



Noise and Vibration

11

11 Noise and Vibration

11.1 Introduction

Delta Electricity's Munmorah Power station located on the NSW Central Coast near Doyalson was constructed as a 1,400MW four unit coal fired power station in 1967. Units one and two ceased operating in the early 1990s. The rehabilitation of units three and four generating plant would replace worn and obsolete components with currently available technology. Noise generated by the refurbished plant is a key environmental issue raised in the Director-General's Requirements (DGRs).

The location of MV coal conveyor can be seen in Figure 11.1. The nearest sensitive receiver is 1 km from the power station noise sources. Sensitive receivers are also located 100 m and 200 m from the MV coal conveyor which is to be replaced with a new conveyor.

The proposed rehabilitation of the power station would not involve any significant changes to the current layout of the site as the majority of the works would occur within the existing plant area.

The proposed rehabilitation works are not expected to introduce additional operational noise or vibration sources and therefore no additional operational impact is to be expected when compared to existing operations on site. Increases in efficiency and the replacement of worn and damaged items of equipment are expected to slightly reduce the operational noise emission levels of the power station.

The proposed upgrade of the MV coal conveyor would follow the current conveyor route. Technical studies for the development of the new conveyor show that it is likely that some transfer stations can be eliminated which would reduce noise emissions when compared to the existing conveyor. The preferred conveyor option is driven from the head-end and tail-end and therefore does not incorporate a mid-section drive minimising the environmental noise impact to surrounding residents adjacent to the conveyor route.

For the present environmental assessment the operational and construction noise emission levels and vibration levels have been assessed against the applicable current standards and the applicable noise and vibration goals.

The plant is to be designed to be 'carbon capture ready' as part of the rehabilitation. At this stage, final preferred technology and configuration are still unknown; therefore accurate sound power level data

for this equipment is not available. A detailed assessment of the noise emissions from this equipment would be conducted during the design stages of this aspect of the Proposal to ensure that noise emissions from the Carbon Capture Plant would not lead to exceedances of the developed Proposal-specific noise goals.

11.2 Director-General's and Department of Planning Requirements

A summary of the Director-General's and the Department of Planning's assessment requirements are as follows:

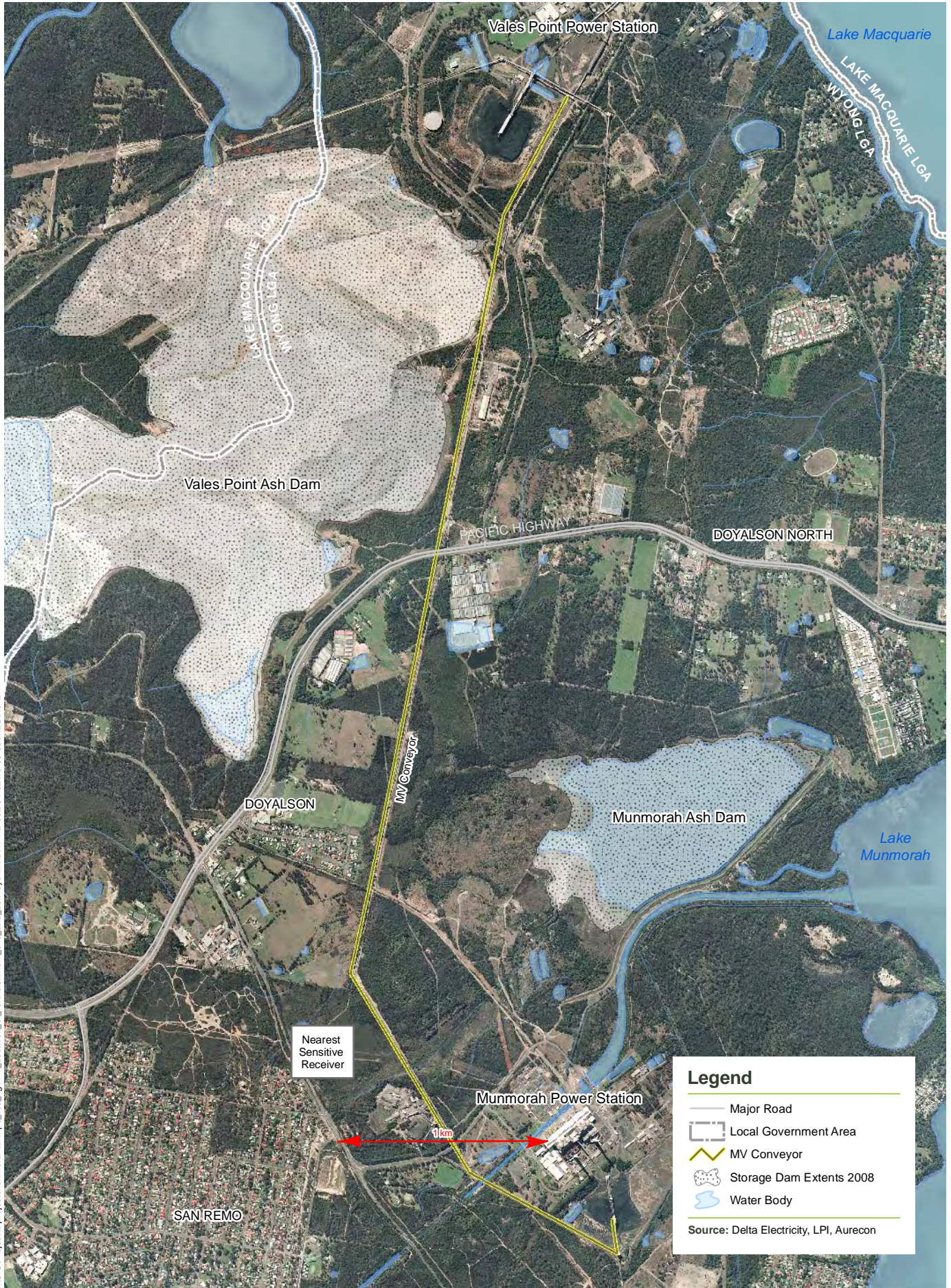
- operational noise impact under worst case operating scenarios and meteorological conditions
- cumulative impact from Munmorah (Colongra), Vales Point and Eraring Power Stations
- Vales Point to Munmorah Power Station Conveyor
- low frequency noise
- peak noise impacts – sleep disturbance
- construction noise in accordance with DECCW construction noise guideline
- vibration from construction and operation
- traffic generated during construction and operation in accordance with ECRTN

These issues are addressed as follows.

First predicted construction noise levels for the refurbishment of the power station plant and for the MV conveyor replacement including construction traffic are shown to be low and compliant with all standards.

Secondly construction and operational vibration is addressed and expected vibration levels are shown to be very low and to comply with all relevant standards with a substantial margin.

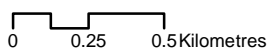
Finally operational noise is addressed. This covers noise generated by the refurbished Munmorah Power Station and MV conveyor and also the cumulative impact of noise from Munmorah and Colongra. Noise profiles generated for these sites indicate that there is no basis to expect cumulative noise impacts from Vales Point and Eraring Power Stations.



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Munmorah Power Station Rehabilitation Environmental Assessment

FIGURE 11.1: Location of refurbishment site and conveyor

11.3 Construction Noise

11.3.1 Construction noise standards

The standard hours of operation for the construction works are specified as follows:

- Monday to Friday: 7.00 am to 6.00 pm
- Saturdays: 8.00 am to 1.00 pm

No work is to be conducted on Sundays or public holidays.

During the standard hours of operation, the NSW Department of Environment, Climate Change and Water (DECCW) *Interim Construction Noise Guideline* specifies that the predicted noise level at a noise sensitive receiver (residential) should be less than the noise management level ($L_{Aeq15min}$). The noise management level is calculated based on the Rating Background Level (RBL) + 10 dBA.

The Noise Management Level for construction work outside of the standard hours is calculated based on RBL+5 dBA.

The rating background level is based on noise survey data, collected in accordance with the procedures defined in the NSW *Industrial Noise Policy*.

Noise monitoring has not been conducted by Aurecon for this stage of the Proposal as comprehensive monitoring recently undertaken at Munmorah Power Station for the development of the Colongra Gas Turbine Power Station was available and considered relevant. This monitoring information has been used to develop noise criteria for the proposed rehabilitation.

11.3.2 Construction noise criteria

Wilkinson Murray acoustic consultants were commissioned to conduct a noise assessment for the proposed Colongra Gas Turbine Facility by Parsons Brinkerhoff in 2005 (Wilkinson Murray, 2005). As part of the assessment, unattended noise monitoring was conducted at four indicative sites from 19 to 29 August 2005. The locations of the monitoring can be seen in Figure 11.2, with the results from noise monitoring given in Table 11.1

Based on the Wilkinson Murray monitoring results in Table 11.1, the following construction noise management limits at the sensitive receivers have been adopted for the construction noise assessment:

Standard hours: $L_{Aeq 15min}$ **46 dBA**
Outside of standard hours: $L_{Aeq 15min}$ **39 dBA**

11.3.3 Construction noise assessment

At this stage, exact construction details are still being finalised, however the total construction period would be greater than three weeks so a quantitative construction noise assessment is required and this has been undertaken. The full assessment is included in Appendix H.

