



Planning

**MAJOR PROJECT ASSESSMENT:
*Munmorah Power Station Rehabilitation***

Director-General's
Environmental Assessment Report
Section 75I of the
Environmental Planning and Assessment Act 1979

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EXECUTIVE SUMMARY

Delta Electricity (the Proponent) has lodged a project application seeking the Minister for Planning's approval for the refurbishment of the Munmorah Power Station, located on the Central Coast of New South Wales adjacent to the coastal lagoons of Lake Munmorah and Lake Budgewoi.

Whilst nominally rated at 600 megawatts, the Munmorah Power Station has not recently been capable of sustained operations at full capacity for base load generation due to the age of the facility and associated reduced efficiencies. The power station was originally commissioned as a four turbine (four x 350 megawatt) base load power station with a total generating capacity of 1,400 megawatts. All units were down-rated to 300 megawatts in 1984 with units one and two subsequently decommissioned in 1996. Units three and four were refurbished in 1989-1990 and have since operated at a reduced capacity.

The Proponent proposes to undertake works to rehabilitate the two remaining generating units of the power station (units three and four) by replacing and refurbishing aged and worn out components with current available technology so as to increase the generating efficiency of the units and restore the output of each unit to its original design capacity of 350 megawatts and increase the operating life of the project by up to 20 years.

The electricity generated by the project would cater in part for electricity demand expected within the next ten years. The project will help manage the risk of the expected energy generating shortfall, if and when it eventuates. The project has a capital value of \$500 million. The Proponent has sought approval for two fuel options to provide maximum development flexibility should the project be progressed, comprising either 100% coal or coal supplemented by a percentage of gas up to a maximum percentage of 75%. The final decision on fuel option would be determined at the time of rehabilitation depending on the economic drivers present at the time including fuel price and applicable legislative framework (i.e. emissions trading scheme and associated carbon prices).

Public reaction to the project has been moderate with 34 submissions being received during the public exhibition period. The majority of submissions received opposed the proposal. Key issues raised in submissions included:

- greenhouse gas emissions and the potential of emissions resulting from the project to contribute to human induced climate change;
- diversification of NSW's energy generation to include a greater proportion of renewable energy generation;
- justification for refurbishment of the power station thereby extending its life by another 20 years;
- air quality impacts to the local and regional area; and
- water quality and aquatic ecological impacts on adjacent lakes.

Seven submissions were received from public authorities including local Councils (Lake Macquarie, Wyong and Marrickville). Marrickville Council objected to the project on the basis of potential climate change impacts from coal-fired power stations. Submissions received from the Department of Defence, the Department of Environment, Climate Change and Water and NSW Office of Water indicated no objection to the project subject to conditions. NSW Health raised support for a dual-fuel option maximising the use of gas. The remaining submissions from Lake Macquarie Council, Wyong Council and the NSW Roads and Traffic Authority did not state a specific position, however, raised comments for the Department's consideration.

A Submissions Report, prepared by the Proponent, addressing the issues raised in the submissions on the Project was submitted to the Department. In addition, the Department commissioned three independent reviews to be undertaken on the project in the areas of greenhouse gas, air quality and noise. The Proponent also prepared a revised air quality assessment as part of its Submissions Report and provided further information regarding its assessment of hydrogen fluoride in an addendum document.

The Department has undertaken a comprehensive assessment of the technical merits of the project and considers that the project can be approved subject to a number of recommended conditions of approval. The Department considers that the project is required to meet the State's baseload electricity demand requirements and therefore is in the public interest. The project comprises rehabilitation of an existing power station and therefore would result in capital cost advantages from the use of existing assets.

With regards to greenhouse gas impacts, the Department considers that the assessment undertaken is sufficient to provide an indication of the likely greenhouse gas emissions resulting from the proposal. While there will be an increase in the total greenhouse gas emissions in NSW by approximately 2.5 per cent for the 100% coal-fired option and 1.8 per cent for the 25 per cent coal and 75 per cent gas-fired option, the impact of these emissions must be balanced against the risks associated with an electricity generation shortfall and the significant social and economic implications to the State should such a situation eventuate. Therefore on balance, the Department has recommended that the project be approved subject to a number of conditions which require the Proponent to clearly demonstrate that best practice technology is to be implemented to minimise greenhouse gas emissions, and to demonstrate that it is investigating carbon reduction technologies that could be feasibly retrofitted to the plant, as well as other emission reduction or offset measures, to reduce or offset greenhouse gas emissions. Specifically in relation to greenhouse gas minimisation, the Department has recommended a specific condition to require the Proponent to, on a triennial basis, evaluate and report on the availability of viable greenhouse gas reduction, mitigation and/or offset options for incorporation into the final project design taking into consideration relevant contemporaneous economic drivers including any applicable legislation such as an emissions trading scheme and updated electricity demand and supply projections. The Department has also required as part of this condition that the report is made publicly available to ensure transparency in the process and to enable the public to have access to the information presented.

Other issues that were raised and assessed as part of this report include air quality impacts (particularly in relation to oxides of nitrogen, sulfur dioxide and particulate emissions), operational noise impacts from the rehabilitated power station and the operation of the upgraded conveyor and water quality and aquatic ecology impacts, particularly from the discharge of cooling water into Lake Budgewoi.

Based on the Department's assessment, as detailed in this report, the Department recommends that the Minister grant project approval to the project, subject to a number of conditions.

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1. BACKGROUND

1.1 Existing Site

Munmorah Power Station comprises an existing coal-fired power station constructed and commissioned between 1967 and 1969, located in the Central Coast of New South Wales adjacent to the coastal lagoons of Lake Munmorah and Lake Budgewoi which form part of the Tuggerah Lakes System (refer Figure 1).

The power station was originally commissioned as a four turbine (four x 350 megawatt) base load power station with a total generating capacity of 1,400 megawatts. All units were down-rated to 300 megawatts in 1984 with units one and two subsequently decommissioned in 1996. Units three and four were refurbished in 1989-1990 and have operated and continue to operate at a reduced capacity (16% capacity factor on average and usually with a single unit) for intermediate load generation.

Figure 1: Regional Context (Aurecon, October 2009)



The power station is located in the Wyong local government area and close to the southern extent of Lake Macquarie local government area, approximately 150 kilometres north of Sydney and 40 kilometres south-west of Newcastle (refer Figure 1). The power station site comprises approximately 940 hectares of which approximately 200 hectares consists of land used by the power station itself and associated infrastructure including ash dams, coal conveyer, cooling water canals and storage areas. The remaining area comprises undeveloped land which forms a "buffer" between the power station and surrounding developed areas including residential development (refer Figure 2). The entire site is owned by Delta Electricity, the operator of the power station. The site is accessed off Scenic Drive via a designated power station access road.

Figure 2: Proposal in relation to Surrounding Land Use (Aurecon, October 2009)



Coal for the power station was originally supplied from two collieries at the site (now decommissioned) and is now sourced from mines further afield and transported to site by trucks or by the Wyee rail line and associated coal unloader and coal conveyer which traverses to the Munmorah site via the adjacent Vales Point Power Station located to the north, also operated by Delta Electricity. The Munmorah coal conveyer between Vales Point Power Station and Munmorah Power Station is approximately 6.4 kilometres long and traverses a number of public roads including the Pacific Highway and Rutleys Road via either existing over or under-passes.

The power station utilises water from the adjacent estuarine lakes for cooling purposes and discharges the heated water back into the lakes (intake from Lake Munmorah and discharge into Lake Budgewoi). Ash produced by the power station is piped to, and stored within, on-site dams (furnace ash) and at the adjacent Vales Point Power Station ash dams (fly ash). Electricity produced at the power station is fed into the electricity grid via an existing 330 kilovolt switch yard and transmission line system (two lines which supply to Sydney and an additional line which acts as an inter-connector with Vales Point Power Station).

1.2 Existing Operations

Electricity is generated at the Munmorah Power Station through the combustion of pulverised coal particles which generate high temperatures at which water is converted into high pressure steam capable of driving the plant's steam-driven electricity generators. The residual exhausts are released into the atmosphere via stacks. The steam production process requires purified water supplies which is sourced from Wyong Shire Council and purified on site at the power station's demineralised water plant. Cooling water sourced from an intake channel from Lake Munmorah is fed through the condenser plant to convert steam back into water which is then re-used in the steam production process with some top-up supplies from Council's water supply (which is also used for general station usage including potable use). The now heated "cooling" water is discharged into Lake Budgewoi via an outtake channel. During periods of high operating capacity and therefore high thermal load release into the cooling water, the discharge water may be mixed with additional cooling water from Lake Munmorah (pumped from the intake channel to the outtake channel via attemperation pumps) to achieve lower water temperatures in the outtake channel (in compliance with licensing limits), prior to discharge into Lake Budgewoi.

Coal ash is generated at the boiler plant where ash particles not subsumed in the combustion process are caught by fabric filters at the exhaust stacks (i.e. "fly ash" comprising very fine coal particles) or accumulates at the bottom of the furnace chamber (i.e. "furnace ash"). The ash is mixed with some of the water re-used in the steam production process and slurred via pipes to onsite or offsite ash dams. Overflow from the ash dams is discharged into the Tuggerah Lakes System. Once their capacity is reached, the ash dams are capped and rehabilitated consistent with natural landform.

1.3 Surrounding Land Use

The power station is located in a highly populated area of New South Wales with the residential suburbs of Halekulani, Budgewoi, Buff Point, San Remo, Blue Haven, Doyalson and Lake Munmorah surrounding the site generally to west, south and north. The power station is located along the shores of the Tuggerah Lakes System which is a popular recreational and tourist location for fishing and boating. Extensive areas of uncleared and undeveloped areas also surround the site (partly made of the site's own buffer land) which adds to the scenic character of the area. Three additional power stations are located in the vicinity or in close proximity to the site:

- the approximately 660 megawatt gas-fired Colongra (peaking) Power Station located directly to the east of the Munmorah Power Station within approximately 4.5 hectares of land, which previously comprised part of the Munmorah Power Station operational area but has since been subdivided and dedicated for the Colongra facility. Gas is transported to the site via connection to the existing Sydney-Newcastle gas pipeline approximately nine kilometres to the north west. The facility commenced operation in December 2009 and is operated by Delta Electricity;
- the approximately 660 megawatt coal-fired Vales Point (base load) Power Station, located approximately five kilometres to the north of Munmorah Power Station along the shores of Lake Macquarie. The power station has been operational since the 1960's and is also operated by Delta Electricity; and
- the approximately 660 megawatt coal-fired Eraring (base load) Power Station, located approximately 17 kilometres to the north along the shores of Lake Macquarie. The power station has been operational since the 1980's and is operated by Eraring Energy.

2. PROPOSED DEVELOPMENT

2.1 Project Description

Whilst nominally rated at 600 megawatts, the Munmorah Power Station has not been capable of sustained operations at full capacity for base load generation in the recent past due to the age of the facility and associated reduced efficiencies. Based on its age and design life, the existing Munmorah Power Station is not expected to operate beyond 2012.

The Munmorah Power Station Rehabilitation project comprises a proposal to rehabilitate the two remaining generating units of the power station (units 3 and 4) by replacing and refurbishing aged and worn out components with current available technology so as to increase the generating efficiency of the units, restore the output of each unit to its original design capacity of 350 megawatts and increase the operating life of the project by up to 20 years.

The proposal (like two other base load generation projects recently considered by the Department - Mount Piper Extension and Bayswater B) comprises part of the New South Wales Government Energy Reform Strategy, which aims to make available a number of power station development sites for future private sector development. As the current operator of the facility, Delta Electricity (the Proponent), has sought planning approval for the proposed rehabilitation, however the project may be progressed in the future by the private sector. Should the project be developed, the rehabilitated plant would have a total generating capacity of 700 megawatts for base load generation, equating to approximately 4,800 gigawatt hours of electricity per annum. The project is estimated to have a capital investment value of \$500 million.

Fuel Type

As part of the rehabilitation project, the Proponent has sought approval for two fuel options to provide maximum development flexibility should the project be progressed. These comprise either:

- 100% coal (as in the current situation); or
- coal supplemented by a percentage of gas up to a maximum of 75% on an energy basis. (Note: due to technical constraints associated with the existing boiler plant, firing with 100% gas is not considered to be feasible as it would not allow required furnace temperatures to be achieved).

The Proponent has indicated that a final decision on fuel option would be determined at the time of rehabilitation depending on the economic drivers present at the time including fuel price and applicable legislative framework (i.e. emissions trading scheme and associated carbon prices). However, the Proponent has identified that the adoption of either option would be technically feasible at the power station and that there are reasonable and feasible options available for sourcing and transporting either fuel type onto the site.

With respect to coal, the Proponent has indicated that (as with the current situation) this fuel type would be sourced from offsite coal mines and transported onto site via the existing Wyee rail line and associated rail unloader and conveyer infrastructure existing at the power station. The Proponent has proposed to discontinue truck supplies of coal onto site and instead proposes to upgrade the capacity of the existing coal conveyer to provide for required loads (approximately 1,600 tonnes per hour). Coal is currently sourced for the power station from the Mandalong coal mine located in the Newcastle coalfields, which is estimated to have recoverable coal reserves of approximately 102 million tonnes. On this basis, and other readily available coal supplies from mines in the Newcastle and Hunter Valley coalfields, the Proponent has indicated that there would be sufficient supplies to meet the future fuel requirements of the power station should it be rehabilitated.

The implementation of the dual fuel option would require a ready supply of gas (up to 61 petajoules per annum) to the power station. Whilst a specific gas pipeline route does not comprise part of the project, the Proponent has identified that gas can be readily transported to the site using either existing adjacent gas pipeline infrastructure (the lateral pipeline from the Sydney-Newcastle line supplying the Colongra Gas-Fired Power Station which has sufficient storage capacity for additional gas transport) or through the construction of a separate gas pipeline within or adjacent to the existing disturbed easement corridor of the Colongra gas pipeline. Should the dual fuel option be determined as the preferred option, separate planning approval would need to be obtained for a final

gas transport option, prior to the implementation of dual fuel firing. With respect to gas supplies, the Proponent has identified that existing gas supplies would be insufficient to meet project demand. However, the Proponent has identified that there are a number of major gas pipeline projects proposed to connect proven gas reserves in Queensland to NSW, which in the event of development would provide sufficient supplies to meet the future requirements of the project. These include:

- the recently approved Queensland to Hunter Gas Pipeline (QLHP) project between the Wullumbilla hub in Queensland and Newcastle (approximately 170 petajoules per annum capacity). Connection of this pipeline to the existing Newcastle-Sydney pipeline would provide a means of gas supply to the Munmorah Power Station via the existing Colongra gas pipeline (already connected to the Newcastle-Sydney pipeline) or via a new pipeline in the same easement as the Colongra pipeline;
- the proposed Newstead to Bulla Park Gas Pipeline project (major project application lodged) between the Wullumbilla hub in Queensland and the existing Moomba-Sydney gas pipeline compression station at Bulla Park west of Cobar. This pipeline would provide a means of gas supply to the Munmorah Power Station via the existing Moomba-Sydney and Newcastle-Sydney pipelines.

Ash Disposal

Depending on the fuel option chosen, ash content of the coal utilised and level of future ash sales for beneficial re-use (e.g. in the cement and concrete industries), the Proponent has identified that the existing ash dams at Munmorah Power Station and Vales Point Power Station may not have sufficient capacity to meet the future ash disposal requirements of the project as well as that generated from the ongoing operation of the Vales Point Power Station (expected to remain operational until approximately 2029), assuming existing ash disposal methods of wet slurry disposal (refer Table 1).

Table 1: Ash Dam Capacity in Years (assuming existing ash disposal methods)

Fuel Type (assuming 24% ash content in coal)	Case 1: Existing level of fly ash sales (~20%) from Vales Point and nil sales from Munmorah	Case 2: Existing level of fly ash sales (~20%) from Vales Point and similar level of sales from Munmorah
100% coal (0% gas)	10 years	13 years
75% coal (25% gas)	11 years	14 years
50% coal (50% gas)	12 years	17 years
25% coal (75% gas)	14 years	21 years (sufficient capacity)

To address the deficit in capacity, the Proponent has identified a number of options that may be implemented on site to increase dam storage capacity, all of which involve retention generally within the existing dam footprint. These include:

- continuation of wet slurry disposal with increased use of ash terracing and raising the dam height to increase the storage area;
- change of disposal method from wet slurry to dry ash storage with various options for dry ash transport to the dams including trucks or conveyor; and
- disposal of ash in nearby disused mine void(s).

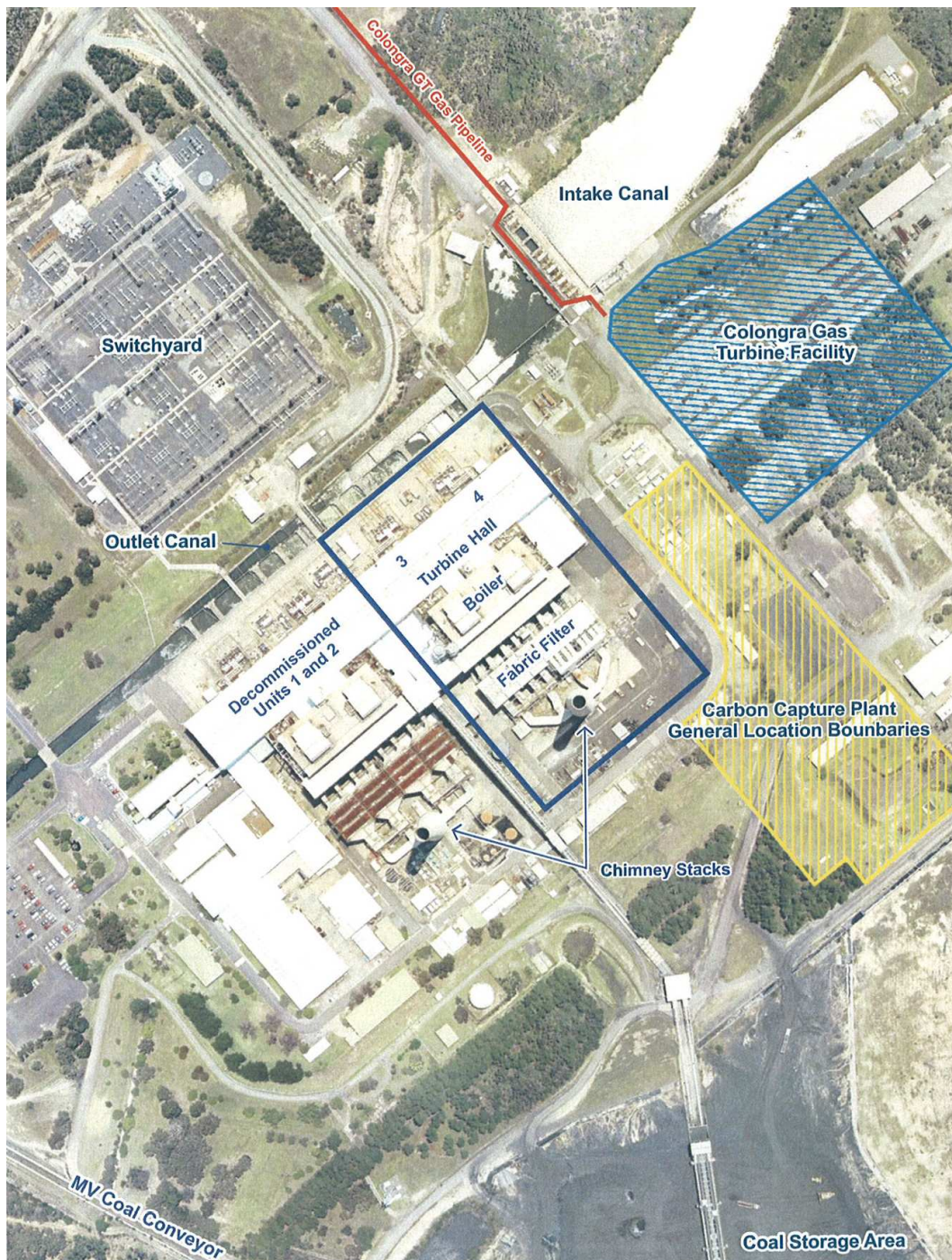
The Proponent has not identified a preferred ash disposal method at this stage noting that this would be further considered once factors influencing ash disposal requirements (including fuel option chosen and level of reuse) have been better resolved. Further, as additional storage capacity is unlikely to be required for at least 10 years (even under the worst case scenario), the Proponent has deferred a decision on a final disposal option to allow maximum flexibility in determining a suitable option taking into account any advances in storage or disposal technology and/ or re-use opportunities which may develop over this time. The Proponent may need additional planning approvals for the final ash disposal option, depending on the scale and nature of development (including associated infrastructure such as conveyers/ pipelines) and impacts involved.

