / year (Roser, 1995).

Following soil acidification, soil nutrients and minerals are dissolved, thus becoming mobile in the environment. Plants are also exposed to trace metals that are toxic to them and will impact the rate at which they uptake other essential soil nutrients and minerals. The microbial population is also modified due to soil acidification, which impacts on nutrient cycling. Such changes are likely to alter the community structure, leading to alterations in plant diversity and abundance. In addition, imbalances in the ratio of nitrogen and sulphur available to plants can also alter the interaction of nutrients (Roser and Gilmour, 1995), particularly as sulphur tends to be the main contributor to acidification (McLean, 1981).

To better understand and qualify the impacts on vegetation and flora from atmospheric emissions on the Burrup, Methanex will encourage the Industry Group that cumulative impacts on vegetation and flora from atmospheric emissions be investigated in consultation with CALM and other experts in this field as required. This may include a baseline survey to assess the current condition of vegetation and ongoing monitoring to identify plant responses to increasing deposition of NO_x and SO_x from the atmosphere.

H.6 Impacts on Freshwater Environments

Although the impact of atmospheric pollution on Australian lakes and streams has not been extensively studied, the effects of acid rain in Northern America and Europe provide an indication of the damage that may occur. The main concern to the Burrup is the potential impacts on ephemeral freshwater pools. The ecosystems and ecology, which these freshwater pools support, is generally unknown. Discussions with CALM (Karratha) and existing industry indicate that no baseline surveys have been undertaken on these aquatic systems. As a result it is difficult to predict the likely impacts that may occur. In the absence of site specific information, the following information discusses typical impacts that occur on much larger freshwater bodies in Canada and United States.

Most undisturbed lakes and streams have a pH of between 6 and 8 (USEPA, 2001). Acid rain can typically enter aquatic ecosystems by either falling directly onto the water surface, or by flowing into the waterbody as runoff. These two mechanisms lead to a two-fold effect of acid rain on lakes and streams: direct and indirect effects.

Acids directly interfere in the ability of organisms to take in oxygen, salt and other nutrients. In general, young organisms, such as embryos, fry and juveniles, tend to be more sensitive than adults (USEPA, 2001). Adult fish are generally unable to survive if the pH is less than 4.8, while eggs and baby fish require the pH to be greater than 5.5 (Farnham, 1999). As a result, a fish population may be entirely lost even if the acidity level is suitable for adult fish survival, since new organisms are not able to develop.

Although some organisms are acid tolerant, many others are sensitive to the pH levels and will be lost in acidic conditions. pH levels of 6 are fatal to plankton, insects and crustaceans (Environment Canada, 1999). At a pH of 5, changes in the structure of the ecosystem occur, with less desirable species of fish, moss and plankton beginning to invade. With pH levels less than 5, there are very few fish species present, and the bottom of the waterbody is covered with undecayed material (Aric, 2000). Terrestrial animals which depend on the aquatic environment are also affected by the changes, in terms of the quantity and quality of their food resources. Mosses tend to dominate the nearshore areas.

The complex interactions that make up an ecosystem mean that the overall influence of atmospheric emissions on a particular organism may impact the food web of which the organism is part of.

The increase in acidity of water dissolves naturally occurring cations in soil and rocks such as the Al^{2+} ion. Al^{2+} is known to be very toxic to organisms and has been noted to burn the gills of fish and accumulate in their organs (Farnham, 1999). This can inhibit diffusion and result in respiratory stress (Aric, 2000). If these conditions are not severe enough to cause the death of the aquatic organisms, they tend to lead to low body weights, reduced egg deposition, deformities, increased susceptibility to disease and less ability to compete for food and habitat (Environment Canada, 1999; USEPA, 2001).

To adequately assess the likely impacts that may occur to the ecology of ephemeral freshwater pools on the Burrup, Methanex will encourage the proposed Industry Group to undertake a baseline survey of ephemeral freshwater pools occurring near to proposed industry in consultation with CALM. It is important to note that consultation with relevant Aboriginal groups may be required as a number of these pools may be considered significant in terms of Aboriginal heritage. Anecdotal evidence from Aboriginal elders would also prove useful to document the changes that have occurred to the freshwater pools.