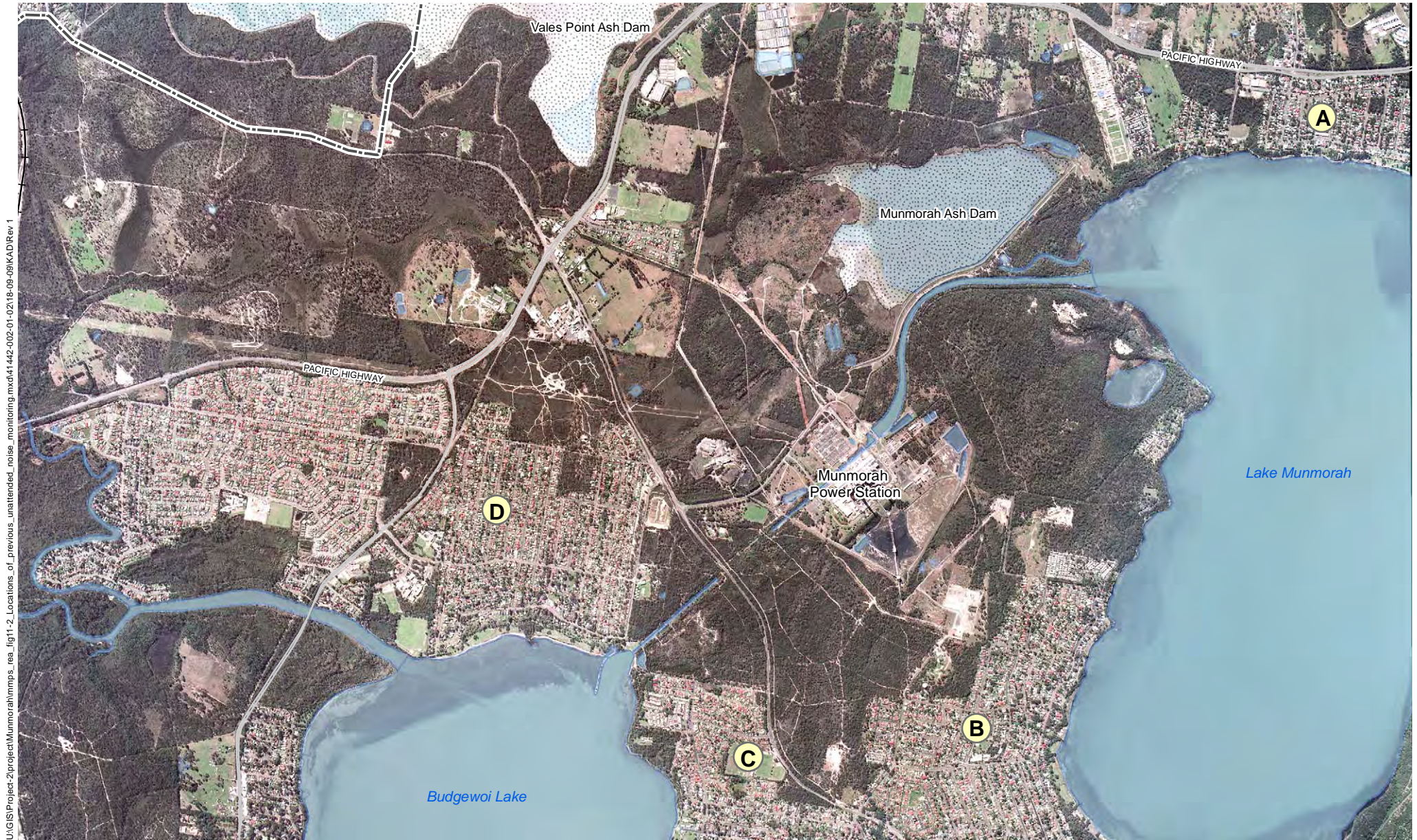
Heavy construction is not expected to be required as the Proposal largely involves rehabilitation or replacement of existing plant and control systems.

The more intrusive construction noise may occur due to the MV conveyor replacement, however work in the vicinity of sensitive receivers would be relatively brief and levels are expected to be well within the standards.

Table 11.1 – Previous unattended noise monitoring results (Wilkinson Murray, 2005)

| Noise catchment area | Noise monitoring location | Approximate distance to Colongra | Rating background noise level RBL (dBA) | | | Lowest ABL (dBA) |
|----------------------|---------------------------------|----------------------------------|---|---------|-------|------------------|
| | | | Day | Evening | Night | |
| A | 14 Kamilaroo Ave, Lake Munmorah | 2.8 km | 38 | 38 | 37 | 35 |
| B | 127 Woolana Rd, Budgewoi | 1.2 km | 36 | 33 | 34 | 32 |
| C | 32 Barega Cl, Buff Point | 1.5 km | 37 | 40 | 36 | 33 |
| D | 83 Perouse Ave, San Remo | 1.4 km | 39 | 38 | 34 | 33 |

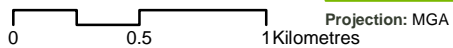
Where: Day: 7.00am to 6.00pm, Evening: 6.00pm to 10.00 pm, Night: 10.00pm to 7.00am



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Munmorah Power Station **Rehabilitation Environmental Assessment**

FIGURE 11.2: Locations of Previous Unattended Noise Monitoring

The impact from construction noise on nearby residents is expected to be minimal. Typical construction noise sources would include the following:

- traffic noise relating to equipment transport
- operation of mechanical equipment such as cranes, oxyacetylene equipment and loaders for dismantling and installing plant
- on-site equipment maintenance generally.

However the main construction activities would be conducted within the existing plant area. The existing overhead crane within the turbine hall building would be used for much of the heavy lifting associated with removing and replacing plant. The turbine hall would also provide attenuation of construction noise.

11.3.4 Construction noise mitigation

Notwithstanding the relatively low levels of construction noise expected, best practice construction methodologies should be implemented to minimise environmental noise emissions from the construction activities. Such methodologies should include but are not limited to:

- minimising tonal reversing alarms with the implementation of broadband reversing alarms
- using a 'forward working procedure' minimising reversing trucks, forklifts etc, wherever possible
- using low noise construction practices where possible
- locating noisy machinery as far from sensitive receivers where possible
- using existing topography and buildings on site as noise barriers between noise sources and sensitive receivers
- consideration of noise emissions from heavy vehicle routes delivering equipment to site and removing waste from site to sensitive receivers
- limiting noisy activities to daytime hours where possible.

A Construction Noise Management Plan would be developed when details of the construction activities are finalised.

11.4 Vibration

11.4.1 Vibration criteria

Acceptable levels of vibration for human comfort are set out by the NSW DECCW in their guideline *Assessing Vibration* (February 2006) (DECCW, Technical Guide). The strictest levels are specified for residences at night. The limit for acceleration in the horizontal plane caused by continuous vibration is 0.0050 m/s^2 and in the vertical plane 0.0070 m/s^2 . For impulsive vibration these limits are 0.071 m/s^2 and 0.010 m/s^2 .

The German Standard DIN 4150 1999-02 gives guidelines for allowable levels of vibration for building structures to minimise superficial damage. If the limits for superficial damage specified in DIN4150 are adhered to, it is highly unlikely that structural damage would occur. For dwellings the maximum allowable vibration velocity under this standard in the horizontal plane is 5 mm/s.

British Standards pertaining to cosmetic damage and human response are BS7385 and BS6472. These provide safe working distances from sensitive receivers for a range of heavy construction equipment ranging from jack hammers and pile drivers to vibratory rollers. The greatest safe working distance arises for human response and is 100 m from an extremely heavy vibratory roller, while for cosmetic building damage safe working distances range up to 25 m.

11.4.2 Vibration assessment

Compliance with all of the above standards is expected with a substantial margin in both construction and operation. The nearest dwelling to the power station is 1 km and heavy construction work is not involved.

Plant to be used in the conveyor replacement would not include heavy vibratory construction plant and would not lead to vibration annoyance at any residence.

Predicted vibration levels from the construction activities of the Proposal are expected to be significantly below the relevant allowable criteria and therefore no specific construction vibration mitigation is required. It is recommended however, that best practice methods are employed to mitigate any possible impacts.

Operational vibration from the power plant and MV conveyor is expected to be negligible, and significantly

below the vibration level criteria at the nearest residences.

No new vibration sources are to be introduced on site and therefore no additional operational impact is expected.

11.5 Operational Noise

11.5.1 Operational noise criteria

The existing Munmorah Power Station Noise Management Plan, developed by Parsons Brinckerhoff in September 2008 for Delta Electricity (Parsons Brinckerhoff, 2008) specifies allowable noise emissions for the existing plant. The rehabilitated power station would be required to comply with the noise emission targets of the existing plant.

Unattended noise monitoring was conducted by Parsons Brinckerhoff at the nearest sensitive locations to the boundary of the plant, 1.0 to 1.5 km from the power station, to determine the existing noise levels and to develop operating noise criteria. The noise survey noted that noise generated by the power station was inaudible at the measurement sites during the daytime due to the influence of local noise sources (eg the Central Coast Highway, local fauna, residential activity and aeroplanes). Measurements taken at night-time indicated that the noise from the power station was audible during periods of low background noise.

The Parsons Brinckerhoff Noise Management Plan did not develop Rating Background Levels for the noise survey data as specified in the NSW *Industrial Noise Policy* (INP), however a summary of the data can be seen in Table 11.2.

The INP sets out intrusive and amenity noise criteria to assess off site noise. The more conservative of the

two limits is selected as the Proposal-specific operational noise goal.

- the relevant intrusive criterion can be summarised as follows:

$$L_{Aeq(15 \text{ min})} \leq \text{RBL} + 5 \text{ dBA}$$

- the acceptable amenity limits for an urban area are listed in Table 11.3.

Monitoring (see Table 11.1) showed a night time RBL of 34 dBA for sites B and D). This determines the allowable operational intrusive noise emissions.

Based on the noise survey results and the procedure described in the INP, the following criteria are developed for the site:

- amenity night-time goal:
- acceptable: 40 dBA $L_{Aeq 15min}$
- maximum: 45 dBA $L_{Aeq 15min}$
- intrusive night-time noise goal: 39 dBA $L_{Aeq 15min}$

The night-time intrusive criterion is the most conservative of the noise goals and as such should be adopted as the Proposal-specific design noise goal. Although the Proposal is a rehabilitation of an existing facility, it is proposed that an aim of the Proposal should be to achieve the Proposal-specific design noise goal (39 dBA) as calculated by the procedure specified by the INP. This would require a reduction in noise emissions from the site as discussed below.