Emission Control

To mitigate greenhouse gas emissions associated with the power station, the Proponent has proposed that the rehabilitated plant would incorporate carbon capture and storage (CCS), should this technology become technically feasible and economically viable in the future. The Proponent has undertaken a preliminary analysis

of potential constraints associated with retrofitting a CCS plant to the Munmorah Power Station (including space, layout and connection constraints) considering amine post-combustion technology (as one of the most technologically advanced CCS options to date) and determined that such a retrofit would be technically feasible and could be accommodated within the existing footprint of the power station site. However, given the preliminary status of investigations in New South Wales into suitable geological sites for carbon storage, the Proponent has not at this stage identified a specific storage site or transport options for the transport and storage of carbon. The Proponent has identified that should a commercially viable CCS option become available in the future (including capture technology, transport and storage options), such an option would be incorporated into the plant. An indicative location of the CCS plant, should it be implemented, was previously identified in Figure 3. Should a CCS plant be required in future, the Proponent would need to undertake a detailed evaluation of potential additional or changed impacts on site (e.g. cumulative noise, air quality, waste management from the incorporation of the CCS plant to existing plant) and any potential for impacts offsite (i.e. from carbon transport and storage options) to determine the need for additional approvals.

Figure 3: Layout of Proposal



Proposal Summary

The key elements of the rehabilitation project are summarised in Table 2 below and outlined in Figure 3.

Table 2: Key Proposal Elements

In the Case of Either Fuel Option	Additional Approvals
<ul style="list-style-type: none"> • upgrade of the steam turbine components of units 3 and 4 (including rotors, inner and possibly the outer casings, blades and diaphragms); • refurbishment of components of the boiler plant (including mills, air fans, pipe work and furnace tubes); • upgrade and refurbishment of the auxiliary equipment (including components of the condenser, circulating water system, air heater, feed pumps, economiser and attemperation pumps); and • incorporation of CCS should it become commercially viable. 	<ul style="list-style-type: none"> • approval for ash disposal options should additional storage capacity be required; and • additional approvals for CCS should this option be pursued in the future (depending on the scale and nature of the final option chosen).
In the Case of a 100% Coal Option	
<ul style="list-style-type: none"> • upgrade of the existing coal conveyer between the Munmorah and Vales Point power stations (MV Conveyer – rated at 350 tonnes per hour) to the same capacity) as the coal conveyer between the Vales Point Power Station and the Wyee rail unloader (RV Conveyer – rated at 1,600 tonnes per hour). This is to minimise coal transfer delays from the RV conveyer to the MV conveyer and to cater for increased coal supply requirements given the upgraded capacity of the power station and the discontinuation of trucked coal supplies. It is unlikely that the coal conveyer would require upgrade under the dual fuel option as the existing conveyer would likely have sufficient capacity to deal with the lower fuel load of coal. 	<ul style="list-style-type: none"> • approval for ash disposal options should additional storage capacity be required.
In the Case of Dual Fuel Option	
<ul style="list-style-type: none"> • installation of gas pressure and temperature regulation station to regulate gas delivery to the power station including reticulation piping; and • replacement of existing oil burners within the boiler with gas burners including associated gas detection and monitoring systems; 	<ul style="list-style-type: none"> • approval for gas pipeline option to transport gas onto the site.

The proposed rehabilitation would be confined to the existing disturbed footprint of the power station (with most work involving refurbishment to internal plant components rather than earthworks), including the coal conveyer upgrade which would be confined to the existing disturbed 10 metre wide conveyer easement. The rehabilitation, (excluding gas pipeline and carbon capture storage development) is expected to take approximately 24 months to complete and generate approximately 150 construction jobs. The rehabilitated power station would not generate any additional operational jobs, however would continue to retain and extend the employment of existing personnel.

2.2 Project Need and Justification

The Proponent has identified the need for the project as being to help address expected growth in electricity demand and potential deficits in baseload electricity supply in New South Wales in the medium to long-term. Based on 2009 electricity demand predictions by Transgrid and recent economic forecast as part of State and Commonwealth budgets, the Proponent has identified that native energy demand in New South Wales in 2015/16 would be 6,480 to 9,770 gigawatt hours higher than 2008/09 levels and up to 11,420 to 15,270 gigawatt hours by 2018/19 depending on the rate of the State's economic growth. The Proponent highlights that none of the predictions take into account the potential for new major industrial development which would have additional implications on demand.

No new base load power stations have been constructed in New South Wales since the Mount Piper Power Plant at Lithgow in 1993. The Proponent has identified that even considering growth in the renewable generation sector with the expanded renewable energy target, without the addition of new base load generating capacity, existing state-owned coal fired generators would be required to sustain a 17% increase in output above 2008/09 levels to achieve forecast demand in 2015/16. This is considered to be an untenable position with respect to maintaining a reliable electricity network, given that the oldest of these plants will be 45 years old by 2015/16. Based on this, the Proponent has identified that there is a need for the development of new base load capacity in New South Wales.

In this regard, the Proponent has highlighted the benefits of the Munmorah rehabilitation project in being capable of being refurbished and available for sustained base load operations within a relatively short timeframe (24 months) and low capital expenditure (approximately one third of the cost of a new ultra super critical power station). Compared to the long-lead time normally associated with new power station development (up to 10 years when considering time associated with planning approvals, detailed design, contracting, construction and commissioning), the Munmorah rehabilitation project represents a means of introducing additional base load capacity to the network in a timely manner that coincides with predicted shortfalls.

Compared to greenfield generation projects, the Munmorah rehabilitation project also has the advantages of comprising an already developed site with established buffer areas to nearest sensitive receptors (including landuse restrictions to prevent future development close to the power station), an operational workforce and functional facility. This includes all required ancillary infrastructure being either already developed (e.g. transmission lines), requiring relatively minor upgrade (e.g. the coal conveyer), or readily available for future development if required (e.g. the gas transmission pipeline). Compared to inland development sites, the coastal location of the site also provides advantages with respect to ready access to water supplies for cooling purposes (the main source of water demand at base load power stations) in time of water scarcity such as drought. On the above basis, the Proponent has suggested that the proposal would provide a cost effective and viable solution to addressing shortfalls in base load generation capacity in New South Wales.

Department's Consideration

The issue of whether additional baseload electricity generation is needed, the justification for proceeding with a fossil-fuelled power station now or in the future and the balance between the benefits (and "disbenefits") of such a generator compared with alternative measures to address energy demand have been issues of substantial debate since inception of the current proposal. It is clear from submissions received in response to the subject application that the issue of justification of the proposal, particularly in light of alternative energy supply measures and the impacts of climate change, are of significant public concern (90 per cent of all comments made in submissions related to these issues).

Submissions received on the proposal had a focus not only on the impacts of climate change, but also questioned the need for additional baseload electricity generation. Submissions consider that the Government has not adequately consulted with the public over the need and justification for additional (fossil-fuelled) baseload power, and whether such a power station is preferable in light of alternative electricity supply and demand management measures, which may be less greenhouse intensive.

While the Department considers that the direct environmental impacts associated with the proposed power station could be mitigated and managed to achieve acceptable environmental outcomes, the strength of sentiment in public submissions suggests that implementation of either the coal- or dual-fuel option, whether now or in the future, is likely to meet public opposition, irrespective of how the proposal may be modified or amended.

The Department considers that an assessment of the need and justification for the proposed power station must begin at first principles and be undertaken in the context of the essential nature of energy and a robust approach to risk management.

In undertaking such an assessment, the Department considers that arguments around need and justification are based on analysis of four key points:

1. the need for, and timing, of additional electricity generating capacity;
2. the consequences of not providing additional electricity generating capacity at the appropriate time;
3. the role of diversity and alternatives in a robust risk management framework; and

4. consideration of the temporal nature of regulatory and market-based issues.

Need for and Timing of Additional Electricity Generating Capacity

Owen Inquiry into Electricity Supply in New South Wales (2007)

On 9 May 2007, the then Premier announced the establishment of the Inquiry into Electricity Supply in New South Wales, and the appointment of Professor Anthony Owen, professor of energy economics at the Curtin University of Technology, to undertake the Inquiry (now commonly referred to as the "Owen Inquiry"). One of the terms of reference for the Owen Inquiry required a [r]eview of the need and timing for new baseload generation that maintains both security of supply and competitively priced electricity. The Owen Inquiry Report was finalised and publicly released on 11 September 2007.

The Owen Inquiry Report (Owen, 2007) presented a comparison and analysis of energy demand forecasts (based on data from the 2007 Transgrid Annual Planning Report) and an expected maximum energy capability of New South Wales power generators. The Owen Inquiry Report estimated that annual energy demand in 2013-14 is likely to be around 10,500 GWh higher than 2006-07 levels. Owen made a number of reasoned assumptions about the achievable capacity factors of generators, the future status of some generators (including the decommissioning of Munmorah and the commissioning of Colongra, Tallawarra and Uranquinty power stations), the future potential for inter-regional transfers with Queensland and Victoria and the capacity for energy demands to be reduced through energy efficiency savings. Taking all of these factors into account and based on the lead times associated with the construction of new power generating facilities (particularly coal-fired, and to a lesser extent, gas-fired power stations), the Owen Inquiry Report recommended that measures be taken to ensure that additional generating capacity was available by 2013/2014. Such measures include securing relevant environmental and planning approvals.

As with any predictive exercise that seeks to determine the position of a complex system at some point in the future, Owen's attempt to pinpoint the time in future at which New South Wales may require additional generating capacity carries with it the cumulative uncertainties of each of the assumptions on which it is based. Owen's task in this case was made even more challenging by the fluid and evolving nature of energy policy, regulation and markets. While any one of the many assumptions that went into Owen's considerations may be debated by the relevant stakeholders, the Department considers that such debates do not shift the broader, fundamental findings presented in the Owen Inquiry Report and reiterated in Owen's separated response to criticisms of that report (Owen, 2009):

1. based on forward projections of energy demands, there is expected to be a point sometime in the next five to ten years where energy demands will exceed energy generation capacity;
2. energy efficiency measures, carbon pricing and renewable energy initiatives have the potential to offset growing energy demands; and
3. if growing energy demands are not fully offset by measures such as these, then New South Wales needs to be prepared for investment in additional generating capacity. This means having additional 'shovel-ready' generating capacity available for implementation if and when it is required, and by corollary, taking steps now to ensure 'shovel-readiness' in future.

The Department considers that these fundamental principles are sound, and should form the basis of consideration of the Munmorah Rehabilitation (similar to the recent assessment of two other baseload power stations: the Mount Piper Extension and the Bayswater B Power Station projects). In the Department's view, Owen identified a future risk of an energy generating shortfall and recommended that the State be in a position to manage that risk, if and when it eventuates.

Recent Transgrid Annual Planning Reports (2008-2010)

Since the Owen Inquiry Report (based on a medium economic growth scenario in Transgrid's 2007 Annual Planning Report supporting a forecast 1,600 GWh per annum growth in energy demand), Transgrid's Annual Planning Reports have presented a decline in forecast energy demand growth. In 2008, this figure had fallen to approximately 1,400 GWh (Transgrid, 2008: 3) and in 2009 to 1,200 GWh (Transgrid, 2009: 3). The two key factors contributing to these reductions in forecast energy demand growth were a lower economic growth outlook and allowances made for residential energy demand reduction measures, specifically, the phasing out of incandescent light bulbs, accelerated uptake of solar hot water systems and small-scale rooftop photovoltaics (Transgrid, 2008: 21; Transgrid, 2009: 19). Transgrid also highlighted a predicted reduction in forecast scheduled

energy demand based on assumed 'much stronger energy contributions from non-scheduled generators, particularly wind farms' (Transgrid, 2009: 22).

Nevertheless, the most recent Transgrid Annual Planning Report, forecasts an increase in energy demand growth with energy projections being 3,034 GWh, or 3.8 per cent, on average (for the common forecast period 2010-11 to 2018-19) higher than 2009 projections. Transgrid has noted that these differences are due to changes in key assumptions used in previous projections primarily, the higher than expected economic growth rates based on faster than expected recovery from the global financial crisis.

In each of the Annual Planning Reports from 2008 to 2010, Transgrid has also highlighted the uncertainty around the timing, scale and effect of the Commonwealth Government's Carbon Pollution Reduction Scheme (CPRS). The CPRS has the potential to affect electricity prices, demand for electricity and investment in renewable energy alternatives, but the extent to which this effect presents itself will depend on the timing of the CPRS and, more significantly, the net carbon reduction outcome targeted by the Scheme.

Current Australian Energy Market Operator Statement of Opportunities (2010)

Based on forecast energy demand growth consistent with Transgrid's medium growth estimate among other contributing sources, the Australian Energy Market Operator (AEMO) has prepared and published the annual Statement of Opportunities for 2010. In that report, AEMO predicts that low reserve conditions (LRC) may occur in New South Wales during 2016/2017 (with a predicted shortfall of 27 megawatts) but more likely in 2017/18 (with a predicted shortfall of 416 megawatts) (AEMO, 2010). AEMO also predicts that this shortfall would increase to 1,335 MW by 2019/2020. In its simplest terms, the LRC point is the time at which the network reliability standard may not be met, and at which point loadshedding may be required and brown-outs may occur in some areas. It is important to note that the LRC does not equate to widespread blackout conditions, although continued demand growth beyond the LRC without provision of additional generating capacity increases the need for loadshedding and exacerbates issues with the quality and reliability of supply (i.e. brown-out extent, severity and duration).

The predicted 2010 LRC point in 2016/2017 is a revision from the 2009 estimate of 2015/2016 and the 2008 estimate of 2014/2015, principally due to the commissioning of a number of gas-fired power stations in New South Wales (including Tallawarra, Colongra and Uranquinty), the expected completion of the upgrade to the Eraring Power Station and the expected upgrade of Tumut 3. The 2010 LRC is also a revision from the Owen Inquiry estimate of 2013/2014 and also the 2007 Statement of Opportunities LRC in 2013/2014. A key assumption applied in the 2010 Statement of Opportunities (as with previous Statements and in the case of the Owen Inquiry) is the decommissioning of the Munmorah Power Station around winter 2014, with a consequent reduction in New South Wales generating capacity of 600MW – as indicated in this report, should approval be granted for this project, the power station may be rehabilitated and recommissioned in the future, if required.

Expected Timing of Additional Generating Capacity Requirements

It has only been three years since the publication of the Owen Inquiry Report, but during that time, the predicted timing of a generation capacity shortfall in New South Wales has similarly shifted by three to four years. This in itself is sufficient to suggest that a level of caution should be applied to predictions made about events five to ten years into the future, based on several assumptions which themselves carry levels of uncertainty. Further, the changing regulatory, policy and market setting for electricity generation in New South Wales and more broadly across the National Electricity Market is another significant factor that has the potential to substantially and rapidly affect future predictions.

It is in this context that the Department considers that estimates of the New South Wales LRC point in 2016/2017 -2017/18 should be viewed with requisite caution and as a current 'best guess' estimate. On the one hand, this estimate may prove to be too early if significant progress is made with demand management, energy efficiency, new (and currently approved) additional renewable generation capacity, and if domestic and international economic activity remains depressed. However, and equally, the 2016/2017 -2017/18 date may prove to be too late if update of demand management and energy efficiency measures is less vigorous than expected and if there is a significant improvement in economic activity (for example, if Transgrid's high economic growth scenario eventuates, rather than the medium/ base scenario). On this latter point, the Department also highlights that demand growth predictions and estimates of the New South Wales LRC point have not accommodated any

potential for sudden significant increases in demands, as may be expected with the establishment of major new energy-intensive developments or industrial complexes. As an example of this, the existing Tomago Aluminium smelter has a constant energy demand of 900MW – establishment of another (hypothetical) energy-intensive industry such as the smelter has the potential to shift the LRC *forward* by several years. In short, it is prudent to bear in mind that energy supply-demand balances have been based on extrapolation of current and historical information (with some reasoned accommodation of variability and change over time), and that potentially different future conditions (relative to the assumptions underpinning the forecasts) may change the conclusions reached by Owen, Transgrid and AEMO.

Based on this reasoning, the Department considers it prudent to take a broad, strategic approach to the issue of timing of additional generating capacity by accepting that such additional capacity *may be required* at any point in the period 2014-2020. That is to say, additional generating capacity should be available for implementation within that period, *if required*, rather than conclusively determining a date for implementation at this time. To do otherwise is to fail to recognise that estimates such as the LRC point are not fixed and determinative, but rather constrained by the uncertainties inherent in the assumptions around matters such as future market conditions, domestic and global economics, demand management and energy efficiency uptake. This approach is consistent with the Owen Inquiry recommendations, and Owen's own clear distinction between the need to be *prepared* and the act of *implementation* (Owen, 2007: 575).

Consequences of Not Providing Additional Generating Capacity

The Department considers that the consequences associated with reaching the LRC point in New South Wales, and the consequences of potentially going beyond that point, are fundamental to contextualisation of the need and justification arguments for the project. As noted above, low reserve conditions represent the point at which the National Electricity Market Reliability Standard may not be met – that is, less than 99.998 per cent of consumer demand is met (or alternatively, that annual levels of unserved energy demand over the long-term exceed 0.002 per cent). It is at this point that network intervention may be required to loadshed.

Any loadshedding event will have negative economic and/ or social impacts, and in some circumstances may even have negative environmental impacts (including, for example, the impacts associated with alternative, temporary power supplies). Around the LRC point, these negative impacts may simply be no more than inconvenience, with the net economic loss potentially being limited. However, beyond the LRC point continued growth in demand will place greater pressure on the network and will ultimately lead to more significant impacts. While any loadshedding that may occur across the network under these circumstances will be managed and undertaken in a controlled manner, it is inevitable that without action to address generating capacity shortfalls that non-essential consumers (including, for example, energy-intensive manufacturing) will be called upon to shed some or all of their usual load. Shortly beyond the LRC point, the negative economic impacts of such actions may be limited, but if allowed to continue over the longer term, or to worsen in frequency, duration or extent then it is likely that cumulative economic impacts will become significant. Loadshedding may also affect the extremities of the network, generally rural and regional communities, with impacts ranging from initial inconvenience to more significant economic and social impacts in the longer term.

