



# **Pluto LNG Project**

## **Five Year Performance Review Report**

### **October 2007 – October 2012**

Ministerial Statement No. 757 *Pluto Liquefied Natural Gas Development (Site B Option)*  
*Burrup Peninsula, Shire of Roebourne*

December 2012

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# 1. Executive Summary

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This Performance Review Report has been prepared to meet the requirements of condition 5-1 of the Ministerial Statement 757 *Pluto Liquefied Natural Gas Development (Site B Option) Burrup Peninsula, Shire of Roebourne* (the Ministerial Statement). This is the first Performance Review Report prepared to meet the Ministerial Statement condition.

The first LNG cargo departed the Pluto LNG Plant on 12 May 2012 and commissioning of the Plant is substantially completed, with some activities remaining in 2013.

This report is split into five main parts, as required by condition 5-1 of the Ministerial Statement 757 to address:

1. the major environmental issues associated with implementing the project; the environmental objectives for those issues; the methodologies used to achieve these; and the key indicators of environmental performance measured against those objectives;
2. the level of progress in the achievement of sound environmental performance, including industry benchmarking, and the use of best available technology where practicable;
3. significant improvements gained in environmental management, including the use of external peer reviews;
4. stakeholder and community consultation about environmental performance and the outcomes of that consultation, including a report of any on-going concerns being expressed; and
5. the proposed environmental objectives over the next five years, including improvements in technology and management processes.

## 2. Report

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### **Environmental challenges associated with implementing the project**

The development of Pluto LNG was referred to the Western Australian Environmental Protection Authority (EPA) for assessment in April 2006 and the Commonwealth Department of Environment and Heritage (DEH) in August 2006 (1 August 2006, DEH reference No. 2006/2968). The proposed development was determined by the DEH to be a 'controlled action' under the provisions of the EPBC Act (24 August 2006). The DEH and EPA subsequently determined that the proposed development should be assessed through a Public Environment Report and Public Environmental Review levels of assessment respectively.

The Public Environment Report (PER) (published in December 2006) identifies and discusses possible environmental issues or challenges associated with implementing the project. These include treated wastewater marine discharge, sea turtle and marine mammal management, air quality, greenhouse gas emissions, dredge impact management, marine quarantine and cultural heritage. Woodside has developed management plans which detail how these environmental issues will be controlled, to reduce impacts and improve environmental outcomes. The management plans describe objectives and the methodologies used to achieve these, as well as indicators of performance.

Table 1 summarizes environmental focus areas and key management objectives, methodologies for implementation and performance indicators. For further information relating to management of environmental issues for Pluto LNG, refer to the current version of the management plans available online at:

<http://www.woodside.com.au/Our-Business/Pluto/Sustainability/Pages/Environment.aspx>

**Table 1** – Pluto LNG Project environmental focus areas, objectives, methodologies and key performance indicators

Environmental Focus Areas	Objectives	Methodologies used to achieve objectives	Key Indicators of Performance
Treated Wastewater Marine Discharge Management	<ul style="list-style-type: none"> <li>• Treat water to a level suitable for ocean discharge;</li> <li>• Reduce environmental impact to as low as reasonably practicable whilst ensuring a high level of ecological protection is maintained around the ocean outfall site;</li> <li>• Ensure management is in accordance with objectives defined in Ministerial Statement No. 757 and Approval to Take a Controlled Action EPBC2006/2968.</li> </ul>	<ul style="list-style-type: none"> <li>• Site water production and collection systems;</li> <li>• Effluent Treatment Plant &amp; Sewerage Treatment Plant;</li> <li>• Tertiary Wastewater Treatment;</li> <li>• Final collection and analysis prior to discharge or reuse by third-party;</li> <li>• Monitoring during start-up and commissioning and ongoing water quality monitoring;</li> <li>• Whole Effluent Toxicity (WET) testing program;</li> <li>• Internal laboratory assessment &amp; external NATA accredited laboratory assessment;</li> <li>• Routine &amp; event based performance reporting to DEC;</li> <li>• Contingency Management Plan with wastewater management alternatives that can be implemented to ensure objectives can still be achieved, even when the treatment plant is not operating as intended.</li> </ul>	<ul style="list-style-type: none"> <li>• Achievement of Environmental Quality Objectives as described in the document <i>Pilbara Coastal Water Quality Outcomes: Environmental Values and Environmental Quality Objectives</i> (DoE 2006);</li> <li>• Compliance with discharge specifications detailed in Table 5-1 of the Management Plan <i>Waste Water Constituents, Sources, Expected and Maximum Concentrations, ANZECC Thresholds and Estimated Annual Loading</i>;</li> <li>• Compliance with requirements specified in Part V Licence under the <i>Environmental Protection Act 1986</i> (WA) (yet to be issued).</li> </ul>
Sea Turtle and Marine Mammal Management	<ul style="list-style-type: none"> <li>• Detect and mitigate as necessary any impact upon marine turtles or marine mammals and their environment from Pluto LNG;</li> <li>• Identify and implement darkness strategies to reduce as far as practicable, lights or light glow interfering with nesting female turtles and hatchlings;</li> <li>• Minimise the impact of waste discharge on sea turtles and marine mammals;</li> <li>• Ensure management is in accordance with objectives defined in Ministerial Statement No. 757 and Approval to Take a Controlled Action EPBC2006/2968;</li> <li>• Minimise the impact of human presence on sea turtle activity on Holden Beach;</li> <li>• Minimise the impact of dredging activities on sea turtles and marine mammals.</li> </ul>	<ul style="list-style-type: none"> <li>• Sea turtle monitoring at Holden Beach prior to commencing construction, during the construction phase of Pluto LNG and ongoing through operations;</li> <li>• Implementation of the Pluto Operational Environmental Lighting Specification;</li> <li>• Audits of lighting during operations against the protocol;</li> <li>• In the event of a hydrocarbon spill, management measures contained within the Woodside Dampier Sub-basin Oil Spill Contingency Plan should be implemented;</li> <li>• Restrict human access to Holden Beach;</li> <li>• No vehicle access is permitted on Holden Beach;</li> <li>• Maintenance of records of sea turtle observations during any future dredging, spoil disposal, rock fill and blasting operations.</li> </ul>	<ul style="list-style-type: none"> <li>• No incidences of adult or hatchling sea turtles being disoriented by light, found to be emitted from Woodside operations;</li> <li>• No turtle deaths associated with Woodside activities (i.e. dredging);</li> <li>• No unauthorized access to Holden Beach by Woodside personnel &amp; contractors.</li> </ul>
Air Quality Management	<ul style="list-style-type: none"> <li>• Minimise environmental impacts associated with air emissions;</li> <li>• Minimise impact on Indigenous rock art on the Burrup Peninsula;</li> <li>• Ensure management is in accordance with objectives defined in Ministerial Statement No. 757 and Approval</li> </ul>	<ul style="list-style-type: none"> <li>• Dry low-NOx emissions control systems on the gas turbines;</li> <li>• Recovery of waste heat from several gas turbine units;</li> <li>• CO2 removed from feed gas in the Acid Gas Removal Unit (AGRU);</li> <li>• Waste gas from the AGRU treated through a</li> </ul>	<ul style="list-style-type: none"> <li>• Achievement of air emissions targets and limits specified in Part V Licence under the <i>Environmental Protection Act 1986</i> (WA) (yet to be issued).</li> </ul>