Proposal-specific design noise goal:
39 dBA $L_{Aeq 15min}$

Table 11.2 – Unattended noise measurements 10-17 September 2008 (Parsons Brinckerhoff, 2008)

| Location | L _{Aeq} dBA | | | L _{A90} dBA | | |
|--|----------------------|---------|-------|----------------------|---------|-------|
| | Day | Evening | Night | Day | Evening | Night |
| Macleay Drive (Sunnyvale Caravan Park), Halekulani | 49 | 41 | 44.5 | 35 | 35 | 35 |
| Kalele Avenue, Halekulani | 61.5 | 51.5 | 50 | 38 | 38 | 39 |
| Alpine Avenue, San Remo | 60 | 55 | 49.5 | 44.5 | 42.5 | 34.5 |

Table 11.3 – NSW INP amenity criteria – suburban environment

| Type of receiver | Period of day/day of week | Acceptable noise level (L _{Aeq} dBA) | Recommended Maximum Noise level (L _{Aeq} dBA) |
|---|--------------------------------|---|--|
| Residential – daytime | 7 am to 6 pm, Monday to Sunday | 50 | 55 |
| Residential – evening | 6 pm to 10 pm | 45 | 50 |
| Residential – Night time | 10 pm to 7 am | 40 | 45 |
| Industrial premises | When in use | 70 | 75 |
| Urban/Industrial Interface – Daytime | 7 am to 6 pm, Monday to Sunday | 65 | 70 |
| Urban/Industrial Interface – Evening | 6 pm to 10 pm | 55 | 60 |
| Urban/Industrial Interface – Night time | 10 pm to 7 am | 50 | 55 |

To assess the cumulative impacts from surrounding noise sources (such as the adjacent Colongra Power Station), the amenity criteria has been applied.

As the plant is expected to be a continuous operation, it is considered that where compliance with the night time noise goal is achieved, relevant day time and evening goals would also be met.

It is proposed that all feasible and practical measures be taken at the design stage to ensure that operational noise emissions from the site achieve the project-specific noise goal and that noise monitoring be conducted in the commissioning stage of the Proposal. If this monitoring shows noise emissions from the Munmorah Power Station at the nearest receiver exceed 39 dBA, a schedule of possible mitigation measures to be implemented would be developed and incorporated into an agreed pollution reduction program to target a reduction in noise impacts to the project-specific noise goal of 39 dBA.

11.5.2 Operational noise sources

The Proposal involves the rehabilitation of an existing facility where worn and technically obsolete equipment is to be refurbished or replaced. Generally this kind of rehabilitation would lead to a decrease in the operational noise emissions from a development to the surrounding environment. This section assesses the proposed plant upgrades with respect to predicted noise emissions relative to the existing.

Redesign of the stack particulate sampling system may be conducted as part of the rehabilitation to ensure that sampling methods comply with the standard testing methodology. This may involve the redesign of the fabric filter ductwork which could impact stack noise emissions. A detailed assessment of stack noise emissions cannot be included here, however this would be conducted at the detailed design stage to ensure that noise emissions comply with the developed noise criteria.

Noise from the power station is primarily from three sources:

- air intake
- noise from turbine/generator hall (including steam driven air ejectors)
- noise from exhaust stack.

In addition, noise is also generated by the MV coal conveyor. The route of the conveyor for the rehabilitation power station would remain essentially unchanged and therefore the noise impacts from the conveyor are expected to be reduced due to improved technology. Feasibility studies provided by Delta Electricity have indicates that some of the existing transfer stations may be eliminated, further reducing conveyor noise. The operating hours of the conveyor are not proposed to be altered.

Noise levels due to other sources are sufficiently lower not to require specific review here.

The three main noise generating items of equipment are currently operating on site, and no significant changes to the equipment sound power levels are expected.

The Parsons Brinkerhoff Noise Management Plan developed for the Munmorah Power Station in September 2008 (Parson Brinckerhoff, 2008) conducted short-term, attended noise monitoring on the eastern, south eastern and western boundaries of the power station to assess the existing environmental noise emissions. The monitoring was carried out at day time from 12.20 to 2.50 pm under neutral meteorological conditions and at night between 11.40 pm and 12.30 am. The noise survey results are summarised in Table 11.6. It is noted that when measurements were taken at night time, with minimal extraneous noise sources present, the noise emissions from the power station were discernable from ambient noise during periods of low background noise.

A review of operational data of the power station revealed that both turbines were operational during the measurements, with a combined power generation of 480 MW. A review of the meteorological conditions (measured at the on-site weather station) was conducted for the period in which noise levels were measured. Meteorological conditions affect noise levels, especially due to wind effects and sound refraction due to temperature inversion. The review indicated a high likelihood of temperature inversion conditions during the night measurements. Note that in Table 11.4 Stability Class A covers the neutral

conditions and Stability Class F refers to the temperature inversion conditions.

Table 11.4 – PB noise survey results (PB 2008)

| Receiver | Munmorah Power Station | |
|----------------------|---|---|
| | Stability Class A Power Station Influence (dBA) | Stability Class F Power Station Influence (dBA) |
| Alpine Ave | <45 (inaudible) | 40-42 |
| Kalele Ave | <37 (inaudible) | 39-40 |
| Sunnyvale Caravan Pk | <36 (inaudible) | 38-39 |

The total output of the current plant is 600 MW, therefore the plant was operating at approximately 80% capacity during the noise survey.


Current noise emissions from the site, measured at the residential receivers during the worst case (temperature inversion) conditions, are marginally compliant with the noise goals, and the sound power levels of the equipment after the proposed rehabilitation to the facilities are expected to be equal to, or below the current levels. The predictions of operational noise have been calibrated to the existing measured noise levels.

11.5.3 Operational noise predictions

SoundPLAN Version 6.5 was used to predict the noise emissions from the site in order to assess the noise emissions against the applicable criteria. As the majority of the equipment on-site would be retained in the refurbished plant, sound power levels of the existing plant were used as a basis of the computational noise model. The predicted noise emissions from the two power stations were calibrated against the previous noise studies for the plants, for both neutral and adverse meteorological conditions, with agreement between the predictions generally within +/- 3dBA at the sensitive residential receivers.

In addition to prediction of noise emissions from the Munmorah Power Station, noise emissions from the adjacent Colongra Gas Turbine facility were incorporated into the simulation in order to assess the cumulative impact of the two industrial sources. Vales Point Power Station has not been included in the simulation due to the large separation distance between the two sites (approximately 6 km).

A detailed three dimensional computational noise model was generated for each site which included the main noise generating sources on the sites, the



surrounding buildings and terrain contours at 2 m intervals.

The generation of the calibrated computational noise model allowed the cumulative impact of the two power station sources to be assessed against the relevant criteria under the worst case meteorological conditions.

Meteorological data from the Munmorah Power Station on-site weather station from 2004 was analysed to examine the incidence of two noise enhancing meteorological conditions:

- source-receiver winds
- temperature inversions.

Source-to-receiver winds

Source-to-receiver winds need to be assessed when wind is a feature of the site. The NSW *Industrial Noise Policy* (INP) indicates that wind is a feature when source-to-receiver wind speeds below 3 m/s occur for more than 30% of the time during any assessment period in any season. This is not the case for Munmorah Power Station, so no further analysis of noise enhancing source-to-receiver winds is necessary for this assessment.

Temperature inversions

The INP states that temperature inversions are a feature of the site when temperature inversions occur for more than 30% of the winter months (June, July and August) during the night period (6 pm to 7 am).

The site is susceptible to moderate F-class Pasquill Stability Class inversions so temperature inversions have been considered in this assessment.

Computational model

The computational noise model using SoundPLAN Version 6.5 includes the site buildings and noise sources for the Munmorah Power Station, the MV Conveyor and the Colongra Gas Turbine facility. A 450 m x 2.4 m noise barrier has been installed adjacent to the MV conveyor as a measure to reduce the Denman Street residents from noise which has also been included in the simulation.

The site layouts for the two power station sites were used as a template for the geometry in the simulation.

In order to quantify the accuracy of the noise model, the predicted values were compared against the

measured and predicted levels developed in the Munmorah Power Station Noise Management Plan (Parsons Brinckerhoff, September 2008) and the Munmorah Gas Turbine Facility Noise Assessment (Wilkinson Murray, September 2005). Calibration of the predicted values was within agreement of +/- 3 dBA of previous noise emission predictions, and compared well to previous noise monitoring conducted on site.

Simulation results

The operational noise contours generated are shown in Appendix H for neutral and temperature inversion conditions.

Plant noise emissions

The noise emissions from both the proposed rehabilitated Munmorah power station and the adjacent proposed Colongra Power Station were predicted and calibrated against previous noise emission modelling documented in the Noise Management Plan (in the case of the Munmorah) or the predicted noise levels as part of the Development Application (in the case of the Colongra). An analysis has been conducted for both the neutral (Stability Class A) and temperature inversion (Stability Class F) conditions.

Full noise contours from the simulations can be seen in Appendix H. These cover the noise emissions from Munmorah Power Station alone, Colongra Gas Turbine Station alone and the combined effects of the two sites. Figures 11.3 and 11.4 present the worst case noise predictions for the combined effects of the two sites under neutral and inversion conditions.

The predicted operational noise levels are compliant with the 39 dBA intrusive noise criterion at all residential locations under neutral conditions with the exception of Ulana and Woolana Avenues where the predicted levels from the rehabilitated Munmorah Power Station reach 40 dBA. Under temperature inversion conditions exceedances may occur at several additional locations.

When both power stations are considered together the amenity criterion of 40 to 45 dBA applies.

Under neutral conditions the maximum noise level reached is predicted to be 41 dBA and this increases under temperature inversion to a marginal exceedance (46 dBA) at Ulana and Woolana Avenues only.

The significance of the exceedances is discussed in the next section.

11.5.4 Conveyor emissions

Two groups of properties are potentially affected by conveyor noise: those located along Denman Street and those located adjacent to the Pacific Highway at Doyalson Welding. The locations are identified in Figure 11.5. The properties located on Denman Street are approximately 100 m from the conveyor, and the properties located adjacent to Doyalson welding are located approximately 200 m from the conveyor.

Previous measurements conducted by PB for the MV conveyor surveyed two sites; 1 and 17 Denman Street between 12.00 am and 1.00 am on 14 March 2008. The measurements showed that the contributions from the MV conveyor at two sites were 39 dBA at 1 Denman Street and 44 dBA at 17 Denman Street. No previous monitoring results for the Doyalson site are available. A noise barrier was installed adjacent to the conveyor to shield the Denman Street residences prior to the measurements.

The noise emissions to the Denman St and Doyalson receivers were also calculated to assess the cumulative impact of the MV conveyor, the Munmorah Power Station and the Colongra Gas Turbine Facility.

The results from the conveyor noise predictions show that under neutral conditions, the predicted levels marginally comply with the maximum Amenity criterion, with exceedances expected under adverse conditions. The addition of the noise barrier adjacent to the Doyalson Welding site is expected to decrease the noise emissions by 6-8 dBA which would reduce the noise exposure to the Doyalson site to within the maximum amenity criterion adopted for the Proposal.