The adverse impacts of operating up to and beyond the LRC point are also an issue in terms of perception and in terms of future growth. Development is attracted to New South Wales based on a number of contributing factors, including the availability and security of essential services, such as electricity provision. Even if the LRC point is not reached, but simply approached, the perception that there isn't, or will not be, sufficient secure energy supplies to continue to support development and to accommodate future development could have a very significant negative effect on further investment in the State. This is particularly relevant in the case of larger-scale, more energy-intensive industrial and manufacturing developments (noting again that demand growth forecasting has not assumed any major new industrial load). This effect is likely to remain as a perception as the State approaches the LRC point, but would become a clear reality once the LRC point is reached: development and investment potential would be significantly impacted in those areas and those sectors that rely on a secure energy supply and for which such a supply has not been provided.

In this context the Department considers it highly undesirable for the State to reach the LRC point or to move beyond it. Ideally, the State will have sufficient installed capacity at any one time to accommodate growth in demand for at least the lead time(s) necessary to implement further measures to keep pace with the growth in

demand. The consequences of not doing so (and going beyond the LRC point) are considered so significant that all reasonable measures should be implemented to minimise the likelihood of those consequences becoming reality.

Diversity and Alternatives in a Robust Risk Management Framework

Consistent with rigorous risk management practice, where a consequence is considered unacceptable, the principal focus should be on minimisation of the likelihood of occurrence. There are a number of measures available to deal with the risk (likelihood) of New South Wales reaching low reserve conditions. These can be broadly grouped into those measures that reduce or limit demand (demand management measures), those that aim to improve the efficiency of existing energy consumption (energy efficiency measures) and those that provide additional generation capacity (generation capacity measures).

It may be tempting to select and elevate one of these groups of measures (demand management, energy efficiency or generation capacity), or a subset of those measures as the single, preferred solution for energy supply-demand management in New South Wales. However, a single group of measures in isolation is inadequate, and inappropriate, in the context of a comprehensive and robust risk management approach and, in some cases, insufficient to fully address the extent of the predicted supply-demand imbalance. As a consequence, the preferable and prudent approach to take is support of all three groups of measures in order to provide the greatest protection against an adverse supply-demand imbalance and to provide a balance between the benefits and constraints of each set of measures.

On the one hand, measures focused on demand management and energy efficiency have practical, social and economic limits. There is a practical extent to which energy efficiency can be improved given current technological advancement, and demand management is similarly constrained by the limits of what can be realistically achieved. There is also a limit to which society at large can and will accept constraints on energy consumption. Ultimately there will be an economic limit placed on the extent to which demand management and energy efficiency measures can be applied if economic growth is still desired. On the positive side, however, many demand management and energy efficiency measures can be pursued with minimal direct environmental or amenity impacts and without significant capital investment. Demand management and energy efficiency are therefore fundamental requirements moving forward with management of energy supply and demand in New South Wales (and more broadly across the National Electricity Market). Further, there is question as to whether demand management measures and energy efficiency schemes and programs could, on balance, support a reduction in energy consumption sufficient to offset the entire average annual growth in energy demands. While these measures may offset energy demands in the short to medium term, it is likely that in the longer term, annual growth in energy demands will outstrip demand management and energy efficiency measures (based on existing technology). As noted in the current Transgrid Annual Planning Report "growth (in energy demand) has continued despite concerted efforts to curb demand through demand management initiatives. Although a substantial policy change is proposed that may dampen future load growth, options still need to be developed to meet the expected demand growth to ensure reliability of supply to support the expected economic and population growth of New South Wales." (Transgrid, 2010: 6).

While demand management and energy efficiency measures have a key role to play, it is apparent that these approaches will not serve to entirely mitigate the risk of a supply-demand imbalance. Therefore, additional generating capacity is a real and necessary requirement to ensure a secure energy system for the State into the medium and longer term. Options available in the suite of generation capacity measures include fossil-fuelled projects, such as the development the subject of the current application, and renewable energy projects, including wind farms, solar power, geothermal facilities, hydro-electric installations and similar technologies.

Renewable energy developments are likely to play an important role in the provision of sustainable energy to address the State's demands into the future. However, and despite a number of approved and proposed wind farm projects in New South Wales, the implementation of wind energy projects (and other renewable energy proposals) is currently not being undertaken at a rate sufficient to address the predicted generation shortfalls. This circumstance may change in future, but at this time it would be imprudent to rely solely on renewable energy projects to address the energy supply-demand balance predictions. There are also existing technical constraints with connection of developments such as wind farms to the grid that need to be resolved if renewable energy projects are to move from being a contributor to a majority component of the State's energy supplies.

In short, the Department considers that the most effective means of ensuring an energy generation and supply system that is effective, secure and environmentally balanced is to deliver a diverse range of energy generating options. Beyond that, market factors, consumer choices and carbon regulation will ultimately regulate generation options from the diverse suite of alternatives available. Demand management and energy efficiency measures will make an important contribution to addressing the future energy-supply demand balance, and wind farms (and other renewable energy projects) similarly have the potential to make significant contributions in this regard. However, it would be imprudent to rely solely on these measures to secure the State's energy supplies given the potentially significant consequences of reaching or passing the LRC point. It is important to have a suite of approved, environmentally acceptable energy generating developments that *could be implemented* if required in future. As highlighted by Owen, the State needs to be *prepared* to implement these options if they are needed (Owen, 2009: 575). If demand management, energy efficiency and renewable energy projects by themselves negate the need for significant additional non-renewable power generation capacity in future, it will be a positive outcome for the State. However, if these measures are relied upon solely to address the predicted energy supply-demand imbalance, the State runs a serious, unacceptable risk of deleterious outcomes in future if these measures fall short of that mark. It is in the interests of the State, and the public, to make all options available for implementation, if needed in future.

The Temporal Nature of Regulatory and Market-Based Issues

If it is accepted that a new non-renewable power generating facility is required in New South Wales in future, then two questions naturally flow in the context of the assessment of the subject and similar applications:

1. why is approval required for gas-firing and dual-fuel options?
2. why is approval required for all three baseload power station projects: Munmorah Rehabilitation, Mount Piper Extension and Bayswater B?

The responses to these two questions largely lies in the arguments already presented above in relation to the uncertainties associated with predicted future conditions (in this case, regulatory and market conditions) and the need to facilitate a diversity of options to manage risk. On the first point, a number of submissions have argued that if dual-fuel firing and coal-firing are current viable options, then dual-fuel firing should be approved and coal-firing excluded based on the superior environmental performance of the dual-fuel option (particularly in relation to greenhouse gas intensity). While this argument may hold some weight under existing regulatory and market conditions, it may not continue to be so into the future. In future there may be constraints in place that affect the viability of either the dual-fuel or the coal-fired option. The most simple of these possible constraints may be availability and cost of fuel, the ability to economically source the necessary technologies, the existence of a carbon price or other market instrument that affects the viability of one technology over another, or a regulatory or policy framework that tips the balance between the technological options. In the context of risk management, it would be imprudent to exclude either fuel source option, based on a comparison of the relative impacts of the two, if both options meet acceptable environmental and amenity outcomes. To do so would be to run the risk that future conditions in fact make the approved technology unviable, with no approved alternative.

This issue also calls into question the role of the planning system, and the environmental impact assessment process, in determining or influencing issues such as fuel source/ nature and independent market mechanisms (such as exist in the National Electricity Market). The Department is required to assess the merits of applications that come before the Minister for Planning against established standards, guidelines and policies. It is beyond the role of the New South Wales Planning system, and this assessment, to set policy relating to carbon regulation and pricing, to set policy on preferred fuels and renewable energy targets, or to establish and implement market-based instruments that would influence these matters. The Department has, however, considered the project (including both dual-fuel and coal-fired options) against existing regulations, policies and standards and considers that both fuel options are not contrary to or inconsistent with existing regulations, policies and standards set by State or Commonwealth Governments.

The second question raised in submissions focuses on the need for all three current baseload generating projects: project application for Munmorah Rehabilitation and concept plan applications for Mount Piper Extension and Bayswater B. In broad terms, the answer again lies in the need to provide a diverse set of options for possible implementation, if required. It is important to highlight, as has been done in submissions, that all three projects will not be required in order to address the generating capacity shortfall predicted over the coming decade. However, there is no guarantee that if all three projects are approved that all three will be viable for

implementation at the time they are required and that the relevant owner of the planning approval will be in a position to act on the approval at that time. The Department therefore considers it justified that all three could be approved, subject to demonstration of acceptable environmental and amenity outcomes. Ultimately it will be the electricity market, and the regulation and policies that influence its operation, that determines whether any or all of the projects are implemented and the timing of implementation. It is difficult to conceive that any of the approvals would be acted upon unless the party acting on the approval was reasonably confident that there was or would be a market to accept its supply of electricity. Such a market would either be present as a result of an identified shortfall in generating capacity to meet demand, or if the relevant party considered that its particular power station project was appropriately placed to out-compete another generator.

On this latter point, submissions have also suggested that if all three baseload power projects are approved and implemented, they have the potential to displace renewable energy generators and to entrench coal-fired power generation. The Department recognises that entry of any or all of the three baseload power projects into the market has the potential, under some conditions, to displace other generators within the 'market hierarchy' – this may include renewable energy projects as well as generation from non-renewable sources. This is, however, the fundamental and necessary nature of the independent, competitive energy market. It is beyond the scope of the planning system and the Department's assessment of these projects to influence or set the direction of such an independent, competitive market. It is, however, the responsibility of Government (State and Commonwealth, as appropriate) to implement regulatory and market instruments (such as the Carbon Pollution Reduction Scheme) to give effect to Government policy on these matters, and to ensure that the 'market-hierarchy' aligns with any applicable Government policy in these areas.

Conclusion

In summary, the Department considers that the Munmorah Rehabilitation project is justified as an important and necessary component of a broader suite of demand management, energy efficiency and capacity generating measures to secure the State's energy supplies into the future. This position is derived from considerations as follows:

1. the need to address the potential for a demand-supply imbalance predicted to occur between 2014 and 2020;
2. the potential significant adverse consequences of not addressing this demand-supply imbalance;
3. the need to comprehensively minimise the risk (likelihood) of these potential significant adverse consequences through a diverse suite of options, including demand management, energy efficiency and generation capacity measures;
4. the importance of not pre-empting future regulatory, market and practical conditions by limiting fuel supply options at this time (subject to both fuel supply options being demonstrated as compliant with established environmental and amenity standards);
5. the risks inherent in delivering large-scale infrastructure projects, and the need to manage such risks through the provision of more than one potential option for future implementation, if required; and
6. the importance of regulation and market-based instruments in delivering Government policy outcomes in the independent, competitive energy market, rather than the New South Wales planning system.

The Department also accepts that the Munmorah Rehabilitation Project provides inherent advantages with respect to providing a cost effective and viable option for meeting the electricity requirements of the State including the short timeframe for rehabilitation, low capital expenditure, and existing established facilities and infrastructure.

3. STATUTORY CONTEXT

3.1 Major Project

The project is declared to be a Major Project under *State Environmental Planning Policy (Major Development) 2005* because it is development for the purpose of an electricity generation facility through coal or gas fired generation that has a capital investment value of more than \$30 million (Schedule 1, Group 8, clause 24(a)). The project is therefore subject to Part 3A of the *Environmental Planning and Assessment Act 1979* (the Act) and the Minister for Planning is the approval authority.

3.2 Critical Infrastructure

On 26 February 2008, the then Minister declared development for the purposes of a facility for the generation of electricity that has a capacity to generate at least 250 megawatts and is the subject of an application lodged pursuant to Section 75E or 75M of the Act prior to 1 January 2013, to be critical infrastructure pursuant to Section 75C of the Act. The proposal meets the definition of critical infrastructure under this order, as the facility is proposed to generate at least 250 megawatts and is subject to a project application lodged pursuant to Section 75E of the Act prior to 1 January 2013.

3.3 Permissibility

The power station rehabilitation works would be confined to existing power station land which is zoned "5(a) Special Uses (Power Station)" under the *Wyang Local Environmental Plan 1991* (Wyang LEP). The rehabilitation works are permissible under this zoning. The coal conveyer upgrade would similarly be confined to the existing coal conveyor easement, the majority of which is located on land zoned "5(a) Special Uses (Power Station)" under the Wyong LEP. Small sections of the easement also traverse land zoned "6(a) Open Space and Recreation" and "7(g) Wetland Management" under the Wyong LEP. The proposed upgrade of the coal conveyer is permissible under each of these zonings.

3.4 State Environmental Planning Policy

With the exception of *State Environmental Planning Policy (Major Development) 2005*, there are no state environmental planning policies that substantially govern the carrying out of the proposal.

3.5 Minister's Approval Power

The Proponent submitted an Environmental Assessment with the Director-General in October 2009. Pursuant to Section 75H and 75I(2)(g) of the Act, the Director-General was satisfied that the Environmental Assessment had addressed the environmental assessment requirements issued on 4 July 2009. A copy of the Environmental Assessment is attached (see Appendix D).

The environmental assessment was placed on public exhibition from 21 October 2009 until 20 November 2009 and submissions invited in accordance with Section 75H of the Act. The Environmental Assessment was also made publicly available on the Department's website.

Following the exhibition period, the Director-General directed the Proponent to respond to the issues raised in submissions. As the project will require an Environment Protection Licence under the *Protection of the Environment Operations Act 1997*, a copy of the submissions were also provided to the Department of Environment, Climate Change and Water, pursuant to Section 75GH of the Act. The Submissions Report (see Appendix C) prepared by the Proponent was subsequently made publicly available on the Department's website.

The Department has met all its legal obligations so that the Minister can make a determination regarding the project.

3.6 Objects of the *Environmental Planning and Assessment Act 1979*

Section 5 of the *Environmental Planning and Assessment Act 1979* details the objects of the legislation. The objects of the Act are:

- (a) to encourage:
 - (i) the proper management, development and conservation of natural and artificial resources, including agricultural land, natural areas, forests, minerals, water, cities, towns and villages for the purpose of promoting the social and economic welfare of the community and a better environment;
 - (ii) the promotion and co-ordination of the orderly and economic use and development of land;
 - (iii) the protection, provision and co-ordination of communication and utility services;
 - (iv) the provision of land for public purposes;
 - (v) the provision and co-ordination of community services and facilities;
 - (vi) the protection of the environment, including the protection and conservation of native animals and plants, including threatened species, populations and ecological communities, and their habitats;
 - (vii) ecologically sustainable development;
 - (viii) the provision and maintenance of affordable housing; and
- (b) to promote the sharing of the responsibility for environmental planning between the different levels of government in the State; and
- (c) to provide increased opportunity for public involvement and participation in environmental planning and assessment.

Of particular relevance to the environmental impact assessment and eventual determination of the subject project application by the Minister, are those objects stipulated under section 5(a). Relevantly, the objects stipulated under (i), (ii), (iii), (vi) and (vii) are significant factors informing determination of the application (noting that the proposal does not raise significant issues relating to land for public purposes, community services and facilities or affordable housing). With respect to ecologically sustainable development, the EP&A Act adopts the definition in the *Protection of the Environment Administration Act 1991*, including the precautionary principle, the principle of inter-generational equity, the principle of conservation of biological diversity and ecological integrity, and the principle of improved valuation, and pricing of environmental resources.

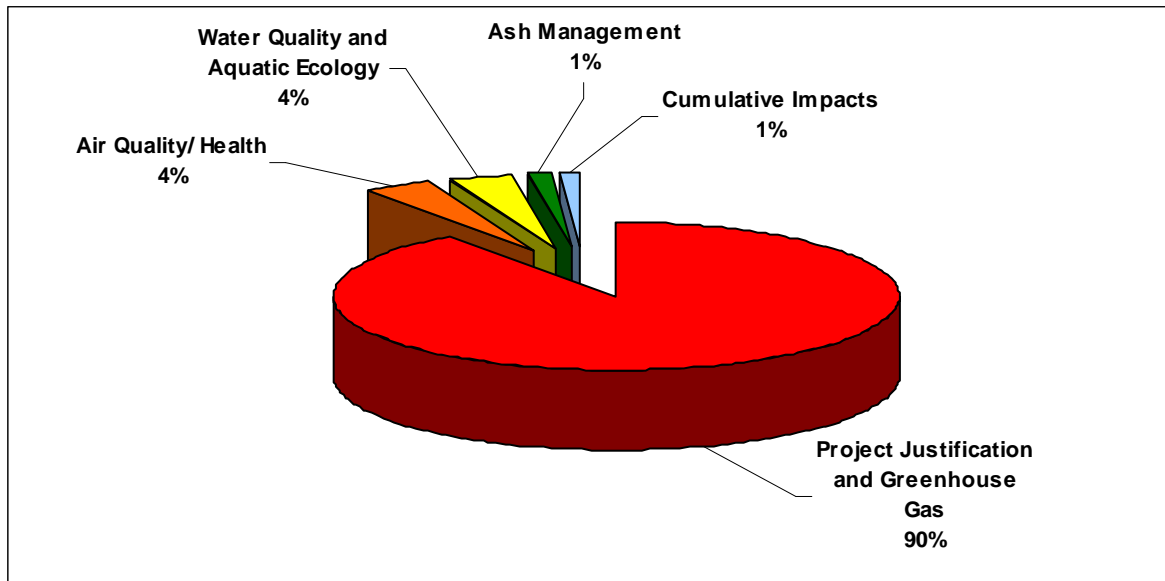
It is important to recognise, that while the EP&A Act includes amongst its objects that the principles of ecologically sustainable development be encouraged, it provides other objects that must equally be included in the decision-making process for the subject proposal. The Department has considered the need to encourage the principles of ecologically sustainable development, in addition to the need for the proper management and conservation of natural resources such as water resources; the orderly development of land; and the protection of the environment as outlined in Section 5 of this report. The agency and community consultation undertaken as part of the assessment process (see Sections 3 and 4 of this report), address objects 5(b) and (c) of the Act.

4. CONSULTATION AND ISSUES RAISED

4.1 Public Submissions

The Department received 34 public submissions on the project during the public exhibition period and one late submission after the close of exhibition. Of these, 32 objected to the project and two indicated support as long as a gas-based option was pursued (one supported the dual-fuel option, whilst the other supported the project only subject to it being modified to be fuelled by 100% gas). The remaining submission did not state a particular position although raised issues for consideration in the Department's assessment. The key issues identified in public submissions are summarised in Figure 3 below.

Figure 3: Issues Raised by Public Submissions



4.2 Submissions from Public Authorities

Seven submissions were received from public authorities: the Commonwealth Department of Defence, NSW Department of Environment, Climate Change and Water (DECCW) including the NSW Office of Water, NSW Health, NSW Roads and Traffic Authority, Wyong Shire Council, Lake Macquarie City Council and Marrickville Council. Marrickville Council objected to the project on the basis of potential climate change impacts from coal fired power stations. The Department of Defence, DECCW and NSW Office of Water indicated no objection to the project subject to conditions. NSW Health raised support for the dual fuel option maximising the use of gas. The remaining agencies did not state a specific position but raised issues for the Department's consideration.