	<p>to Take a Controlled Action EPBC2006/2968;</p> <ul style="list-style-type: none"> <li>• Adopt best practise pollution control measures.</li> </ul>	<p>Regenerative Thermal Oxidiser (RTO);</p> <ul style="list-style-type: none"> <li>• Design for 'no continuous flaring';</li> <li>• Use of nitrogen to maintain the continuous purge of flare piping;</li> <li>• Air monitoring (ambient &amp; point source emissions, dark smoke, nitrogen deposition);</li> <li>• Reporting of emissions in accordance with legal and other requirements.</li> </ul>	
Greenhouse Gas Abatement Program	<ul style="list-style-type: none"> <li>• Ensure the plant is designed and operated in a manner which achieves reductions in greenhouse gas emissions as far as practicable;</li> <li>• Provide mechanisms for identifying and evaluating emissions improvements;</li> <li>• Provide for ongoing greenhouse gas emissions reductions over time;</li> <li>• Manage greenhouse gas emissions in accordance with the Framework Convention on Climate Change 1992, and consistent with the National Greenhouse Strategy.</li> </ul>	<ul style="list-style-type: none"> <li>• Design and technology choices i.e. Acid Gas Removal, Thermal Combustion Unit, Waste Heat Recovery, Tandem Dry Gas Seals, optimising nitrogen content in the fuel gas, floating roof Condensate storage tanks, nitrogen flare purging, relief valve minimisation and Main Cryogenic Heat Exchanger redesign;</li> <li>• Market offsets – contract with CO2 Australia to offset reservoir CO2 emissions;</li> <li>• Identify and implement energy efficiency and production optimization opportunities.</li> </ul>	<ul style="list-style-type: none"> <li>• Annual greenhouse gas emissions calculations and reporting as required by the <i>National Greenhouse and Energy Reporting Act 2007</i>;</li> <li>• Progress against energy efficiency metrics.</li> </ul>
Dredge Impact Management	<ul style="list-style-type: none"> <li>• Ensure that dredging and dredge spoil disposal activities associated with construction are undertaken and managed in a way that reduces the environmental impacts of the works to as low as reasonably practicable (ALARP);</li> <li>• Address requirements of conditions in Ministerial Statement 757, Commonwealth Approvals Decision EPBC 2007/2968, and the requirements of the Sea Dumping Permit (No. SD2006/0033);</li> <li>• To manage turbidity-generating activities and works associated with the proposal;</li> <li>• Implement Best Environmental Practice (BEP) dredging and manage impacts on water quality and coral health, including the optimum timing of works with respect to sea and meteorological conditions; and</li> <li>• Have contingency measures in place that will be undertaken in the event that specified threshold limits for coral condition and water quality are exceeded.</li> </ul>	<ul style="list-style-type: none"> <li>• Support implementation of a Dredge Environmental Management Group;</li> <li>• Outline Impact Criteria Zones and threshold coral mortality and water quality limits that will be used as management and stop-work trigger levels;</li> <li>• Disposing of the bulk of the dredged spoil outside of Mermaid Sound so as to minimise the risk of impact of the spoil disposal activities on the proposed Dampier Archipelago Marine Park;</li> <li>• Baseline water quality and sedimentation studies;</li> <li>• Coral and non-coral benthic habitat surveys including baseline coral condition study;</li> <li>• Coral condition monitoring &amp; spawning monitoring during dredging activities;</li> <li>• Stop-dredging procedures; and</li> <li>• Comprehensive hydrocarbon management measures will be implemented, including prevention and response measures in place as part of an approved Oil Spill Contingency Plan.</li> </ul>	<ul style="list-style-type: none"> <li>• Water quality; No long-term change from background levels occur as a result of human activities in sanctuary, special purpose (mangrove protection), special purpose (benthic protection), special purpose (intertidal reef protection) and recreation zones;</li> <li>• No significant release of hydrocarbons during dredging and disposal works;</li> <li>• Water quality is managed to meet conditions in the Ministerial Statement;</li> <li>• No impact on coral habitat from dredging activities.</li> </ul>
Marine Quarantine Management (Invasive Marine Species Management)	<ul style="list-style-type: none"> <li>• Minimise risk of introducing Invasive Marine Species (IMS) into Australian waters;</li> <li>• Comply with existing State and Commonwealth legislation in relation to management of IMS;</li> <li>• Reduce the risk of unplanned activity schedule delays and cost increases as a result of unanticipated IMS management response requirements imposed by</li> </ul>	<ul style="list-style-type: none"> <li>• Conduct risk assessments as required by the IMS Management Plan;</li> <li>• Depending on the level of risk identified, implement management options such as applying a limit of three entrances into the Invasive Marine Species Management Area, treatment of vessel internal seawater systems, inspection, vessel rejection /</li> </ul>	<ul style="list-style-type: none"> <li>• Compliance with all legal and other requirements relating to marine quarantine management;</li> <li>• If IMS are identified, management in accordance with Woodside procedures and legal requirements;</li> <li>• No introduction of Invasive Marine Species as a result of Woodside activities.</li> </ul>