11.5.5 Operational noise assessment

The predicted noise emissions from the Munmorah site would exceed the night time noise criterion by up to 2 dBA during neutral and 6 dBA during adverse meteorological conditions. The inclusion of noise

emissions from the adjacent Colongra Power Station increases noise levels by up to 2 dBA when compared to noise emissions from Munmorah Power Station alone however, based on the amenity criterion, the maximum exceedance remains at 5 dBA at the worst case receiver during worst case meteorological conditions.

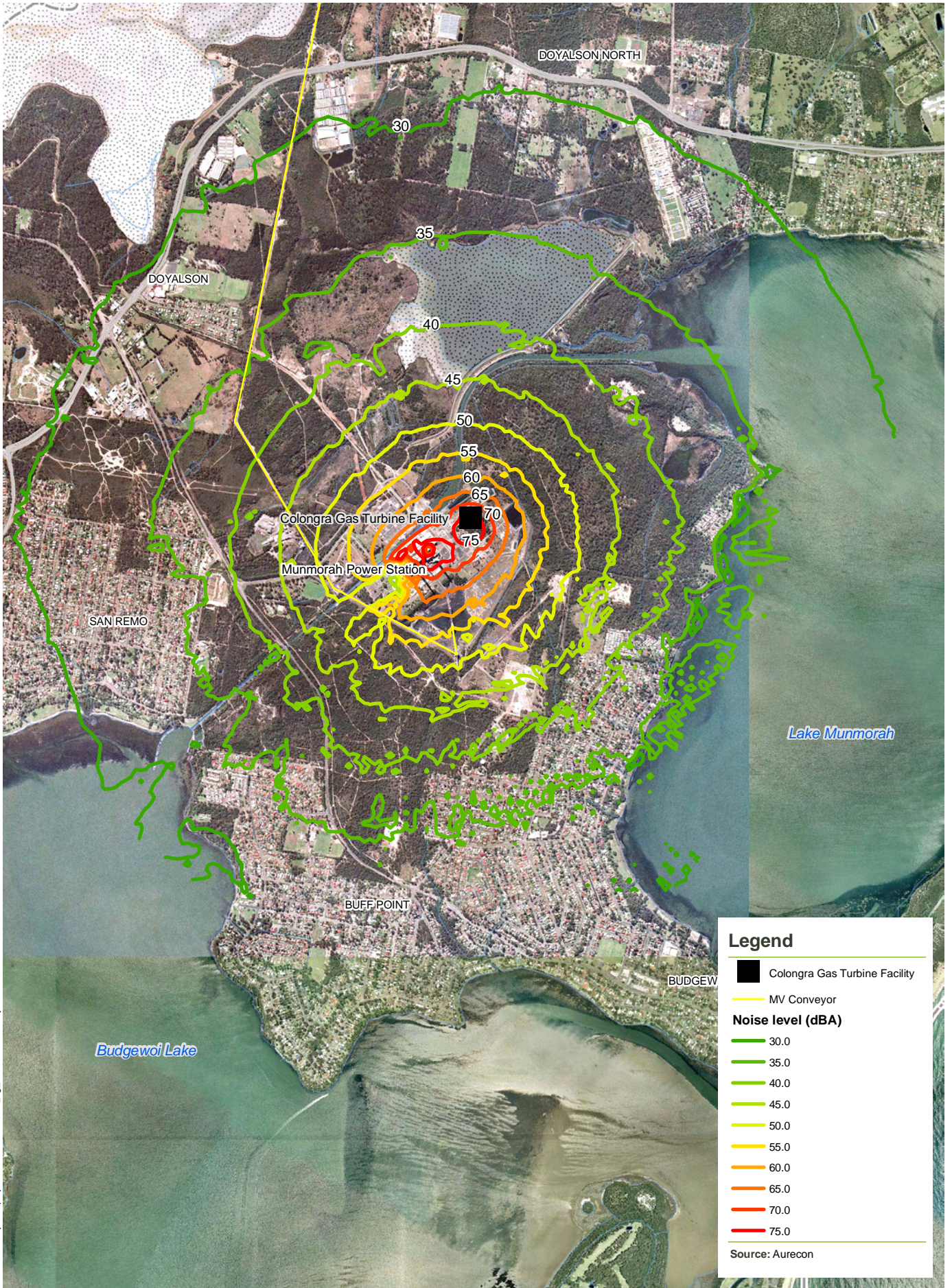
It is proposed that the combined noise emissions from the Colongra and Munmorah Sites should comply with the INP amenity criteria, which aims to set a maximum average noise level for various types of receivers. The acceptable amenity criterion for a suburban/rural receiver is 40 dBA, with a recommended maximum of 45 dBA. It can be seen that the maximum exceedance of the criteria is 1 dBA during the worst case meteorological conditions.

11.5.6 Future noise predictions

A primary aim of the rehabilitation of the facility is to return the capacity of the plant from the current reduced capacity of 600 MW to the original design of 700 MW. Although manufacturer's data is not available for the new items of equipment to be installed, it is possible to make predictions regarding the increase in noise levels generated by the upgrading of the plant with the increase in capacity. The key upgrade to the facility is the replacement of the turbines to allow for more efficient energy generation, the turbines/halls are therefore a major noise source on site.

Noise control formulae developed by the US military indicate only very small sound power increases due to the restoration of power station capacity from 600 MW to 700 MW.

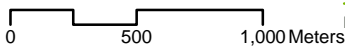
Given that the upgrading of the turbine involves the replacement of old equipment with current technology, it is expected that the noise level increases associated with the increase in capacity would be offset by new, low noise turbine technology.



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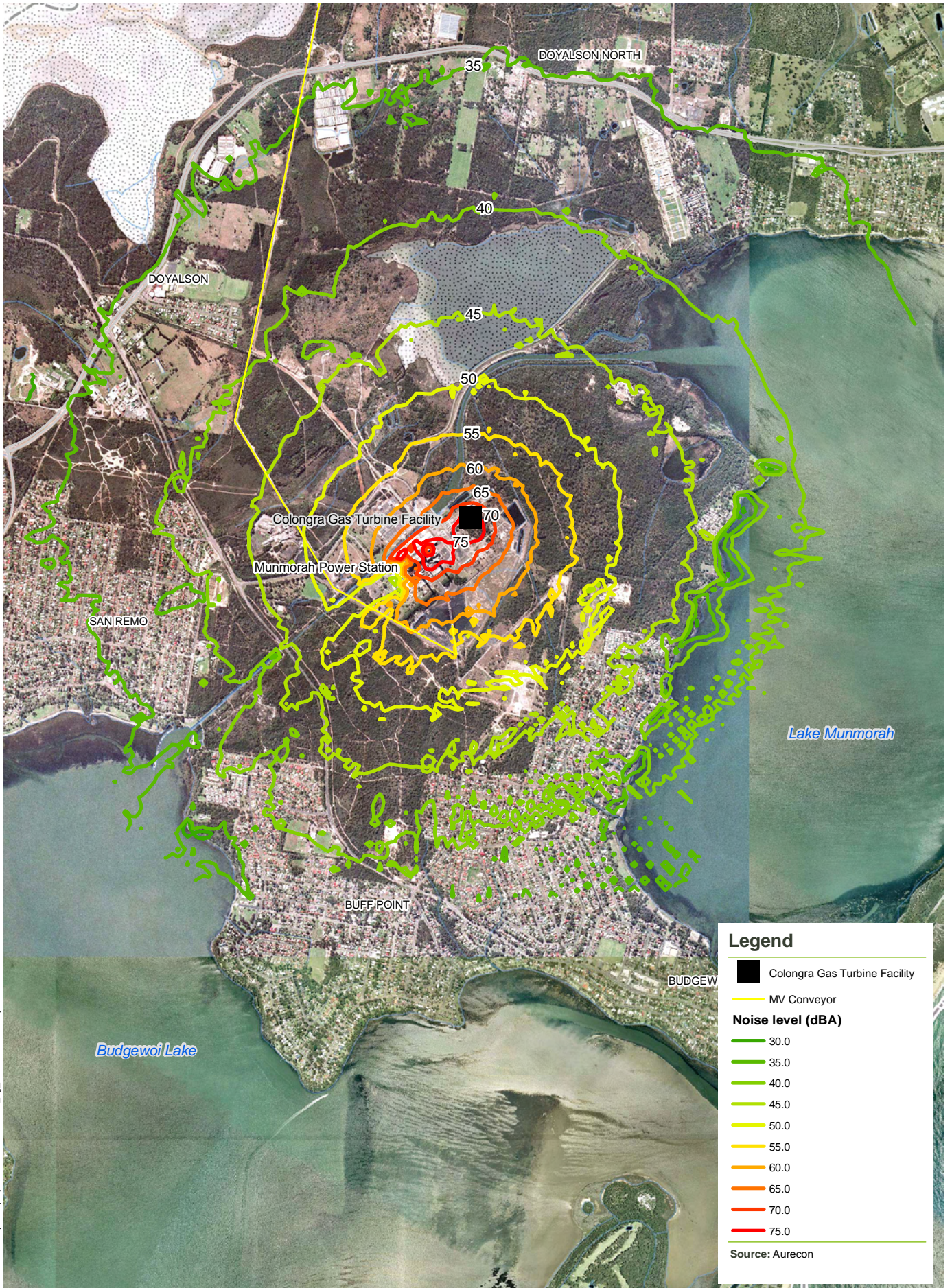
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Munmorah Power Station **Rehabilitation Environmental Assessment**

FIGURE 11.3: Combined Colongra Power Station and Munmorah Power Station - Stability Class A (Neutral)



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Legend

- Colongra Gas Turbine Facility
- MV Conveyor

Noise level (dBA)

- 30.0
- 35.0
- 40.0
- 45.0
- 50.0
- 55.0
- 60.0
- 65.0
- 70.0
- 75.0

Source: Aurecon

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Munmorah Power Station **Rehabilitation Environmental Assessment**

FIGURE 11.4: Combined Colongra Power Station and Munmorah Power Station - Stability Class F (Adverse)

11.5.7 Proposed plant upgrades

As discussed, the major upgrades to the plant involve the rehabilitation of the turbine blades, which is likely to slightly reduce noise emissions from power station site and the replacement of the MV conveyor is expected to significantly reduce conveyor noise.