Commonwealth Department of Defence (DoD)

- Noted that the power station is located approximately 50 kilometres from the nearest RAAF Base at Williamstown.
- Noted that the height of the structure and associated exhaust plumes could pose an aviation hazard.
- Indicated that DoD would have no objections to the project subject to the proposal being assessed for aviation safety by the Civil Aviation Safety Authority.

NSW Department of Environment, Climate Change and Water (DECCW)

- Raised concerns regarding the sufficiency of the Proponent's air quality assessment with respect to: SO₂ predictions at nearest sensitive receivers; fugitive emissions associated with pre-combustion coal handling; cumulative impact assessment of hydrogen fluoride, mercury cadmium and dioxins; inaccurate SO₂ and NO₂ contour plots; representativeness of background data used in determining cumulative contributions from other power stations including Colongra, Vales Point and Earing; inaccurate interpretation of meteorological data; and lack of identification of sensitive receptors including sensitive landuses with respect to hydrogen

fluoride emissions. DECCW recommended that an updated air quality assessment be presented as part of the Proponent's response to submissions.

- Recommended conditions of approval with respect to greenhouse gas emissions requiring the Proponent to evaluate and report on the availability and feasibility of measures to reduce and/or offset greenhouse gas emissions from the project.
- Considered that the Proponent's noise assessment had provided sufficient information to demonstrate that the proposal could be developed to achieve compliance with relevant noise criteria and recommended conditions of approval with respect to noise limits and ongoing performance verification and monitoring requirements.
- Required clarification on whether the cooling water discharge modelling undertaken to determine impacts on seagrass distribution represented "worst case" impacts. Recommended condition of approval requiring ongoing monitoring of seagrass distribution and where impacts were attributable to the project ameliorative measures to be implemented or the impacts offset. Also recommended conditions of approval requiring ongoing investigation into alternatives for discharge of cooling water into the estuarine lake for implementation in the future where practicable.
- Noted that the Proponent's assessment of potential water quality impacts from the ash dams to the lakes (including bio accumulation) were based on dated studies and recommended a condition of approval requiring the Proponent to carry out water and sediment quality studies to determine the mass load of metals being discharged and requiring the Proponent to investigate and implement where practicable alternative methods for ash management which eliminated the need for discharge into the lakes system.
- Recommended conditions of approval with respect to Aboriginal heritage requiring the protection of the existing identified objects on site (including appropriate buffer areas) and ensure that construction work within the conveyer corridor be undertaken in consultation with relevant Aboriginal heritage stakeholders.
- Noted that the level of ecological assessment undertaken for the project was adequate based on the lack of vegetation disturbance proposed as part of the project.
- Noted that depending on the final methodology determined for addressing future ash disposal, the ash disposal method may result in additional impacts including dust, water quality and flora and fauna (if additional expansion was proposed) and would need to be assessed appropriately in the future. Recommended a condition of approval requiring the Proponent to investigate and implement where practicable alternative methods for ash management including reuse opportunities.

NSW Office of Water (NOW) (part of DECCW)

- NOW indicated support for the project subject to it complying with current water licensing requirements and that any additional water supply is sourced in accordance with the principles and access rules in force under the *Central Coast Water Sharing Plan 2009* and recommended conditions of approval in this regard.

NSW Health

- Noted that increased greenhouse gas emissions could adversely impact on the environment and thereby indirectly impact on human health. Noted that all practical steps should be taken to reduce and mitigate greenhouse gas emissions and in this regard supported the dual-fuel option which maximised the use of gas.
- Noted that sulfur dioxide, nitrogen oxides and particulates are associated with a range of short and long term health effects including exacerbations of chronic respiratory conditions and introduction of cardiopulmonary disease.
- Considered that the air quality assessment presented in the Environmental Assessment is insufficient for a comprehensive health impact assessment and recommended further modelling to present predicted incremental increases in SO₂, NO₂ and PM₁₀ at representative sensitive receivers and recommended that the modelling be independently assessed by DECCW to validate the Proponent's air dispersion predictions.
- Noted that the World Health Organisation (WHO) guideline values for 10 minute and 24 hour SO₂ concentrations (500 µg/m³ and 20 µg /m³, respectively) are predicted to be exceeded and recommended that best practice mitigation methods be incorporated into the project including maximising the use of gas and the use of low-sulfur coal, where possible. However, noted that comprehensive health assessment is not possible given the limitations of the assessment.
- Noted that the project appears to meet the WHO guidelines for NO₂ of 40 µg/m³ (annual mean) and 200 µg/m³ (1 hour mean), however noted that comprehensive health assessment is not possible given the limitations of the assessment.

- Noted that the project appears to exceed the DECCW PM₁₀ limit of 50 µg/m³ (24 hour average) and predicts an increase to annual PM₁₀ levels above background levels, however noted that comprehensive health assessment is not possible given the limitations of the assessment.
- Noted that noise can pose a general public health risk including excessive noise posing annoyance impacts. Noted that infants, school children, shift workers and people with mental health conditions are at most risk from noise impacts.
- Recommended that the Proponent's noise assessment be independently reviewed by DECCW. Also recommended that the project incorporate all reasonable and feasible noise mitigation measures to ensure compliance with project specific noise levels (with consideration to cumulative impacts from the Colongra gas-fired power station and the coal conveyer) including developing a "Noise Control Plan" in consultation with the local community.
- Noted that it was unclear from the Proponent's Environmental Assessment whether the proposal would increase electro-magnetic effects (and associated health risks) from any changes to transmission line infrastructure.

NSW Roads and Traffic Authority (RTA)

- Recommended that the Proponent consult with the RTA in determining appropriate route for the haulage of over-dimensional and over-mass plant such as turbines. Raised preference for the F3 Freeway to be used as a haulage route.
- Recommended that any haulage should be subject to an appropriate Transport Management Plan which addressed preferred routes, transportation dates and times supported by traffic volume profiles, route constraints and contingency plans for emergency situations or breakdowns. Noted that the Transport Management Plan should also address any impact to local traffic from operational maintenance activities, should these involve the transport of large equipment.
- Noted that all required permits for the transport of over-mass equipment would need to be obtained prior to the commencement of such transport during construction or maintenance activities. Noted that any works within the road corridor would require a permit under the *Roads Act 1993* from the relevant roads authority.

Wyong Shire Council

- Recommended conditions of approval in relation to noise, including the requirement to implement all reasonable and feasible noise mitigation to achieve a project specific noise level of 39 dB(A); the preparation of a commissioning acoustic noise report to determine the performance of the plant and where criteria is exceeded to undertake additional measures (including acoustic shielding at receivers) to ensure that criteria is achieved; and the preparation of a Construction Noise and Vibration management plan to manage potential noise and vibration impacts during construction.
- Raised concerns regarding the sufficiency of the Proponent's ecology assessment including:
 - Aquatic ecosystems: representativeness of seagrass data used in the assessment (i.e. use of dated data and data collected when the project was operating at low loads and recommendation that the modelling of cooling water discharge on seagrass distribution include a comparison of the rehabilitated plant against the do nothing option (i.e. Munmorah not being rehabilitated and closing down in 2012). Also noted that the assessment of cooling water discharge had not considered the potential for the proliferation of pest species, pathogens and disease. Recommended conditions requiring ongoing monitoring of seagrass distribution once the power station was operational; and
 - Terrestrial ecology: identified a number of species, communities or habitat of conservation significance which Council considered were likely to occur within the development footprint (particularly the conveyer corridor) which were not considered to have been adequately assessed by the Proponent including the Swamp Oak Floodplain Forest endangered ecological community, freshwater wetlands, ground orchid species, roosting habitat for the Large-footed Myotis and habitat of migratory birds. Council considered that insufficient details or consideration had been provided in relation to: potential impacts of groundwater and surface water leachate (e.g. boron) from ash dams (which are not clay lined) on wetlands including SEPP14 wetlands; clarification of any additional land clearance associated with ash dam expansion; impacts to revegetation work undertaken by Landcare groups; clarification of any additional clearing associated with bush fire management; impacts to remnant vegetation corridors as identified in the draft North Wyong Structure Plan (including the major east-west fauna corridor which is

- currently bisected by the coal conveyer); potential noise and artificial lighting impacts on fauna species; and the adequacy of database searches undertaken to determine the presence of threatened species.
- Noted that the viability/ span of ash dams had not taken into account climate change risks and existing practices of depositing other fill material in the ash dams.
 - Noted that the project would require an increase to the volumes of water currently supplied by Council (for use in the station's steam plant and for general domestic use including fire services) by 59 mega litres (ML) per annum to a total of 380 ML per annum following the plant's rehabilitation. Council indicated preference that this water supply be sourced from Council's recycled water supplies rather than potable supplies. Noted that the additional water supply would be subject to relevant permits under the provisions of the *Water Management Act 2000* and to additional water supply contributions. Also required clarification on whether the proposal would increase loading on Council's sewerage system. The Council identified that it was conducting discussions with the Proponent regarding the use of alternate water supplies to decrease potable water consumption and indicated that it would continue these discussions.
 - Noted that the proposal does not take adequate consideration of the principles of ecological sustainable development (particularly the precautionary principle) with respect to consideration of renewable alternatives to energy generation.
 - Noted that the ongoing use of coal would have broader implications on mine subsidence impacts associated with the mining of the resource.

Lake Macquarie City Council

- Raised no issues.

Marrickville Council

- Noted that Council had adopted a position of opposing all new coal-fired power stations in NSW on the grounds that it is incompatible with mitigating climate change.
- Noted the then Premier's support for new base load power stations in NSW to be gas-fired and requested that new coal-fired power stations be rejected in favour of investment directed towards energy efficient measures and renewable power sources.

4.3 Submissions Report

Upon review of the submissions received during the exhibition period the Department directed the Proponent to prepare a Submission Report. The Proponent's response to submissions did not lead to any changes to the project, as such a Preferred Project Report was not prepared.

The Submissions Report (including finalised Statement of Commitments) was made publicly available on the Department's website and a copy provided for comment to the Department of Environment, Climate Change and Water including the NSW Office of Water. DECCW confirmed that it was able to grant a licence for the project. The Department has considered the recommendations of DECCW (including NSW Office of Water) in formulating recommended conditions of approval for the project.

4.4 Department's Consideration

The Department's consideration of issues raised in public and agency submissions is summarised in Table 3.

Table 3: Department's consideration of issues raised in Submissions

Issue	Department's Consideration
Need and Justification	Section 2.2
Greenhouse Gas	Section 5.1
Air Quality	Section 5.2
Noise and Vibration	<p>The Department has focused its assessment of noise on operational noise impacts, noting that the project is unlikely to generate any significant risks with respect to:</p> <ul style="list-style-type: none"> • construction noise and vibration - due to the intermittent and finite nature of works; the large buffer distance between power station works (where a large percentage of the works would be confined) and nearest sensitive receptors (approximately one kilometre); and as much of works at the power station would involve internal fit-out which would be acoustically shielded by the

	<p>existing facade;</p> <ul style="list-style-type: none"> operational vibration – due to the large buffer distance between power station and nearest sensitive receptors (approximately one kilometre); and construction or operational traffic noise – due to traffic generated by the project only expected to travel existing high traffic volume roads (e.g. F3 Freeway, Pacific Highway and New England Highway), where project traffic noise is unlikely to be perceptible from existing traffic. Further, the Proponent has proposed to discontinue coal trucking into the site (such that the main source of operational traffic would be light vehicles from personnel) resulting in an overall decrease to ongoing traffic noise impacts from the project. <p>The Department's assessment of operational noise impacts is presented in Section 5.3.</p>
Water Quality and Aquatic Ecology	Section 5.4
Water Supply	<p>The Department understands that Wyong Shire Council is discussing the issue of additional water supplies for the project with the Proponent and would hold further discussions in regard to substituting potable water supplies with other water sources such as recycled water. The Office of Water expects the Proponent to comply with its current corporate licensing requirements in accordance with the rules in force under the Central Coast Water Sharing Plan 2009. The Environmental Assessment outlined water saving measures that have been implemented at the site to reduce water consumption and the document indicated that the Proponent would continue to review options for further water saving measures across its Central Coast power stations. The Proponent's Submissions Report also confirmed that the Proponent would continue to review options with Wyong Council to undertake further water savings in accordance with its Water Management Plan.</p>
Ash Disposal	<p>The Department is satisfied that the ash disposal options identified by the Proponent to address future ash disposal requirements are technically feasible noting that many of these options are currently being used successfully at other coal-fired power stations in NSW. Further, based on the Proponent's constraint analysis, the Department is satisfied the options are unlikely to pose significant environmental risks subject to appropriate management, noting the Proponent's commitment to minimise the potential for additional vegetation disturbance by increasing the dam height to gain additional storage space rather than by expansion and to confine associated infrastructure such as ash pipelines/ conveyers etc to existing disturbed corridors, where possible. Furthermore, given the existing considerable buffer distance to nearest sensitive receivers, the Department considers that any additional dust (assuming dry storage) or visual (from increase to dam height) impacts are unlikely to be intrusive and can be managed including through the implementation of appropriate rehabilitation requirements. The Department has recommended comprehensive water quality monitoring and management requirements to ensure continuous improvement of performance with respect to discharges to the Tuggerah Lakes System (refer Section 5.4) and these would apply to any future ash disposal system implemented. To ensure that future ash disposal options are determined with due consideration to environmental constraints, the Department has, consistent with DECCW requirements, recommended a condition of approval requiring the Proponent to investigate all feasible options for future ash disposal (including maximising opportunities for reuse - to reduce the requirement for storage on site) with consideration to applicable environmental criteria.</p>
Terrestrial Ecology	<p>Whilst accepting that the ecological assessment undertaken by the Proponent has some limitations, the Department is satisfied that the level of assessment is commensurate with the expected level of impact from the project. Given the negligible vegetation disturbance proposed as part of the proposal (i.e. the works at the power plant being confined to already developed and operational plant areas and works at the conveyor being limited to the existing cleared 10 metres conveyor easement) and given the extensive areas of high quality vegetation that would be retained on site (as buffer areas), the Department is satisfied that the rehabilitation project would not pose a significant risk to terrestrial ecology at a local or regional scale.</p>
Aboriginal Heritage	<p>The Department notes that the Proponent has not undertaken a quantitative Aboriginal heritage impact assessment for the project (including survey of the areas proposed to be disturbed), however is satisfied that the project is unlikely to pose a significant risk of disturbing or impacting on Aboriginal heritage values, as the works would be confined to existing disturbed and operational areas with respect to the power station and to an already disturbed corridor with respect to the coal conveyor. Notwithstanding, the Department has recommended conditions of approval requiring the Proponent not destroy, modify or impact on PAD 1 (AHIMS 45-7-0249) or PAD 2 (AHIMS 45-7-0250) and to ensure demarcation of these areas to protect them from construction activities. In addition, the Department has recommended that all works associated with the upgrade of the MV conveyor shall be undertaken within the existing disturbed corridor and that a suitably qualified</p>

	archaeologist/ Aboriginal cultural expert shall attend all soil-disturbing and excavation works to assist with the identification of any potential items of Aboriginal heritage significance uncovered during those works. In the event that previously unknown items of actual or potential Aboriginal heritage significance are uncovered, all works that may affect those items shall cease, and the Proponent shall contact and comply with the requirements of DECCW with respect to the handling and management of the items, including any requirements to consult with representatives of the Aboriginal community.
Aviation Safety	The Department is satisfied that the proposal would not pose an unacceptable risk level to aviation safety noting that the plant is located well away from airports (the nearest airfield being 10 kilometres away) and is not within major flight paths. Further, the power plant is an existing known hazard with existing tallest building elements (exhaust stacks) not expected to change height as a result of the rehabilitation and whilst the project is predicted to slightly increase volumetric flow rates at the stacks (6% higher) which could result in higher exhaust plume heights compared to existing operations, the plume rise is expected to be well below the original 'as built' plant with all four generators operating. The Civil Aviation Safety Authority and AirServices Australia were notified as part of the exhibition of the project but did not make a submission on the proposal. The Department has recommended a condition of approval requiring the Proponent to consult with the Civil Aviation Safety Authority prior to the commencement of construction, in relation to any modifications to instruments or procedures required at the Warnervale Airport, or other airports where relevant, as a result of the project and that the Proponent shall fund any such modifications.
Gas Pipeline	The Department is satisfied that the Proponent has demonstrated that there are feasible options for the delivery of gas to the site, that would not pose significant environmental constricts, should the dual-fuel option be pursued (such as the use of the existing Colongra gas pipeline or the development of a new pipeline within the existing disturbed easement of the Colongra pipeline). Whilst noting that a new pipeline would require a separate planning process, the Department is satisfied that the options identified to date for gas delivery to the site (subject to availability of supply) do not pose any unacceptable environmental risks which would preclude dual-fuel development on site.
Other Issues	The Department is satisfied that these matters have been adequately addressed in the Proponent's Submissions Report and / or Statement of Commitments.

5. ASSESSMENT OF ENVIRONMENTAL IMPACTS

After consideration of the Environmental Assessment, submissions received, Submissions Report and Statement of Commitments, the Department has identified the following key environmental issues associated with the proposal:

- Greenhouse Gas;
- Air Quality;
- Operational Noise; and
- Water Quality and Aquatic Ecology.

All other issues are considered to be adequately addressed by the Proponent's Submissions Report and Statement of Commitments.

5.1 Greenhouse Gas

Issue

The Environmental Assessment included an assessment of the greenhouse gases predicted to be emitted as a result of the Proposal. The assessment focussed on carbon dioxide (CO₂), methane (CH₄) and nitrous oxide (N₂O). The assessment used methodologies from the Australian Government's *National Greenhouse and Energy Reporting System (NGERS) Technical Guidelines* and the *NSW Greenhouse Gas Reduction Scheme (GGAS)* reporting structure. The Environmental Assessment included:

- prediction of total greenhouse gas emissions for construction and operation of the project;
- comparison of greenhouse gas emissions against NSW averages;
- consideration of mitigation measures to reduce greenhouse gas impacts; and
- methods for emissions reduction and carbon offsetting.

Brief discussion was also provided on the impacts of the Australian Government's *Carbon Pollution Reduction Scheme (CPRS)* on the proposal.

Generation of greenhouse gas emissions

The assessment undertaken by the Proponent predicted Scope 1, 2 and 3 emissions for the proposed Munmorah rehabilitation. Scope 1 emissions included point source emissions, Scope 2 emissions included emissions from purchased electricity consumed on site and Scope 3 emissions included emissions relating to the extraction and transportation of fuels. A breakdown of the predicted emissions, for both construction and operation are provided in Table 4 and Table 5 below.

