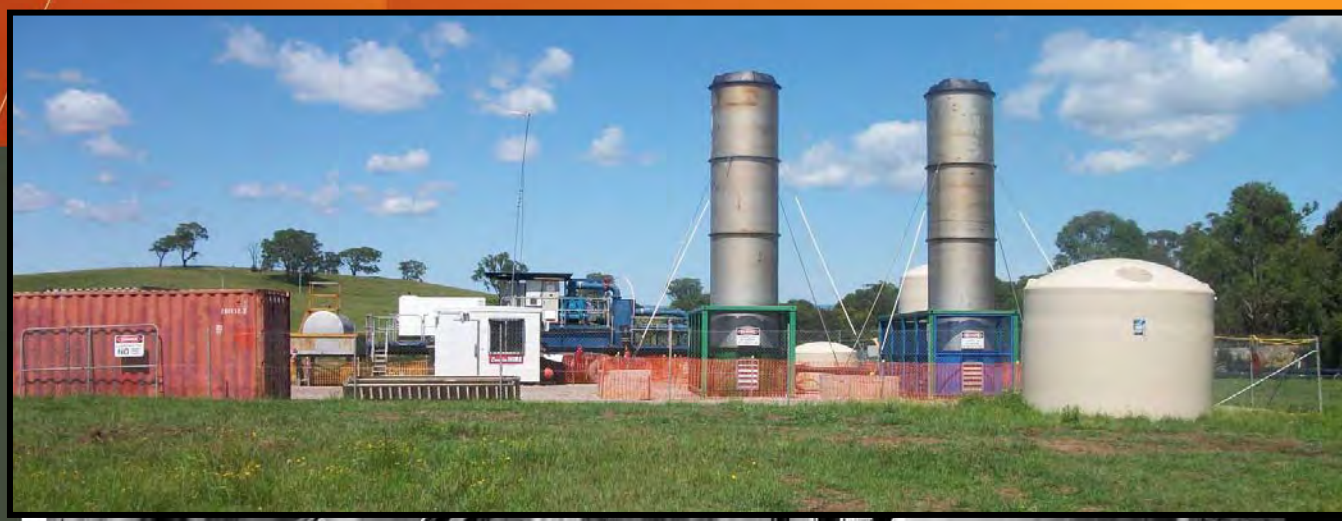

WEST CLIFF AREA 5 GOAF GAS DRAINAGE PROJECT

ENVIRONMENTAL ASSESSMENT FOR LONGWALL 35

SECTION 75W MODIFICATION APPLICATION # 3: PROJECT APPROVAL MP 07_0073

May 2011

Revision No: 0 - Final For Issue

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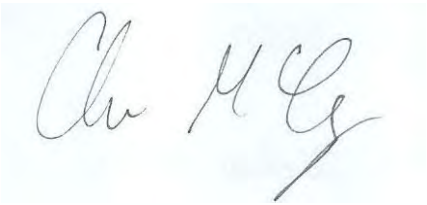
1 CONTACT INFORMATION AND DECLARATION

Chris McEvoy, (Associate of Niche Environment and Heritage) prepared this Environmental Assessment. Chris McEvoy holds a Bachelor's Degree in Environmental Science and Graduate Diploma in Education.

1.1 DECLARATION

I certify that I have prepared this Environmental Assessment for the proposed changes (Modification #3) to surface goaf gas extraction associated with Longwall 35 for the West Cliff Goaf Gas Project. To the best of my knowledge, it is true in all material particulars and does not, by its presentation or omission of information, materially mislead.



Chris McEvoy
Associate
Niche Environment and Heritage Dated 11 May 2010

2 EXECUTIVE SUMMARY

BHP Billiton Illawarra Coal (Illawarra Coal) proposes to modify the West Cliff Surface Goaf Gas Drainage Project Approval (MP 07_0073) in accordance with s75W of the *Environmental Planning and Assessment Act 1979*.

The scope of the modification includes:

- The construction of approximately twelve vertical gas extraction wells over Longwall 35 (with a contingency of at least six further wells if required), connecting overland pipelines and extraction of goaf gas at a centralised extraction/flaring plant located at up to three separate locations;

And/or, if viable,

- A combination of a 24hr/day Medium Radius Drilling (MRD) compound and extraction plant located near the proposed vertical well 35-7, in addition to at least five vertical wells 35-8 to 35-12 and their associated pipelines and extraction plant (with a contingency for three additional wells if required). The MRD site, (if proven viable) would operate 24 hours a day and would negate the need to establish vertical wells 35-1 to 35-7, their associated pipelines and extraction plant;

This modification application is requesting approval for additional contingency boreholes to be drilled if required, subject to the gas conditions encountered. At this stage, up to six contingency borehole locations have been nominated should they be required. This modification application requests approval to locate additional contingency boreholes (if required) anywhere within the orange “SGW Assessment Area” polygons shown in Figure 2. Any such additional site, if required, would be free of environmental constraints, and would achieve all environmental performance standards, as addressed in the Environmental Management Plan (EMP).

An Environmental Assessment of the modified project has been undertaken. The EA indicates that the modified project provides improved environmental performance for greenhouse gas emissions by flaring increased volumes of gas, and by increasing capacity of the flaring system, which is achieved by installing a third flaring stack.

The noise assessment undertaken by Wilkinson Murray indicated that without mitigation, the Drilling of MRD well is predicted to exceed relevant criteria, especially during the night time period. With 5 metre high temporary noise barriers around the MRD borehole sites, however, noise levels are predicted to be acceptable.

Noise emissions from some vertical wells sites are predicted to exceed management levels at surrounding receivers. Temporary noise barriers of varying heights and setbacks were investigated. With the inclusion of the temporary noise barriers, noise criteria are predicted to comply with relevant criteria at all surrounding receivers during standard construction hours.

The noise assessment undertaken by Wilkinson Murray indicated that operational noise from the proposed extraction plants are predicted to be within the relevant noise criteria

Ecological and Cultural Heritage assessments have been undertaken and determined that no impacts to native vegetation, threatened species or archaeological sites are expected. One well (35-4) was relocated to avoid a ridgeline of potential Archaeological sensitivity based on an Aboriginal Objects Due Diligence Assessment.

The nature of other impacts such as visual amenity, waste, traffic, and surface water remain largely unchanged from those predicted in the original project EA.

3 INTRODUCTION

The West Cliff Coal Mine – Surface Goaf Gas Drainage Project was approved by the Minister for Planning on 8 December 2008 (Project Approval MP 07_0073). A modification (referred to as Modification #1) was approved by the NSW Department of Planning (DoP) on 7 December 2009 for:

- Two additional goaf gas extraction wells (referred to as LW34-9 and LW34-10) above Longwall 34;
- Linking the gas extraction wells over Longwall 34 to one of two extraction plants by buried pipeline;
- The addition of flare units to maximise the abatement of greenhouse gas if gas flow rates consistently exceed the capacity of the existing flare units to oxidise methane.

A second minor modification (referred to as Modification #2) to develop two additional goaf gas extraction boreholes (34-11 and 34-12) above Longwall 34 (and associated goaf gas extraction infrastructure) was submitted in December 2010 and was approved on 29 April 2011.

A further modification (referred to as Modification #3) is now proposed to develop additional goaf gas extraction boreholes (and associated goaf gas extraction infrastructure) above Longwall 35.

The site of the proposed works occurs within a rural environment to the north of the township of Appin, NSW (**Figure 1, Attachment A1**). The location of the proposed works in relation to Modification #3 (Longwall 35) is shown in **Figure 2**.

The modification to the Project as approved necessitates a modification to the Project Approval in accordance with s75W of the *Environmental Planning and Assessment Act 1979*. All other aspects of the Project including the technologies for goaf gas extraction and management remain unchanged.

4 SCOPE OF MODIFIED PROJECT

4.1 PROPOSED MODIFICATION #3

The proposed wells are located on both the western and eastern sides of Appin Road and are required to drain goaf gas from Longwall 35.

The scope of the modification includes:

- The construction of approximately twelve vertical gas extraction wells over Longwall 35 (with a contingency of at least six further wells if required), connecting overland pipelines and extraction of goaf gas at a centralised extraction/flaring plant located at three separate locations during the course of the project;

and/or, if viable,

- A combination of a 24hr/day Medium Radius Drilling (MRD) compound and extraction plant located near the proposed vertical well 35-7, in addition to at least five vertical wells (35-8 to 35-12) and their associated pipelines and extraction plant (with a contingency for three additional wells if required). The MRD site, (if proven viable) would operate 24 hours a day and would negate the need to establish vertical wells 35-1 to 35-7, their associated pipelines and extraction plant;

Figure 2 outlines the scope of the proposed Project modification and the proposed location of gas extraction wells for Longwall 35 and the proposed associated infrastructure such as pipelines and extraction plants. Refer **Attachment A**.

The total number of goaf gas drainage boreholes for the Project as approved subject to Modification #2 is therefore proposed to be increased:

- from twenty three to thirty five (if only vertical gas extraction wells are utilised);

and/or,

- from twenty three to twenty nine (if a combination of MRD and vertical boreholes are utilised);

However this modification is requesting approval for additional contingency boreholes to be drilled if required, subject to the gas conditions encountered. Gas volumes can vary significantly, so the flexibility to drain additional gas within a high gas area of a Longwall is seen as essential to maintaining a safe and productive mine. At this stage, up to six contingency borehole locations have been nominated should they be required. (Refer **Figure 2**. This modification application requests approval to locate additional contingency boreholes (if required) anywhere within the orange "SGW Assessment Area" polygons shown in **Figure 2.** Any such additional site would be free of environmental constraints, and would achieve all environmental performance standards, as addressed later in this document and its appendices.

Extraction plants will extract goaf gas from the relevant wells indicated in **Figure 2.** Goaf gas extraction and flaring associated with mining Longwall 35 will occur using the same techniques and technologies as per the approved project. BHP Billiton Illawarra Coal (Illawarra Coal) proposes to extend the operational philosophy of linking gas extraction wells to a centralised extraction plant, flares and vent stack. This design improves environmental outcomes for construction noise during goaf gas well drilling, reduces greenhouse gas emissions and also reduces visual impacts.

4.2 JUSTIFICATION

The additional Longwall 35 goaf gas extraction wells are required to more effectively manage methane gas within the Longwall 35 goaf area during mining in order to maintain safety during longwall mining operations. The modification will result in a net decrease in greenhouse gas emissions as much of the methane extracted from the wells will be flared (oxidised) rather than being emitted to the atmosphere via the mine's ventilation system.

In the original Environmental Assessment it was envisaged that Illawarra Coal would seek approval for surface gas management works associated with the remainder of West Cliff Area 5 in accordance with the requirements of the Bulli Seam Operations Part 3A Project Approval.

As the Bulli Seam Operations Part 3A approval has not yet been granted, Illawarra Coal urgently seeks s75W modification approval for the Longwall 35 goaf gas extraction system in order to maintain a safe working environment in the mine.

4.3 AFFECTED PROPERTIES

The works associated with the proposed modification West Cliff Goaf Gas drainage Project over Longwall 35 will take place on several properties identified as:

- Lot 1 DP 595956.
- Lot 1 DP70208.
- Lot 101 DP716209.
- Lot 24 DP700072.
- Lot 11 DP744101.
- Lot 1 DP744101.
- Lot D DP377759.
- Lot 1 DP595956.

Refer **Figure 2**, Attachment A.

Landowner access agreements between Illawarra Coal and the owners of the above properties are in place.

4.4 TIMING

The development of Borehole 35-1 is anticipated to commence in August 2011 subject to the timing project approval is received. Extraction from Longwall 35 is expected to commence in September 2011 and be completed around December 2012. Subsequent boreholes are being planned for Longwalls 36 and 37 and will be included in a Gas Drainage Management Plan submitted to the Department when the Bulli Seam Operations Approval is granted.

Gas drainage is an important safety and production issue for underground coal mines especially those with high inherent gas levels in the coal resource in the Bulli Seam. This modification proposal addresses mining delays that could result as a consequence of gas accumulation in operating areas of the mine.

4.5 COMPARISON OF THE APPROVED AND MODIFIED PROJECT

A comparison of the Approved Project and the proposed Modified Project is summarised in **Table 1**. The information presented in Table 1 reflects the Project Description as published in the Department of Planning (2008) Major Project Assessment: West Cliff Gas Drainage Project with the relevant amendments as per Modification #1 and #2.

A Statement of Commitments (largely identical to that provided with the Modification #2 EA), is provided in **Appendix A.3**.

The Environmental Management Plans that are required under Schedule 3 of the Project Approval have been updated taking into consideration the proposed modifications to the project. The Environmental Management Plans are provided in **Appendix A.5**.