It is proposed that noise performance of plant be considered in specifying and evaluating tenders for the plant upgrades.

11.5.8 Impulsive noise events

A steam safety valve release causes a maximum noise event which may lead to sleep disturbance in the local community. The boiler safety valve release is an automated event which may occur at any time, and therefore an assessment of possible sleep disturbance must be conducted. The Parsons Brinkerhoff Munmorah Power Station Noise Management Plan (Parson Brinckerhoff, 2008) also assessed the noise emissions from the boiler over pressure release valve, where a short burst of pressure is released to the environment. Measurements conducted on the over pressure valve revealed that the sound power level of the safety release valve and the over pressure valve were both approximately 120 dBA.

The Noise Management Plan adopted a sound power level of the valve release event as 120 dBA, and using computational noise modelling, predicted the noise level at the nearest receptor as 28 dBA. The NSW INP specifies a +5 dBA correction for noise sources with impulsive characteristics, therefore the predicted level, when corrected for the impulsive nature of the safety valve release event is 32 dBA.

Assuming a 10 dBA transmission loss through a façade with an open window to allow for natural ventilation, an internal sound pressure level in the worst affected bedroom would be 22 dBA. Based on

these predicted values, an awakening response to this event is not expected.

However it is proposed that best practice measures be implemented to control noise emissions from the steam release. It is therefore proposed that silencers should be installed to the steam release valves as a matter of best practice.

11.5.9 Operational noise mitigation

It is expected that the combination of the rehabilitation activities proposed for the Munmorah Power Station would result in an overall reduction in the operational noise emissions from the plant, therefore, additional mitigation measures are not proposed at this stage.

Due to the custom nature of the equipment involved in the rehabilitation of the plant, obtaining accurate sound power level data from the manufacturer may be difficult. In order to minimise operational noise emissions, it is therefore recommended that where low noise options exist for equipment, these should be specified, as a matter of best practice.

Commissioning measurements would be taken once rehabilitation works are complete to assess the environmental impact from the rehabilitation works. If the noise emissions are found to be excessive when compared to the developed operational environmental noise emissions criteria, mitigation measures should be developed to reduce the noise emissions to within the noise emission criteria.

Should commissioning measurements reveal an unreasonable noise level at the nearest residential receivers, remedial work should be considered. The scope of the remedial acoustic treatment would depend on the source of the offending noise and may include the increase of building envelope construction, installation of silencers, or the installation of noise barriers etc.



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 0 0.25 0.5 Kilometres

Projection: MGA

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FIGURE 11.5: Sites potentially affected by conveyor noise

11.5.10 Operational noise mitigation

It is expected that the combination of the rehabilitation activities proposed for the Munmorah Power Station would result in an overall reduction in the operational noise emissions from the plant, therefore, additional mitigation measures are not proposed at this stage.

Due to the custom nature of the equipment involved in the rehabilitation of the plant, obtaining accurate sound power level data from the manufacturer may be difficult. In order to minimise operational noise emissions, it is therefore recommended that where low noise options exist for equipment, these should be specified, as a matter of best practice.

Commissioning measurements would be taken once rehabilitation works are complete to assess the environmental impact from the rehabilitation works. If the noise emissions are found to be excessive when compared to the developed operational environmental noise emissions criteria, mitigation measures should be developed to reduce the noise emissions to within the noise emission criteria.

Should commissioning measurements reveal an unreasonable noise level at the nearest residential receivers, remedial work should be considered. The scope of the remedial acoustic treatment would depend on the source of the offending noise and may include the increase of building envelope construction, installation of silencers, or the installation of noise barriers etc.

11.6 Traffic Noise Assessment

An assessment of the possible impacts from traffic movements through the construction period and operations following rehabilitation has been considered in Appendix H and is summarised in this Section.

A consideration of the traffic volumes discussed in Chapter 12 has identified the insignificant contribution of the project to local traffic volumes. The operation of the rehabilitated power station is not expected to create additional traffic flows to the area. Minor additional heavy vehicle access is expected to be required during the construction phase.

The Central Coast Highway, which conveys vehicles to the site, has been classified as freeway/arterial road for assessment against the Environmental Criteria for Road Traffic Noise (ECTRN) (EPA 1999), due to the characteristically heavy and continuous traffic flows.

The ECTRN recommends target noise levels of 60 dBA (LA_{eq15hr}) for the daytime period and 55 dBA (LA_{eq9hr}) for the night time period for residential receivers adjacent to existing freeway/arterial roads. The ECTRN also recommends that noise arising from traffic generated by a development should not increase existing noise levels by more than 2 dBA. While an assessment of existing road traffic noise has not been conducted it is predicted that traffic arising from the development should satisfy the 2 dBA requirement in all cases.

11.6.1 Construction Traffic

It is expected that potential traffic impacts would occur during the construction phase of the project where additional heavy vehicles would be used to transfer goods to and from the site. Construction traffic may temporarily impact normal traffic flow, however based on the construction traffic estimates, potential impacts on the local traffic conditions are likely to be extremely low.

The indicative average construction workforce numbers during the rehabilitation (around 100) represents an insignificant increase in overall traffic volumes on the Central Coast Highway and would not be expected to increase traffic noise. These traffic movements would be expected to occur during peak traffic flow periods.

Construction traffic noise impacts would be mitigated by limiting heavy vehicle movements to the daytime period, where practicable. These issues would be addressed in detail in the construction noise and vibration management plan.

11.6.2 Operational Traffic

Traffic associated with the operation of the plant is expected to be similar to existing operations, as the workforce is expected to be effectively the same, and as coal would no longer be transported by road, there would be a slight reduction in heavy vehicle movements.

As there is no increase in operational vehicle numbers, the predicted operational traffic noise emissions of the proposed plant will be minor and equivalent to, or slightly reduced in comparison to the existing emissions.

Parking of staff vehicles occurs on site which is significantly removed from adjoining residential receivers.

11.7 Conclusions

Noise emissions from the proposed rehabilitation of the existing Munmorah Power Station have been assessed and compared to the existing noise sources on-site. The proposed rehabilitation works are not expected to introduce additional operational noise or vibration sources and therefore no additional operational impact is expected when compared to existing operations on-site. Increases in efficiency and the replacement of worn and damaged items of equipment are expected to slightly reduce the operational noise emission level of the power station.

At this stage, construction requirements and techniques have not been confirmed, however preliminary assessment of noise and vibration impacts from construction indicate that minimal construction impacts are expected. A Construction Noise and Vibration Management Plan would be developed to assess in detail the impact of construction noise on the local community and ensure noise criteria are met once a detailed construction schedule is developed.

Potential traffic noise impacts of the project have been considered in accordance with the Environmental Criteria for Road Traffic Noise. No significant traffic noise impact is predicted during the construction phase and operational traffic noise is predicted to improve following rehabilitation as workforce traffic flows are insignificant and will remain the same and occasional deliveries of coal by road would also no longer occur. Construction traffic noise impacts would be mitigated by limiting heavy vehicle movements to the daytime period where practicable. These issues would be addressed in detail in the construction noise and vibration management plan.

Noise emissions from the proposed rehabilitated Munmorah Power Station have been predicted at the surrounding residences based on information regarding the existing noise emissions from the plant. Predictions show that under adverse meteorological conditions, some exceedances of the criteria are expected. However, as accurate data of the sound power levels of the proposed refurbished equipment is not yet available, all feasible and reasonable noise control measures would be implemented during the design stage to reduce the noise emissions from the plant.

It is proposed that commissioning measurements would be conducted after completion of the rehabilitation, and, if found to be excessive, remedial action would be implemented to reduce noise emissions. Such action may include additional treatment of building facades, installation of acoustic

barriers etc. When final design options for the plant are confirmed preferred suppliers should provide acoustic data for review against modelling inputs and final comparison against existing noise emissions.

The erection of an additional noise wall beside the MV conveyor near Doyalson Welding would be expected to mitigate conveyor noise to within acceptable levels.



Waste Management

9

9. Waste Management

This chapter of the Environmental Assessment provides the likely waste generation associated with the project. This will specifically look at the generation of obsolete equipment resulting from the upgrade of the turbines, boiler and auxiliary plant and the increases expected in the generation of fly ash and furnace ash.

9.1 Introduction

The Department of Environment and Climate Change's waste regulatory framework is administered under the principal legislation of the *POEO Act* and

the *Waste Avoidance and Resource Recovery (WARR) Act 2001*. Achieving a reduction in waste generation, and turning waste into recoverable resources is a priority for NSW.

Changes to NSW waste legislation took effect in April 2008 following consultation with the waste industry and the broader community in 2007. The result of this consultation was a reduction in licensing categories for waste and a streamlined waste classification system (see Table 9.1).

Table 9.1 – Revised classifications for waste

| Revised Classification | Old Classification |
|--|--|
| General solid waste (putrescible) (includes general household waste) | Solid waste |
| General solid waste (non-putrescible) | Solid waste Inert waste |
| Restricted solid waste | Industrial waste |
| Liquid waste | Group A (industrial liquids and sludges) Group B (grease trap and food waste) Group C (septic tank waste) Non-controlled aqueous liquid Hazardous liquid waste |
| ⁽¹⁾ Hazardous waste (includes waste that meets the criteria for assessment as dangerous goods under the Australian Code for the Transport of Dangerous Goods by Road and Rail) ¹ | Hazardous solid waste |
| Special waste (includes clinical and related waste, asbestos waste and waste tyres) | None existed |

Source : DECCW website - <http://www.environment.nsw.gov.au/waste/classification.htm>

Note: (1) **Class 1:** Explosives, **Class 2:** Gases (compressed, liquefied or dissolved under pressure), **Class 8:** Corrosive substances, **Division 4.1:** Flammable solids (excluding garden waste, natural organic fibrous material and wood waste, and all physical forms of carbon such as activated carbon and graphite), **Division 4.2:** Substances liable to spontaneous combustion (excluding garden waste, natural organic fibrous material and wood waste, and all physical forms of carbon such as activated carbon and graphite), **Division 4.3:** Substances which in contact with water emit flammable gases, **Division 5.1:** Oxidising agents, **Division 5.2:** Organic peroxides, **Division 6.1:** Toxic substances

¹ From Australian Dangerous Goods Code and POEO Act (Part 3, clause 49)

The classifications are specified in the *POEO Act* (Schedule 1, Part 3) and by Department of Environment and Climate Change Guidelines². Once a waste is properly classified, appropriate management options for it can be considered, as required under the *POEO Act* and the associated regulations.