Table 4: Estimated Greenhouse Gas Emissions during Construction (100% Coal Option)

Emissions	Activity	GHG Emissions (tonnes CO ₂ -e p.a.)
Scope 1	Direct Emissions from Combustion	336
Scope 2	Indirect Emissions from Electricity Usage	2,930
Scope 3	Lifecycle Assessment (production of materials and plant used)	272,926
Total	Scope 1, 2 and 3 emissions construction	276,192

Table 5: Estimated Greenhouse Gas Emissions from Operation

Parameter	100% Coal	25% Gas	50% Gas	75% Gas
Unit efficiency (HHV) (sent out)	37.5%	37.4%	37.3%	37.0%
Scope 1 emissions (tCO ₂ e/year) (at 80% capacity factor)	3,960,000	3,550,000	3,150,000	2,750,000

Scope 2 emissions (tCO ₂ e/year) (at 80% capacity factor)	90,000	90,000	90,000	90,000
Scope 3 emissions (tCO ₂ e/year)				
Extraction of coal	73,890	56,115	37,939	19,143
Transportation of Coal	10,415	7,910	5,348	2,698
Gas Exploration	0	7,351	14,876	22,660
Gas processing	0	6,144	12,433	18,939
Gas Transmission	0	8,720	8,720	8,720
Total Scope 1, 2 and 3 emissions	4,134,305	3,726,240	3,319,316	2,912,160

From the data provided in Tables 4 and 5, construction of the rehabilitated plant is predicted to generate 276,192 tonnes of CO₂e annually. The generation of greenhouse gas emissions vary according to the proportion of coal and gas that will be utilised as fuel for the operation of the plant. For a plant based on 100% coal, greenhouse gas emissions have been predicted at approximately 4.13 million tonnes of CO₂e/year, decreasing with the increasing use of gas as a co-firing option.

Comparison against NSW and national averages

The Proponent provided an indication of the predicted greenhouse gas emissions intensity of the project against the NSW pool coefficient. The predicted greenhouse gas emissions intensity for the proposed Munmorah rehabilitation was calculated as 868 kg CO₂-e/MWh for the 100% coal-fired option reducing to 780 kg CO₂-e/MWh (25% gas), 694 kg CO₂-e/MWh (50% gas) and 608 kg CO₂-e/MWh for the 75% gas-fired option. The Proponent compared these emission intensities against the NSW Pool Coefficient, which represents the emissions of greenhouse gases (in tonnes of carbon dioxide equivalent) per MWh of electricity supplied from the 'pool' of major power stations serving the NSW electricity grid. For 2009, the NSW Pool Coefficient was 967 kg CO₂-e/MWh (greenhouse gas emission intensity). The Proponent has noted that all options being considered for the Munmorah rehabilitation will have greenhouse gas emission intensities lower than the current NSW Pool Coefficient.

In relation to Munmorah's contribution to total national greenhouse gas emissions, the Environmental Assessment indicated that it provided a conservative estimate of the percentage contribution based on a 20 year operational life of the rehabilitated plant from 2010, as outlined in Table 6.

Table 6: Contribution of the Project to Total Australian Greenhouse Gas Emissions (two units);

	Year	100% Coal	25% Gas	50% Gas	75% Gas
Munmorah contribution to Total Australian Emissions	2010	0.68%	0.61%	0.54%	0.47%
	2030	0.55%	0.50%	0.44%	0.39%

Mitigation measures to reduce greenhouse emissions

The Proponent has indicated that reducing the greenhouse gas emissions from the power station may ease the effects of a carbon tax which may be introduced as part of the Government's Carbon Pollution Reduction Scheme (CPRS). The Proponent has investigated a number of measures to reduce and/or offset emissions from the project including carbon capture and storage (CCS), fuel replacement using a mixture of coal and gas and also biomass co-firing. Amine-based post-combustion carbon capture technology was identified as the preferred CCS technology for the project at this stage. The Proponent has indicated that amine scrubbing systems are capable of removing between 80 and 95% CO₂ in a flue gas stream.

The Proponent has committed to designing the plant to incorporate carbon capture and storage should this technology become technically feasible and economically viable in the future. The Proponent has assumed that the carbon capture plant would be sized to handle 1 million tonnes of CO₂ per year as this is the module size currently under development by vendors. In time, the Proponent has assumed that the plant would be able to accommodate capture modules totalling 100% of flue gas flow.

Submissions

Ninety per cent of public submissions received on the project raised increasing greenhouse gas emissions and associated climate change impacts from the operation of the rehabilitation and ongoing operation of the power station as issues of significant concern. A number of submissions also indicated that their preference would be to see the power station close and focus on the development of the renewable energy sector for energy generation. The comments made in relation to greenhouse gas and climate change can be summarised as follows:

- objection to the development of fossil fuel power stations in NSW, particularly coal-fired power stations;
- the power station should not be refurbished, rather, it should be closed immediately as it is one of the most polluting power stations in the world;
- it is inappropriate to extend the life of any coal or gas-fired power station – all new energy should be pollution free;
- noting that the proposal will significantly increase national, state and local greenhouse gas emissions and that the additional generation of greenhouse gas emissions is unacceptable;
- stating that it is unacceptable to be increasing emissions in the context of rapid global warming as a result of findings of the International Panel on Climate Change;
- Munmorah was scheduled to close in 2014 – if approved the rehabilitation will cause Munmorah power station to continue to emit between 2.84 and 4.04 million tonnes of CO₂-e/annum for up to 20 years potentially contributing over 80 million tonnes CO₂-e over a 20 year period to NSW's greenhouse emissions;
- even operating with partly gas will increase NSW greenhouse gas emissions at a time when the state's emissions should be significantly reduced;
- cleaner energy alternatives should be considered; and
- identified that carbon capture and storage is a long way from being a feasible and deployable option.

Agency submissions such as DECCW noted that all fuel options associated with a rehabilitated plant will represent a significant source of greenhouse gas emissions in NSW. DECCW indicated that all fuel options will result in improved emissions intensity compared to current emissions intensity of electricity supply in NSW. DECCW stated that the Proponent identified that exploration of storage options is currently being undertaken by the Department of Industry and Investment, however, the Proponent did not identify currently available storage options or transport options to carbon storage locations.

NSW Health commented on the potential for increased greenhouse gases to adversely impact on the environment and indirectly on human health and it indicated that all practical steps should be taken to mitigate greenhouse gas emissions. Additionally, Marrickville Council indicated its opposition to the project on the grounds that it is incompatible with mitigating "dangerous climate change". Wyong Shire Council indicated that it considered that the project does not adequately address the principles of ecologically sustainable development as it maintains the status quo for energy production and entrenches energy production from coal rather than investing in more sustainable alternatives given the serious implications of climate change.

Consideration

The Department accepts that greenhouse gas emissions generated from anthropogenic sources are a recognised contributor to climate change. Effects of climate change are generally recognised as effects such as sea level rise, temperature rise, variation in rainfall, increased frequency and intensity of storm events and associated changes to environmental conditions such as drought, bushfire and ecological changes. Associated social impacts of such effects may include impacts to food production and food security, threats to coastal or low lying settlements and altered distribution of infectious diseases.

Nevertheless the Department recognises that the effects of a specific project on climate change cannot be reliably or meaningfully quantified. In this regard the Department has focused its assessment on quantifying, assessing and limiting the greenhouse gas emissions associated with the project, which are a tangible and measurable element that can be regulated. The Department recognises that the issue of greenhouse gas emissions is both complex and contentious, and that it would be preferable to provide an electricity solution involving nil additional greenhouse gas emissions. Section 2.2 discusses the need for additional fossil-fuel based baseload electricity generation in the context of predicted supply-demand shortfalls and the rates of take up of to date of renewable generation options.

Independent Review

The Department commissioned Arup Pty Ltd (Arup) to undertake an independent peer review of the Proponent's greenhouse gas assessment. The review confirmed that the Proponent had undertaken a technically appropriate greenhouse gas assessment of the project. In relation to the estimates of Scope 1 emissions, Arup considered the estimates to be generally acceptable, however, it raised issues with the assumed capacity factor, estimates of thermal efficiency and fuel properties used.

Arup considered that the quantification of Scope 1, 2 and 3 emissions for the construction phase of the project was appropriate. Following a review of the calculations undertaken by the Proponent to quantify Scope 1, 2 and 3 emissions from the operational phase of the project, Arup considered that the estimates from fuel combustion did not represent a worst case scenario for the project and the use of generic NGA fuel factors was likely to slightly underestimate Scope 1 emissions under typical operations. Arup considered the quantification of Scope 2 emissions to be a good estimate of the Scope 2 emissions for the project, however, it considered that potentially significant sources of Scope 3 emissions were not included in the assessment such as fuel usage in the extraction and processing of coal and natural gas and potential emissions that could be offset by the plant's waste stream. Arup estimated that the Scope 3 emissions from the extraction, processing and supply of coal is around 39% higher than that outlined in the Proponent's greenhouse gas assessment for the 100% coal mix scenario.

With respect to thermal efficiency, Arup considered that the calculations made by the Proponent were overestimated as the estimates did not include electricity purchased from the electricity grid which was assumed to be required to run the power station. When this was factored in to the calculations, the thermal efficiency of the plant decreased by approximately 2%, resulting in a thermal efficiency of electricity sent out being 36.3% for the 75% gas option to 36.7% for the 100% coal option. From the review comparison against best practice thermal efficiency, Arup concluded that the project is significantly below best practice for thermal efficiency when compared to either current coal-fired or gas-fired generation technology. Arup indicated that a wet cooled Combined Cycle Gas Turbine plant would represent the best achievable practice for the project site, however the Proponent has indicated that using 100% gas would not be feasible as it would require significant modification to the existing boiler which would affect the financial viability of the project. In addition, the Proponent noted that demolition and complete conversion to a Combined Cycle Gas Turbine would be well outside the scope and objectives of the project as it would obviate the inherent capital cost advantages of rehabilitation through use of the existing plant. The capital cost outlay associated with conversion to CCGT rather than rehabilitation of the existing plant was also acknowledged by Arup.

Arup considers that the annual average emissions intensity of the rehabilitated project with 100% coal fuel mix is likely to be more than the current average emissions intensity of electricity generation in NSW (assuming the Climate Group figures) by a small margin, however when using the maximum proportion of gas in the fuel mix is likely to be significantly less than the NSW average emissions intensity at current levels and into the foreseeable future. Further Arup considered that average NSW emissions intensity was likely to decrease in future assuming a move towards a lower carbon economy and therefore the 100% coal fuel mix would likely have an emission intensity considerably greater than the average NSW emissions intensity in the future.

The project would result in decreased emissions intensity when compared to the current state of the power station. Notwithstanding, Arup considers that the greenhouse gas emissions outlined in the assessment would represent between 0.69% and 0.99% of national emissions (all sectors) over the life of the project (2015-2034). Arup noted that the Commonwealth *Environmental Protection and Biodiversity Conservation Act 1999* (EPBC Act) is currently under review and there is a proposal to include a greenhouse trigger in the reviewed Act, however, the Department understands that this is not supported by the Commonwealth. Arup suggested that under any of the proposed trigger scenarios, the project would be required to seek approval from the Australian Government under the reviewed Act, and that the greenhouse gas emissions would be considered significant.

In relation to the evaluation of greenhouse gas mitigation measures, Arup considers that the feasibility of gas co-firing has been appropriately considered and would result in reduced emissions, however, commented that the Proponent made no commitment on the proportion of gas to be used or identified any trigger points for the introduction of gas to the fuel mix. Arup considered the evaluation of biomass co-firing to be incomplete in the Proponent's greenhouse gas assessment. Further, the review noted that solar thermal augmentation was not

mentioned by the Proponent even though it is a proven technology which is already utilised at Macquarie Generation's coal-fired power station at Liddell. Arup stated that no analysis of the potential for carbon capture to become commercially available and viable within the lifetime of the project is contained in the Environmental Assessment and the Proponent's documentation did not identify any feasible carbon transport or storage options, routes or sites and for this reason concluded that the Munmorah rehabilitation project, as proposed, is not carbon capture ready.

Arup considered the Proponent's evaluation of the potential impacts of a Carbon Pollution Reduction Scheme on the project (with and without mitigation) to not be sufficiently detailed and suggested the use of "Long Run Marginal Cost" (a means of determining costs of investment in new electricity generation infrastructure on a per unit of generation basis) as a means of more accurate calculations. The Arup report included some preliminary calculations in this regard considering the project at various fuel mix ratios and other mitigation options. The Arup evaluation suggested that at a carbon price up to \$50/tCO₂e the 100% coal option would be more commercially viable than using a proportion of gas in the fuel mix.

Arup recommended that conditions be imposed at two stages over the life of the project – prior to determination, Arup recommended that the issues raised with estimates in the greenhouse gas assessment be resolved and that all potential options be evaluated and compared based on best available models for a carbon price trajectory and technology costs. Secondly, Arup recommended that over the life of the project, the Proponent be required to assess options to mitigate emissions and adopt augmentation technology including carbon capture and storage and solar augmentation as new and updated information relating to carbon price, technology costs and technological developments emerge.

In its response to the issues raised by Arup as part of the independent review, the Proponent provided further information or clarification. The Proponent stated that the capacity factor (the percentage of time that the station would operate under normal operating conditions) of 80% over the power station's entire life is felt to be representative of a worst-case scenario and has stated that the existing capacity factor of the Mount Piper Power Station was 77% over the first 16 years of its commercial life. The Proponent stated that the use of generic coal data was undertaken in accordance with the methodology specified in the National Greenhouse Accounts Factors as stipulated by the Director-General requirements and is intended to be used with the emission factor data from NGA Factors.

The Proponent stated that the Scope 3 emission data calculated by Arup was based on the use of black coal (for uses other than electricity generation or coking) and therefore is not appropriate for use with the calculation of Scope 3 emissions for the project since the primary purpose for the use of coal at Munmorah is for the generation of electricity. The independent review indicated that Scope 3 emissions from fuel consumption emissions from the extraction and processing of coal was not included in the calculations and the Proponent has revised its calculations to include these items, as outlined in Table 7. The Proponent has stated that the revised Scope 3 emissions associated with the operation of the project remain small in comparison to the total emissions from the facility.

Table 7: Revised Scope 3 Emissions and Total Emissions (t CO₂e/year)

Emission Source	100% Coal	25% Gas	50% Gas	75% Gas
Unit efficiency (HHV) (sent out)	37.5%	37.4%	37.3%	37.0%
Scope 1 emissions (tCO ₂ e/year) (at 80% capacity factor)	3,960,000	3,550,000	3,150,000	2,750,000
Scope 2 emissions (tCO ₂ e/year) (at 80% capacity factor)	90,000	90,000	90,000	90,000
Scope 3 emissions (tCO ₂ e/year)				
Extraction of coal	91,936	69,821	47,206	23,819
Transportation of coal	12,959	9,842	6,654	3,357
Fuel consumption emissions – extraction	12,692	9,639	6,517	3,288

and processing of coal				
Gas exploration and processing	0	35,409	71,651	109,143
Gas transmission	0	8,720	8,720	8,720
Total Scope1, 2 and 3 emissions	4,167,587	3,773,431	3,380,748	2,988,327

The Proponent also revised the comparison between the expected emissions of the Munmorah rehabilitation with the expected national emissions for the life of the project to take into consideration more recent data available from the 2008 Treasury report "Australia's Low Pollution Future: The Economics of Climate Change Mitigation" and amended Table 6.13 of its Greenhouse Gas Assessment which resulted in the contribution of the Munmorah rehabilitation to total Australian emissions being revised as outlined in Table 8. The Proponent has stated that the revised figures confirm that the project will make a small contribution to the total national emissions during its projected operating life.

Table 8: Revised Contribution of Project to Total Australian Greenhouse Gas Emissions

	Year	100% Coal	25% Gas	50% Gas	75% Gas
Munmorah contribution to Total Australian Emissions	2010	0.74%	0.67%	0.59%	0.52%
	2030	1.36%	1.22%	1.09%	0.96%

The Proponent has stated that rehabilitation of the plant would achieve greater plant reliability and efficiency and enable it to extend its operating life by up to 20 years by taking a commercial advantage of utilising existing generating assets rather than investment in new capital assets. The Proponent has agreed with Arup that a wet-cooled Combined Cycle Gas Turbine Plant would be significantly more efficient than the current rehabilitation proposal, however, development of that nature would not meet the project objectives and the cost benefit would not be realised with this alternative scenario.

The Proponent provided further information regarding fuel replacement measures and provided some comment regarding the options identified by Arup as part of the independent review (gas-fuel mixture, biomass co-firing, solar thermal augmentation and carbon capture and storage). In relation to the gas fuel mixture, the Proponent has confirmed that substantial boiler modification would be required for the existing plant to operate it on 100% gas and that the additional cost would have a significant impact on the financial viability of the project. The Proponent has stated that the continued use of coal has a number of advantages in the medium term as it provides a facility that does not immediately require the development of a new gas supply infrastructure. In addition, the Proponent has stated that the trigger point referred to by Arup for the inclusion of gas into the fuel mix would be based on technical/commercial analysis to demonstrate the project viability to move to gas firing and would require the development of associated gas infrastructure.

For biomass co-firing, the Proponent stated that it is technically feasible and that a more detailed technical/commercial analysis will be undertaken during the detail design phase. The Proponent has stated that solar thermal augmentation will not be considered as there is insufficient land area at Munmorah to achieve reasonable capacity and the solar insolation is not as good as inland locations. In relation to carbon capture and storage readiness, the Proponent has indicated that the Munmorah rehabilitation project would be developed to an appropriate stage of readiness to facilitate the future economic uptake of the latest available capture technology.

In relation to the operation of a Carbon Pollution Reduction Scheme, the Proponent has indicated that the Australian Emission Unit price would need to be significantly greater than \$50/tCO₂e to economically justify the inclusion of gas or biomass in the fuel mixture.

Department's consideration

The Department has reviewed the Environmental Assessment, the independent review of the greenhouse gas assessment and the Proponent's response to the independent review, as well as the submissions received on this issue. The Department considers that the assessment undertaken is sufficient to identify the likely greenhouse gas emissions resulting from the proposal.

As outlined in Section 2.2 of this report, renewable energy sources, energy efficiency and demand management, while being important measures for reducing energy demands and total greenhouse gas emissions, do not by themselves represent a sufficiently robust approach to addressing the risk of an energy supply-demand imbalance in future. While these measures may well expand in future to provide a greater contribution towards addressing these matters, it would be imprudent to assume they will develop rapidly enough to fully resolve predicted shortfalls in energy generating capacity over the coming decade. As a consequence, there is a real need to be prepared for implementation of a fossil-fuelled power generating facility if and when it is required.

In this context, it is not possible to fully remove greenhouse gas emissions from the solution to the predicted supply-demand imbalance. There will be greenhouse gas emissions associated with this solution, regardless of whether a coal-fired or a dual-fuel facility is built. Further, and as outlined in Section 2.2 of this report, it would be imprudent to select the exact proportion of fuels at this time (and, arguably, not the role of the planning system to do so) given that the economic and commercial situation at the time of needing additional baseload capacity may be different from current conditions. It is the role of separate Government policy, regulation and relevant market instruments to influence the economic and commercial conditions that would drive energy generation towards or away from coal or gas fuel. By approving the project which can be fuelled by 100% coal as a worst-case scenario and up to 25% coal and 75% gas, the planning system not only delivers an approval that sufficiently deals with the risk of an energy-generation shortfall, but it also leaves open the appropriate role of Government policy, regulation and market instruments to influence the direction of new energy generation and the proportion of fuel types that will be implemented.