Table 1: Summary of Approved and Modified project Scope

Aspect	Project Description – as per (Modification #2)	Project Description – as proposed (Modification #3)
Project summary	Construction and operation of up to 23 coal seam gas boreholes in 'Area 5' of West Cliff Coal Mine and flaring and venting the extracted gas. Gas extraction wells will be linked via pipeline to one of two centralised extraction plant/flares/vent stacks via surface pipelines. Where the pipelines will be visible from Appin Road, or at the request of the landowner, the pipelines will be buried. The extraction plant compounds will be located at least 1km away from the nearest residence. Modification #1 approved an increase from 8 boreholes to 10 boreholes for Longwall 34. The total number of goaf gas drainage boreholes approved (21) remained the same due to shorter Longwalls 33 and 34. Modification #2 (if approved) will grant consent to an increase from 10 boreholes to 12 boreholes for Longwall 34.	Construction and operation of up to 35 coal seam gas boreholes in 'Area 5' of West Cliff Coal Mine and flaring and venting the extracted gas. Gas extraction wells will be linked via pipeline to one of three centralised extraction plant/flares/vent stacks via surface pipelines. The pipelines will generally be indistinguishable from Appin Road and therefore the intention is to lay the pipelines on the ground surface or to bury the pipelines. The extraction plant compounds will be located at least 500m away from the nearest residence. A total of 12 boreholes are proposed for Longwall 35. The total number of goaf gas drainage boreholes will be increased by 12 with approval sought for additional contingency wells if required, subject to the approval of Modification #3. The modification #3 application is requesting approval for additional contingency boreholes to be drilled if required, subject to the gas conditions encountered. Any such additional site, if required, would be free of environmental constraints, and would achieve all environmental performance standards, as addressed in the EMP.
Project location	Area 5 of West Cliff Coal Mine, situated approximately 3km north of Appin. Individual boreholes would be located near the edges of longwall panels 32 to 34.	As approved and adding boreholes, pipelines and extraction plant over Longwall 35 as indicated on the attached plans.

Aspect	Project Description – as per (Modification #2)	Project Description – as proposed (Modification #3)
Project procedure	The following procedure would be undertaken for each borehole: Site establishment, including clearing of a 30 x 40 m area of land, and installing drilling equipment and site facilities; Drilling of boreholes to a depth of 500m, just above the Bulli Seam at a diameter of roughly 0.3 m; Casing of boreholes with cemented steel; Continuous operation of the extraction plant once the longwall has passed a gas extraction well; Establishment of two centralised mobile gas extraction, pipelines and flaring co-located with wells 34-4 and 34-5. Extraction will maximise volume of gas extracted and flared for well systems 34-1 to 4 and then 34-5 to10. Where the pipelines will be visible from Appin Road, or at the request of the landowner, the pipelines will be buried; Extraction of gas using a diesel or gas powered vacuum pump – timing of extraction dependant on rate of longwall extraction; Detailed monitoring, then flaring and, if required, venting of the gas; and Decommissioning of each borehole in accordance with the requirements of the DPI for exploration boreholes.	The following procedure would be undertaken for each borehole: Site establishment, including clearing of a 30 x 40 m area of land, and installing drilling equipment and site facilities; Drilling of boreholes to a depth of 500m, just above the Bulli Seam at a diameter of roughly 0.3 m; Casing of boreholes with cemented steel; Continuous operation of the extraction plant once the longwall has passed a gas extraction well; Establishment of up to three centralised mobile gas extraction plant, pipelines and flaring units. Extraction will maximise volume of gas extracted from goaf at the south eastern end of this Longwall 35. At the request of the landowner, the pipelines may be buried, otherwise they will be on the surface as in previous Longwalls; Extraction of gas using a diesel or gas powered vacuum pump – timing of extraction dependant on rate of longwall extraction; Detailed monitoring, then flaring and, if required, venting of the gas; Illawarra Coal will be adding an additional flaring unit (from 2 to 3) for Longwall 35 providing increased capacity to flare larger volumes of methane; and Decommissioning of each borehole in accordance with the requirements of the DPI for exploration boreholes.
Associated facilities	Access roads, parking areas, diesel tanks, pipelines, fencing materials, buried polyethylene piping.	As approved. Note: Modification #3 is proposing to place polyethylene piping on the surface of the ground.
Hours of operation	Construction (drilling etc) would take place between 7am and 6pm, Monday to Friday. Gas extraction, flaring and venting would occur 24 hours a day, 7 days a week However, if the Proponent has a written negotiated noise agreement with all affected landholders and a copy of this agreement has been forwarded to the Department and DECCW, then the Proponent may undertake construction activities outside of the permitted hours. (Mod #2)	As approved.
Rehabilitation	Each site would be rehabilitated upon decommissioning, with re-spreading of top soil, seeding with native vegetation species and ongoing maintenance.	As approved. Note: Modification #3 will use pasture grass species to re-seed the site. The borehole and gas extraction site occur wholly within improved pastures.
Employment	Three full time positions would be created over the lifetime of the Project.	As approved.

Aspect	Project Description – as per (Modification #2)	Project Description – as proposed (Modification #3)
Residential receivers	The nearest residences are situated immediately east of Appin Road, each roughly 70-300m from the closest borehole site.	The nearest residences are situated immediately east of Appin Road, approximately 80-1050m from the closest borehole site. The extraction plants will be located over 500m from the nearest residence.
Capital cost	$2.5 million.	As approved.

Key: Qualifying information on project as approved.
Qualifying information on project as proposed and highlighting extent of any change as per Modification #3 (this proposal).

5 ENVIRONMENTAL ASSESSMENT OF MODIFIED PROJECT

A comprehensive EA was undertaken for the Approved Project. This EA identified, investigated and justified a range impacts relevant to the Project. These include:

- Air quality and dust
- Surface water management
- Noise
- Flora & fauna
- Traffic
- Waste Management
- Cultural Heritage
- Visual Impact.
- Greenhouse Gas

A comparison of the environmental impacts between the Approved Project (as per Modification #2) and the proposed Modified Project (Modification #3) is provided in **Table 2**.

Table 2: Summary of Environmental Aspects

Aspect	Approved Project (as per Original EA and Modification #2)	Proposed Modification #3
Operational Noise	Original EA: For boreholes within close proximity to a residence, the boreholes are to be joined by pipelines and extraction plant/flares and vent stack was to be located at least 500m away in accordance with negotiated outcome with DoP. See Section 4.3 and Appendix II of the EA. Modification #1: Modification #1 proposed to extend the operational philosophy negotiated with DoP for the Approved Project to link all boreholes to one of two centralised extraction plants. Extraction plants are the major source of operational noise and will be at least 1km away from the residential receivers. Extraction plants will be inaudible at new locations. Modification #2 proposes to link both boreholes 34-11 and 34-12 to one centralised extraction plant located to the north east of the borehole sites. The extraction plant will be the major source of operational noise and is proposed to be located approximately 500m from the nearest residence.	Modification #3 proposes to link boreholes to centralised extraction plants at three locations. Wells 35-6 to 35-9 will be serviced by a plant located at a previously used site over Longwall 34. If an MRD borehole is viable, only two extraction plants will be necessary, one located at 35-7 which will service wells 35-1 to 35-9, and one at 35-12 servicing wells 35-10 to 35-12. Refer Figure 2. The extraction plant will be the major source of operational noise and is proposed to be located approximately 500m from the nearest residence. A noise assessment has been undertaken by Wilkinson Murray and determined that Noise levels from goaf gas drainage plants are predicted to be within the relevant noise criteria without the provision of specific noise mitigation. Refer Appendix A4.

Aspect	Approved Project (as per Original EA and Modification #2)	Proposed Modification #3
Construction Noise	Original EA: 2-3 weeks for gas extraction boreholes. Construction between 7am and 6pm, Monday to Friday. See Section 4.3, Appendix II of the original EA and the DoP Assessment Report Modification #1: A Noise Assessment of the Modification #1was undertaken by Wilkinson Murray and is provided in Appendix C of the Modification #1 EA. The Noise Assessment concluded that the construction noise generated by the project will be in excess of the RBL +10 = 41 dB management level but less than the 75 dB management levels described in the DECCW (2009) Construction Noise Guidelines. The maximum construction noise level at a residential premises will be 63 dB, otherwise predicted construction noise levels are less than 56 dB. The management of construction noise for gas extraction wells will be in accordance with the requirements of the Project Approval and the DECCW (2009) Guidelines. This includes: ❒ 2-3 weeks construction duration for gas extraction boreholes. ❒ Construction between 7am and 6pm, Monday to Friday. ❒ Orientation of the drill rig with the quietest side facing the residential premises. ❒ Using well maintained and quiet drilling equipment. ❒ Informing neighbours of the work and its duration. Wilkinson Murray also considered the construction noise generated by pipe laying and trench excavations. The additional boreholes are adjacent to the Appin Road. Appin Road is a major arterial road between Campbelltown and Appin/Wollongong that has significant heavy vehicle traffic. Appin Road is significant noise source that impacts on nearby residential receivers. Appin Road is between the additional borehole sites and the residential receivers. See Modification #1 EA and Appendix C of the Modification #1 EA. For gas extraction wells 34-11 and 34-12 (Mod #2) Illawarra Coal is also committing to installing temporary noise barriers around the drilling compounds to minimise noise impacts as far as practical. This is expected to reduce drilling noise levels by approximately 5-10dB at neighbouring residences.	For Modification #3 a Noise Assessment of the project has been undertaken by Wilkinson Murray and is provided in Appendix A4. The Noise Assessment concluded that the Drilling of the potential MRD borehole 35-7 is predicted to exceed relevant criteria, especially during the night time period. 5m high, temporary noise barriers were modelled around MRD well sites and noise levels are predicted to be acceptable with this mitigation. Noise emissions from many vertical wells sites are predicted to exceed management levels at surrounding receivers. Temporary noise barriers of varying heights and setbacks were investigated. With the inclusion of the temporary noise barriers, noise criteria are predicted to be satisfied at all surrounding receivers during standard construction hours. Refer Section 7.4 Appendix A4. The EMP will address all mitigation measures required in detail. Refer Appendix A5. The management of construction noise for gas extraction wells will generally be in accordance with the requirements of the Project Approval and the DECCW (2009) Guidelines. This is: ❒ 2-3 weeks construction duration for gas extraction boreholes. ❒ Construction between 7am and 6pm, Monday to Friday. ❒ Orientation of the drill rig with the quietest side facing the residential premises. (This may reduce noise levels by up to 9dB). ❒ Using well maintained and quiet drilling equipment. ❒ Informing neighbours of the work and its duration. ❒ If the Proponent has a written negotiated noise agreement with all affected landholders and a copy of this agreement has been forwarded to the Department and DECCW, then the Proponent may undertake construction activities outside of the permitted hours. (Mod #2) Wilkinson Murray has also considered construction noise generated by pipe laying and trench excavations. Some of the additional boreholes are in close proximity to Appin Road. Appin Road is a major arterial road between Campbelltown and Appin/Wollongong that has significant heavy vehicle traffic and is a significant noise source that impacts on the adjacent residential receivers.

Aspect	Approved Project (as per Original EA and Modification #2)	Proposed Modification #3
Greenhouse Gas	Original EA: Extraction could only occur from one borehole at a time (except the three most easterly boreholes that were to be linked by a single pipeline to the one extraction plant). Mobile extraction plant (s) would have to move from bore to bore as mining progresses. Residual goaf gas not extracted by surface extraction plant may enter the mine ventilation system and be emitted from vent shaft. Approximately ~154 kt CO_2-e expected to be abated during the scope of the project. See Section 4.9 and Appendix VI of the EA. Modification #1: Gas extraction will occur simultaneously from several boreholes once 'goafing'[1] occurs. The centralised extraction plant will be moved once from Well 34-4 to Well 34-5 depending on longwall progression. The modified system is able to extract more residual goaf gas, thereby minimising gas entering the mine ventilation system. The increased number of boreholes enables more gas to be extracted and flared, as opposed to entering the mine ventilation system where it is ultimately emitted to the atmosphere at an upcast ventilation shaft. If gas extraction significantly exceeds the capacity of the existing dual flare system that oxidises the methane (Global Warming Potential of 21) to carbon dioxide (Global Warming Potential of 1) and water, then an additional flare units may be added to maximise GHG abatement. As described in the original EA (section 4.9), gas flows from individual wells is highly variable. The existing two flare GHG abatement system is estimated to abate ~154 kt CO_2-e during the scope of the project. However this could increase, possibly by up to a total of ~230 kt CO_2-e, if gas is extracted from more boreholes and over a longer time, and additional flare units are utilised to abate the increased volume of gas extracted. Also see Section 4.9 and Appendix VI of the original EA. Modification #2: Gas extraction will occur simultaneously from both the 34-11 and 34-12 boreholes once goafing occurs. GHG abatement estimates for the project remain unchanged.	Modification #3: Gas extraction will occur simultaneously from several boreholes once goafing occurs. The modified system is able to extract more residual goaf gas, thereby minimising gas entering the mine ventilation system. The increased number of boreholes enables more gas to be extracted and flared, as opposed to entering the mine ventilation system where it is ultimately emitted to the atmosphere at an upcast ventilation shaft. PAE Holmes (2011) conducted an air assessment for Longwall 35 and concluded existing goaf gas capture and flaring at LW34 with 2 flares is estimated to offset approximately 73 kt CO_2-e / annum of GHG emissions. If 3 flares operate for LW35, this is estimated to increase to 93 kt CO_2-e / annum. As described in the original EA (section 4.9), gas flows from individual wells is highly variable.
Air Quality and Dust	Original EA: Minor concentrations of odour, airborne pollutants and dust impacts were predicted to occur well below DECCW impact assessment criteria. Emission sources moved from borehole to borehole, with the closest being 500m from the nearest residence. See Section 4.1 and Appendix I of the EA. Modification #1: The air quality impacts from the modified Project will be similar or less than those predicted to occur in the Approved Project. The source of odour (from gas emissions from the vent stack) and airborne pollutants (from methane combustion in the flare and diesel generator) are	Modification #3: The air quality impacts from the modified Project will be similar to those predicted to occur in the Approved Project. The source of odour (from gas emissions from the vent stack) and airborne pollutants (from methane combustion in the flare and diesel generator) are associated with the extraction plant, and these will be located 500m from the nearest residence, thereby enabling more dispersion to occur. PAE Holmes (2011) conducted an air assessment for Longwall 35 and concluded Modelling of emissions from the operation of the proposed goaf gas extraction plants indicate air quality impacts on residential receivers will be minimal, and well under relevant criteria. Modelling indicates that odour impacts are unlikely during normal

[1] Goafing refers to the expected collapse of the mine ceiling as the longwall mining equipment progresses through the length of the longwall.