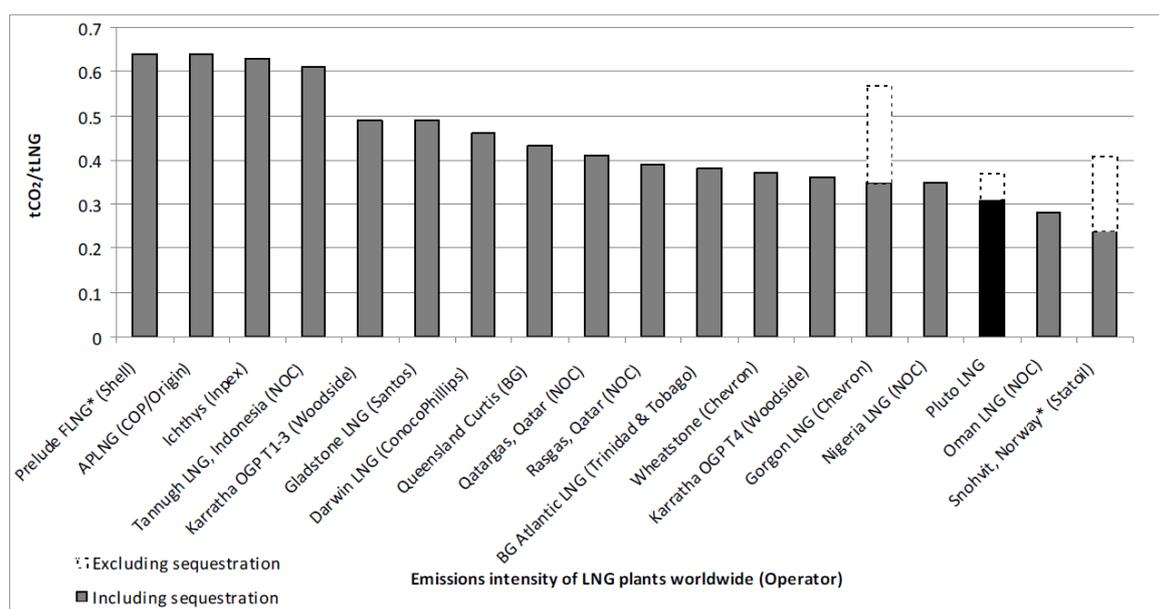
	<p>Government upon entry into Australian waters;</p> <ul style="list-style-type: none"> <li>• Meet approval conditions in relation to management of IMS for Pluto LNG (i.e. Ministerial Approval, Part V Licence etc.).</li> </ul>	<p>replacement or a risk based alternative;</p> <ul style="list-style-type: none"> <li>• Inspections following procedures outlined in the IMS Management Plan;</li> <li>• Notification of relevant authorities if IMS is identified;</li> <li>• Liaison with qualified IMS Inspector to establish management options if IMS identified.</li> </ul>	
<p>Cultural Heritage Management</p>	<ul style="list-style-type: none"> <li>• Develop a comprehensive understanding of heritage at Pluto LNG Park;</li> <li>• Design the footprint in a way which minimises impacts on heritage;</li> <li>• Relocate heritage from footprint to other areas on the Pluto LNG Park without damage;</li> <li>• Protect heritage located in the non-disturbance area from damage;</li> <li>• To comply with approval and consent conditions, commitments and legislative requirements.</li> </ul>	<ul style="list-style-type: none"> <li>• Engage Traditional Custodians, Archaeologists and Anthropologists to conduct heritage surveys and provide advice;</li> <li>• Use heritage survey reports to inform design and footprint for Pluto LNG;</li> <li>• Engage with Traditional Custodians to refine design and footprint of Pluto LNG;</li> <li>• Engage Traditional Custodians and Archaeologists to oversee the relocation of heritage;</li> <li>• Install fencing and signage around the disturbance area boundary;</li> <li>• Ensure activities on Pluto LNG site only proceed either with the appropriate permit (containing all necessary protection measures) or within the disturbance area by providing appropriate education (i.e. inductions);</li> <li>• Maintain a register of heritage commitments and consent conditions.</li> </ul>	<ul style="list-style-type: none"> <li>• Heritage surveys completed;</li> <li>• Heritage landscape understood;</li> <li>• Woodside has worked closely with Traditional Custodians since October 2005 to gain an understanding of the Indigenous heritage landscape;</li> <li>• The Pluto LNG Foundation Project footprint was designed in consultation with local Indigenous people to avoid 92% of rock art engravings on our leases;</li> <li>• The 176 panels with engravings that could not be avoided were safely relocated to a nearby natural setting with the guidance of local Indigenous groups and in accordance with government approvals;</li> <li>• Compliance with all legal and other requirements.</li> </ul>