The Department considers, therefore, that the question to be addressed as part of this assessment is not whether coal-fired or dual-fuel options are preferable based on a comparison of the total predicted greenhouse gas emissions from each. Rather, it is to consider whether each fuel option, in isolation from the other, represents the most efficient and least greenhouse gas intensive configuration for that particular fuel. That is – whether the Proponent has presented the most greenhouse efficient coal option currently commercially available, and the most greenhouse gas efficient gas option currently commercially available.

Generation of greenhouse gas emissions

Based on a worst-case scenario of 100% coal, operation of the proposal will generate approximately 4,167,587 tonnes CO_{2-e} per year decreasing to 2,912,160 tonnes CO_{2-e} per year for the 25% coal-75% gas-fired option. The Department concurs with the consideration by Arup and the Proponent, that the estimates of the Scope 1 and 2 emissions are appropriately conservative, and notes the revised predictions provided for the Scope 3 emissions by the Proponent. Whilst the Arup report has highlighted some uncertainty associated with the scale of Scope 3 emissions potentially associated with the project (particularly with respect to fuel extraction and transport to site), the Department considers the level of assessment undertaken to be acceptable in the context of inherent uncertainties associated with modelling variables and is indicative of likely greenhouse gas impacts associated with the project.

As noted in the submissions received, the total annual production of greenhouse gases generated from the proposal will increase both the NSW and Australian greenhouse gas emissions. While this increase in total greenhouse gas emissions would be driven by energy demands, to appropriately consider the potential greenhouse gas impacts of the proposal, it is first important to contextualise the potential impact within recent NSW and Australian performance.

Comparison of greenhouse gas emissions against NSW and national averages

In 2007, it was estimated that total greenhouse gas emissions in Australia, as carbon dioxide equivalents, were 597.2 million tonnes, up by 9.3 per cent from 1990 levels (Commonwealth of Australia, 2009). The major contributor to this increase came from the stationary energy sector, which alone grew in emissions by 49.5 per cent to 291.7 million tonnes CO_{2-e}. Recorded total greenhouse gas emissions in New South Wales have generally remained stable during the period 1990 to 2007, slightly increasing from 160.7 million tonnes in 1990 to 162.7 million tonnes in 2007 (Commonwealth of Australia and DECCW, 2009). Reduced emissions in other sectors have offset a recorded increase in emissions from the New South Wales stationary energy sector from 59.9 million tonnes of CO_{2-e} in 1990 to 79.4 million tonnes in 2007 (approximately 33 per cent increase).

In the context of 2007 greenhouse gas emissions, the Department has calculated the percentage impact of the proposal, which without any mitigation or offsets, would:

- increase total New South Wales emissions by approximately 2.5 per cent for the 100% coal-fired option and 1.8 per cent for the 25% coal and 75% gas-fired option; and
- increase total Australian emissions by approximately 0.7 per cent for the 100% coal-fired option and 0.5 per cent for the 25% coal and 75% gas-fired option.

The Department acknowledges that the Australian and NSW Governments have made a commitment to reducing Australia's GHG emissions by 60 per cent by 2050 on 2000 levels, however, recognises that at this stage, it is unclear whether targets as part of a CPRS or equivalent scheme will be set at a five per cent or 25 per cent reduction (or somewhere in-between) on 2000 levels by 2020. As such, it is difficult to quantify the effect of the CPRS or equivalent and therefore, to accurately calculate the effect of the rehabilitated power station on national emissions, except to note that the proposal *will* increase national greenhouse gas emissions by some amount. The quantum of greenhouse gas increase represents the inevitable cost of meeting consumer energy demand in the case that market forces (influenced by consumer choice and regulation) retain the viability of fossil-fuel generators compared to alternatives.

Predictions of thermal efficiency and consideration of best available technology

The Department notes that the project as with other generators in the NSW energy sector would be subject to regulation by the CPRS (or equivalent), when it comes into effect in the future. The CPRS would provide a market based mechanism for regulating greenhouse gas generators, setting a level playing field for all generators through standard carbon pricing which would in effect result in less carbon efficient generators being out-competed by those with greater carbon efficiencies. The Department considers that the CPRS and other State and National greenhouse gas/ climate change policies are likely to play a significant role in the proportion of fuel (coal/gas) utilised for the project, and the need for the proposal to be as efficient as possible. As discussed in Section 2.2, the CPRS has the potential to affect electricity prices, and demand for electricity, but the extent to which this effect presents itself will depend on the timing of the CPRS and, more significantly, the net carbon reduction outcome targeted by the Scheme.

The Department accepts that the least greenhouse gas intensive option for coal is to utilise ultra supercritical coal units and the least greenhouse intensive option for gas is to utilise Combined Cycle Gas Turbine technology. The Department concedes that it is not possible to convert the Munmorah Power Station to an Ultra Supercritical coal-fired power station or to a Combined Cycle Gas Turbine Facility without dramatically altering the project proposal and significantly altering the capital investment value, the time involved for implementation and consequently the financial viability of the project for the Proponent. The Proponent has stated that a Combined Cycle Gas Turbine Facility would need to undergo planning as a stand alone project and that the Munmorah site may not be the optimal location for such a facility. The Department understands that the project, as proposed, can be commissioned within a relatively small timeframe compared to the construction of an entirely new project and therefore the advantage of redeveloping an existing asset would not be realised. The Department has accepted this argument in the context of the expected shortfall in energy supply and demand which is predicted to occur over the next decade (refer to Section 2.2).

The Proponent has indicated that the existing generating units are sub-critical coal-fired units which will remain so following the rehabilitation and will be comparable with the latest current sub-critical units in NSW at Mt Piper or Bayswater power stations. Given that the project represents rehabilitation and not construction of a new plant, it is unlikely to achieve best practice thermal efficiency and therefore the Department required the Proponent to incorporate all reasonable and feasible design measures to achieve best practice emissions intensity within the engineering constraints and parameters of a rehabilitation project. In this context, the Department considers that the Proponent has been too quick to dismiss the option of plant modifications (i.e. boiler upgrade) to facilitate the project being fuelled on 100% gas and considers that this option should be further investigated by the Proponent as a means to reducing greenhouse gas emissions and other pollutants from the project. The relevant components of this position are outlined further below.

Emissions reduction and carbon offsetting

The Department considers that the Proponent has undertaken a detailed review of the available emissions reduction options and that currently, post-combustion carbon capture appears to be the most promising

technology being developed at this time. However, the Department also considers that the Proponent should be made to consider modifications to the boiler as a future option to allow the plant to potentially accept 100% gas. While the Department understands that this option is not currently financially viable for the Proponent due to the substantial costs involved, the financial viability of this option may change in the future depending on the carbon price associated with a CPRS and therefore may become viable over time as an alternative to carbon capture and storage options. The Department therefore considers that the option to modify the boiler should not be dismissed by the Proponent at this stage of the project's development, and has taken this into consideration in the recommendations for conditions associated with minimising greenhouse gas impacts, as detailed below.

The Department also concurs with Arup that emission offsetting measures (such as renewable energy augmentation, for example solar augmentation, which is currently used at Liddell on a demonstration scale) may become more commercially viable over time, and may also be preferable to implementing CCS options. With regard to the Proponent's commitment to designing the plant to be 'carbon capture ready', the Department considers it preferable not to 'lock-in' a preferred technology at this time, noting that any such technology may be superseded by advancements that may occur over time. As such, the Department has recommended that the Proponent shall design and construct the project so as not to preclude cost-effective retro-fitting of post – combustion carbon capture technology. In addition, the Department has recommended a condition of project approval to require the Proponent, on a triennial basis, to evaluate and report on the availability of viable greenhouse gas reduction, mitigation and/or offset options that may be applied to the project taking into account relevant contemporaneous economic drivers including applicable legislative framework (such as an emissions trading scheme) and electricity demand and supply projections. The report is required to evaluate the viability of options including carbon capture and storage, solar augmentation, biomass co-firing and undertaking additional boiler modifications to enable the plant to accept 100% gas fuel using Long Run Marginal Cost methodology as employed in the Arup report. In the event that a carbon pollution reduction scheme does not eventuate or if the Proponent is not in full compliance with that scheme, the Department has recommended an additional condition of approval that the Proponent will then be required to prepare and submit to DECCW a pollution reduction program designed to implement the technically and economically feasible measures identified above to the satisfaction of the Director-General of DECCW.

In its report, Arup noted that the Commonwealth's *Environment Protection and Biodiversity Conservation Act 1999* is currently under review, and if greenhouse gas emissions are included as one of the matters of national environmental significance (NES), the proposal would likely have a significant impact under the Act. As stated previously, the Department understands that greenhouse gas emissions will not be included as part of the assessment of matters of NES.

Many of the submissions raised the issue of the clear link between increased greenhouse gas emissions leading to increased climate change impacts. The Department considers that its role is to assess the proposal based on best available technology and project need, considering the environmental, social and economic impacts of the proposal. The Department considers that there are likely to be other opportunities to offset the greenhouse gas emissions generated by the proposal, and that it is not in the public interest to allow a situation to eventuate where the demand for electricity exceeds the available supply, which would also have deleterious economic and social impacts. In NSW, approximately 90 per cent of electricity generated is sourced from black coal, and greenhouse gas emissions from the electricity sector represent around one-third of the state's emissions (Department Infrastructure and Investment, 2009). However, as noted in the NSW State Plan (2009), the Government is developing and implementing a detailed *Climate Change Action Plan* and *Clean Energy Strategy* which includes measures such as supporting distributed co- and tri-generation energy in offices, industry, shopping centres and apartment blocks, supporting natural gas supply and pipeline projects across NSW, and investing \$100 million to support development of carbon capture and storage technology to reduce emissions from coal-fired power generation.

Conclusion

As noted at Section 3.6 above, in considering greenhouse gas emissions and the proposal generally, the Department has had regard to the principles of ecologically sustainable development, particularly the precautionary principle, the principle of inter-generational equity and the principle of conservation of biological diversity and ecological integrity. While the Department recognises that those principles would be promoted by providing electricity with no additional greenhouse gas emissions (and where that is not feasible, by minimising

additional greenhouse gas emissions), it also recognises that those principles are to be balanced against other aspects of the public interest.

While renewable generation, demand management and energy efficiency measures are currently being pursued in the market, as noted in Section 2.2, there remains a risk that these options by themselves will not be sufficient to address growing power demands and the need to secure the State's energy future.

Furthermore, despite the fact that the Minister for Planning has approved more than 1,000 megawatts of wind farms over the last few years, only a small number of the wind farms are currently operational, or in the process of construction. Given this experience, it is clear that although renewable energy proposals are being approved, there is a lag in their implementation. Notwithstanding this, with the NSW and Australian Government's targets of 20 per cent renewable energy consumption by 2020, additional wind and other alternative/renewable energy generation proposals are being submitted and are currently in various stages of assessment with the Department. However, while the market is pursuing this generation, it is unlikely that enough alternative energy generation will be implemented in the short to medium term at a sufficient rate to address demand growth.

The reality is that baseload (coal, gas-fired or dual-fuel options) generation is likely to remain a necessity in the short to medium term. It is prudent therefore, that opportunities are examined to address this risk. In doing so, there is also opportunity to investigate and implement performance and efficiency improvements to ensure that any fossil fuel-fired proposal reflects best practice. The current project applies this prudent approach to managing risk in the context of baseload generating capacity within the engineering constraints and parameters of a rehabilitated project. While there will be an increase in the total greenhouse gas emissions in NSW from the facility, the impact of these emissions must be balanced against the risks associated with a generating shortfall and the significant social and economic implications to the State should such a situation eventuate. On balance, therefore, the Department has recommended that the project be approved subject to a number of conditions being met which require the Proponent to clearly demonstrate that it is undertaking all economically reasonable and feasible measures to minimise greenhouse gas emissions, and to demonstrate that they are investigating carbon reduction technologies that could be feasibly retrofitted to the plant, as well as other emission reduction or offset measures, to reduce or eliminate greenhouse gas emissions.

5.2 Air Quality

Issue

The existing Munmorah Power Station is classified as a Group 2 facility under the *Protection of the Environment Operations (POEO) (Clean Air) Regulation 2002* (i.e. it is a facility which commenced operations after 1 January 1972 and prior to 1 July 1979). Under Clause 22 of the Regulation, a change in plant intensity such as that proposed triggers a requirement to meet Group 6 emission limits (i.e. the project would commence operations after 1 September 2005). The Environmental Assessment states that the operational performance of the existing Munmorah Power Station would comply with Group 6 requirements for all regulated emissions with the exception of NO_x.

As part of the Environmental Assessment, the Proponent analysed the expected performance of the rehabilitated plant taking into account key emissions associated with coal firing (i.e. nitrogen oxides, sulfur oxides, fluoride, particulate matter and trace elements such as metals). The Environmental Assessment assessed 100% coal firing as a worst case scenario, on the basis of lower emission rates being expected for each of the pollutants under a dual fuel option with emissions decreasing as the proportion of natural gas used in the fuel mix increased. Based on its analysis, the Proponent determined that even under worst case (i.e. both units operating at 350MW and 100% coal-firing) the proposal would (with the exception of NO_x) achieve, or perform better than, all Group 6 emission limits specified in the POEO Regulation. In relation to NO_x, the Proponent identified that tangential low NO_x burners with separate overfire air technology will be installed as part of the rehabilitation and that these burners will provide significant reductions in NO_x emissions such that the emissions are likely to meet or be very close to the Group 6 emission limits.

Sulfur dioxide is currently not regulated under the *Protection of the Environment Operations (POEO) (Clean Air) Regulation 2002* for Group 6 facilities. The Proponent has identified that the existing power station operates with

a guaranteed fuel sulfur content of 1%. To reduce the potential for SO₂ impacts from the rehabilitated plant, the Proponent has committed to the use of low sulfur content coal (0.7%) in operations.

The Proponent's Environmental Assessment also included a local air quality assessment taking into consideration cumulative impacts from surrounding power stations. The Proponent's assessment identified that rehabilitated power station could achieve all relevant ground level air quality criteria with the exception of SO₂ in the 10 min and 1 hour averaging periods and particulate matter (PM₁₀) in the 24 hour averaging period.

Submissions

Of the public submissions received, only four per cent raised air quality as an issue of concern. The specific issues that were raised included the continuing problem of air-borne coal dust in the local area and general pollution from the power station from toxins and other emissions.

Of the government authority submissions, air quality was raised as an issue of concern by NSW Health and DECCW. NSW Health indicated that the data presented in the Environmental Assessment was insufficient for a comprehensive health impact assessment such that further modelling was recommended to provide predicted incremental increases in SO₂, NO₂ and particulate matter (PM₁₀) for a sample of sensitive receivers. In relation to sulfur dioxide, NSW Health recommended that best practice mitigation measures be incorporated into the project as well as the use of gas or low-sulfur content coals be utilised as a fuel source. NSW Health also indicated that the PM₁₀ concentration predicted will exceed the DECCW limit of 50 µg/m³.

DECCW provided a large number of comments with regard to the air quality assessment undertaken as part of the Environmental Assessment. DECCW indicated that the assessment contained a number of technical errors and contradictory statements which made it difficult to understand and interpret. DECCW also stated that the information presented was not sufficiently robust to be confident in setting limits for a number of air pollutants. DECCW indicated that due to the deficiencies in the air quality assessment, the Proponent should provide an updated air quality assessment to be considered as part of its response to submissions.

Consideration

The Department has reviewed the air quality assessment provided by the Proponent in the Environmental Assessment. Coupled with this review, the Department also commissioned an independent review of the assessment to assist with its consideration of potential air quality impacts associated with the proposal.

Independent Review

Heggies Pty Ltd was commissioned by the Department to undertake an independent expert review of the air quality assessment. The review stated that a review of the assessment was made very difficult by the large number of errors found within the air quality assessment however it attempted to concentrate on the technical aspects of the document. Comments made by the independent review can be summarised as follows:

- The impact of the Colongra Gas Turbine Facility has been included within the cumulative assessment but only in the crudest of ways and the approved upgrade of the Eraring Power Station has not been included at all even though the discussion in the Environmental Assessment indicates otherwise;
- No justification is made with respect to why the second highest hourly NO₂ concentration was selected as the background concentration in the cumulative assessment as opposed to DECCW's preference of using the 100th percentile background level, nor why the data from the Lake Munmorah Public School monitoring station was used in preference to the Wyee monitoring station data when the Wyee data was used in the assessment of background SO₂;
- Further information and assurances should have been provided regarding the representativeness of meteorological year 2004 used in the air quality modelling where comparisons of a number of years should be presented to provide surety of the selected year;
- No detailed review of the local air quality impact section could be provided as it was found to be difficult to read and understand the methodological approach undertaken – significant errors within tables of results also made the assessment of the results difficult; and
- Statements in the regional and inter-regional impacts section of the document are not consistent and detailed modelling is required to be undertaken to confirm "no adverse impacts".

The review concluded that a significant amount of further assessment with regard to air quality was required to be undertaken prior to the consideration of a project approval.

Updated Air Quality Assessment

In response to DECCW's comments and the conclusions of the independent review, the Proponent provided an updated air quality assessment as part of its Submissions Report.

Group 6 Emission Limits

The Proponent's revised assessment indicated that due to the increased thermal efficiencies expected to be gained from the rehabilitation of the plant, all relevant Type 1 and Type 2 stack emission limits specified under the *Protection of the Environment Operations (POEO) (Clean Air) Regulation 2002* for Group 6 facilities would be able to be complied with by the power station, under worst case scenarios of 100% coal firing and full load. This includes the limit for NO_x emissions, which the revised the revised assessment indicated could be achieved under both the 100% coal or gas scenarios with the implementation of new low NO_x coal burners, which would ensure emissions of less than 500 mg/m³. In relation to particulate matter, the revised assessment indicated that Group 6 emissions limits of 50 mg/m³ would be achieved through the efficient maintenance and operation of stack fabric filters, which would facilitate high levels of emission control.

With respect to SO₂ which is not regulated under the *Protection of the Environment Operations (POEO) (Clean Air) Regulation 2002*, the Proponent's modelling has indicated that the 100% coal scenario would involve an stack emission rate of 1665 mg/Nm³, based on a worst-case sulfur content scenario of a 0.7%. The Proponent has indicated that is would be approximately 30% higher than the emissions that result from typical coal currently consumed at the plant (which although guaranteed to be no more than 1% in sulfur content, has typically comprised much lower sulfur content – around 0.41%). The Proponent has proposed a limit of 1700 mg/m³ as a reasonable stack limit based on the predicted worst case emission rates. The Proponent has identified that the emission rates of sulfur would decrease as the percentage of gas used in the fuel mix increases (refer Table 9).

Table 9: Predicted SO₂ Emissions

	100% Coal	25% Gas	50% Gas	75% Gas
Typical coal used in operations (0.41% sulfur content)				
SO ₂ (mg/m ³)	975	732	489	243
Worst case Coal (based on 0.7% sulfur content)				
SO ₂ (mg/m ³)	1665	1250	835	415

Source: Table 4.6 from Attachment B of Submissions Report

Local Air Quality Impacts

In relation to local air quality impacts, the Proponent's revised assessment included a more detailed consideration of cumulative impacts from the operation of the nearby Eraring, Colongra and Vales Point power stations. With respect to Eraring, the Proponent's assessment included a 14% increase in ambient pollutant concentrations to take into account the approved upgrade of that power station which is not yet operational. DECCW considered this to be acceptable.