The wastes likely to be generated as a result of the construction rehabilitation works will include general solid waste resulting from the removal of old and worn turbine and boiler parts.

The operation of the rehabilitated station will result in the same or similar waste streams to that of the currently operational station. There will be a likely increase in the production of furnace and fly ash. This is discussed separately in Section 9.4.

9.2 Regulations and Guidelines

9.2.1 Protection of the Environment Operations Act 1997

Environmental Protection Licenses are issued by the Department of Environment, Climate Change and Water to the owners of industrial premises under the *POEO Act*. The licence conditions relate to pollution prevention and monitoring, and cleaner production through recycling and reuse and the implementation of best practice.

Munmorah Power Station's EPL license provides list of possible wastes generated on the premises and what may be disposed of to the ash dam or within the ash dam catchment.

The wastes generated on site are also managed by Delta Electricity's waste management framework which addresses waste reduction, reuse and recycling.

9.2.2 Waste Reduction and Purchasing Policy

The NSW Government's Waste Reduction and Purchasing Policy (WRAPP) was announced by the Premier in September 1997. The policy requires all state government agencies and state owned corporations to develop and implement a WRAPP plan to reduce waste in four scheduled areas:

- paper products
- office equipment and components
- vegetation material
- construction and demolition material

It also requires that priority be given to buying materials with recycled content where they are cost and performance competitive. WRAPP plans provide information on strategies each agency will undertake to reduce waste and increase purchases of recycled content products and provide data on:

- total quantities of scheduled wastes being generated and recycled; and
- total quantities of materials being purchased which contain recycled content.

Delta Electricity fully complies with the NSW Government's WRAPP and aims to reduce landfill by about 10% each year in accordance with WRAPP (Delta Sustainability Report, 2008).

The WRAPP indicates that waste is sorted into general wastes (including putrescible wastes), recyclables, refuse oil, metals, timber, concrete and vegetation, with categories for recyclable waste being the same as that used by local Councils for residents (Connell Wagner, 2008). The most significant non-hazardous waste generated is ash (fly ash and furnace ash).

The policy requires agencies to report progress in implementing their WRAPP plans biennially to the Department of Environment and Conservation³ and therefore monthly records are kept of:

- Rubbish to tip (tonnes)
- Recycled material (cubic metres)
- Scrap ferrous metal (tonnes)
- Waste oil (litres)
- 205 L drums
- Scrap ni-hard (tonnes)
- Paper
- Toner cartridges

² NOTE: The Department replaced the *Environmental Guidelines: Assessment, Classification and Management of Liquid and Non-liquid Wastes* with a series of new Waste Classification Guidelines which are available from the Department website.

³ Formerly the NSW Environment Protection Authority – <http://www.wrapp.nsw.gov.au/whatis/aboutwrapp.shtml>

9.3 Waste Generated During Construction

The proposed rehabilitation programme will not involve any significant changes to the current layout of the site. Therefore no major earthworks and demolition of existing plant will be required. The majority of the waste will be generated through the upgrade of some components and the replacement of other outmoded boiler and turbine parts. The waste generated is likely to include:

- Condenser, furnace and turbine tubes
- Waterboxes, water coolers and strainers
- pipe work
- Outmoded pumps, motors and fans
- Heater baskets and seals
- Brush gear
- Hydrogen driers
- Seal oil systems
- Capacitors
- 110V and 50 Batteries
- Lamps, wiring

These wastes are all classified as General solid waste (non-putrescible) and would be form part of the normal register of waste generated during day to day maintenance operations and are managed in accordance with Delta Electricity's waste management framework.

There is also likely to be some liquid waste in the form of waste oil and waste water. These will also be managed in accordance with the waste management framework and within the current water management principles.

9.4 Waste Generated During Operation

9.4.1 Munmorah Power Station waste streams

The waste streams identified in Table 9.2 are generated during the normal day to day operation of Munmorah Power Station.

These streams, other than ash which is discussed in more detail in below, are not expected to change significantly as a result of the operation of the rehabilitated power station.

Table 9.2 – General waste streams generated Munmorah Power Station

| Waste Stream | Description | Arrangement | Volume Recycled \ Reused |
|--------------------|--|---|--|
| General waste | Household waste that contains putrescible organics | Municipal Services | |
| Ash | Fly ash Bottom ash Cenospheres | Vales Point ash dam – Blue Circle Ash (combined figure for Delta CC ash production) Munmorah ash dam – Blue Circle Ash – Note that no ash is reclaimed from Munmorah ash dam. Blue Circle Ash only reclaim at Vales Point ash dam. Morgan Ash take flyash direct from fabric filter hopper outlets at Vales Point. Vales Point ash dam – Blue Circle Ash | 17% - 30% 1% (Cenospheres) |
| Mixed recyclables | Paper, cardboard boxes and cartons, Glass, PET plastic containers (not plastic bags), Aluminium and steel cans | Municipal Services | 60 to 80% |
| Metals | Mixed ferrous Other non-ferrous metals | Specialist waste contractors | 40 to 80% |
| Electrical | Scrap electrical cables, components, sundry items | Specialist waste contractors | 40 to 60% |
| Drums / containers | 205L Metal drums 20L & 25L plastic drums 200L Hydrazine containers | Specialist waste contractors Specialist waste contractors Specialist waste contractors | 70% 40 to 80% 40 to 80% |
| Oils / Grease | Lubricating and sump Oil Turbine oil Transformer oil Grease | Specialist waste contractors Specialist waste contractors Specialist waste contractors Specialist waste contractors | 40 to 80% 40 to 80% 40 to 80% 10 to 40% |
| Solvents / paints | Parts cleaning solvent Other solvents and paints | Specialist waste contractors | 60 to 90% |
| Batteries | Vehicle batteries Rechargeable (Ni-Cd) batteries | Specialist waste contractors | 60 to 80% Not recycled |
| Tyres | Tyres (car and coal vehicles) | Specialist waste contractors | 60 to 80% |
| Other | Toner cartridges Styrofoam Salvage items Sewage effluent Conveyor belts | Specialist waste contractors Specialist waste contractors Specialist waste contractors San Remo sewage treatment plant Specialist waste contractors | 60 to 80% 60 to 80% >80% n/a 60 to 80% |

NOTE: Estimates are low (10 to 40%), moderate (40-60%), High (60-80%), Very High (>80%)

9.5 Ash Generation and Storage

The combustion of coal produces around 25% ash of which about 10% is furnace ash and 90% is fly ash. While beneficial use of the ash product is preferred and promoted, the majority of ash produced by power stations is currently stored in ash dams.

Munmorah Ash Dam is located on the southern side of the Pacific Highway, approximately 1 km north of Munmorah Power Station, immediately west of Lake Munmorah. The Munmorah Ash Dam was originally designed to store both furnace ash and fly ash from Munmorah Power Station, but since the early 1970's, fly ash from Munmorah Power Station has been deposited in the Vales Point Ash Dam. The fly ash from Munmorah power station is collected in the fabric filters and is transported via two fly ash pipelines to the disposal point at Vales Point Ash Dam.

Vales Point Ash Dam is located on the western side of the Pacific Highway, approximately 1 to 2 km southwest of Vales Point Power Station, at the southern end of Lake Macquarie. It was originally designed to store fly ash and furnace ash produced by Vales Point Power Station and commenced operating in 1962. (Aurecon, May 2009)

9.5.1 Current estimated storage capacity and dam volumes

A capacity survey of the Vales Point and Munmorah ash dams was undertaken in 2008 (Connell Wagner, 2008). Projections of ash production were based on historical levels of coal usage, ash generation and ash sales. These were used to predict possible ash scenarios and hence the expected storage life of the facilities (Table 9.3).

Table 9.3 – Estimated ash dam capacity (Aurecon, May 2009)

| Ash dam | Area (ha) | Estimated Capacity (m ³) | Estimated Life |
|-------------|-----------|--------------------------------------|--|
| Vales Point | 450 | 17.5 million | 2032 (~23 years), if annual average ash sales were 20% |
| Munmorah | 105 | 2.8 million | Not calculated – assumed sufficient |

9.5.2 Storage capacity based on increased power generation

Based on the results of the ash dam surveys undertaken by Connell Wagner in 2008, a further investigation was carried out to establish future ash storage requirements following the progressive commissioning of the rehabilitated plant around 2014 to 2015. This information is based on the assumption that Munmorah will operate at 700MW at 80% capacity factor and based on current planned operations for both Vales Point and Munmorah Power Stations.

Ash production volumes are dependant annual power production requirements for the power station, power plant design and performance, coal properties (particularly % ash content) and ash sales. Based on these requirements a number of scenarios were identified as being indicative of future coal characteristic and of future planned ash sales. The scenarios are as follows:

- range of coal with varying ash content ie 22% and 24% based on historical data.
- Ash sales from Vales Point Power Station – 20% (it is currently estimated that approximately 17% of ash from Vales Point ash dam is sold)
- Ash sales from Munmorah Power Station – 20% No ash is currently sold at Munmorah Power Station

Table 9.4 provides a summary of various scenarios based on 100% coal firing and based on the worse case scenario. This table indicates when ash storage at Vales Point ash dam will be exhausted, based on current wet transport and placement methods.

Table 9.4 indicates that the rehabilitation of Munmorah Power Station will shorten the expected life of the ash dams by anything between two and eight years depending on the ash content of the coal. The impact of ash sales to industry for beneficial use is significant.

As part of the technical investigations carried out by Aurecon, the PROATES model was also used to calculate the ash disposal requirements for the various gas / coal scenarios. Table 9.5 summarises these results. All cases assume the 24% ash 'rehabilitation' design coal.