Aspect	Approved Project (as per Original EA and Modification #2)	Proposed Modification #3
	associated with the extraction plant, and these are now located in excess of 1km from the nearest residence, thereby enabling more dispersion to occur. Modification #2: The air quality impacts from the modified Project will be similar to those predicted to occur in the Approved Project. The source of odour (from gas emissions from the vent stack) and airborne pollutants (from methane combustion in the flare and diesel generator) are associated with the extraction plant, and these will be located over 500m from the nearest residence, thereby enabling more dispersion to occur.	operations and no odour complaints have been received from current operations. Air quality impacts during the construction phase will be minor, short lived and easily controlled through commonly applied dust management measures. Refer Appendix A.8.
Flora and Fauna	Original EA: Two boreholes approved that required clearing of native vegetation. Rest of disturbance on highly modified agricultural land. See Section 4.4 and Appendix III of the EA. Modification #1: One borehole location requiring native vegetation clearing. Well 34-1 requires some minor (< 1 ha) of clearing of Shale Sandstone Transition Forest that is currently in poor condition. Approximately 10 trees will be required to be cleared. The amount of clearing of native vegetation is less than the Approved Project. The location of Well 34-1 is in accordance with the recommendations made by Biosis Research (see Appendix III p32-33 of the original EA) in respect to the alternative location for borehole PA03. The rest of disturbance of highly modified agricultural land. Modification #2: Drilling and gas extraction from 34-11 and 34-12 will disturb only a small area of highly modified pasture.	Modification #3: Drilling activities and gas extraction infrastructure for Longwall 35 will disturb only a small area of highly modified pasture. No native vegetation clearing is proposed and an inspection of the sites by an ecologist has determined the activity will have no impact on threatened flora or fauna species. Refer Figure 4. Refer Appendix A.6.

Aspect	Approved Project (as per Original EA and Modification #2)	Proposed Modification #3
Visual	Original EA: Extraction plant and flares just visible from Appin Road. See Section 4.8 and Appendix V of the EA. Modification #1: Extraction plant and flares will not be visible from Appin Road. They are shielded by topography when viewed from Appin Road. Where the pipelines will be visible from Appin Road, or at the request of the landowner, the pipelines will be buried. The disturbed pipe line route re-grassed to minimise visual impact. Modification #2: Extraction plant and flares will not be clearly visible from Appin Road. They are shielded by topography when viewed from Appin Road. Pipelines are not likely to be visible from Appin Road and they will be placed on the land surface. The borehole sites 34-11 and 34-12 will be less visible from Appin Road than the preceding boreholes due to some shielding by topography and trees, however the temporary noise barriers that will surround the compounds will be visible from Appin Road.	Modification #3: Extraction plant and flares will not be clearly visible from Appin Road. They are shielded by topography when viewed from Appin Road. Pipelines will be largely indistinguishable from Appin Road and they will be placed on the land surface. The borehole sites 35-8, 35-9, 35-10 will be visible from Appin Road as per the similarly located approved boreholes in Longwall 34. However, the temporary noise barriers that will surround the compounds will reduce visual impacts from Appin Road.
Landowner agreements	Original EA, Modification # 1 and Modification #2: Obtained	Modification #3: Obtained
Cultural heritage	Original EA: Biosis Research recommended that Leafs Gully 1 (52-2-2265) open artefact scatter that was located on the access track to PA01 and PA04 be avoided by using alternative access. See Section 4.7 and Appendix IV of the EA. Modification #1: No cultural heritage sites have been identified for the modified Project associated with Longwall 34, and as such, no impacts are expected to occur. Modification #2: A cultural heritage assessment has been undertaken by Niche. No cultural heritage sites have been identified for the modified Project associated with boreholes 34-11 and 34-12, and the extraction plant. No impacts are expected to occur.	Modification #3: An Aboriginal Objects Due Diligence Assessment has been undertaken by Niche. Proposed borehole 35-4 has been relocated 60m to the north west to avoid a ridgeline of potential archaeological sensitivity. Refer Figure 4. This will be documented in the EMP (Appendix A.5) with other cultural heritage safeguards. No Aboriginal cultural heritage sites have been identified for the modified Project associated with goaf gas infrastructure for Longwall 35. No impacts are expected to occur. Refer Appendix A.7.

Aspect	Approved Project (as per Original EA and Modification #2)	Proposed Modification #3
Surface water	Original EA, Modification #1 and #2: Soil and erosion control measures will be implemented during construction activities. See Section 4.2 of the EA.	Modification #3: Soil and erosion control measures will be implemented during construction activities as per consent, Statement of Commitments and the Environmental Management Plans. Refer to Attachments A.5 below.
Groundwater	Original EA and Modification #1 and #2: Each vertical gas extraction well will be cased and grouted to below the Hawkesbury Sandstone to prevent the ingress of groundwater into the well and contamination of aquifers. See Section 1.2 of the original EA.	Modification #3: As approved.
Traffic	Original EA, and Modification #1 and #2: No impact of local traffic was predicted to occur. See Section 4.5 of the EA.	Modification #3: As approved. Access to sites will be largely via existing farm access tracks. Refer to Figure 5- Access Plan.
Waste	Original EA, Modification #1 and #2: During construction, port-a-loos will be provided. All other wastes will be reused, recycled or disposed off at licensed facilities by licensed contractors. See Section 4.6 of the EA.	Modification #3: As approved.
Management Plans	Original EA, Modification #1 and #2: Required for; vegetation clearing and rehabilitation, noise and erosion/sediment control.	Modification #3: The proposed design does not impact on any additional environmental aspects. The management plans submitted in Appendix A.5 have been updated for the proposed sites and cover all the relevant aspects of environmental management for the project. Refer Appendix A.5.

6 CONCLUSION

Illawarra Coal proposes to modify the West Cliff Surface Goaf Gas Drainage Project Approval (MP 07_0073) in accordance with s75W of the *Environmental Planning and Assessment Act 1979*.

The scope of the modifications include:

- The construction of approximately twelve vertical gas extraction wells over Longwall 35 (with a contingency of at least six further wells if required), connecting overland pipelines and extraction of goaf gas at a centralised extraction/flaring plant located at up to three separate locations;

and/or, if viable,

- A combination of a 24hr/day Medium Radius Drilling (MRD) compound and extraction plant located near the proposed vertical well 35-7, in addition to at least five vertical wells 35-8 to 35-12 and their associated pipelines and extraction plant (with a contingency for three additional wells if required). The MRD site, (if proven viable) would operate 24 hours a day and would negate the need to establish vertical wells 35-1 to 35-7, their associated pipelines and extraction plant;

An Environmental Assessment of the modified project has been undertaken. The EA indicates that the modified Project provides improved environmental performance for greenhouse gas emissions by flaring increased volumes of gas, and by increasing capacity of the flaring system, which is achieved by installing a third flaring stack.

The noise assessment undertaken by Wilkinson Murray indicated that without mitigation, the drilling of MRD well 35-7 is predicted to exceed relevant criteria, especially during the night time period. With 5 metre high temporary noise barriers around MRD well sites, however, noise levels are predicted to be acceptable.

Noise emissions from many vertical wells sites are predicted to exceed management levels at surrounding receivers. Temporary noise barriers of varying heights and setbacks were investigated. With the inclusion of the temporary noise barriers, noise criteria are predicted to be satisfied at all surrounding receivers during standard construction hours.

The noise assessment undertaken by Wilkinson Murray indicated that operational noise from the proposed extraction plants are predicted to be within the relevant noise criteria

Ecological and Cultural Heritage assessments have been undertaken and determined that no impacts to native vegetation, threatened species or archaeological sites are expected. One well (35-4) was relocated to avoid a ridgeline of potential Archaeological sensitivity based on an Aboriginal Objects Due Diligence Assessment.

The nature of other impacts such as visual amenity, waste, traffic and surface water remain largely unchanged from those predicted in the original project EA.

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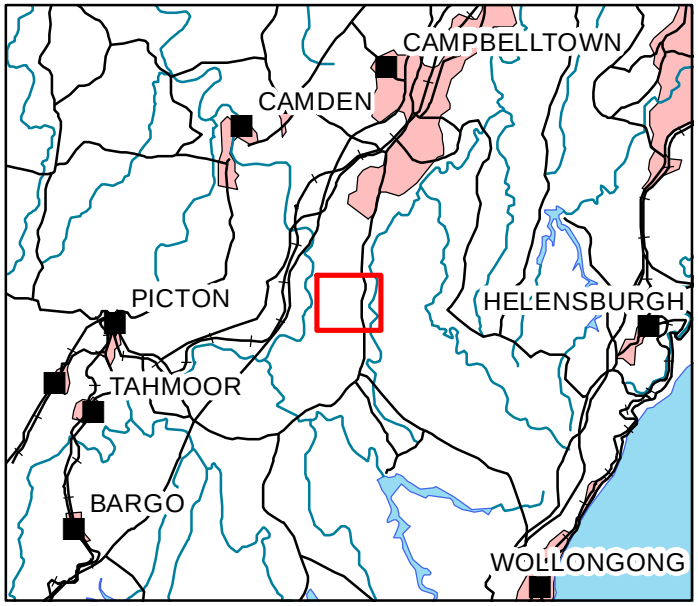
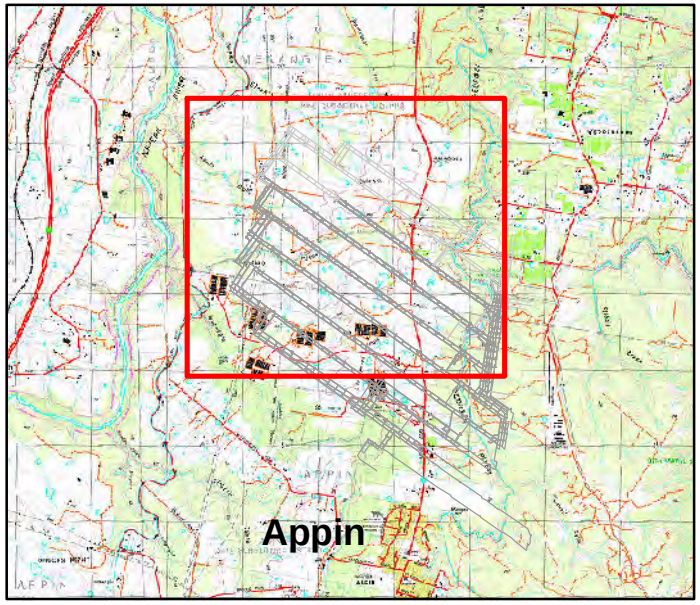
A.1 FIGURES





295000 296000 297000

6219000 6218000 6217000

Appin Road

GEORGES RIVER

Longwall 37

Longwall 36

Longwall 35

Longwall 34

MYLLAN CREEK

35-1 35-2 35-2a 35-3 35-4 35-4a 35-5 35-6 35-6a 35-7 Potential MRD-35-7 35-8 35-8a 35-9 35-10 35-10a 35-11 35-11a 35-12

0 250 500 1,000 Metres

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Legend

MRD Wells

SGW Vertical Wells

Contingency

Proposed

Electricity Transmission Line

Natural Gas Pipeline

SGW Surface Sites

Drill compounds

Extraction Plants

Aerial Photography 2007

West Cliff Area 5 Surface Goaf Gas Drainage

Longwall 35

Figure 1: Location and Scope of Project Modification # 3

Date: 4 May 2011

Author: R. Jenkins

Signed Off: C. McEvoy

Version 1

Horizontal Datum MGA - Zone 56

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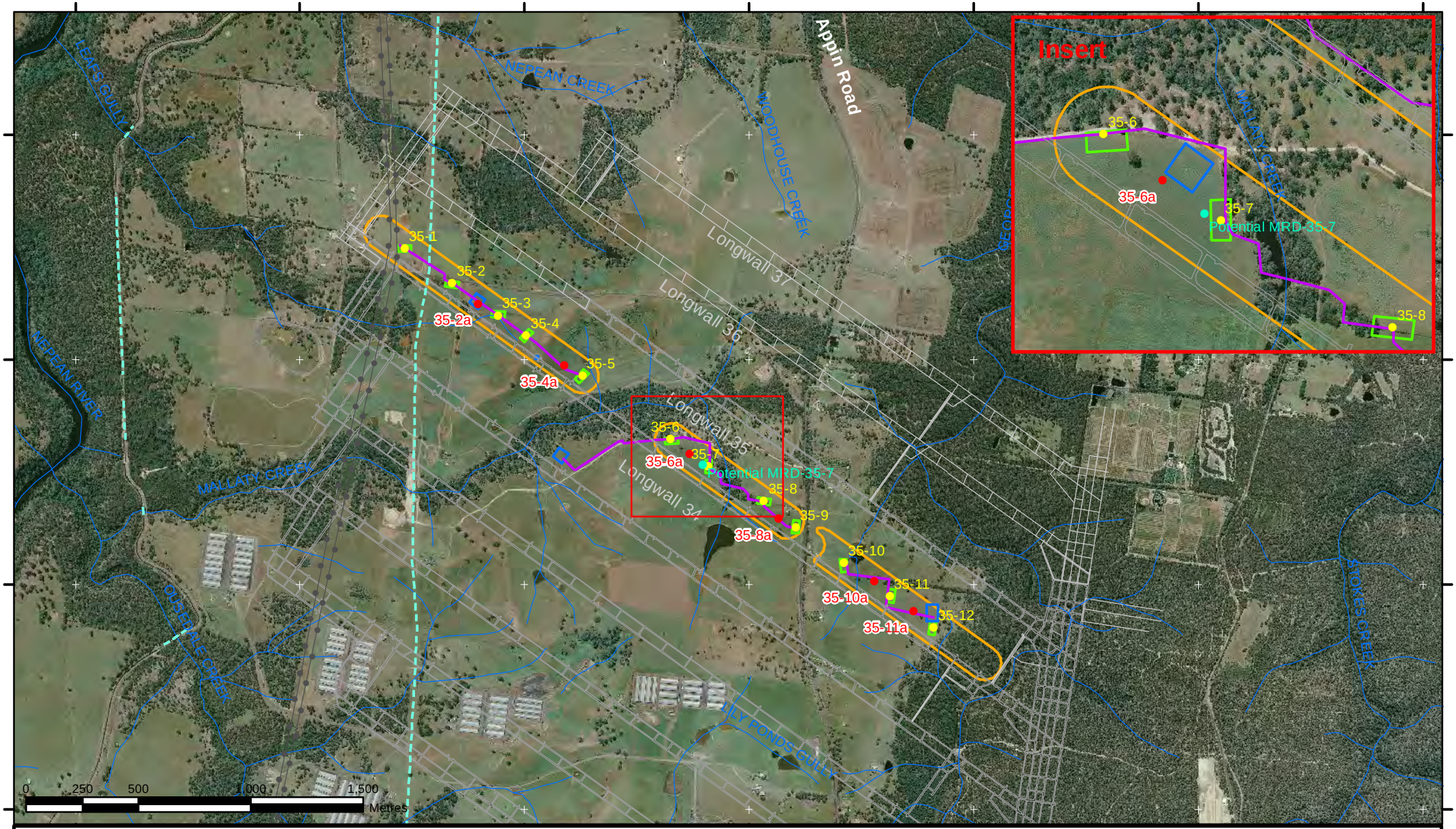