NO₂

In terms of NO₂, the revised cumulative assessment indicated that ground level concentrations of NO₂ at all sensitive receptors would comply with the annual air quality goal of 62µg/m³ and the 1 hour goal of 246µg/m³.

SO₂

The cumulative air quality impacts for SO₂ indicated that the annual and daily goal would be complied with; however, the modelling predicted two exceedances of the hourly goal at three sensitive land uses and exceedances of the 10 minute average goal at four sensitive receptors. The Proponent has indicated that the interpretation of the results should be undertaken with caution as the use of the TAPM air pollution model has been known to overestimate impacts by as much as 50% (Lilley *et al*, 2007 – as quoted in the revised air quality assessment).

Both the Department and DECCW queried the level of exceedances that were predicted and the Proponent arranged for Malfroy Environmental Services to examine the validity of the modelling results at the two occasions where the highest exceedances were identified within the modelling domain (28 January and 31 March). At the

request of DECCW, the Proponent also arranged for the Malfroy report to be reviewed by Mr Bill Physick, an independent meteorologist and air quality modeller. The subsequent reports, detailed in the Proponent's Supplementary Submissions Report, indicated that the air quality model (TAPM) may have resulted in plume dispersion being under-estimated and therefore the maximum concentrations being over-estimated on both occasions. The Malfroy report concluded that the probability of the highest concentration predicted by TAPM occurring is in the order of 1 in 350,000 hours (approximately once in 40 years). The Physick review of the Malfroy report concluded that the report was based on solid data and science and that the conclusions that follow are logical and robust.

Particulate Matter

For fine particulates (PM₁₀), the revised air quality assessment indicated that the rehabilitation of the Munmorah power station would make a negligible contribution of 4.3 µg/m³ on a daily basis compared to an existing daily background air quality level of 51.8 µg/m³ which already exceeds the daily air quality goal of 50µg/m³. The annual contribution of particulates from the power station was also identified to be negligible (1.3 µg/m³) and cumulatively with background levels (i.e. 1.3 + 18.5 = 19.8 µg/m³) was identified to achieve air quality goals for the annual averaging period (i.e. 30 µg/m³).

Other

The cumulative assessment in relation to the concentrations of other pollutants associated with the project (carbon monoxide, lead, hydrogen fluoride and heavy metals) indicated that the emissions were in compliance with the relevant air quality goals.

DECCW Comments

Based on its review, DECCW considered that the updated assessment had addressed the most significant deficiencies that were previously identified as part of its submission. Notwithstanding, DECCW indicated that more information was required to fully assess the project's impacts in relation to hydrogen fluoride as the revised air quality assessment did not clearly explain the methodology adopted to determine hydrogen fluoride ground level concentrations in the local air quality assessment. Specifically DECCW queried why the emission concentration for hydrogen fluoride in the revised assessment appeared to be tripled compared with the exhibited Environmental Assessment but produced exactly the same results.

Department's Consideration

Based on the Proponent's revised air quality assessment, the Department is satisfied that the Proponent has demonstrated that the Munmorah Power Station can be rehabilitated, either as a 100% coal or dual-fuel option, to achieve compliance with each of the currently regulated stack emission limits for Group 6 facilities. Consequently, the Department has recommended conditions of approval imposing these air quality limits on the project (or lower limits where these can be archived – refer hydrogen fluoride below). The Department is also satisfied that the Proponent has undertaken an assessment consistent with the *Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales* (DECC, 2005), which specifies ground level concentrations standards that must be achieved to ensure no unacceptable amenity or health risks with respect to air quality.

NO₂

In relation to NO₂ emissions, the Department is satisfied that the Proponent has demonstrated that the rehabilitated plant can achieve relevant ground level concentration air quality limits and therefore would not pose an unacceptable risk to local air quality.

SO₂

In relation to SO₂ (for which the POEO Regulation does not specify a Group 6 limit), the Department notes that the Proponent has proposed a stack concentration limit (1700 mg/m³) that is greater than the worst case SO₂ stack emission rates predicted to occur (1665 mg/m³) based on the worst case coal sulfur content of 0.7% proposed to be used. The Proponent has proposed this approach on the basis that the stack concentration is an instantaneous measurement whilst coal sulfur content is a monthly average. This means that over the course of a given month coal with a sulfur content either more or less than 0.7% may be used, however over the entire month, the average sulfur content of the coal would be no greater than 0.7%. Therefore, the Proponent has sought a stack concentration higher than the worst case stack concentrations predicted for a 0.7% sulfur content (i.e. 1700 mg/m³ rather than 1665 mg/m³) to provide a buffer – to take into account those intermittent instances

where coal of greater than 0.7% sulfur content maybe burnt and result in an instantaneous stack concentration of greater than 1665 mg/m³ (even though the monthly average of coal sulfur content remains at 0.7%).

The Department notes that the local air quality assessment based on a stack concentration of 1665 mg/m³ has indicated that some short term exceedances of the air quality goals may occur for SO₂ at sensitive receptor locations. Whilst the Department notes the conclusions of the Malfoy and Physick reports, which indicate that the short-term exceedances identified (based on a stack concentration of 1665 mg/m³) are based on conservative modelling assumptions and expected to be very infrequent in nature, the Department equally notes DECCW's advice that there remains some uncertainty in the model validation (with respect meteorological conditions) which makes it inappropriate to totally disregard the modelled exceedances presented in the assessment. Given there is some uncertainty regarding whether the likelihood of short-term SO₂ exceedances can be totally discounted under a stack emission concentration of 1665 mg/m³, the Department does not support an even higher stack limit of 1700 mg/m³ being imposed, which is likely to pose a higher risk of exceedances.

Based on the information provided by the Proponent in relation to coal quality used at the power plant, the Department considers that the key controlling factor for sulfur emissions is the sulfur content of coal used at the plant. In this regard, the Department notes that the remaining two power stations in the Central Coast (Vales Point and Eraring) are currently limited to a coal sulfur content of 0.5% and that the typical sulfur content of coal used at the Munmorah plant presently is around 0.41%. The Proponent has suggested that an 0.7% sulfur content is required to take into account potential changes to coal supply sources in the future, which may have a higher sulfur content than that currently used (i.e. up to 0.7%). However, the Departments considers that such future changes are not guaranteed and not sufficient grounds for recommending an 0.7% coal sulfur content for the power station. In particular, the Department considers that the existing operations of Vales Point and Eraring, which use coal with a sulfur content of 0.5%, (including the recently approved upgrade in capacity of Eraring), demonstrate that coal supplies of low sulfur content are readily available for power stations in the Central Coast. On this basis, the Department in consultation with DECCW has determined that a coal sulfur content of 0.5% (monthly average) is appropriate for the project and is consistent with the limits set for the other coal-fired power stations in the Central Coast. The Proponent has subsequently accepted this limit.

Based on the Proponent's predicted stack emissions of 975 mg/m³, on the basis of a 0.41% coal sulfur content, DECCW has estimated that a 0.5% sulfur content coal would likely result in stack concentration levels in the range of 1200 mg/m³. The Department considers that this level of emission concentration at the stack would pose a low risk of exceedance of relevant SO₂ ground level concentration criteria at sensitive receptors. Although (as noted above), a monthly average limit on coal sulfur content would not prevent the occasional incidence of coal of a higher sulfur content being used, the Department considers that the majority of coal used at the plant would need to be of a sulfur content at or around 0.5% to ensure compliance with the monthly average limit. (i.e. isolated occasions of high sulfur content coal (>0.5%) being used would need to be compensated with the use of lower sulfur content coal for the remainder of the month to ensure that the monthly average limit of 0.5% can be complied with). Consequently, the Department considers that in practice, the risk of high sulfur content coal (greater than 0.5%) being burnt regularly at the power station would be low.

Notwithstanding, the Department considers that appropriate controls should be placed on the power station such that any occasional incidence of coal of >0.5% sulfur content being burnt does not pose an unacceptable risk of short-term SO₂ impacts, which exceed ground level concentration criteria though short duration but acute emissions. In this regard, the Department notes that DECCW originally proposed a stack limit of 1250 mg/m³ with a sulfur coal content of 0.5%, however, the Proponent raised significant concerns regarding this limit as providing significant risk of non-compliance, by not including sufficient provision (or buffer) for occasional instances where coal sulfur content of >0.5% may be bunt (even though the monthly average limit of 0.5% sulfur content is complied with). DECCW subsequently, recommended a stack limit of 1665 mg/m³ with a monthly average sulfur limit of 0.5% in consideration of the issues raised by the Proponent.

The Department supports this approach, noting that this would in effect limit the maximum sulfur content of coal used at the plant to 0.7%, in those occasional instances where coal of greater sulfur content than 0.5% is burnt. The Department considers that the imposition of a 1665 mg/m³ stack concentration limit in the context of a 0.5% limit on coal sulfur content would not pose an unacceptable risk of exceeding ground level concentration criteria at sensitive receptors, as the likelihood that an incidence of coal burning at 0.7% would coincide with those worst

case operating and meteorological conditions (including surrounding power stations operating at full capacity) under which exceedences are predicted, is considered to be very low. Consequently, the Department is satisfied that a proposed regulatory approach of a stack concentration limit of 1665 mg/m³ coupled with a monthly average coal sulfur content limit of 0.5% would provide a robust framework for the regulation of SO₂ from the power station and ensure no unacceptable risks to local air quality amenity. The Department also considers this to be a more workable and sensible approach that would not lead to unnecessary instances of non-compliance with the (instantaneous) stack concentration limit, even though the overall monthly limit of coal sulfur content is being complied with. The Department notes that the stack limits recommended for the project (which is a compliance limit) would be more stringent than the current reporting limits of around 600ppm imposed at Vales Point and Earing, which is equivalent to a stack concentration limit of around 1716 mg/m³.

Notwithstanding the above, the Department accepts that as the air quality assessment for the project has been based on the expected modelled performance of the rehabilitated power station rather than actual manufacturer's emission guarantees or real data from a rehabilitated power plant of similar design, there is some uncertainty regarding whether the proposed SO₂ concentration limit would reflect the actual performance of the rehabilitated power station. In this regard the Department notes that the actual performance of the project may be far superior to that predicted. In this regard, the Department has recommended conditions of approval requiring the SO₂ emissions performance of the project to be monitored for a minimum two year period following the commencement of operation, and where this monitoring clearly demonstrates that a lower stack concentration limit than that imposed can be achieved, then the lower stack concentration would apply to the power station. This conditions framework would ensure that the rehabilitated power station is required at a minimum to achieve a stack concentration limit of 1665 mg/m³ unless it can demonstrate that a lesser stack limit can be achieved, in which case the lesser limit would apply. The two year performance review would not provide a mechanism for increasing the stack limit in any way. Should the Proponent require a higher stack limit (for example to account of future changes to sulfur content in coal supplies etc), this as with any other proposed change to the project, would need to be subject to a separate modification assessment process under the EP&A Act, with appropriate justification and assessment of the change taking into account any cumulative impacts from the other power stations at the time of application.

Particulate Matter

In relation to particulates, the Proponent has proposed a solid particle limit of 50 mg/m³ which is considered appropriate given that the Proponent has stated that solid particles from the facility are expected to be well below this level. DECCW previously recommended a level of 30 mg/m³. The Department has, however, recommended that the Proponent be required to install emissions monitoring equipment capable of monitoring and reporting solid particle emission on a continuous basis in mg/m³. In addition, the Department has recommended that after two years of operation, the Proponent be required to submit a Proof of Performance Report on the operational performance of the continuous monitoring equipment and the capability of the plant to meet a solid particle limit of 30 mg/m³ measured as a 24 hour average which is consistent with recommendations made for both the Bayswater B and Mount Piper Power Station Extension proposals.

Other

Based on the negligible contributions of carbon monoxide, lead and heavy metals predicted to result from the project, which demonstrate that air quality criteria would be comfortably achieved even taking into account background concentrations of these pollutants, the Department is satisfied that the project would not pose an unacceptable risk to local air quality with respect to these pollutants. Whilst the predicted contributions for chlorine and sulfuric acid mist are close to the relevant air quality limits for these pollutants, based on historic monitoring for the Munmorah power station (including when it was operating at loads similar to the proposed loads of the rehabilitated plant), which indicate these emissions to be orders of magnitude lower than the predicted concentrations, the Department is satisfied that the project would not pose a significant emissions risk with respect to these pollutants in terms of local air quality amenity.

In relation to hydrogen fluoride, DECCW queried the fact that an emission concentration limit of 30 mg/m³ was used in the revised air quality assessment to determine potential impacts, which was three times greater than the concentration modelled in the original assessment, however, the model produced similar results. When questioned about this, the Proponent indicated that despite the use of different emission rates, the similarities in

the results was purely coincidental. The Proponent has further clarified the methodology undertaken for the revised assessment and documented it in its Supplementary Submissions Report.

The Proponent has stated that the proportion of fluorine in coal is variable as is the proportion of fluorine in the coal which is admitted to the atmosphere. The Proponent's modelling in the revised assessment assumed that 100% of the fluorine present in the coal would be emitted which is considered to be conservative. The Proponent has indicated that modelling results show that hydrogen fluoride levels are expected to be in the order of 20 mg/m³ which includes coal with maximum fluorine content. As a comparison, a level of 17 mg/m³ has been recorded at Vales Point which burns similar coal to that undertaken at Munmorah. The Proponent has sought a limit for hydrogen fluoride of 30 mg/m³ (which is lower than the Group 6 limits) as providing sufficient flexibility in the choice of coal used at the power station. The Proponent considers that this criterion could comfortably be met and the DECCW has accepted this limit. On this basis, the Department has recommended 30 mg/m³ as the stack emission concentration limit for the project. The Department has reviewed the supplementary information provided by the Proponent in relation to the revised assessment undertaken for hydrogen fluoride and accepts that the ground level concentrations predicted are based on valid and robust assessment methodology. The Department notes that this assessment has indicated that cumulative contributions of hydrogen fluoride (power station + background) would not exceed ground level concentration criteria for this pollutant. On this basis, the Department is satisfied that the project would not pose an unacceptable risk to local air quality for this pollutant.

Conclusion

In summary and with consideration to the recommended conditions of approval, the Department is satisfied that the air quality impacts of the project can be regulated consistent with acceptable amenity and human health standards.

5.3 Operational Noise

Issue

The proposed rehabilitation of the power station would not involve any significant changes to the current layout of the site with the majority of the works proposed to occur within the existing plant area. The location of the plant in relation to surrounding residential areas is shown on Figure 4.

The Environmental Assessment states that the rehabilitation works would not introduce additional operational noise or vibration sources and therefore no additional operational noise impacts are expected when compared to existing operations. The Environmental Assessment indicates that slightly reduced operational noise levels are expected as a result of increases in efficiency and the replacement of worn and/or damaged items of equipment. The nearest residential receiver to the power station is approximately one kilometre from the site.

Coal is proposed to be transported to the site via the Munmorah-Vales Point (MV) Conveyor which is to be replaced with a new conveyor which would largely follow the existing conveyor route. Sensitive noise receivers are located between 100 and 200 metres from the conveyor alignment, however, the Environmental Assessment has stated that some transfer stations can be eliminated which would reduce operational noise emissions when compared to the noise generated by the existing conveyor. The Proponent has stated that the preferred conveyor option is driven from the head-end and tail-end without a mid-section drive thereby minimising the environmental noise impacts to surrounding residents adjacent to the conveyor route.

The existing power station operates in accordance with the Munmorah Power Station Noise Management Plan, developed for the Proponent in 2008. The plan specifies the allowable noise emissions from the existing plant based on an intrusive night-time goal of 39 dBA (L_{Aeq15min}) which is based on a night-time Rating Background Noise Level (RBL) of 34 dBA as measured by the Proponents consultants in 2005 at the two nearest residential receivers. The Proponent indicated that when both the Munmorah and Colongra Power Stations are considered together, an amenity criteria of between 40 and 45dBA would apply.

Noise from the power station is primarily from three sources being the air intake, noise from the turbine/generator hall and noise from the exhaust stack. Noise is also generated from the operation of the conveyor, however, due to improved technology and a new conveyor, noise from the use of the conveyor to transport coal is expected to

be reduced when compared to existing noise generated. A noise barrier was installed adjacent to the conveyor to shield the Denman Street residences from conveyor noise.

Figure 4: Location of Munmorah Power Station and Conveyor



The Proponent proposes to install an additional barrier in the vicinity of Doyalson Welding (refer Figure 5) to protect the residences there from adverse conveyor noise. The Environmental Assessment indicates that the effect of the additional barrier would be to reduce noise levels by 6-8 dBA and result in noise levels at residential receivers complying with the intrusive criteria of 39 dBA.

Based on computer modelling undertaken as part of the operational noise assessment, the Environmental Assessment states that the predicted noise emissions from the Munmorah Power Station could exceed the night-time criterion by up to 2 dBA during neutral meteorological conditions and by up to 6 dBA during adverse conditions. The inclusion of noise emissions from the adjacent Colongra Power Station results in noise levels increasing by a further 2 dBA, however, the Proponent states that this would result in an exceedance of the maximum amenity criteria by only 1 dBA during neutral meteorological conditions and up to 6 dBA during worst-case conditions.

The Proponent has stated that the refurbishment of the plant would result in reduced noise emissions and therefore specific mitigation measures have not been proposed. While some noise exceedances have been predicted, the Proponent has stated that all feasible and reasonable noise control measures would be implemented during the design stage to reduce the noise emissions from the plant. The Proponent has also

committed to undertake noise measurements once rehabilitation works are complete to assess operational noise and if necessary develop mitigation measures including increasing the building envelope, installation of silencers or the installation of noise barriers to reduce noise emissions to within the noise emission criteria.

Figure 5: Residences in Proximity to Coal Conveyor



Submissions

No public submissions raised noise as an issue of concern regarding the proposal. Of the government authority submissions received, noise was raised as an issue by NSW Health, the Department of Environment, Climate Change and Water (DECCW) and Wyong Shire Council.

NSW Health indicated that community noise can pose a general public health risk and be a source of considerable annoyance. It recommended that the Proponent be instructed to develop a "noise control plan" in

consultation with the community and that cumulative impact of noise should also be considered from the Colongra gas turbine facility, the MV conveyor and the existing Munmorah power station. NSW Health indicated that best practice noise mitigation methods should be used to achieve the "acceptable project specific noise goal" that is established.

DECCW indicated in its submission that it conducted a detailed review of the noise impact assessment undertaken by the Proponent and considered that it was generally consistent with the NSW Industrial Noise Policy and DECCW environmental assessment requirements, although it commented that while the Environmental Assessment detailed various mitigation measures that could be employed to control noise, there was no commitment by the Proponent to adopt any of the measures or an assessment to show that the adoption of the measures would result in compliance with the criteria. DECCW also noted that the proposed refurbishment may include the provision to enable up to 75% gas to be used to fire the plant in combination with coal and that the noise impact assessment did not specifically consider low frequency noise. DECCW made a number of recommended conditions of approval in relation to the project including recommended project specific design noise goals that should be adhered to by the Proponent, as outlined in Table 10 below.