## Progress in achieving sound environmental performance

The design of Pluto LNG facilities was carried out utilising the Woodside project management process. This process has in-built systems for evaluation and assurance, and consideration of the benefits and challenges of alternative design elements. In particular, industry benchmarking and best available technology were a focus, to ensure that sound environmental performance is inherent in all areas of the plant.

### Industry Benchmarking

Benchmarking allows for comparative analysis to identify previous and current status of a certain element in an industry. As part of the Pluto LNG Project, a benchmarking study was conducted to examine the greenhouse intensity of major LNG plants worldwide (existing and planned). In the report *Pluto LNG Project Greenhouse Gas Abatement Program* (Woodside Burrup Pty Ltd., 2011a) data has been collated to show greenhouse emission intensities, and compare the predicted performance of the Pluto LNG Project with other plants.



**Figure 1** – Greenhouse Intensity of Major LNG Plants Worldwide (Existing and Planned) (Woodside Burrup Pty Ltd. 2011a, Page 18)

The greenhouse gas emissions intensity benchmarking study illustrates that the predicted performance of Pluto LNG plant is representative of the LNG industry’s current average greenhouse efficiency (see Figure 1). In addition to the efforts of Woodside in identifying and implementing greenhouse gas mitigation opportunities during the design phase, reservoir CO<sub>2</sub> has been offset to further lower greenhouse gas emissions, which places the Pluto LNG plant as one of the most greenhouse friendly LNG projects worldwide.

## Use of Best Available Technology

Several studies have been carried out through various stages of the Pluto LNG Project, to determine what is best practice for major plant, to minimise environmental impact. Best practice is taken to mean Best Practicable Measures (BPM) as defined in the Western Australian Guidance No. 55 on the Assessment of Environmental Factors, consistent with the *Environmental Protection Act 1986*.

### *Air emissions*

The *Assessment of Best Practice for Minimising Emissions to Air from Major Plant* (Foster Wheeler Worley, 2007) examined best practice techniques for atmospheric emission minimisation. The report reviewed options for aspects of plant design such as the flare, gas turbines and thermal oxidiser.

Conclusions made in the report include:

- Plant design to eliminate continuous operational flaring meet with the general indications of the European Union based Best Available Technique Guidelines. This is due to the use of techniques such as high integrity multiple voting systems in the distributed control system, utilising split range flow control valves to recover gas where appropriate and balancing/recovering gas into the fuel system as far as practical;
- Gas Turbine technology selected for Pluto LNG represents a well proven design which, when combined with Dry Low NO<sub>x</sub> based emissions control, results in low NO<sub>x</sub> emissions guaranteed at levels below the Australian regulatory limits; and
- Some waste gas streams which cannot be reincorporated into the process will be treated with a thermal oxidiser (rather than venting) to convert the hydrocarbon fractions into oxidised by-products, to minimise environmental impact and protect human health.

A plan is currently being implemented to address design specification issues identified with the Main Flare and Storage and Loading Flare. In particular, flare configuration and usage will be changed so that smoke emissions can be reduced under low flow conditions.

Operation of installed equipment to best practice standards is an ongoing improvement process. At this point in time, equipment such as the Nitrogen Rejection Unit, Regenerative Thermal Oxidiser and the Boil-off Gas Compressor are still undergoing commissioning.