Table 9.4 – Predicated life for Vales Point ash dam (100% coal firing)

| | BASE CASE | CASE 1 | CASE 2 |
|--|-----------------------------------|-------------------------------|--|
| Scenario / ash content of coal | Munmorah not Rehabilitated | Munmorah Rehabilitated | 20% Fly Ash Sales from Munmorah |
| 20% Fly Ash Sales from Vales Point PS | | | |
| 22% | 2033/2034 | 2025/2026 (-8) | 2026/2027 (-7) |
| 24% | 2031/2032 | 2023/2024 (-8) | 2024/2025 (-7) |

NOTE: Numbers in parenthesis (-8) indicate the reduction in predicted life time in years from the base case (Munmorah not rehabilitated and closing in 2012)

Table 9.5 – Calculated ash production rates taken from PROATES (Aurecon, 2009)

| | Original Perf (1969) 2 X 350MW 100% Load | Recent Perf. (2006) 2 X 290MW 100% Load | Predicted Performance 2 X 350MW 100% Load | | | | Approx 80% Load |
|----------------------------|---|--|--|------------|------------|------------|------------------------|
| | | | 0% | 25% | 50% | 75% | |
| Gas input energy | 0.0% | 0.0% | 0% | 25% | 50% | 75% | 0.0% |
| Total ash (kg/s) | 10 | 9 | 10 | 7 | 5 | 3 | 8 |
| Total ash (kt/yr/Unit) | 324 | 298 | 306 | 233 | 157 | 79 | 259 |
| Total ash (kt/yr/Station) | 647 | 595 | 613 | 465 | 315 | 159 | 517 |
| Fly ash (kt/yr/Station) | 550 | 506 | 521 | 396 | 267 | 135 | 440 |
| Bottom ash (kt/yr/Station) | 97 | 89 | 92 | 70 | 47 | 24 | 78 |

Table 9.6 – Predicted life for Vales Point ash dam based on PROATES calculated ash production rates (24% ash)

| | BASE CASE | CASE 1 | CASE 2 |
|-------------------------|-----------------------------------|-------------------------|-----------------------|
| Gas input energy | Munmorah not Rehabilitated | No fly ash sales | 20% ash sales |
| 0% | 2031/2032 | 2021/22 (-10) | 2024/2025 (-7) |
| 25% | | 2022/23 (-9) | 2025/2026 (-6) |
| 50% | | 2023/24 (-8) | 2028/2029 (-3) |
| 75% | | 2025/26 (-6) | 2032/2033 (+1) |

Figures in bold indicate an extension of life over the current expected 2031/32

Table 9.6 indicates the estimated time when ash storage at Vales Point ash dam will be exhausted, based on current wet transport and placement methods and using the values provided in Table 9.5

The Munmorah Ash Dam has an estimated storage capacity of 2.8 million m³. If it is assumed both furnace ash and fly ash are stored in Munmorah ash dam, with no ash sales it is estimated that for assumed ash content between 22% and 24% Munmorah Ash dam is capable of storing the total ash production for seven to eight years, using the existing wet disposal slurry system.

As the currently operating units at Vales Point Power Station are expected to continue operating until 2029, a further estimate of available ash storage has been undertaken based on, the storage available in Munmorah ash dam and the surplus storage available in Vales Point Ash Dam. This scenario considers the possible separation of the Vales Point and Munmorah assets, in a way that does not impact Vales Point operations.

Taking the storage capacity scenarios of both ash dams in to account, with the proviso that ash storage for Vales Point Power Station is able to store its projected ash production, it is predicted that, in the absence of significant increases in the demand for ash products, flyash could continue to be stored in Vales Point Ash Dam until around 2019/20. Beyond that, alternative ash storage strategies for about 6 Mt of Munmorah fly ash, probably within the boundaries of the existing Central Coast Ash Dams would need to be investigated.

Several options for flyash disposal technologies have been identified and considered feasible at a conceptual level, but there would need to be further detailed feasibility studies to confirm their viability. The options are considered in the following section.

9.6 Future ash disposal options for Munmorah

At Delta Electricity's request, Aurecon has undertaken a preliminary investigation of viable options for the disposal of flyash from Munmorah Power Station, beyond the current projected life of the Vales Point ash dam.

9.6.1 Assumption used

A number of assumptions have been used to assess future ash storage options. The worse case scenario assumed is 26% ash content and current estimated ash sales of 17%.

It has also been assumed that Munmorah will be refurbished in the period 2012/13 and that Vales Point cease operation in 2029 and Munmorah will cease operation in 2034.

9.6.2 Ash disposal options considered

The following options have been identified Table 9.6 provides an overview of the feasibility and environmental considerations for each of the options.

- **Options 1a and 1b:** Retain the current lean slurry disposal systems at Vales Point (1a) and Munmorah (1b) with additional ash terracing to increase storage capacity. This technique of ash storage is a proven storage method for a range of industrial by-products.
- **Options 2a and 2b:** Install a dry ash collection system with pneumatic conveyer to transport flyash to Vales Point Ash Dam (2a) and to Munmorah Ash Dam (2b)
- **Options 3a and 3b:** Install a dry ash collection system and use trucks to transport flyash to Vales Point Ash Dam (3a) and Munmorah Ash Dam (3b)
- **Options 4a and 4b:** Install a dry ash collection system with enclosed conveyer to transport flyash to Vales Point Ash Dam (4a) and Munmorah Ash Dam (4b)
- **Options 5a and 5b:** Installation of dry ash collection system with dense slurry mixing and pumping system to Vales Point Ash Dam (5a) and Munmorah Ash Dam (5b).
- **Option 6:** It may also be possible to pump flyash to a nearby disused mine site for back-filling. This would be done by dense slurry pumping.
- **Option 7:** For all the above options, additional ash terracing, ash fencing and/ or turkeys-nest emplacements could be installed on top of the existing ash placements, to enable the stacking of flyash to a higher level.

Raising the level of the ash dam may also be an option once the dam is filled, with the ash dam wall extensions being constructed of flyash, and terraced back in from the existing ash dam walls.

Table 9.7 – Summary of flyash disposal options for Munmorah and Vales Point

| Option Number | description | Comment | Environmental Considerations |
|---------------|--|--|---|
| 1a | retain lean slurry disposal system to Vales Point ash dam with additional ash terracing to increase storage capacity | This is a low cost option using current system. Adding a series of ash fences will enable ash terracing and/or turkey-nesting and the stacking of flyash to a higher level. This technique of ash storage is a proven storage method for a range of industrial by-products. | <ul style="list-style-type: none"> • Lake Water usage – High water usage and associated ash water management requirements. Possible impacts on groundwater and discharge to local catchment • Dust – some dust emissions from ash dam surface if allowed to dry out • Visual – additional visual impact may result as the height of the dam is increased |
| 1b | retain lean slurry disposal system with new pipelines to Munmorah ash dam with additional ash terracing to increase storage capacity | Low cost option with established access. Includes new flyash conveying pipeline is laid in the existing bottom ash conveying pipeline corridor to the Munmorah ash dam. A return water system will need to be provided to recover the water from the lean slurry for re-use. | <ul style="list-style-type: none"> • Lake Water usage – High water usage and associated ash water management requirements. Possible impacts on groundwater and discharge to local catchment. Water return system would ensure re-use of water and place less dependence on domestic water supply. • Dust – some dust emissions from ash dam surface if allowed to dry out • Visual – additional visual impact may result as the height of the dam is increased • Other – the use of existing pipeline corridors will minimise additional impacts during construction ie vegetation clearing, heritage |
| 2a | Install dry ash collection system with pneumatic conveying to Vales Point ash dam | High capital and operating costs for compressor plant. This option is not practical and has not been considered further , due to the distance involved (approximately 3.5 to 4 km) | Not considered further |
| 2b | install dry ash collection system with pneumatic conveying – Munmorah ash dam | Conveying system requires very large, dedicated compressed air plant to shift the flyash. High capital and operating costs associated with compressor plant. | <ul style="list-style-type: none"> • Lake Water usage – significantly reduced surplus water required and therefore reduced associated management issues ie possible groundwater impacts and discharges to local catchment are reduced • Dust - areas of exposed uncapped ash are reduced but an ongoing dust suppression system including need for water truck or sprinkler system will be required for the conveyor system • Noise – noise impacts will likely result due to the compressor operation but noise impacts considered less than option 3a and 3b and can be managed. • Other – the use of existing pipeline corridors will minimise additional impacts during construction ie vegetation clearing, heritage |

| Option Number | description | Comment | Environmental Considerations |
|---------------|---|--|--|
| 3a | install dry ash collection system at Munmorah with fly ash being trucked to Vales Point ash dam | This option was not considered further , as it would involve regular and frequent truck movements on public roads between Munmorah and the Vales Point ash dam. | The potential for ash spillage and/ or airborne dust during transport and the hazard created by the significant truck movements on public roads are likely to be unacceptable. |
| 3b | install dry ash collection system with fly ash being trucked to Munmorah ash dam | The suitability and/or need to upgrade the access road would need to be assessed. This method of ash placement is currently successfully used at various locations, including Delta Electricity's Mount Piper Power station near Lithgow. | <ul style="list-style-type: none"> • Lake Water usage – low water usage and therefore significantly reduced surplus water and associated management issues. • Dust - Reduced areas of exposed uncapped ash however ongoing dust suppression will be required until exposed areas are capped ie additional water trucks or sprinkler system. • Transport – increased number of trucks required to travel between the power station and ash dam with possible dust and noise issues to be managed. • Noise – noise of compressors, conveyors at ash dam etc will be managed through the noise management plan. Levelling and compacting of the conditioned fly ash within the storage area would be achieved using a front-end loader or bulldozer • Other – if access road require upgrade, possible impacts associated with vegetation clearing would need to be assessed. If managed correctly this can be achieved with minimal impact. |
| 4a | install dry ash collection system with enclosed conveyor taking flyash to Vales Point ash dam | Ash conveyor would probably follow existing ash or coal conveyor corridor. Required to travel a long distance and would need to cross the Pacific Highway possibly requiring a dedicated conveyor bridge. Ongoing maintenance of ash conveyor will be required and can be difficult. | <ul style="list-style-type: none"> • Lake Water usage – low water usage and therefore significantly reduced surplus water and associated management issues. • Dust - Reduced areas of exposed uncapped ash however ongoing dust suppression will be required until exposed areas are capped ie additional water trucks or sprinkler system. Although an enclosed system there may be potential for dust escaping along the conveyor route which would be managed. • Noise – increased noise over conveyor route. Noise at ash dam would need to be managed as levelling and compacting of the conditioned fly ash would be achieved using a front-end loader or bulldozer • Transport – Avoids the use of trucks on roads • Other – the use of existing pipeline corridors will minimise additional impacts during construction ie vegetation clearing, heritage. However if a dedicated conveyor bridge is required an more detailed assessment will be required at the time of construction |