Table 10: Noise Limits as Recommended by DECCW

Location	Day L _{Aeq,15 mins}	Evening L _{Aeq,15 mins}	Night	
			L _{Aeq,15 mins}	L _{Amax} or L _{A1, 1 min}
Macleay Drive (Sunnyvale Caravan Park), Halekulani	39	39	39	45
Kalele Avenue, Halekulani	39	39	39	45
Alpine Avenue, San Remo	39	39	39	45
Any residence on Denman Street, Doyalson	39	39	39	45
Any residence adjacent to the Pacific Highway at Doyalson Welding	39	39	39	45

Note: The above noise limits apply under all meteorological conditions with the exception of winds greater than 3 metres/second at 10 metres above ground level; or stability category F temperature inversion conditions and wind speeds greater than 2 metres/second at 10 metres above ground level.

DECCW also recommended that a noise compliance assessment be undertaken and submitted to both the Department and DECCW annually to assess compliance with the noise levels specified in Table 10 above.

In relation to operational noise, Wyong Shire Council identified that some noise exceedances are expected from the rehabilitated plant at surrounding residences and therefore recommended that commissioning measurements should be completed and that all on-site mitigation measures, as recommended by the acoustic consultant be complied with to ensure that the noise levels do not exceed the project specific noise criteria of 39 dBA. The Council indicated that should the commissioning measurements indicate potential impacts to surrounding residences, the Proponent should be required to implement additional acoustic treatments to reduce noise to acceptable levels.

Consideration

The Department has reviewed the Environmental Assessment, including the specialist noise technical assessment and considers that the noise from the project can be managed such that no adverse noise impacts are expected to be experienced at the nearest residential receivers to the site during the power stations operation (i.e. together with the operation of the adjacent Colongra Power Station and the MV Conveyor). The Proponent has stated in its Submissions Report that it will undertake noise monitoring following commissioning of the project and if monitoring indicates an exceedance of the project specific noise limits it will develop and implement mitigation measures to target a reduction in noise impacts to the project specific noise goal of 39 dBA.

Independent Review

The Department commissioned Heggies Pty Ltd to undertake an independent peer review of the noise assessment. In relation to operational noise, the review indicated that a rating background level (RBL) of 36 dBA should be adopted for the daytime period and an RBL of 33 dBA for the evening and night-time period at all residential receiver locations. In addition, the review indicated that the Proponent's wind analysis did not appear to be undertaken in accordance with the NSW Industrial Noise Policy's requirements.

The review outlined that daytime operating noise levels for the rehabilitated Munmorah Power Station would generally range between 28 dBA and 40 dBA at the nearest residential receiver and therefore would comply with the daytime criteria of 41 dBA. Night-time noise levels would range between 32 dBA (Lakeside Village) to 45 dBA (Ulana Avenue and Woolana Avenue) during noise enhancing weather conditions and therefore would result in an exceedance of the project specific noise level. For the conveyor, the independent review indicated that the predicted daytime operating noise levels would range from 40 dBA (Denman Street) to 48 dBA (Pacific Highway) during calm weather conditions and therefore would result in an exceedance of up to 7 dBA above the project specific noise level of 41 dBA. The predicted night-time operating noise levels for the upgraded conveyor were generally shown to range between 49 dBA (Denman Street) to 53.5 dBA (Pacific Highway) during noise enhancing weather conditions, substantially exceeding the evening and night-time project specific noise levels. The review outlined that the Proponent should be required to prepare a comprehensive meteorological assessment based on temperature inversion measurements relevant to the local area or alternative weather stations recordings as guided by the requirements of the NSW Industrial Noise Policy or in the absence of such an assessment shall design the project to comply with the specific noise levels as presented by Heggies (i.e. an $L_{Aeq,15\ min}$ noise level of 41 dBA for the daytime and 38 dBA for the evening and night-time period).

The Proponent's response to the independent review indicated that it agreed with the adoption of an RBL of 36 dBA for the daytime period and an RBL of 33 dBA for the evening but does not accept an RBL of 33 dBA for the night-time period as previous noise monitoring indicated an RBL of 34 dBA for the night-time period at the nearest residential receiver.

Department's Consideration

The Department has reviewed the noise impact assessment undertaken by the Proponent and considers that it provides an adequate level of assessment to determine whether noise and vibration is expected to be a major issue for the proposal. The Department has considered the comments made by Heggies as part of the independent review however has accepted that the Proponent's project specific noise goals have been based on noise monitoring results undertaken at the nearest residential receiver. In addition, the Department notes that DECCW has also accepted the Proponent's noise monitoring results and project specific noise levels.

The Department notes that the Proponent did not provide an indication of mitigation measures that would be implemented as part of the project to reduce noise emissions from the operation of the plant and its associated conveyor. The Department considers that standard noise mitigation measures exist that could be applied to the project and would expect this to be confirmed during the detail design stage of the project in order to comply with noise limits recommended by DECCW. Such measures include acoustic shrouding, selection of low noise pumps and fans and acoustic barriers such as noise walls or earthen bunds around the plant.

The Department has recommended that the Proponent ensure that the final project design (including the upgrade of the MV conveyor) meets the specific limits for noise at the closest residential receivers to the site (as outlined in Table 11). The Department has also recommended a specific condition of approval that the Proponent confirm the noise emissions from the operation of the refurbished plant (and upgraded conveyor) within three months of the plant being operational and to outline what mitigation measures will be implemented should exceedances of the project specific noise limits be revealed from noise monitoring undertaken at that time.

5.4 Water Quality and Aquatic Ecology

Issue

Munmorah Power Station uses potable water (from the Central Coast water supply) and salt water (from Lake Munmorah) for its electricity generating activities. The Environmental Assessment states that under current operations a large proportion of the water, including potentially contaminated stormwater runoff, is firstly treated and then discharged to the Munmorah Ash Dam, located to the north of the site. The remaining water system outputs from the site include steam plant release to the atmosphere, Wyong Sewerage System, Vales Point ash transport water management system or salt water discharge to Lake Budgewoi. With regard to the salt water cooling system, the information outlined in the Environmental Assessment indicates that the power station draws cooling water for condenser cooling from Lake Munmorah via a 1.8 kilometre canal that connects Lake Munmorah with Lake Budgewoi. Cooling water is drawn from the inlet canal and passes through the system absorbing waste heat from the steam cycle. Warmed water is then discharged back into the outlet canal which

flows into Lake Budgewoi. The existing power station operates under Environment Protection Licence No. 759 which requires that cooling water discharged to Lake Budgewoi must have a temperature of 35 °C with an allowance for temperatures to reach 37.5 °C for up to 1.5% of the time. The power station is licensed to discharge up to 4,750 ML/day of cooling water, however the system typically discharges 1,175 ML/day for one unit and approximately 2,350 ML/day for two units operating.

The channel between Lake Budgewoi and Lake Munmorah was deepened when the Munmorah power station was constructed to improve the circulation of water between the two lakes. A training wall, which deflects the warm water plume away from seagrass beds, was also constructed at the outlet to increase the mixing with cooler lake water in the discharge area. The Environmental Assessment states that the wall deflects the plume from seagrass beds on its western side as well as beds located on the north western and western side of Lake Budgewoi.

Modelling was undertaken as part of the Environmental Assessment for the "as built" and "rehabilitated" scenarios to determine the impact of the plume at the outlet. The results predicted that the worst-case outlet temperature of a two unit, untempered refurbished power station plume would be 36 °C. The "refurbished" scenario resulted in a plume that was 3 °C cooler than the "as built" plume and the plume extent was also reduced by approximately 50 metres. The Environmental Assessment has concluded that the area of seagrass exposed to elevated temperatures would be smaller for the "refurbished" scenario.

In terms of water quality, the power stations existing EPL indicates that nutrients and various metals are required to be monitored yearly with selenium required to be monitored quarterly, total suspended solids fortnightly and pH, monthly. The Environmental Assessment states that the Proponent, while requiring to monitor metals on a yearly basis, undertakes monitoring twice per year.

As part of the Environmental Assessment, previous water quality studies were reviewed regarding the project's contribution to the water quality in the lake system. It should be noted that water quality monitoring was undertaken when the power station was operating at low output (average of 150MW). The results of water quality monitoring studies indicated little variability between the lakes and concluded that small differences were unlikely to be of a magnitude to have ecological or biological consequences. Monitoring undertaken by the Proponent as part of its EPL reporting conditions also indicated that the three lakes have similar water quality, however on average Lake Budgewoi is slightly warmer.

Water is also discharged from the Munmorah Ash Dam at a rate of 17 ML/day into the cooling water inlet canal. The Environmental Assessment states that average metal concentrations in the ash dam discharge are generally less than the ANZECC water quality guidelines except for copper which exceeds the guidelines some of the time. Nutrient concentrations in the discharge fluctuate, however, average reactive phosphorus and total suspended solids are marginally above the guideline limits. The Environmental Assessment states that ambient water quality characteristics are not expected to change as a result of the proposal.

In relation to aquatic ecology, studies undertaken by CSIRO, 1990 and Roberts, 2001 (as quoted in the Environmental Assessment) concluded that the power station has had substantial impacts on seagrass and associated fauna within one kilometre of the cooling water outlet. Seagrass maps provided in the Environmental Assessment indicate the consistent depletion of *Zostera* seagrass beds near the cooling water outlet and the documentation states that the temperature difference directly adjacent to the outfall is above the tolerance limit of this species. Outside the immediate discharge zone, the Environmental Assessment indicates that seagrass communities continue to exist. Modelling undertaken as part of the Environmental Assessment indicates that temperatures in the seagrass beds are expected to be the same or only slightly lower than the "as built" plume and therefore the rehabilitation is not expected to cause a change in impacts on seagrasses in the lakes. The Environmental Assessment indicates that the Proponent proposes to map the distribution of seagrasses during the summer 2009/10 and establish a programme of ongoing monitoring of seagrass distribution following the rehabilitation of the power station in consultation with DECCW.

Studies by the CSIRO, as quoted in the Environmental Assessment, also indicated that there was no evidence of excessive bioaccumulation of metal concentrations in seagrass or sediment dwelling biota in the lakes and the metal concentrations in the sediment were lower than the ANZECC sediment quality guidelines for the protection

of aquatic life. The Environmental Assessment states that as the mass emissions from the power station would remain the same or less than the "as built" units, the sediment trace element concentrations are predicted to continue to be below the ANZECC guidelines as a result of the proposal.

Submissions

None of the public submissions raised any specific issues regarding water quality or aquatic ecology associated with the proposal. From the government authority submissions received, the only organisations that raised issues with regard to water quality and/or aquatic ecology were DECCW and Wyong Shire Council.

DECCW raised some questions regarding the modelling undertaken as part of the Environmental Assessment in terms of whether it was actually the worst-case scenario because of inconsistencies between the text in the Environmental Assessment and the model. Given the issues raised, DECCW has recommended that the Proponent be required to carry out long term monitoring of the water temperature and seagrass beds within the northern end of Lake Budgewoi. DECCW has also recommended that the Proponent be required to report any observed reductions in seagrass area and, where attributable to power station operations, describe the ameliorative measures to be implemented. Where impacts are considered unavoidable, DECCW considers that the Proponent should be required to offset any impacts.

In its submission, DECCW has clearly stated that its aim is to continue to reduce pollutant loads on central coast estuarine lake systems over time and therefore also considers that the Proponent should be required to investigate longer term options to minimise thermal loads which should include an investigation into the feasibility of constructing and operating a pipeline from the ocean to supply cooling water.

In relation to water quality, DECCW raises concerns that the CSIRO studies quoted by the Proponent are almost 20 years old and therefore the Proponent should be required to carry out water and sediment quality studies to determine mass load of metals being discharged from the Munmorah ash dam into Lake Budgewoi. In addition, given that Lake Budgewoi and Lake Munmorah are effectively closed lake systems, DECCW considers it appropriate that the Proponent investigate feasible options to reduce, treat and/or eliminate wastewater discharges from the site, particularly discharges from the Munmorah Ash Dam. DECCW provided the Department with recommended conditions of approval reflective of the above issues raised.

In its submission, Wyong Shire Council indicated that it does not consider that an adequate assessment on aquatic ecosystems was undertaken as part of the Environmental Assessment as the assessment relied on old seagrass data and dated studies. Council also raised the concern that much of the data that was collected was during periods of low power station output and it therefore considers that the impacts cannot be adequately assessed. The Council also indicated that the Environmental Assessment did not provide any discussion on the impacts of cooling water in relation to the proliferation of pest species and/or pathogens and disease and that ongoing monitoring of seagrass distribution and health should be undertaken by the Proponent as a safeguard.

Consideration

The Department has reviewed the Environmental Assessment, the submissions received and the Proponent's response to the issues raised and considers that the Proponent should be required to undertake an ongoing monitoring program with respect to water quality near the discharge point for cooling water and for monitoring of seagrass distribution and health within the northern area of Lake Budgewoi.

While the Department notes the Proponent's concerns that the power station is not the only contributor to pollutants to the Tuggerah Lakes System, the Department considers that an ongoing water quality and aquatic ecological monitoring program will highlight potential environmental impacts to the lake system (specifically Lake Munmorah and Lake Budgewoi) and therefore be a starting point to determine the cause of the impact. If the impact can be attributable to the operation of the power station, the Proponent would then be in a position to develop and implement appropriate reasonable and feasible mitigation measures which could then be monitored over time, or to provide an offset, as appropriate.

The Department agrees with comments made by DECCW in relation to the Proponent investigating alternative options to supply cooling water to the plant. In addition, the Department considers that this investigation should

also include the investigation of alternative options for discharging cooling water into the Tuggerah Lakes System and considers that the ocean could be investigated for both options. While the Proponent has indicated in its response to submissions that these options have been investigated in the past, no report could be located. The Proponent has also indicated that there would be inherent risks associated with the construction of two tunnels as the area has been mined extensively in the past and the construction works would entail their own environmental impacts that would require management. The Proponent also noted that operationally this option would require a large pumping station to be constructed which would consume at least 5MW of energy thereby reducing the power stations overall efficiency and increasing its greenhouse gas footprint.

As a result of discussions between the Department and the Proponent regarding the investigation of alternative options to supply and discharge cooling water from the plant, the Proponent commissioned Aurecon to prepare a high level preliminary feasibility study of ocean cooling for the Munmorah power station. This report forms part of the Proponent's Supplementary Submissions Report and investigated five possible options, as follows:

- Option 1 – a pipeline from the power station to discharge warm water to the ocean and using the existing inlet system from Lake Munmorah;
- Option 2 – a pipeline from the ocean to supply cooling water to the power station and retaining the existing discharge to Lake Budgewoi;
- Option 3 – a pipeline from the power station to discharge warm water to the ocean and another pipeline from the ocean to the power station to supply cooling water;
- Option 4 – an inlet pipeline from the ocean to Lake Munmorah; and
- Option 5 – an inlet pipeline from the ocean to Lake Munmorah and a discharge connection from Lake Budgewoi to the ocean.

High level concept engineering and cost estimates was provided for each option in the Supplementary Submissions Report together with a broad discussion of the potential impacts of each option in relation to lake ecology, water flows and levels, terrestrial ecological impacts and a socio-economic assessment. The report concluded that while ocean cooling configurations could reduce thermal loads within Lake Munmorah and Lake Budgewoi, the Proponent considers that the potential impact from the options may have a greater impact on the environment, ecosystems and the surrounding community than the continued operation of the existing system. Following further discussions between the Proponent, DECCW and the Department, the Proponent submitted an additional report to the Department outlining that the costs involved in the investigations associated with Option 3 relating to engineering design, geotechnical investigations, hydrodynamic studies and other environmental studies and community consultation would be approximately \$2.6 million. This is additional to the construction of Option 3 which was calculated by the Proponent as approximately \$320 million. The Department has accepted that, at this point in time, the Proponent has demonstrated that the cost implications of providing two pipelines between the power station and the ocean for the supply and discharge of cooling water are considered cost prohibitive, particularly as the severity of any impacts of the current system have not been established.

The Department has also recommended that a Temperature and Seagrass Monitoring Program be undertaken by the Proponent as well as a Water and Sediment Quality Study as part of the conditions of project approval.

6. CONCLUSIONS AND RECOMMENDATIONS

The Department has undertaken a detailed assessment of the proposed refurbishment of the Munmorah Power Station, having regard to the Proponent's Environmental Assessment, Submissions Report, the issues raised in agency and public submissions and the independent reviews which were commissioned by the Department to review the greenhouse gas assessment, the air quality assessment and the noise impact assessment.

The Department considers that the Proponent has undertaken an adequate and appropriate level of environmental assessment and the Department is satisfied that it can recommend project approval subject to specific conditions. On balance, the Department considers the project to be justified and in the public interest and should be approved subject to the Department's recommended conditions of approval and the Proponent's Statement of Commitments.

While there is substantial debate over the benefits and disbenefits of the project, particularly in relation to its predicted greenhouse gas emissions, the predicted shortfall in electricity generation cannot be met purely by renewable energy projects, contrary to public submissions. The Department considers that the project is justified as an important and necessary component of the broader suite of demand management, energy efficiency and capacity generating measures required to secure the State's energy supplies into the future as it would contribute to satisfying the demand-supply imbalance of electricity generation expected to occur between 2014 and 2020.

The Department considers that the project has the added advantage of being an existing power station which is capable of being refurbished utilising existing assets within a relatively short time period to extend the life of the facility by up to 20 years. The Department also considers that the project can be undertaken with minimal impact on the surrounding environment as the rehabilitation would be confined to the existing disturbed footprint of the power station (with most work involving refurbishment to internal plant component rather than earthworks), including the coal conveyer upgrade which would also be confined to the existing disturbed corridor. As outlined in the Environmental Assessment and in this report, it is the operation of the project that has the potential to result in significant environmental impacts, particularly in relation to greenhouse gas emissions, air quality and potentially impacts on water quality and associated aquatic ecology.

Operation of the project is predicted to generate approximately 4.2 million tonnes of CO_{2-e} per year for the 100% coal-fired option and approximately 3 million tonnes of CO_{2-e} per year for the 25%coal/75% gas dual-fuel option. Considering the need for the project, as outlined in Section 2.2 of this report, and the level of predicted greenhouse gas emissions, the Department has recommended that the Proponent be required to clearly demonstrate that it is continually investigating carbon reduction technologies with the intention that these measures could be retrofitted to the plant, as well as other emission reduction technologies or offset measures that could be implemented as part of the project to reduce or offset greenhouse gas emissions.

In relation to air quality, the Department has recommended that the Proponent be required to operate the plant to ensure that it meets strict concentration levels for a range of air pollutants and to undertake monitoring on a continual basis to enable it to demonstrate compliance with the concentration limits. Where exceedances are identified, the Proponent is required to provide details of remedial measures that will be implemented to reduce point source emissions and ground level concentrations in consultation with the DECCW. In order to minimise adverse impacts to water quality and aquatic ecology, the Department has recommended that the Proponent be required to operate the plant so that the temperature of any water discharged from the cooling water outlet canal into Lake Budgewoi never exceeds 37.5 C.

The Department recommends that the Minister for Planning:

- consider the findings and recommendations of this report;
- approve the project application, subject to conditions, under section 75J of the *Environmental Planning and Assessment Act 1979*; and
- sign the attached project approval (Tagged "A").

APPENDIX A – RECOMMENDED CONDITIONS OF APPROVAL

APPENDIX B – STATEMENT OF COMMITMENTS

APPENDIX C – RESPONSE TO SUBMISSIONS

APPENDIX D – ENVIRONMENTAL ASSESSMENT