### *Power generation*

Selection of power generation technology considered criteria such as reliability, stability, efficiency, capital cost and delivery timeframes. Several alternative technologies and power generating combinations were investigated, including Aero Derivative Gas Turbine generators (ADGT) and industrial gas turbines operating in combined cycle together with Heat Recovery Steam Generators (HRSG) and steam turbines. Using information garnered from technology comparison to inform decision making, Train 1 has carried forward the establishment of five GE Frame 6B gas turbines operating in open cycle (with waste heat recovery). The selection was made based on favourable capital costs, delivery timeframe and water consumption drivers, which significantly outweighed the benefits gained from the other evaluated power generation options.

### *Liquefaction*

The report *Pluto LNG Project Greenhouse Gas Abatement Program* (Woodside Burrup Pty Ltd., 2011a) summarizes technology options that were investigated for liquefaction, during

the early phases of project design. Criteria used to assess the best available technology included CAPEX ranking, production per train, high heating value and schedule ranking. Qualitative analysis was also carried out, comparing safety, operations and maintenance as well as environmental factors of the different technology options. From the options that were investigated, outcomes indicated that the Shell Foster Wheeler Worley C3MR process was more favourable in all categories, leading to the implementation of this technology.

### **Wastewater**

To ensure sound environmental performance relating to wastewater discharges, various water recovery studies and reuse options were assessed during project development. The key outcomes of these investigations recommended:

- Optimisation of water influent contaminant levels, to maximise the potential for on-site reuse (and, as a consequence, maximise the end quality of treated wastewater); and
- Inclusion of extensive treatment systems for all process and process area stormwater streams to meet plant service water specifications.

Water treatment systems have been designed to enable extensive reuse within the plant, which in turn should result in substantially reduced surplus volumes requiring disposal. It is recognised however that the option for discharge to ocean needs to be retained to provide a disposal route for infrequent volumes of excess treated effluent from both the effluent treatment plant (when supply exceeds the re-use requirements or the re-use specification cannot be achieved) and sewage treatment plant (when on-site irrigation cannot be used).

Various options for ocean discharge were considered, including discharge into water of depth greater than 30m outside the Dampier Archipelago, discharge via a purpose built diffuser located at the end of the Pluto LNG plant export jetty, and discharge into the Water Corporation's existing Multi-User Brine Return Line (MUBRL) with outfall located in King Bay. Option 2 was considered the base case in the Pluto LNG Project Public Environment Review; however following further discussion with regulators and authorities, Option 3 was also taken forward for detailed consideration. Discharge to the Water Corporation's existing MUBRL was adopted as the preferred approach.

## Improvement in environmental management

In November 2012 the Pluto LNG Project won the Sir William Hudson Award at the National Engineering Excellence Awards. Ian Pedersen, who chairs the Awards judging panel said the project demonstrated robust planning and practical engineering solutions, and was “a fine integration of engineering with community consultation and consideration for the environment exhibited throughout project delivery”.

At the Engineering Excellence Awards Mr Pedersen noted “the project is considered one of the world’s most environmentally friendly LNG plants, delivering the largest marine monitoring program of its kind in WA while minimising the impact of dredging activity.”

Dredge disposal management is just one demonstration of improvement in environmental management for the project; other areas include sea turtle management and greenhouse gas abatement.

### Dredge Disposal Management

The Pluto LNG Project included a major dredging program with the removal of up to 14.1 million m<sup>3</sup> of material to construct a turning basin, berth pocket, approach channel, and gas trunkline trench. All dredge spoil was disposed of at sea in accordance with Sea Dumping Permit SD2006/0033, with the activities taking place between November 2007 and May 2010.

The Environmental Impact Assessment (EIA) carried out in early stages of project conception indicated a risk of coral impact resulting from dredge induced turbidity and sedimentation. Proactive measures taken to mitigate this risk, particularly relating to the trunkline dredging scope, included:

- Conducting overflow optimisation trials offshore then limiting overflow when stripping surface fines, while ‘near field’ plume mapping provided rapid performance feedback to the management team; and
- Scheduling work such that offshore dredging could be completed outside Mermaid Sound (distant from coral habitat) during the autumn mass coral spawning event. This was supported by plume extent and spawn dispersion research.

Overseeing dredging activities was the Dredge Environment Management Group (DEMG), which was formed to provide independent and timely advice on various matters to the Minister for Environment and Woodside.

The Dredge Environmental Management Group provided regular formal written comment and advice to the Office of the Environmental Protection Authority (OEPA) and Woodside on a range of issues raised by the OEPA, Woodside or the DEMG itself. In a summary report submitted to the Minister for Environment in 2011, some features of the dredging program which were noted by the DEMG included:

- Throughout the dredging program, there was no occasion when an increase in turbidity above set trigger limits was considered to be a direct result of dredging or spoil disposal;
- Long-term monitoring of Impact sites inside Zone C (the proposed Dampier Archipelago Marine Park) of the modelled Zone of Potential Influence indicated no long-term elevation in turbidity relative to Reference sites;
- Information from 25 routine coral monitoring sites surveyed 61 times over more than two years, including two full summer periods since dredging commenced, revealed no

individual impact site was shown to suffer mortality of corals which could be attributed to dredging;

- The dredging program was modified during major mass coral spawning events to reduce the turbidity that may be experienced by coral larvae. This included a cessation of dredging close to major coral colonies, based on an understanding of the timing and patterns of spawning in this area;
- Dredging management in “real time” was undertaken based on the knowledge of the nature and location of dredging operations, field observations, near field instrumentation/monitoring, experience of the expected levels of turbidity that could be generated, and the current and expected meteorological and oceanographic conditions.