| Option Number | description | Comment | Environmental Considerations |
|---------------|---|---|---|
| 4b | install dry ash collection system with enclosed conveying to Munmorah ash dam | The conveyor to Munmorah ash dam would need to follow the existing bottom ash slurry disposal pipeline corridor, or the pipeline access road. Apart from the potential for localised impacts, this option would be expected to be practicable and achievable. | <ul style="list-style-type: none"> • Lake Water usage – low water usage and therefore significantly reduced surplus water and associated management issues. • Dust - Reduced areas of exposed uncapped ash however ongoing dust suppression will be required until exposed areas are capped ie water trucks or sprinkler system. Although an enclosed system, potential for dust escaping along the conveyor route would require management. • Noise – increased noise over conveyor route although less likely impact the local residents compared to option 4a. Noise at ash dam would need to managed as levelling and compacting of the conditioned fly ash would be achieved using a front-end loader or bulldozer • Transport – Avoids the use of trucks on roads • Other – the use of existing pipeline corridors will minimise additional impacts ie vegetation clearing, heritage |
| 5a | install dry ash collection system with dense slurry mixing and pumping system – Vales Point ash dam | A new dense phase fly ash pipeline would be required but would follow existing pipeline corridor. System is used at other mines in NSW. | <ul style="list-style-type: none"> • Lake Water usage – lower water usage than the lean phase slurry and therefore reduced surplus water and associated management issues. • Dust - Reduced areas of exposed uncapped ash however ongoing dust suppression will be required until exposed areas are capped ie water trucks or sprinkler system. • Noise – some noise suppression may be required at Munmorah for the pumps but likely to be managed within the noise management plan. • Other – the use of existing pipeline corridors will minimise additional impacts ie vegetation clearing, heritage |
| 5b | install dry ash collection system with dense slurry mixing and pumping system – Munmorah ash dam | A new dense phase fly ash pipeline would be required but would follow existing pipeline corridor. A return water system would need to be provided to recover the water from the slurry for re-use. | <ul style="list-style-type: none"> • Lake Water usage – lower water usage than the lean phase slurry and therefore reduced surplus water and associated management issues. Water return system will also ensure re-use of water and place less dependence on domestic water supply • Dust - Reduced areas of exposed uncapped ash however ongoing dust suppression will be required until exposed areas are capped ie water trucks or sprinkler system. • Noise – some noise suppression may be required at Munmorah for the pumps but likely to be managed within the noise management plan. • Other – the use of existing pipeline corridors will minimise additional impacts ie vegetation clearing, heritage |

| Option Number | description | Comment | Environmental Considerations |
|---------------|---|---|--|
| 6 | install dry ash collection system with dense slurry mixing and pumping system – backfill disused mine | Potential to sterilise access to coal resources. | <p>Environmental issues will vary depending on site selected and would require detailed evaluation of any proposed site.</p> <ul style="list-style-type: none"> • Lake Water usage – potential groundwater contamination, although less water is used in the dense slurry than is used in a lean slurry. • Visual – visual impacts are reduced substantially with the underground storage of fly ash |
| 7 | ash terracing, ash fencing and/or turkey-nesting | <p>Can be applied to most of the above options and is relatively inexpensive to do.</p> <p>Large gains in available storage volume can be achieved.</p> | <ul style="list-style-type: none"> • Visual – additional visual impact may result as the height of the dam is increased • Dust – ongoing dust suppression will be required until exposed areas are capped ie water trucks or sprinkler system. • Other – Erosion controls and management required |

9.6.3 Discussion

It is estimated that until Munmorah is decommissioned (in 2034) up to 8.77 million m³ flyash will require disposal. Of this only 840,000 m³ can be disposed of using current methods in the Vales Point ash dam (assuming 26% ash content of coal, current 17% ash sales at Vales Point, no raising of ash dam walls or ash terracing and Vales Point being decommissioned in 2029). Projections based on a combination of worst case scenarios suggest that alternatives for Munmorah flyash disposal could be required as early as 2011.

However, given that Munmorah Ash Dam has a 2.8 million m³ capacity, both flyash and furnace ash could be directed to the Munmorah Ash Dam for an intermediate period of time (up to at least 2019 depending on ash sales). This would require the establishment of a return water management system for the effective management of surplus water.

A preliminary investigation has shown that alternative technologies for the storage of the worst case surplus ash are viable at a conceptual level, but will need to be considered in more detail, to confirm their viability and a preferred option.

9.7 Beneficial uses for fly ash

Furnace ash and fly ash can be used for a number of building and landscaping products. The quality of ash by products is dependent on the quality of the coal, the efficiency of the furnace, the method of ash collection, crushing, transport, where the product is collected and any further treatment undertaken.

9.7.1 Furnace ash uses

- To provide a lightweight aggregate in concrete. Lightweight concrete is mainly used to create lightweight masonry products.
- Furnace ash can be used as a sand replacement for road base, building foundations, pipe bedding and other construction uses where sand is used.
- Due to its particle size and grading furnace ash can be used where free draining or filtering material is needed.
- Furnace ash has successfully been used in blends with organic material to produce potting mixes and topdressing.

9.7.2 Fly ash uses

- Dry fly ash can be used as a partial replacement for cement in concrete. The addition of fly ash produces a more durable concrete.
- Fly ash stabilised with cement can be used for road construction as a road base.
- Fly ash can be used for structural purposes such as retaining walls, embankments and landfill.
- Fly ash is being used as landfill to rehabilitate open cut coal mines.
- Trials in Western Australia have proved the viability of fly ash when used to amend topsoils, for use in non-edible agriculture such as turf farms and subsequent uses in park lands and golf courses.

9.7.3 Cenospheres

Many plastics, composites and paints use fillers during their manufacturing processes. Cenospheres can be used as a filler for various applications. These include:

- pattern making
- mould making and casting
- foam-filled sandwich glass fibre panels
- fire-resistant boarding
- urethane systems
- PVC frames
- putty
- paint and varnish
- radio and infra-red stealth.

(UK DTI, 2002)

9.7.4 Improving ash quality

Ash quality is of importance if the product is to be used in particular industries, this is specially so for the construction industry. At present the ash that is sold is extracted from the ash steams at locations that maximise its value for certain uses.

Carbon in ash has the greatest impact on the quality of ash, but fineness of flyash and colour (whiteness) of cenospheres can reduce the value of the product.

Numerous technologies can be considered for improving the quality of the flyash (ie beneficiation); however the adoption of these technologies depends

on current markets and economics. While not a significant issue at present, the beneficiation of fly ash may become increasingly important should Delta Electricity be required to increase the amount of fly ash utilised in the future (UK DTI, 2002).

9.8 Mitigation Measures

Delta fully complies with the NSW Government's WRAPP and aims to reduce landfill by about 10% each year in accordance with WRAPP (Delta Sustainability Report, 2008).

Solid waste is segregated into recyclable and non-recyclable waste products where possible and disposed off-site by licensed waste contractors. All waste is classified and disposed of in accordance with the *Waste Classification Guidelines*⁴ produced by the Department of Environment, Climate Change and Water.

The Munmorah ash dam is managed through the Central Coast Ash Dam Management plan, which is revised on a five yearly basis. This includes the ongoing monitoring of discharges from the ash dam (Chapter 8) and ongoing monitoring of dust emissions (Chapter 7).

In the absence of new markets, sales of Delta Electricity Central Coast flyash, furnace ash and cenospheres is expected to continue at around current rates. While Delta Electricity aims to increase these sales in the future and continues to encourage development of new markets for these products increases in the volume of ash sales are not certain. It is noted that current ash sales reflect the state of the market for the beneficial use of ash products at present and significant increases may be unlikely without market and regulatory changes.

In order to secure the projected ash disposal requirements for Vales Point Power Station, the rehabilitated Munmorah Power Station will need to develop new ash storage arrangements.

A preliminary investigation has identified that viable options for the disposal of flyash from Munmorah Power Station can be developed. Several options for flyash storage technologies have been identified and considered feasible at a conceptual level. Some of these options, subject to further detailed investigation, appear to be capable of being incorporated within existing disturbed areas of one or both power station sites.

⁴ Waste Classification Guidelines replaced the *Environmental Guidelines: Assessment, Classification & Management of Liquid & Non-Liquid Wastes* (1999)

Further detailed feasibility studies are required to confirm a preferred option. While the development of a new ash storage system may require a separate Environmental Approval, potential Environmental concerns have been screened in this EA.

A decision to proceed to seek approval to develop a new storage would be based on commercial arrangements and actual ash production rates and storage requirements in the next few years.

9.9 Conclusions

As the rehabilitation works will occur within the existing plant layout of the power station, the management of solid and liquid waste will be managed in accordance with existing waste management plans. Delta Electricity are required to record and report the quantities of wastes generated on an annual basis.

In the absence of new markets, sales of Delta Electricity Central Coast flyash, furnace ash and cenospheres is expected to continue at around current rates.

Based on projections of the life of the Vales Point Ash Dam, and in consideration of current ash sales, fly ash from Munmorah can be stored within this facility for around 6 – 7 years without jeopardising the storage requirements for Vales Point. .

In the event that options for the co-firing with gas become commercially attractive, lower coal usage would result and therefore less ash would be produced and the period that ash storage is available would be extended.

Currently fly ash is disposed of at Vales Point ash dam and furnace ash from Munmorah Power Station is disposed of in the Munmorah ash dam. Munmorah ash dam has a capacity of 2.8 million m³ which is expected to be more than sufficient to store furnace ash for the proposed 20 year life extension of the power station.

Fly ash from Munmorah Power Station will continue to be disposed of at Vales Point ash dam while surplus storage beyond the projected life of Vales Point Power Station is available. Beyond this (estimated 6-7 years), fly ash disposal from Munmorah will require the development of new ash storage options. The necessary planning approvals for additional storage of Munmorah fly ash will be sought as required.