Legend

MRD Wells

SGW Vertical Wells
- Contingency
- Proposed

Electricity Transmission Line

Natural Gas Pipeline

SGW Pipelines

SGW Surface Sites
- Drill compounds
- Extraction Plants

SGW Assessment Areas

Aerial Photography 2007

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West Cliff Area 5 Surface Goaf Gas Drainage

Longwall 35

Figure 2: Scope of Project
Modification # 3

Date: 4 May, 2011
Author: R. Jenkins
Signed Off: C. McEvoy

Version 1
Horizontal Datum
MGA - Zone 56

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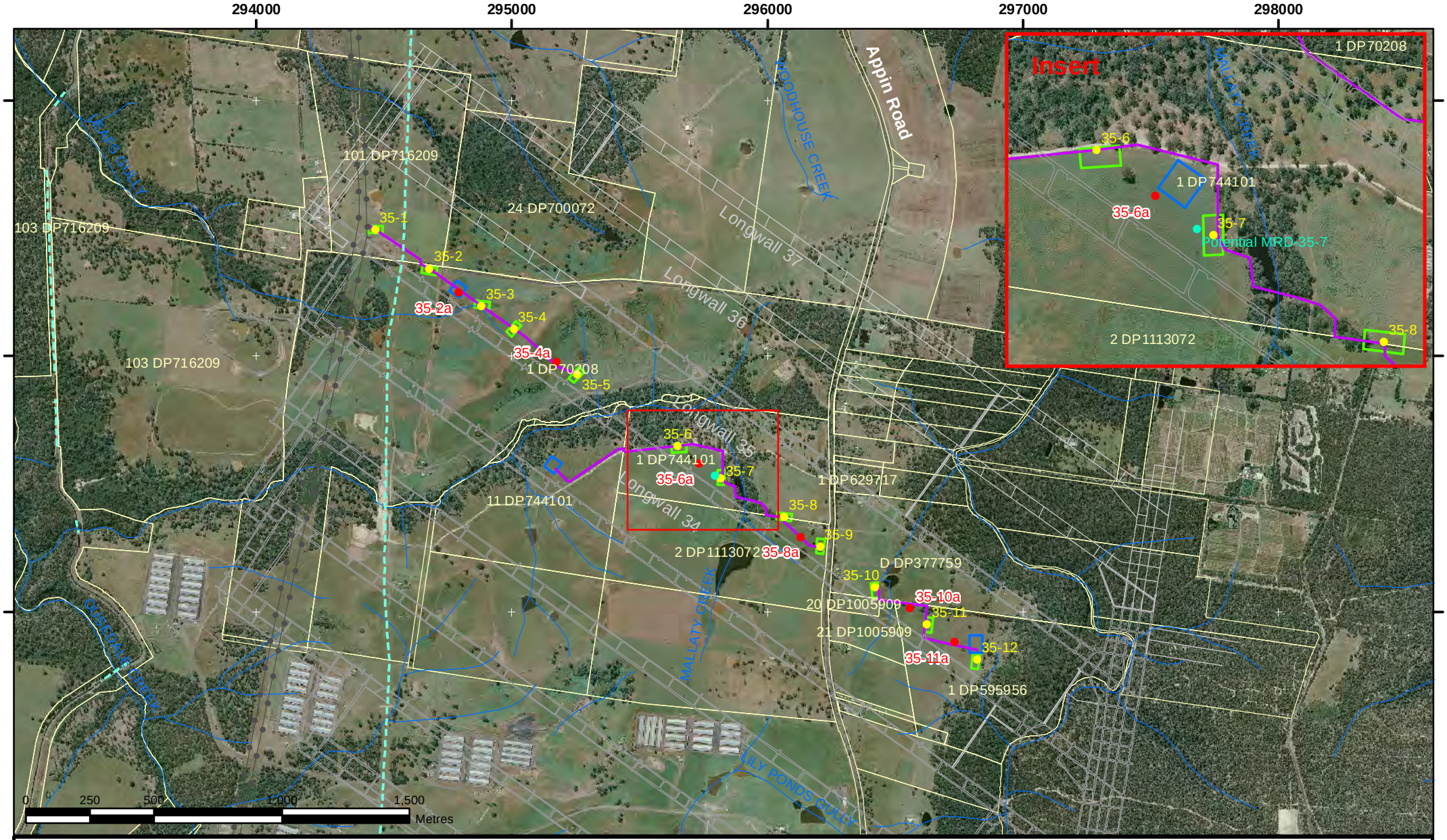

Legend

MRD Wells

SGW Vertical Wells
- Contingency
- Proposed

Electricity Transmission Line

Natural Gas Pipeline

SGW Pipelines

Cadastre

SGW Surface Sites
- Drill compounds
- Extraction Plants

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West Cliff Area 5 Surface Goaf Gas Drainage

Longwall 35

Figure 3: Cadastral Plan

Date: 4 May, 2011
Author: R. Jenkins
Signed Off: C. McEvoy

Version 1
Horizontal Datum
MGA - Zone 56

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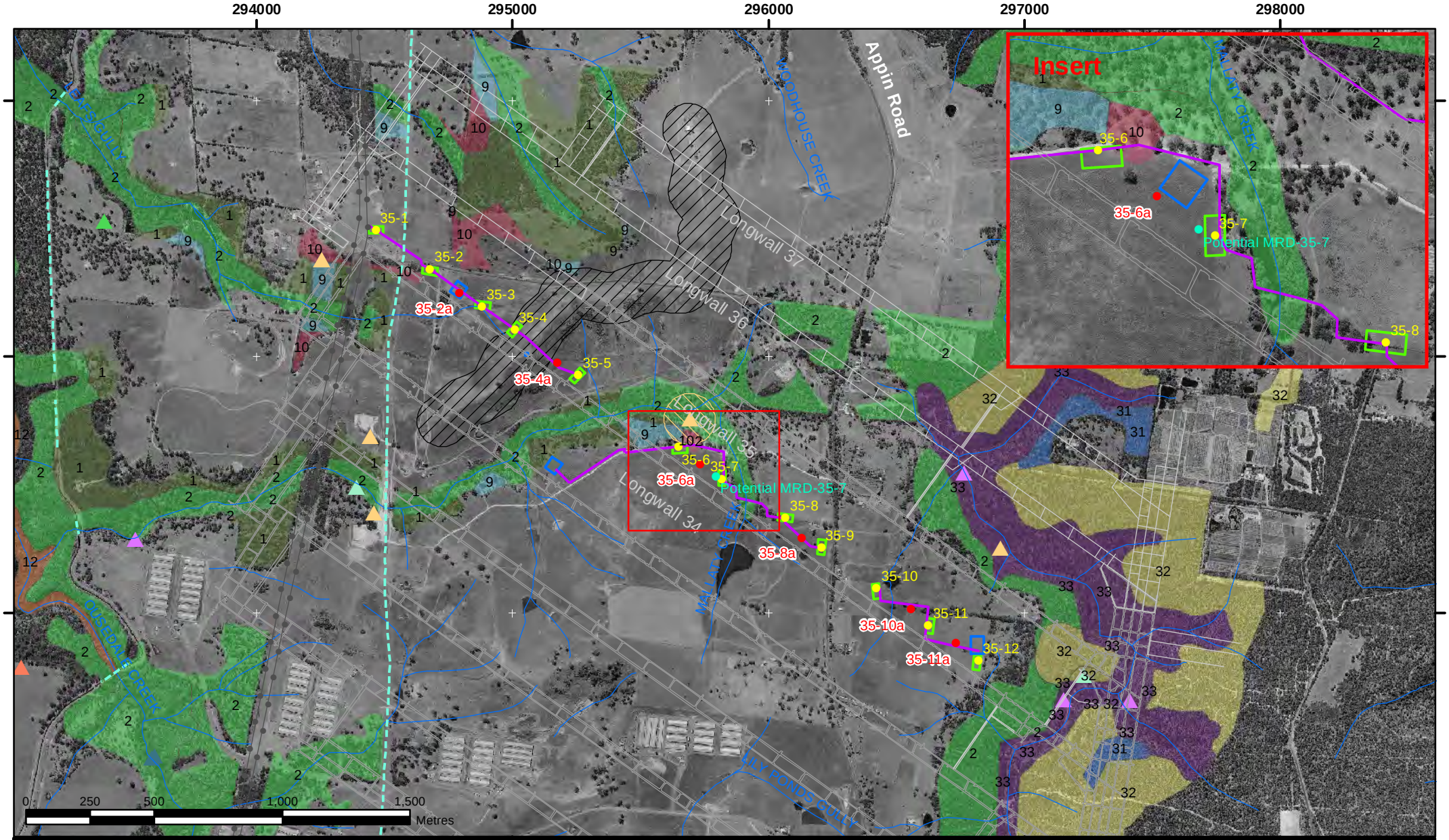

MRD Wells
SGW Vertical Wells
Contingency
Proposed
Electricity Transmission Line
Natural Gas Pipeline
SGW Pipelines
SGW Surface Sites
Drill compounds
Extraction Plants
Archaeological Avoidance Buffer
Potentially Archeologically Sensitive Ridgeline

Archaeological Sites
Axe Grinding Groove
Open Camp Site
Potential Archaeological Deposit
Scarred Tree
Shelter with Art
Shelter with Art and Artefact

Cumberland Plain Vegetation
1 - Shale Sandstone Transition Forest (Low Sandstone Influence)
10 - Shale Plains Woodland
12 - Riparian Forest
2 - Shale Sandstone Transition Forest (High Sandstone Influence)
31 - Sandstone Ridgetop Woodland
32 - Upper Georges River Sandstone Woodland
33 - Western Sandstone Gully Forest
9 - Shale Hills Woodland

Aerial Photography 2007

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West Cliff Area 5 Surface Goaf Gas Drainage
Longwall 35
Figure 4: Constraints Plan

Date: 4 May, 2011
Author: R. Jenkins
Signed Off: C. McEvoy

Version 1
Horizontal Datum
MGA - Zone 56

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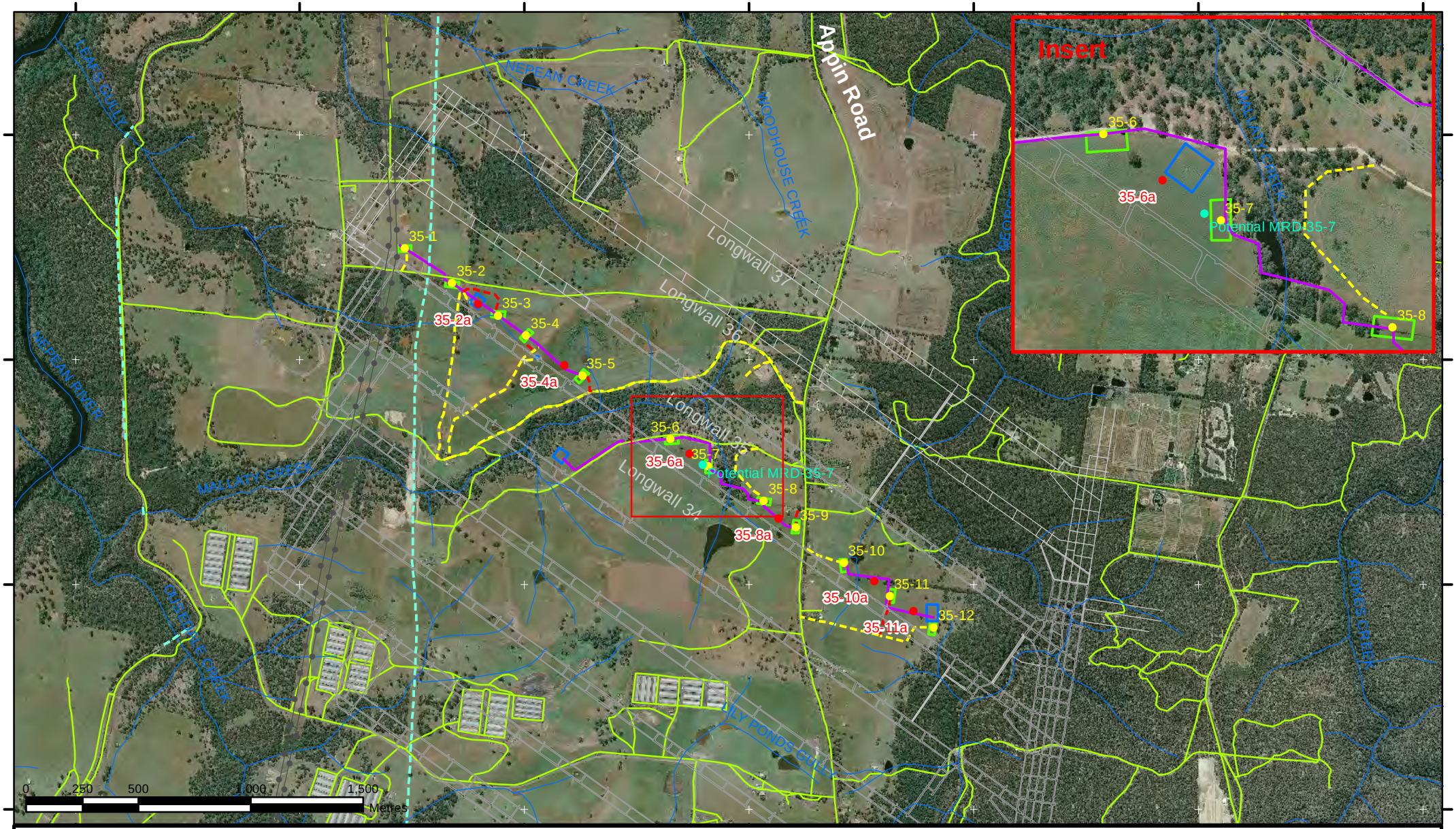