Post dredging benthic habitat, and drop camera habitat surveys, were carried out in 2010/11. Findings of these surveys were such that it was determined by the OEPA that further post dredging surveys required under Condition 6-13 of the Ministerial Statement were no longer required.

### Sea Turtle Management

The main potential stressor for sea turtles, identified as requiring management, is light emissions from the plant onto Holden Beach and the surrounding water. To better understand potential impacts and how these could be managed, Woodside conducted baseline sea turtle surveys of Holden Beach prior to commencing project construction.

A second survey period occurred between January 2007 and June 2007, finding no evidence of adult sea turtles on Holden Beach during this time. Utilizing information gathered during these and other monitoring programs, an operational environmental lighting specification was prepared and approved by the DEC.

In February 2012 an independent technical review of the Sea Turtle Management Plan and a lighting audit was carried out for Woodside by Blue Planet Marine. In summarizing findings from the review, Blue Planet Marine stated that:

*“The lighting audit and assessment of turtle monitoring activities determined that, while there are some recommendations regarding the management of light spill from some individual lights within Site A for the Pluto LNG facility, Woodside are currently doing all that is reasonably practicable to minimise and monitor potential impacts from the development”.*

They also determined that Woodside *“have undertaken additional steps to minimise and monitor impact of the development on sea turtles and marine mammals within the region”.*

Measures taken to minimise the potential impacts of light spill onto Holden Beach include:

1. Minimising light spill on the beach and sea surface by adopting a turtle friendly lighting plan;
2. Reducing the intensity of lighting sources within the Pluto LNG facility;
3. Using lighting sources with selected wavelengths that minimise effects on turtles;
4. Undertaking monitoring of turtle nesting and hatchling activity on Holden Beach;
5. Undertaking lighting audits on a regular basis; and
6. Undertaking corrective action to address light spill sources identified during the lighting audit.

## **Greenhouse Gas Abatement**

The purpose of the Greenhouse Gas Abatement program developed for Pluto LNG Project is to minimise the greenhouse gas footprint. One of the mechanisms being implemented to achieve this goal is the use of carbon sequestration in the form of bio-sequestration (planting of trees). Woodside has established an extensive bio-sequestration project through CO2 Australia to offset the reservoir CO2 from the Pluto gas field that will feed Train 1. This \$100 million investment is Australia's largest commercial emissions offset program based on dedicated forest carbon sink plantings. Woodside will offset approximately 5.1 Mt CO2-e for the life of Train 1 at Pluto LNG.

As well as bio-sequestration, a Greenhouse Gas Improvement Plan (Improvement Plan) has been developed, based upon current knowledge and activities planned for the first two years of operation of Train 1, from achievement of steady state operations. The Improvement Plan will be internally reviewed annually and updated to reflect any additional initiatives that might be identified during the preceding year's operational experience. Refer to Table 3 for Improvement Plan initiatives.

## Stakeholder and community consultation

The table below outlines stakeholder and community consultation that has been carried out for Pluto LNG. Engagement with stakeholders and community is most often carried out by the locally-based community relations team, with environmental issues making up just one component of topics covered. Engagement with regulators such as the Department of Environment and Conservation is generally undertaken by the Environmental Advisor's onsite.