H.7 Impacts on Marine Environments

Also of importance to the Burrup Peninsula are the marine environment and the organisms that form part of the marine ecosystem. Preliminary investigations suggest that the proposed atmospheric emissions from industry on the Burrup are highly unlikely to cause an impact on the marine environment. Sulphur and nitrogen are elements that occur in natural abundance in seawater. Any predicted atmospheric deposition is unlikely to have an impact as concentrations will be greatly diluted.

Natural levels of sulphur in seawater have been measured at 928mg/ L mainly dissolved as SO_4^{2-}(Riley and Chester 1971). Levels of total nitrogen have recently been measured in King Bay at 140 to 153µg/L and levels of oxidised nitrogen (NO_2 + NO_3) were 2.7 to 5.0µg/L. These levels are comparable to the predicted annual deposition of 13,320µgSO_x /m^2 and 860µgNO_x /m^2. Any fall out from atmospheric emissions of SO_x and NO_x will be widely dispersed over a very large area of marine waters, further dilution will occur once it enters the sea aided by the extremely large volume of water and the high tidal movement in the region.

It is therefore highly unlikely that any change will occur in sulphur or nitrogen levels in seawater.

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Impacts on Marine Fauna (Turtles) from Artificial Lighting

Appendix I

I.1 Impacts on Turtles

There is no anticipated significant impact on turtles from the proposed methanex plant. There are no turtle nesting beaches on the Burrup, including at Hearson and Cowrie Coves, and the Methanex plant will be located several hundred metres from these coves. A justification is presented below.

1. Whether Hearson Cove or Cowrie Cove are used for nesting by turtles.

Hearson Cove is a sandy beach used by the public. Turtles are not known to currently use this beach for nesting (P. Kendrick, CALM pers comm.) as it does not have the characteristics of a beach suitable for nesting (generally ocean-facing, high energy beaches). Thus, there is no issue with nesting adults or hatchlings at Hearson Cove.

Cowrie Cove is dominated by a mangal habitat, and sandy beaches used by turtles for nesting sites are absent. Turtles do not nest at Cowrie Cove.

2. Whether hatchling turtles would be attracted to lights on the proposed facility.

It is well known that hatchling turtles use light as a cue for orientation immediately after hatching at night. On naturally lighted beaches, hatchlings show an immediate and well-directed orientation towards water. This behaviour is innate and guided not only by the brightness, but also shape and sometime colour of light sources. On beaches with artificial lighting, hatchlings become misdirected by brighter artificial light and usually suffer high rates of mortality from exposure and predation.

Hatchlings tend to move towards the brightest light source, which is usually an artificial light or lights (Witherington and Martin 1996). This behaviour has been reported in several species of turtle (e.g. loggerhead and hawksbill turtles: Peters and Verhoeven 1994; green turtles: Salmon et al. 1992). Beach slope and silhouette are also secondary cues (Salmon et al. 1992; Salmon and Witherington 1995).

Since Hearson and Cowrie Coves are not known to be nesting beaches, there is little likelihood of artificial lights causing misdirection and mortality in hatchlings. However, it might also be suggested that lights could attract turtle hatchlings once they are in the water. There is experimental and observational evidence that once turtle hatchlings reach the water, they establish offshore headings using wave surge cues near the substratum in relatively shallow water (Wang et al. 1998), and subsequently use magnetic cues, thereby continuing to migrate away from the coast once it is out of sight (Goff et al. 1998). Thus, it appears that lights would not cause misdirection and mortality in swimming hatchlings.

3. Whether adult turtles would be attracted by artificial light sources that would result in misdirection and mortality.

Circumstantial observations and experimental evidence show that artificial lighting on or near beaches tends to deter turtles from emerging from the sea to nest (Witherington and Martin 1996). Artificial lighting also leads to the abandonment of nesting attempts on the beach. However, there are some beaches that are used as nesting sites that are also subject to artificial lighting (e.g. Varanus Island; pers. obs.).

Adult turtles can also become disoriented by artificial lights near nesting beaches (P. Kendrick, CALM pers. comm.). The lack of nesting beaches on the Burrup precludes this situation. However, it might also be suggested that non-nesting adults might be attracted to artificial lights, but there has been no recorded case of this at the Burrup to date despite the presence of a multitude of artificial light sources.

Recommendations

No specific recommendations are made in regard to turtles due to the absence of nesting beaches near the proposed Methanex plant, and the unlikelihood that turtles in the water will be attracted to lights.

I.2 References

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