Legend

MRD Wells
- Contingency
- Proposed

Electricity Transmission Line

Natural Gas Pipeline

Site Access Tracks
- Proposed
- Existing

Surveyed Roads

SGW Pipelines

SGW Surface Sites
- Drill compounds
- Extraction Plants

Aerial Photography 2007

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Illawarra Coal

West Cliff Area 5 Surface Goaf Gas Drainage

Longwall 35

Figure 5: Access Plan

Date: 4 May 2011
Author: R. Jenkins
Signed Off: C. McEvoy

Version 1
Horizontal Datum
MGA - Zone 56

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A.2 SITE PHOTOS

SITE PHOTOGRAPHS

Plate 1: Gas well 35-1 location

Plate 2: Gas well 35-2 location

Plate 3: Gas well 35-3 and Flare Extraction Unit site

Plate 4: Gas well 35-4 location

Plate 5: Gas well 35-5 location looking north

Plate 6: Gas well 35-6 location

Plate 7: Gas well 35-7 location

Plate 8: Gas well 35-8 location

Plate 9: Gas well 35-9 beyond the pipes,

Plate 10: Gas well 35-10 location

Plate 11: Gas well 35-11 – location east

Plate 12: Gas well 35-12 location west

A.3 REVISED STATEMENT OF COMMITMENTS

- ❒ BHPBIC will continue to operate its office in the Appin Business and Shopping Precinct during the operation of the project.

- ❒ BHPBIC will continue to operate a 24-hour contact telephone line.

- ❒ BHPBIC will continue to support the operation of the Appin Area Community Working Group and associated community liaison activities.

- ❒ There will not be any on-site worker accommodation.

- ❒ Stormwater runoff and sediment/erosion will be managed in accordance with guidelines detailed in the Landcom Publication, “Soils and Construction” Volume 1, 4th Edition, dated March 2004.

- ❒ Each borehole will be plugged and abandoned in accordance with requirements of the Department of Primary Industries (Mineral Resources) for exploration boreholes, EDG01 Borehole Sealing requirements on Land: Coal Exploration.

- ❒ When appropriate and possible, gas will be flared utilising flaring units, hired from Landfill Management Systems Pty Ltd (LMS). If additional gas is available, additional flare units may be utilised to maximise the abatement of greenhouse gas emissions.

- ❒ BHPBIC proposes to minimise the disturbance of native vegetation. The proposed location of boreholes have been modified to achieve this objective.

- ❒ Exposed areas will be managed to minimise dust emissions.

- ❒ The Drill Rig (s) will normally operate in the daytime hours of 7 am to 6 pm. However there may be occasions when for operational reasons drilling is conducted outside these hours, in consultation with the landowner. The Gas Extraction and Flaring equipment will operate continuously around the clock.

- ❒ For gas wells 35-1, 35-8, 35-9, 35-10 and potential MRD 35-7, temporary noise barriers will be erected around drilling compounds during drilling to reduce noise and visual impacts.

- ❒ Any chemicals used on site will be taken off site after use and disposed of appropriately.

- ❒ Appropriate safety measures will be implemented to ensure workforce and public safety during the times when heavy equipment is moved on public roads.

- ❒ Wastes will not be disposed on site. Port-a-loo facilities will be used on site. Packaging wastes will be recycled or sent to appropriate existing landfill sites.

- ❒ Metals will be recycled in the current system. Potential for timber to be recycled will be investigated, otherwise this material, which is classified as builders waste, will be sent to an appropriate landfill. Any protective packing materials will be recycled.

- ❒ To avoid impacting upon unidentified Archaeological sites, all vehicles and work movements will stay in previously cleared and disturbed areas. The construction methods of infrastructure installation will be kept to a minimum and above ground alternatives will be considered where possible (i.e. Illawarra Coal is committing to placing the gas lines on the lands surface for the works associated with Modification #3.

- ❒ Should any Aboriginal relics be encountered during work, the work will cease within the vicinity of the find and the Office of Environment and Heritage and Aboriginal stakeholders notified. A qualified archaeologist may also be required to assess the find.

- ❒ Any disturbed surface area (other than necessary vehicle access tracks) external to the compounds will be spray-grassed or seeded to reduce the amount of exposed soil.

- ❒ Any unnecessary lights will be extinguished and essential service lights will be shielded at night.

- ❒ The compounds will be kept clean and tidy.

- ❒ BHPBIC will endeavour to minimise visible light emitted from the flaring of goaf gas.

- ❒ After the compounds are dismantled BHPBIC will remediate the sites.

- ❒ All of the Contractor's workforce will undertake West Cliff Colliery Safety and Environmental Training prior to commencing work on site.

- ❒ The Contractor will ensure all equipment is maintained in a safe and secure condition during the Project period.

- ❒ When the Project is complete the drilling and flaring equipment and all rubbish and construction debris will be removed from all areas disturbed by the works and the surface graded to smooth contours. The cleanup shall be to the satisfaction of Illawarra Coal's Site Engineer.

- ❒ The Contractor will ensure that employees, delivery trucks and sub-contractors do not park on public roads when working on the Project.

- ❒ The Contractor will also ensure that trucks and machinery leaving the site do not spill any waste materials on public roads. If this occurs it will be the Contractor's responsibility to clean up the spillage.

A.4 NOISE ASSESSMENT

ACOUSTICS AND AIR

WEST CLIFF GOAF GAS DRAINAGE
LONGWALL 35
NOISE ASSESSMENT

REPORT NO. 11041-LW35
VERSION B

WILKINSON MURRAY

WEST CLIFF GOAF GAS DRAINAGE
LONGWALL 35
NOISE ASSESSMENT

REPORT NO. 11041-LW35
VERSION B

MAY 2011

PREPARED FOR

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PO BOX 514 UNANDERRA
NEW SOUTH WALES 2526 AUSTRALIA

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TABLE OF CONTENTS

GLOSSARY OF TERMS

Most environments are affected by environmental noise which continuously varies, largely as a result of road traffic. To describe the overall noise environment, a number of noise descriptors have been developed and these involve statistical and other analysis of the varying noise over sampling periods, typically taken as 15 minutes. These descriptors, which are demonstrated in the graph overleaf, are here defined.

Maximum Noise Level (L_{Amax}) – The maximum noise level over a sample period is the maximum level, measured on fast response, during the sample period.

L_{A1} – The L_{A1} level is the noise level which is exceeded for 1% of the sample period. During the sample period, the noise level is below the L_{A1} level for 99% of the time.

L_{A10} – The L_{A10} level is the noise level which is exceeded for 10% of the sample period. During the sample period, the noise level is below the L_{A10} level for 90% of the time. The L_{A10} is a common noise descriptor for environmental noise and road traffic noise.

L_{Aeq} – The equivalent continuous sound level (L_{Aeq}) is the energy average of the varying noise over the sample period and is equivalent to the level of a constant noise which contains the same energy as the varying noise environment. This measure is also a common measure of environmental noise and road traffic noise.

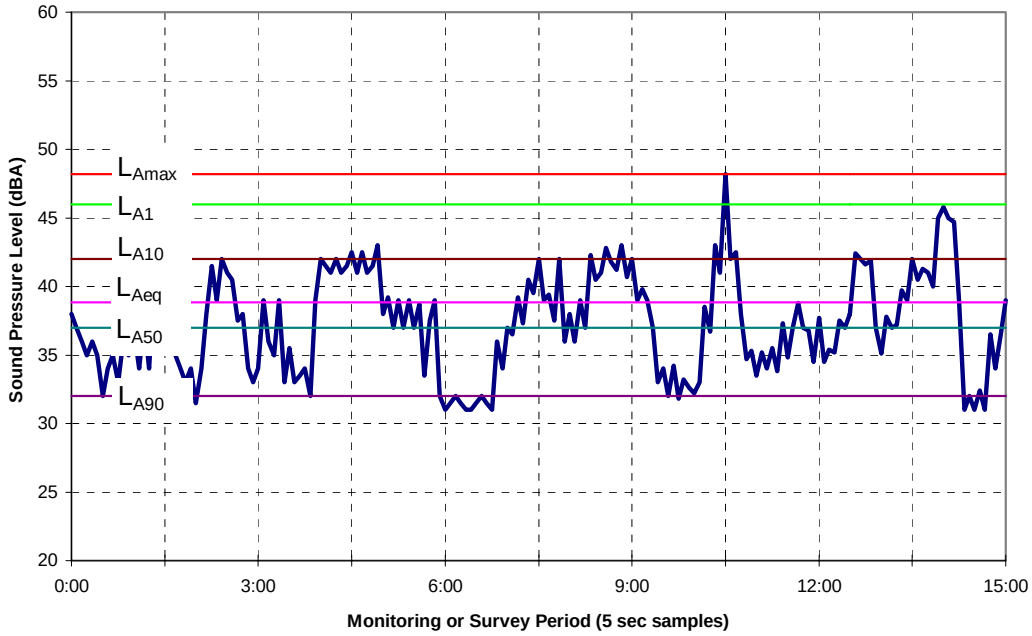
L_{A50} – The L_{A50} level is the noise level which is exceeded for 50% of the sample period. During the sample period, the noise level is below the L_{A50} level for 50% of the time.

L_{A90} – The L_{A90} level is the noise level which is exceeded for 90% of the sample period. During the sample period, the noise level is below the L_{A90} level for 10% of the time. This measure is commonly referred to as the background noise level.

ABL – The Assessment Background Level is the single figure background level representing each assessment period (daytime, evening and night time) for each day. It is determined by calculating the 10^{th} percentile (lowest 10^{th} percent) background level (L_{A90}) for each period.

RBL – The Rating Background Level for each period is the median value of the ABL values for the period over all of the days measured. There is therefore an RBL value for each period **–** daytime, evening and night time.

Typical Graph of Sound Pressure Level vs Time



1 INTRODUCTION

BHP Billiton Illawarra Coal (BHPBIC) operates the West Cliff longwall coal mine in the Appin area. Part of the operation of this mine involves the removal of goaf gas. Goaf gas is the gas that remains in a mined section of the longwall and if it is not removed this presents a potential hazard to workers in the adjoining mine shafts. To remove this gas, vertical wells are drilled from the surface and the gas is extracted.

BHPBIC are preparing a Section 75W application for the extraction of goaf gas from Longwall 35. This report presents an assessment of the potential for noise impacts arising from the construction and operation of gas wells and extraction plants proposed for this longwall.

2 SITE DESCRIPTION

The site and surrounds are predominantly rural. Several sparsely located residences neighbour the site.

An aerial photograph and a site plan showing the proposed goaf plant, wells and surrounding receivers are shown in Figure 3-1 and Figure 3-2 respectively.

Table 2-1 shows the identified surrounding receivers and the approximate distances to the nearest drill site and the proposed goaf plant. The receiver numbers correspond to the numbers in Figure 3-2.

Table 2-1 Surrounding Residential Receivers

Receiver #	Distance to Nearest GOAF Plant (m)	Distance to Nearest MRD Site (m)	Distance to Nearest Vertical Well Drilling Site (m)
1	600	1300	100
2	540	540	400
3	570	570	550
4	840	840	830
5	700	700	680
6	690	670	650
7	670	630	590
8	590	550	500
9	590	540	380
10	630	550	230
11	500	420	80
12	630	590	110
13	550	680	140
14	540	810	270
15	500	1000	400
16	700	2000	310
17	560	1800	180
18	700	1100	630
19	1100	1300	1050

3 PROPOSAL DESCRIPTION

The proposal is for the construction and operation of the following:

- 12 vertical gas wells;
- one Medium-Radius Drilling (MRD) directional wells; and
- three Goaf Gas Extraction Plants (plus one already approved).