**Table 2** - Stakeholder and community consultation about environmental performance and Pluto LNG.

Stakeholder	Location	Forum/mechanism	Topic of discussion / main messages	Outcomes/feedback
Shire of Roebourne – CEO	Karratha	Face-to-face and phone call briefings.	<ul style="list-style-type: none"> <li>Ongoing briefings through construction, start-up and commissioning including updates on progress (specifically key milestones), flaring activities, noise and air monitoring.</li> </ul>	<ul style="list-style-type: none"> <li>Information well received and appreciated;</li> <li>No formal feedback logged.</li> </ul>
Shire of Roebourne – Shire President	Karratha	Face-to-face and phone call briefings.	<ul style="list-style-type: none"> <li>Ongoing briefings through construction, start-up and commissioning including updates on progress (specifically key milestones), flaring activities, noise and air monitoring.</li> </ul>	<ul style="list-style-type: none"> <li>Information well received and appreciated;</li> <li>No formal feedback logged.</li> </ul>
Shire of Roebourne - Councillors	Karratha	Presentation to council meetings.	<ul style="list-style-type: none"> <li>Ongoing briefings through construction, start-up and commissioning including updates on progress (specifically key milestones), flaring activities, noise and air monitoring.</li> </ul>	<ul style="list-style-type: none"> <li>No formal feedback logged.</li> </ul>
Pilbara Development Commission - CEO	Karratha	Face-to-face and phone call briefings.	<ul style="list-style-type: none"> <li>Ongoing briefings through construction, start-up and commissioning including updates on progress (specifically key milestones), flaring activities, noise and air monitoring.</li> </ul>	<ul style="list-style-type: none"> <li>Information well received and appreciated;</li> <li>No formal feedback logged.</li> </ul>
Pilbara Cities - CEO	Karratha	Face-to-face and phone call briefings.	<ul style="list-style-type: none"> <li>Ongoing briefings through construction, start-up and commissioning including updates on progress (specifically key milestones), flaring activities, noise and air monitoring.</li> </ul>	<ul style="list-style-type: none"> <li>Information well received and appreciated update;</li> <li>No formal feedback logged.</li> </ul>
Member for North West	Karratha	Face-to-face and phone call briefings.	<ul style="list-style-type: none"> <li>Updates on key milestones and achievements.</li> </ul>	<ul style="list-style-type: none"> <li>No formal feedback logged.</li> </ul>
Federal Member for Durack	Perth	Phone call briefings.	<ul style="list-style-type: none"> <li>Updates on key milestones and achievements.</li> </ul>	<ul style="list-style-type: none"> <li>No formal feedback logged.</li> </ul>
Karratha Community Association	Karratha	Presentation to association members and email/phone call updates.	<ul style="list-style-type: none"> <li>Ongoing briefings through construction, start-up and commissioning including updates on progress (specifically key milestones), flaring activities, noise and air monitoring.</li> </ul>	<ul style="list-style-type: none"> <li>No formal feedback logged.</li> </ul>
Dampier Community Association	Dampier	Presentation to association members and email/phone call updates.	<ul style="list-style-type: none"> <li>Ongoing briefings through construction, start-up and commissioning including updates on progress (specifically key milestones), flaring activities, noise and air monitoring.</li> </ul>	<ul style="list-style-type: none"> <li>No formal feedback logged.</li> </ul>
Dampier Port Authority (DPA)	Burrup	Face-to-face briefings and email updates.	<ul style="list-style-type: none"> <li>Ongoing briefings through construction, start-up and commissioning including updates on progress (specifically key milestones), flaring activities, noise and air monitoring.</li> </ul>	<ul style="list-style-type: none"> <li>One formal enquiry on Pluto flaring was taken by DEC in October 2012. In response, Woodside provided information for circulation to DPA staff and presented to the DPA Health and Safety meeting on 6 Dec 2012.</li> </ul>
Burrup industry near neighbours	Burrup	Presentation to Pluto site industrial near neighbours and email/phone call updates.	<ul style="list-style-type: none"> <li>Updates on key milestones and activities that could be of interest to site near neighbours.</li> </ul>	<ul style="list-style-type: none"> <li>No formal feedback logged.</li> </ul>
Traditional Custodian (TCs) Groups	Perth, Karratha, Roebourne	Individual meetings; Meetings with individual language groups; Meetings with combined language groups including quarterly updates; Roebourne office created to facilitate ongoing consultation.	<ul style="list-style-type: none"> <li>Cultural heritage management;</li> <li>Footprint of LNG facility;</li> <li>Key milestones and developments.</li> </ul>	<ul style="list-style-type: none"> <li>Feedback influenced footprint design;</li> <li>Feedback influenced and continues to influence heritage management;</li> <li>Traditional Custodians kept up to date with project developments.</li> </ul>
	Pluto LNG site	Heritage surveys; Monitoring of activities; Site visits.	<ul style="list-style-type: none"> <li>Cultural heritage management;</li> <li>Key milestones and developments.</li> </ul>	<ul style="list-style-type: none"> <li>Feedback influenced footprint design;</li> <li>Feedback influenced and continues to influence heritage management;</li> <li>Traditional Custodians kept up to date with project developments.</li> </ul>

Department of Indigenous Affairs	Perth	Written reports.	<ul style="list-style-type: none"> <li>Update on heritage management and compliance with consent conditions.</li> </ul>	<ul style="list-style-type: none"> <li>Compliance;</li> <li>Feedback on heritage management received.</li> </ul>
Karratha and Dampier Chamber of Commerce and Industry - CEO	Karratha	Face-to-face and phone call briefings.	<ul style="list-style-type: none"> <li>Ongoing briefings through construction, start-up and commissioning including updates on progress (specifically key milestones), flaring activities, noise and air monitoring.</li> </ul>	<ul style="list-style-type: none"> <li>Information well received and appreciated update;</li> <li>No formal feedback logged.</li> </ul>
Woodside Community Liaison Group	Karratha	Presentation to group.	<ul style="list-style-type: none"> <li>A Woodside Community Liaison Group has existed in a variety of forms and provided a forum to share ongoing Project information and updates to a range of community stakeholders. While the formal group was disbanded mid 2011, community engagement continues through various direct and indirect activities.</li> </ul>	<ul style="list-style-type: none"> <li>No formal feedback logged.</li> </ul>
WA Police – Pilbara District Superintendent	Karratha	Face-to-face and phone call briefings.	<ul style="list-style-type: none"> <li>Updates on key milestones and achievements.</li> </ul>	<ul style="list-style-type: none"> <li>No formal feedback logged.</li> </ul>
Department of Environment and Conservation (DEC)	Karratha	Meetings, ongoing email notifications and phone calls to local DEC representatives. Periodic meetings with Perth-based DEC representatives.	<ul style="list-style-type: none"> <li>During start up and commissioning activities DEC received three formal enquiries about Pluto activities;</li> <li>7 November 2012 – update to DEC on recent Pluto community notifications and stakeholder engagement activities.</li> </ul>	<ul style="list-style-type: none"> <li>Woodside formally logged the enquiries in the company stakeholder interaction database and provided a written response;</li> <li>DEC appreciated the update and supported ongoing, timely community notifications about significant Pluto activities, especially increased flaring.</li> </ul>
King Bay Game Fishing Organisation	Dampier	Phone call briefings.	<ul style="list-style-type: none"> <li>Updates on key milestones and achievements.</li> </ul>	<ul style="list-style-type: none"> <li>No formal feedback logged.</li> </ul>
Nickol Bay Sport Fishing Club	Dampier	Phone call briefings.	<ul style="list-style-type: none"> <li>Updates on key milestones and achievements.</li> </ul>	<ul style="list-style-type: none"> <li>No formal feedback logged.</li> </ul>
Friends of Australia Rock Art (FARA)	Perth, Karratha	Annual FARA meetings.	<ul style="list-style-type: none"> <li>Heritage management;</li> <li>Key milestones and developments.</li> </ul>	<ul style="list-style-type: none"> <li>Up-to-date information provided.</li> </ul>
General public	Shire of Roebourne	<ul style="list-style-type: none"> <li>Flyer drop to all residential addresses in Karratha and Dampier;</li> <li>Ads in both local papers (Pilbara News and Pilbara Echo);</li> <li>Ad campaign on local radio station;</li> <li>Access to Woodside staff through 1800 information line, Karratha Town Office, Roebourne Office and North West Shelf Visitors Centre;</li> <li>Attendance / information stalls at community events.</li> </ul>	<ul style="list-style-type: none"> <li>Undertaken to support plant start-up and commissioning activities. Two separate flyer drops were completed;</li> <li>Ads were placed periodically throughout the Project to advise the community of ongoing site activities in particular during plant start-up and commissioning relating to onsite flaring;</li> <li>Ad campaigns were run on the local radio station advertising the local Woodside Public Enquiry Line number which the public can call if they have a question about a Woodside-operated facility in the Shire of Roebourne;</li> <li>Woodside staff were available to take and facilitate public enquiries through any of these locations.</li> </ul>	<ul style="list-style-type: none"> <li>No formal feedback logged, however stakeholders mentioned during other engagement with Woodside the information was well received and appreciated.</li> </ul>

## Proposed environmental objectives over the next five years

While opportunities for improvement have been identified for greenhouse gas emissions (see Table 3 below), the new condition of the plant means that other opportunities are limited, with the main focus being implementation of the operational aspects of the various management plans (i.e. air quality management and treated wastewater marine discharge management).

Following establishment of steady state operating conditions, environmental activities will also focus on the development of baseline data for emissions and discharges, with an aim to improve understanding of equipment function and identify any future improvement opportunities.

Cultural heritage objectives over the next five years include continued implementation of the Pluto Cultural Heritage Management Plan and a continuation of activities seeking advice from Traditional Custodians, Archaeologists and Anthropologists as required. The purpose of these tasks is to protect heritage in the Burrup region whilst maintaining compliance with legal and other requirements.

The following table lists greenhouse gas emission improvement activities, as identified to date, that will be undertaken for Train 1 between start-up and the first two years of steady state operations (Woodside Burrup Pty Ltd. 2011a, Page 41):

**Table 3 – Greenhouse gas emissions improvement activities (Pluto LNG Train 1)**

Ref No.	Task	Purpose	Output	Timing
1	Monitor atmospheric emissions, energy consumption and LNG production	Validate existing emission estimates, greenhouse predictions and design criteria or understand any variance	Establish baseline emission estimates and greenhouse intensity	First year of steady state operations
2	Undertake a Leak Detection and Repair Program	Minimise emission losses and maximise operational efficiency	Recommendations for minimising leaks	First year of steady state operations
3	Undertake a Flare Gas Recovery Study	Maximise operational efficiency	Recommendations for gas recovery	Second year of steady state operations
4	Undertake an energy efficiency review of the plant	Maximise operational efficiency and improving plant performance and emissions intensity	Establish a revised (reduction) target for greenhouse intensity and make recommendations for improving energy efficiency	Within 18 months of steady state operations
5	Identify energy efficiency gains and improved greenhouse emissions intensity by integrating systems for future expansion	Maximise operational efficiency and improve emissions intensity	Revised cumulative emissions estimates and greenhouse intensity	In parallel with Pluto expansion plans
6	Continue to monitor market abatement opportunities	Maximise efficiency of global greenhouse gas reduction efforts for any additional Pluto offsets	Understanding of market offset opportunities for business evaluation	Within 18 months of steady state operations
7	Review Greenhouse Gas Improvement Plan and incorporate any identified actions	Maintain a "live" improvement plan	Annual review and incorporation of identified initiatives where appropriate	Around the anniversary of steady state operations, annually
8	Review and update the Greenhouse Gas Abatement Program	Maintain transparency over Woodside's greenhouse gas efficiency performance on the Pluto LNG Project	Updated Greenhouse Gas Abatement Plan.	5 years from steady state operations, or prior to commissioning of new trains

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