Each of the vertical wells will take approximately 2.5 weeks to construct. During this time the site will be cleared and drilling will be conducted.

For engineering reasons, MRD wells require 24 hour operation during drilling. The MRD well is likely to take approximately six weeks to complete.

Pipelines connecting each well to the corresponding goaf plant will need to be constructed. One of two methods will be utilised. Buried pipelines involve trenching and installing the pipes before backfilling and compacting. Alternatively, the pipelines could be left above ground along existing fence lines. The duration of construction depends greatly on the length of pipeline required for each well. Typically 1-3 weeks would be expected for each well.

The goaf gas extraction plant consists of the following:

- vacuum pump with electric motor, and inlet/outlet manifolds;
- gas/water separator;
- flow control recirculation;
- discharge gas pipe work to discharge point;
- discharge stack; and
- associated diesel powered electricity generator or direct connection to mains electrical power.

The goaf gas drainage plant will operate 24 hours, seven days a week. The plant is anticipated to be operational for several months only.

The proposal details identify well and goaf plant sites that have been determined at this preliminary stage as being the preferred locations for these items. BHPBIC are seeking approval for these activities to occur over broader areas surrounding the identified sites, as a contingency.

3.1 Hours

The bulk of construction will be limited to the DECCW's recommended standard construction hours, namely:

- Monday to Friday 7am to 6pm
- Saturday 8am to 1pm
- No work on Sundays or Public Holiday

Drilling of MRD wells will require 24 hour drilling, seven days. Where noise levels emissions are acceptable, drilling of vertical wells may also be undertaken on a 24-hour basis. The operation of the goaf gas extraction plants will be 24-hours, seven days.

Figure 3-1 Aerial Image of the Site

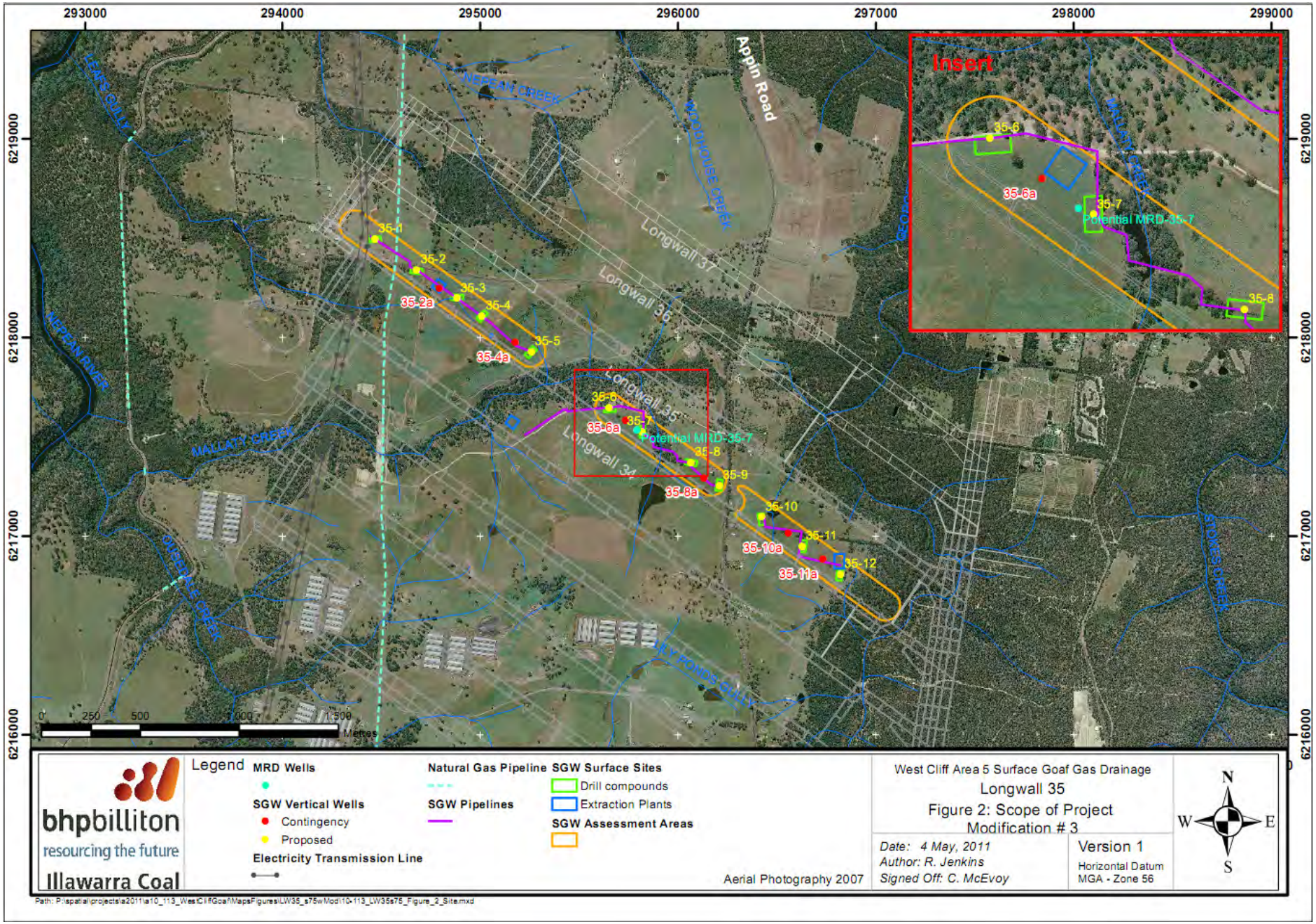
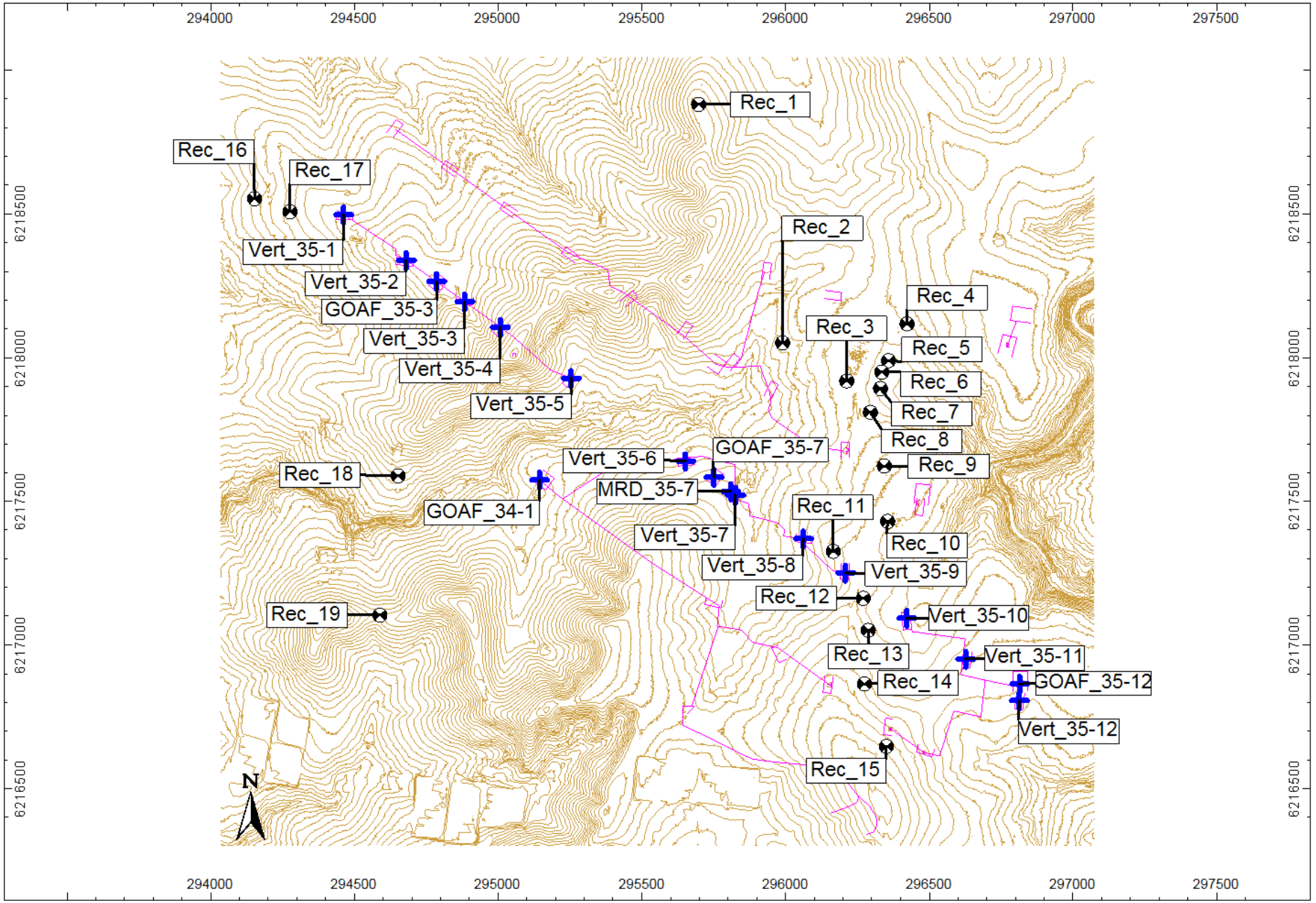


Figure 3-2 Site Plan Showing Wells, Extraction Plants, Receivers and Ground Height Contours



4 EXISTING NOISE LEVELS

4.1 Measurement Locations

Existing noise levels were monitored using unattended noise loggers at the following locations, being representative of the residences most likely to be affected by noise from the proposal:

- Location A 371 Appin Road, Gilead (Receiver 10); and
- Location B 353 Appin Road, Gilead (Receiver 17).

These monitoring locations are shown in Figure 3-2 by their respective receiver identifiers.

4.2 Long-Term Monitoring

Noise levels were monitored continuously during the following periods:

- Location A Thursday, 10 March through Thursday, 24 March 2011
- Location B Monday, 4 April through Monday, 11 April 2011

The noise monitoring equipment used for these measurements consisted of environmental noise loggers set to A-weighted, fast response, continuously monitoring over 15-minute sampling periods. This equipment is capable of remotely monitoring and storing noise level descriptors for later detailed analysis. The equipment calibration was checked before and after the survey and no significant drift occurred.

The logger determines $L_{A1,}$ $L_{A10,}$ L_{A90} and L_{Aeq} levels of the ambient noise. The $L_{A1,}$ L_{A10} and L_{A90} levels are the levels exceeded for 1%, 10% and 90% of the sample time respectively (see glossary for definitions). The L_{A1} is indicative of maximum noise levels due to individual noise events such as the occasional passby of a heavy vehicle. This is used for the assessment of sleep disturbance.

The L_{A90} level is normally taken as the background noise level during the relevant period. The L_{Aeq} level is the Equivalent Continuous Sound Level and has the same sound energy over the sampling period as the actual noise environment with its fluctuating sound levels. The L_{Aeq} is used for the assessment of operational noise and traffic noise. The L_{A10} is used for the assessment of construction noise.

These noise levels were recorded every 15-minutes during the monitoring period. Monitored noise levels are shown in graphical form in Appendix A.

The measured noise levels are shown in Table 4-1. At each location the Rating Background Level (RBL) for each of the standard daytime, evening and night-time periods have been determined in accordance with the *INP*. The RBL is a summary value representing background noise over a long period, and is defined in the *INP*.

Table 4-1 Measured Noise Levels (dBA)

Location	Rating Background Level (RBL)			$L_{Aeq,period}$ (dBA)		
	Day	Evening	Night	Day	Evening	Night
A – 371 Appin Road	43	47[2]	42	55	59	53
B – 353 Appin Road	36	36	34	51	42	43

Note: 1. Daytime 7.00am–6.00pm; Evening 6.00pm–10.00pm; Night 10.00pm–6.00am.
2. The *DECCW* recommend that where the evening RBL exceeds the daytime RBL, the daytime RBL should be adopted for the evening period.

During installation and collection of the noise loggers we observed that traffic noise was the dominant source of L_{A90} noise levels. Wildlife and naturally occurring sounds (e.g. wind in trees) also contributed to the ambient noise environment. During the night time period L_{Aeq} noise levels are expected to be dominated by traffic noise.

We did not observe any industrial noise during our site visits.

5 NOISE CRITERIA

5.1 Operational Noise Criteria

This section of the report discusses noise criteria for the assessment of operational noise relating to the goaf gas extraction plants. The main noise sources within the goaf plants are a diesel generator and a pump/compressor.

The NSW *Industrial Noise Policy* (INP) is applicable to operational noise.

The *INP* specifies two noise criteria - intrusiveness criteria and amenity criteria. The intrusiveness criterion is relative to the level of existing background noise and is defined as a permitted level above the Rating Background Level (RBL). The amenity criterion sets an upper limit for industrial noise in an area.

5.1.1 Intrusiveness Criterion

The intrusiveness criterion specifies that the $L_{Aeq\ 15\ minute}$ noise level from the proposed source should not exceed the RBL by more than 5dBA. The RBL is an overall single-figure background level representing each measurement period (day, evening and night) over the whole monitoring period.

The *INP* requires that where noise sources contain certain characteristics, such as tonality, impulsiveness, intermittency or dominant low frequency content, a modifying factor should be applied because this type of noise typically causes greater annoyance to the community.

5.1.2 Amenity Criterion

The *INP* prescribes different amenity criteria depending on the characteristic environment of an area. In this case, the potentially affected residences are in an area which would be classified as “Rural”, and the relevant recommended “acceptable” amenity levels for $L_{Aeq,Period}$ are 50, 45 and 40 dBA for daytime, evening and night time periods respectively.

To set the amenity criteria for any project the INP has a sliding scale based on the existing industrial noise. As there is no significant existing source of industrial noise in this area the above values become the amenity criteria.

Where existing traffic noise levels are sufficiently high (greater than 10 dB above the base amenity criteria) the *INP* permits an adjustment of the amenity criterion. The measured night time $L_{Aeq,period}$ at Location A was 53 dBA and therefore a relaxation of the amenity criterion may be appropriate, as traffic noise was identified as the dominant noise source. Upon review of the night time noise levels, which approached 35 dBA on several nights, we consider that relaxing the amenity criteria is not appropriate for the noise environment in question.

5.1.3 Project Specific Noise Level Criteria

The amenity criteria are to be assessed over entire time period ($L_{Aeq,period}$). while intrusiveness criteria apply to any 15 minute period ($L_{Aeq,15min}$). The operation of the goaf gas extraction plant is sufficiently constant that the two descriptors can be considered synonymous at the source. Therefore it is appropriate to define a single noise criterion for the assessment of operation noise – the Project Specific Noise Level (PSNL) Criterion.

The amenity, intrusiveness and PSNL noise criteria for potentially affected receivers are presented in Table 5-1. Where practicable, noise levels should be controlled to below these limits.

Table 5-1 Noise Level Criteria - dBA

Rec. #	Intrusiveness Noise Criteria, $L_{Aeq, 15minutes}$			Amenity Criteria, $L_{Aeq,period}$			PSNL Criteria, L_{Aeq}		
	Day	Evening	Night	Day	Evening	Night	Day	Evening	Night
1-15	**48**	48[2]	47	50	**45**	**40**	48	45	40
16-19	**41**	**41**	**39**	50	45	40	41	41	39

Note: 1) Daytime 7.00am–6.00am; Early Morning 6.00am–7.00am; Evening 6.00pm–10.00pm; and Night 10.00pm-6.00am.

2. The *DECCW* recommend that where the evening RBL exceeds the daytime RBL, the daytime RBL should be adopted for the evening period.

5.1.4 Sleep Disturbance

For the night time period it is also necessary to consider the potential for sleep arousal resulting from short term noise events. The DECCW recommends that as a screening criterion the $L_{A1,1min}$ or L_{Amax} noise level should not exceed the background L_{A90} level by more than 15dBA.

As the operation of the plant is constant, with no significant variation in noise level, there is no potential for sleep disturbance from impulsive noise events. As such this is not discussed further.

Vehicles may be required to access the extraction plant at night but this would only be in the unlikely event of an emergency or a shutdown. Given the distance to the receivers and the infrequent occurrence of these events we do not consider that it warrants assessment.

5.2 Construction Noise Goals

The NSW DECCW *Interim Construction Noise Guidelines (ICNG)* recommends the following objectives:

Recommended standard hours of work

- Monday to Friday 7am to 6pm
- Saturday 8am to 1pm
- No work on Sundays or Public Holiday

Management Noise Goals

Noise goals are detailed in Table 5-2.

Table 5-2 Noise at Residences using Quantitative Assessment

Time of Day	Management Level $L_{Aeq,15min}$	How to Apply
Recommended standard hours: Monday to Friday 7 am to 6 pm Saturday 8 am to 1 pm No work on Sundays or public holidays	Noise affected RBL + 10 dB	The noise affected level represents the point above which there may be some community reaction to noise. • Where the predicted or measured $L_{Aeq,15\ min}$ is greater than the noise affected level, the proponent should apply all feasible and reasonable work practices to meet the noise affected level. • The proponent should also inform all potentially impacted residents of the nature of works to be carried out, the expected noise levels and duration, as well as contact details.
	Highly noise affected 75 dB(A)	The highly noise affected level represents the point above which there may be strong community reaction to noise. • Where noise is above this level, the relevant authority (consent, determining or regulatory) may require respite periods by restricting the hours that the very noisy activities can occur, taking into account: 1. times identified by the community when they are less sensitive to noise (such as before and after school for works near schools, or mid-morning or mid-afternoon for works near residences 2. if the community is prepared to accept a longer period of construction in exchange for restrictions on construction times.

Under the Guidelines, work conducted outside standard construction hours requires:

- a strong justification for the work being done at this time;
- application of all feasible and reasonable work practices to meet a noise level of RBL + 5dBA; and
- where this level cannot be achieved, negotiation with the community.

In the past, Wilkinson Murray has suggested that if noise is inaudible, or almost inaudible, at relevant receivers, strong justification for work outside standard hours would not be required. A level of RBL – 5 dBA is considered to be sufficiently close to being inaudible that it is acceptable. This criterion has been specified on previous construction projects at night and no noise complaints were received at this noise level.

A night time background noise level of 34 dBA was measured at Location B. The night time RBL at Location A is 42 dBA; however the prevalence of L_{A90} noise levels approaching 35 dBA suggests that this noise level needs to be considered in defining a quantitative measure of audibility. Therefore external noise levels of 29 dBA at Location B and 30 dBA at Location A are recommended as being appropriate for work to proceed outside standard construction hours, without the need to demonstrate reasons that works are required during these times.

Note that the above reasoning is most applicable to works in the middle of the night. Works on weekends during the daytime, which are still outside standard construction hours, are considered unlikely to generate complaints if the noise level is at or below 35 dBA, or RBL

minus 5 dBA, whichever is greater.

The site specific construction noise goals are presented in Table 5-3.

Table 5-3 Construction Noise Goals

Receivers	Management L_{Aeq} Noise Level			
	Standard Construction Hours RBL + 10 (dBA)	Outside Standard Construction Hours		
		With Justification RBL + 5 (dBA)	Without Justification	
			Night	Daytime
1-15	53	47	30	38
16-19	46	39	29	35

If operations must occur outside the standard construction hours then Wilkinson Murray recommends that a written negotiated noise agreement with all affected landholders be negotiated.

Wherever such agreements have been established to the satisfaction of DoP, then the noise goals outlined in this section need not be achieved to permit works outside standard construction hours.

6 OPERATIONAL NOISE ASSESSMENT

6.1 Assessed Sites

At this early stage BHPBIC has identified preferred sites for goaf gas extraction plants.

Assessment has focused on the preferred sites, as detailed noise modelling was able to be undertaken for these.

Approval is being sought for less defined areas in which extraction plants may be located as a contingency. To facilitate the management of noise emissions from these broader areas, we have calculated buffer distances outside which criteria are predicted to be met under most conditions.

6.2 Goaf Plant Source Noise Levels

In order to establish the source noise levels of the proposed goaf gas plant, noise measurements of a similar, existing goaf gas extraction plant at West Cliff Mine Area 5 were conducted on 8 April 2009.

Noise measurements were conducted using a Bruel and Kjaer Type 2260 Sound Level Meter (SLM). The SLM holds current NATA calibration and has been internally laboratory calibrated within the past three months in accordance with Wilkinson Murray Quality Assurance procedures. Additionally the calibration was checked in the field before and after the measurements and no significant drift was observed. Spectra were measured in standard third-octave bandwidths.

From these measurements the diesel generator was identified as the dominant noise source. There was also some notable noise emission from the vacuum pump. These sources were shielded in some directions by associated equipment, and thus the noise level varied with direction.

As the orientation of the proposed goaf plant is unknown at this stage, the highest measured sound power level has been applied to all directions. The assumed sound power level is shown in Table 6-1.

Table 6-1 Sound Power Level (dB) – Goaf Gas Plant

Octave Band Centre Frequency (Hz)								dBA
31.5	63	125	250	500	1k	2k	4k	
105	117	98	94	92	87	80	79	95

The measured noise level also showed a tonal characteristic in the 80Hz third-octave. This tone has been assessed in accordance with the INP and was judged not to render the total noise tonal under the DECCW's definition, as the level in the third octave containing the tone does not exceed the adjacent bands by 15dB or more.

6.3 Noise Level Calculation

Noise levels experienced by a receiver at relatively large distances from a source can vary

considerably under different meteorological conditions, particularly at night. Prevailing wind and air temperature gradients will change over the course of the night time period, and hence noise levels at receivers will change, even when the source noise level is constant.

The *INP* generally directs the use of a single set of adverse meteorological data to use in the assessment of noise impacts; however Wilkinson Murray has adopted a more rigorous approach in past assessments where noise levels at residences are calculated under a varied set of existing meteorological conditions. Measured statistical occurrences of these conditions over a period of one year are then applied to the results, and a 10^{th} percentile exceedance level calculated, which is then compared with relevant criteria. This approach is generally more conservative than one using a single set of meteorological data as it accounts for the directional distribution of prevailing winds for each residence surrounding the site.

This alternative assessment procedure involves significantly greater computational complexity than the use of a single set of meteorological conditions, but provides a much more direct and comprehensible description of noise impacts at a receiver. This approach of using the 10^{th} percentile calculated noise level as a measure of noise impacts on residences has been considered acceptable by the DECCW, DoP and local councils for previous similar assessments.

6.3.1 Meteorological Data

Meteorological data for the site was generated by PAEHolmes using the CALMET model. Data for the 2009 calendar year was used. The data includes wind speed, wind direction, temperature and Pasquill stability class from which the likelihood of temperature inversions was calculated.

The full methodology of calculation of temperature inversion strengths for the proposal can be found in Appendix E of the INP.

6.3.2 The ENM Computer Noise Model

Operational noise levels at residences were calculated using the Environmental Noise Model (ENM) prediction model.

The ENM model has been endorsed by the DECCW for environmental noise assessment. It takes account of noise attenuation due to geometric spreading, atmospheric absorption, shielding and the effect of acoustically soft ground. It can also be used to predict noise levels under various meteorological conditions, defined by a combination of temperature gradient, wind speed and wind direction.

Noise levels were calculated using the ENM model under a total of 91 meteorological conditions. A statistical data set representing the proportional occurrence of these conditions over a year was then applied to the calculated noise levels. The noise level exceeded for 10% of the time during each of the day, evening and night time periods was then calculated.

It should be noted that the calculations described above rely on predictions produced by the ENM model. This model is based on simple assumed vertical profiles of temperature and wind speed, and does not accurately model more complex situations. In particular, there are times when a combination of non-linear vertical temperature and wind speed profiles can result in “focussing” of noise in a small area. In these events, increases in noise level of 10-20dBA can occur over periods of minutes to hours. The frequency of these events, and the level of noise enhancement occurring, cannot be accurately predicted using ENM or any other known model. However, the validation of the model used has shown good correlation between measured and

predicted noise levels as a 10th percentile exceedance level.

6.3.3 Noise Calculations

Predicted 10th percentile exceedance noise levels for the operational goaf gas extraction plants are presented in Appendix B.

The 10th percentile exceedance noise levels are predicted to be within relevant criteria at all receivers, for all goaf gas extraction plants. The highest predicted noise levels are 40 dBA at Receiver 2, resulting from GOAF 36-7 during the winter evening period.

Therefore the noise impacts associated with each of the goaf gas extraction plants whilch have been assessed is considered acceptable.

6.4 Contingency Areas

In order to determine buffer distances outside which criteria are predicted to be met, noise levels were calculated at varying distances from the goaf gas extraction plant source.

The modelling assumed the following:

- Non-flat ground for non-barrier scenarios
- Flat ground for barrier scenarios
- 3m/s downwind condition
- 3°/100m temperature inversion

The assumption of flat ground will not be accurate in all cases and some consideration must be given to the relative topography of the source and receiver when applying the calculated buffer distances.

Meteorological conditions have been included in the calculation because they are considered to have a potentially significant impact, especially during the night time period. The assumed conditions are considered generally to be worst-case conditions and as such the approach is conservative.

Table 6-2 presents the calculated buffer distances to satisfy the minimum criterion, which is 39 dBA.

Table 6-2 Buffer Distances to Satisfy 39 dBA from Goaf Gas Extraction Plants

	Mitigation - Barrier				
Height	**0m**	**3m**	**4m**	**5m**	**5m**
Setback[1]	**Nil**	**10m**	**10m**	**10m**	**5m**
Buffer Distance	350m	100m	60m	<50m	<50m

Note: 1. Setback of barrier from the source.

We recommend that if a plant is to be located near to the above buffer distances from a residence (or a point up to 30m from a residence), then further investigation should be undertaken. The need for further investigation could be negated by selecting mitigation that exceeds the specified requirement for the given distance between source and receiver.

If the receiver is significantly above the source, then the performance of noise barriers could be compromised and in this case we recommend further investigation if the distance between source and receiver is less than 100m. Outside this distance the selection of higher barriers located closer to the source should be sufficient.

7 CONSTRUCTION NOISE ASSESSMENT

7.1 Assessed Sites

As with operational noise, preferred sites and contingency areas have been identified by BHPBIC.

Assessment has again focussed on the preferred sites, with buffer distances calculated to aid the management of noise emissions in contingency areas.

7.2 Source Noise Levels

In order to establish the source noise levels of the MRD and Vertical Well drill rigs, attended measurements of each rig were undertaken during April 2011 while they were operational in the Appin area.

Noise measurements were conducted using a Bruel and Kjaer Type 2260 Sound Level Meter (SLM). The SLM holds current NATA calibration and has been internally laboratory calibrated within the past three months in accordance with Wilkinson Murray Quality Assurance procedures. Additionally, the calibration was checked in the field before and after the measurements and no significant drift was observed.

As the orientation of the drill rigs at each location is unknown at this stage, the highest measured sound power level has been applied to all directions. The assumed sound power levels are as follows:

- MRD Drill Rig 113 dBA
- Vertical Well Rig 109 dBA

These noise source levels are similar to the levels determined from previous measurements by other noise consultants of these and similar drill rigs.

7.3 MRD Noise Level Calculation

Noise levels for MRD wells were calculated using the methodology detailed in Section 6.3. For MRD drilling there is an operational requirement for drilling to take place on a 24-hour, 7-day basis, and hence relevant noise criteria are based on the “with justification” criteria in Section 5.

7.3.1 MRD Noise Calculations

Predicted 10^{th} percentile exceedance noise levels for the MRD well are presented in Appendix C.

The 10^{th} percentile exceedance noise levels resulting from MRD 35-7 are predicted to exceed the night time noise criteria at several receivers (2-6 and 8-11). Therefore it is necessary to consider noise mitigation.

A 5m noise barrier was modelled at a setback of 5m from the noise source. The barrier is shown in Appendix D. With this mitigation the 10^{th} percentile noise levels from MRD 35-7 are predicted to be within the relevant criteria. The highest predicted 10^{th} percentile noise level with the barrier is 38 dBA at Receiver 17, which does not receive any shielding from the proposed barrier.

Therefore, with the proposed mitigation the noise emissions from the MRD drilling are predicted to be acceptable.

7.3.2 MRD Contingency Areas

In order to determine buffer distances outside which criteria are predicted to be met, noise levels were calculated at varying distances from the MRD source.

The modelling assumed the following:

- Non-flat ground for non-barrier scenarios
- Flat ground for barrier scenarios
- 3m/s downwind condition
- 3°/100m temperature inversion

The assumption of flat ground will not be accurate in all cases and some consideration must be given to the relative topography of the source and receiver when applying the calculated buffer distances.

Meteorological conditions have been included in the calculation because they are considered to have a potentially significant impact, especially during the night time period. The assumed conditions are considered generally to be worst-case conditions and as such the approach is conservative.

Table 6-2 presents the calculated buffer distances to satisfy the respective criteria, which are 39 and 47 dBA.

Table 7-1 Buffer Distances for MRD Drilling

	Mitigation - Barrier				
Height	**0m**	**3m**	**4m**	**5m**	**5m**
Setback[1]	**Nil**	**10m**	**10m**	**10m**	**5m**
Receivers 1-15 – 47 dBA	1600m	900m	300m	200m	140m
Receivers 16-19 – 39 dBA	>2000m	1600m	1300m	1100m	700m

Note: 1. Setback of barrier from the source.

The above buffer distances demonstrate the importance of shielding in permitting MRD drilling at night.

We recommend that if MRD drilling is to be located near to the above buffer distances from a residence (or a point up to 30m from a residence), then further investigation should be undertaken. The need for further investigation could be negated by selecting mitigation that exceeds the specified requirement for the given distance between source and receiver.

If the receiver is significantly above the source then the performance of noise barriers could be compromised, and in this case we recommend further investigation if the distance between source and receiver is less than 100m. Outside this distance the selection of higher barriers located more closely to the source should sufficiently attenuate noise from the MRD rig.

7.4 Vertical Well Noise Level Calculation

Noise levels for this operation are calculated using the same procedures described above for MRD drilling. In this case it is envisaged that drilling will be conducted during standard construction hours only. However, the case of drilling operations conducted out of hours is also investigated and required mitigation measures are described. For vertical well drilling, the relevant criteria for operations conducted outside normal construction hours are considered to be the "without justification" criterion described in Section 5.

7.4.1 Vertical Well Noise Calculations – Standard Construction Hours

Predicted noise levels for the vertical wells are presented in Appendix D.

Exceedances of the standard construction hours criteria are predicted to result from drilling of several proposed vertical wells. Table 7-2 presents a summary of the predicted exceedances.

Table 7-2 Summary of Receivers Predicted to Receive Exceedances

Vertical Well	Receivers Predicted to Exceed Criteria
VERT 35-1	17
VERT 35-8	11
VERT 35-9	11, 12
VERT 35-10	12, 13

Noise barriers were modelled where appropriate around wells that were predicted to cause exceedances. The locations of these barriers are shown in Appendix F. Table 7-3 presents a summary of the barrier height (above drill pad level), and the setback from the main noise source, of the modelled barriers.

Table 7-3 Summary of Barrier Heights and Setbacks

Vertical Well	Barrier Height (m)	Barrier Setback (m)
VERT 35-1	3	10
VERT 35-8	4	10
VERT 35-9	4	10
VERT 35-10	4	5

With the provision of the above barriers, noise levels are predicted to be within the relevant criteria at all receivers.

7.4.2 Vertical Well Noise Calculations – Outside Standard Construction Hours

Noise emissions from drilling of all vertical wells are predicted to significantly exceed night time ("without justification") criteria, even with the barriers detailed in Section 7.4.1 implemented. Therefore we recommend that drilling vertical wells at the preferred sites not be undertaken outside the daytime.

During the daytime, outside standard construction hours (i.e. weekends and public holidays), significant exceedances of criteria are predicted to result from most well sites. Table 7-4 presents a summary of well sites where drilling during these periods would be considered acceptable.

Table 7-4 Summary of Receivers Predicted to Receive Exceedances

Vertical Well	Comment on Predicted Noise Levels
VERT 35-3	Negligible 1 dBA exceedance predicted at Rec 17.

Therefore we recommend that drilling be limited to standard construction hours at all wells except those identified in Table 7-4, where work outside standard construction hours but during the daytime could be permitted.

7.4.3 Vertical Well Contingency Areas

In order to determine buffer distances outside which criteria are predicted to be met, noise levels were calculated at varying distances from the Vertical Well Drill Rig source.

The modelling assumed the following:

- Non-flat ground for non-barrier scenarios
- Flat ground for barrier scenarios
- Still, isothermal conditions for daytime

The assumption of flat ground will not be accurate in all cases and some consideration must be given to the relative topography of the source and receiver when applying the calculated buffer distances.

Table 7-5 presents the calculated buffer distances to satisfy the respective criteria.

Table 7-5 Buffer Distances for Vertical Well Drilling

Height	Time Period	Criteria (dBA)	Mitigation - Barrier				
			0m	3m	4m	5m	5m
Setback[1]			Nil	10m	10m	10m	5m
Receivers 1-15	Day – Standard Hours	53	240m	80m	60m	50m	<50m
	Day – Outside Standard Hours	38	1100m	400m	300m	240m	200m
	Night	30	>2000m	2000m	1800m	1400m	450m
Receivers 16-19	Day – Standard Hours	46	500m	180m	140m	120m	90m
	Day – Outside Standard Hours	35	1400m	550m	450m	350m	260m
	Night	29	>2000m	>2000m	2000m	1500m	500m

Note: 1. Setback of barrier from the source.

We recommend that if a plant is to be located near to the above buffer distances that further investigation should be undertaken. The need for further investigation could be negated by

selecting mitigation that exceeds the specified requirement for the given distance between source and receiver.

If the receiver is significantly above the source then the performance of noise barriers could be significantly compromised and as such we recommend further investigation if this scenario exists and the distance between source and receiver is less than 100m. Outside this distance the selection of higher barriers located more closely to the source should sufficiently attenuate noise from the vertical well rig.

7.5 Construction of Gas Pipelines

For construction of the gas pipelines, given the amount of construction work required, the likely duration and the distance to the nearest receivers, a qualitative assessment of impacts is warranted in accordance with the *Interim Construction Noise Guideline* (ICNG).

The following are construction plant items that we envisage will be used, and typical sound pressure levels at 7m.

- Excavator 84dBA
- Truck 83dBA

These plant items will be audible at receivers surrounding the works, and will likely exceed noise management levels. None of the equipment anticipated to be required during construction is listed as "annoying" in the ICNG, nor does it exhibit any characteristics (such as tonality or impulsiveness) that would warrant such a distinction.

We recommend the following measures be adopted to minimise noise impacts during construction:

- Work should be limited to the DECCW's standard construction hours, namely
    - 7.00am to 6.00pm Monday to Friday
    - 8.00am to 1.00pm Saturday
    - No work on Sundays or public holidays
- Potentially affected residences (i.e. within 300m of the works) should be contacted and notified of the works and their anticipated duration.

With the implementation of the above measures we consider that noise emissions during construction of the pipelines will not adversely impact neighbouring receivers.

7.6 Construction Vehicles on Access Roads

At this stage the locations of access routes to each of the well and extraction plant sites is unknown. Given the infrequent nature of vehicle noise from these access routes and the duration of construction, a qualitative assessment of impacts is warranted in accordance with the *Interim Construction Noise Guideline* (ICNG).

The most intensive use of access roads will occur at shift change times and during the delivery of heavy equipment.

We recommend the following measures be adopted to minimise noise impacts during

construction.

- The delivery of heavy equipment and materials should, wherever possible, be scheduled to occur during the less sensitive daytime period.
- The location of access roads should, wherever possible, be selected to maximise distance and topographic shielding from surrounding receivers.
- Potentially affected residences (i.e. within 300m of the route) should be contacted and notified of the works and their anticipated duration. Specific notification of heavy vehicle movements outside the daytime period is advised.

With the implementation of the above measures we consider that noise emissions from vehicles accessing the site will not adversely impact neighbouring receivers.

8 CONSTRUCTION MITIGATION MEASURES

Our assessment has identified the need for mitigation measures to be adopted during construction for this project. In particular, temporary noise barriers have been modelled and are proposed to be implemented around several of the well sites. This section of the report details further potential noise mitigation options and their anticipated effect on noise emissions.

In general, management of noise requires attention to the following:

- construction hours;
- noise monitoring on site and at sensitive receivers;
- training and awareness;
- communication;
- incident and emergency response; and
- non-conformance, preventative and corrective action.

Where appropriate the specific noise mitigation measures could include the following:

- orienting equipment away from sensitive receivers;
- using noise source controls, such as the use of residential class mufflers, to reduce noise from all plant and equipment including cranes , excavators and trucks;
- selecting plant and equipment based on noise emission levels;
- using alternative construction methods to minimise noise levels;
- providing alternative arrangements with affected residents such as temporary relocation; and
- using spotters, closed circuit television monitors, “smart” reversing alarms, or “quacker” type reversing alarms in place of traditional reversing alarms.

Education and training of site staff is necessary for satisfactory implementation of noise mitigation measures. Education and training strategies should focus on:

- site awareness training / environmental inductions that include a section on noise mitigation techniques / measures to be implemented throughout the project;
- ensuring work occurs within approved hours;
- locating noisy equipment away from sensitive receivers;
- orienting directional noise emitters away from sensitive receivers;
- using noise screens for mobile plant and equipment;
- ensuring plant and equipment is well maintained and not making excessive noise; and
- turning off machinery when not in use.

For noise mitigation measures that result in a direct reduction in noise level, indicative noise reductions that can potentially be achieved by these measures, subject to the type and number of equipment and intensity of construction activities, are shown in Table 8-1. Other measures

that also provide significant benefits are listed in Table 8-2. It is recommended that these be considered in preparation of a construction noise management plan prior to commencing works on site.

Table 8-1 Measures to Reduce Construction Noise Levels

Management Measure	Potential Noise Reduction, dBA
Administrative Controls	
Turning off machinery when not in use	0-5
Engineering Controls	
Screen or enclosure for stationary equipment	10-15
Orienting equipment away from sensitive receivers.	3-9
Using noise source controls, such as the use of residential class mufflers, to reduce noise from all plant and equipment including bulldozers, cranes, graders, excavators and trucks	5-10
Selecting site access points and roads as far as possible away from sensitive receivers	3-6
Employ non noise-generating structures such as site offices, storage sheds, stockpiles and tanks as noise barriers	5-10

Table 8-2 Other Measures to Mitigate Construction Noise Impacts

Management Measure
Administrative Controls
Operate during approved hours
Undertake regular noise monitoring to determine the impact of operating plant on sensitive receivers
Appropriate training of onsite staff
Undertake community consultation and respond to complaints in accordance with established project procedures
Engineering Controls
Using spotters, closed circuit television monitors, “smart” reversing alarms, or “squawker” type reversing alarms in place of traditional reversing alarms to minimise the intrusiveness of reversing alarms

9 CONCLUSION

Wilkinson Murray has conducted an assessment of operational and construction noise associated with the extraction of goaf gas from Longwall 35 at BHPBIC's West Cliff Mine near Appin, NSW.

Assessment has been conducted in general accordance with the DECCW's *Industrial Noise Policy* and *Interim Construction Noise Guideline*.

Noise levels from goaf gas drainage plants are predicted to be acceptable without the provision of specific noise mitigation.

Drilling of MRD 35-7 is predicted to exceed relevant criteria, especially during the night time period. 5m high, temporary noise barriers were modelled around this site and noise levels are predicted to be acceptable with this mitigation.

Noise emissions from many vertical wells sites are predicted to exceed management levels at surrounding receivers. Temporary noise barriers of varying heights and setbacks were investigated. Section 7.4 details the specifications of these barriers. With the inclusion of the temporary noise barriers, noise criteria are predicted to be satisfied at all surrounding receivers during standard construction hours. Drilling from all vertical well sites during the evening and night time periods (outside standard hours) is predicted to exceed relevant criteria and is therefore not recommended. Similarly most well sites are predicted to exceed relevant criteria outside standard construction hours during the daytime (i.e. weekends and public holidays); however vertical well 35-3 is predicted to produce acceptable noise levels during these times and work could be permitted to occur at this location.

Contingency areas for wells and extraction plants have been assessed by specifying buffer distances, outside which noise levels are predicted to be acceptable. We recommend that if a plant or well is to be located near to the buffer distances from sensitive receivers, further investigation should be undertaken. The need for further investigation could be negated by selecting mitigation that exceeds the specified requirement for the given distance between source and receiver. Similarly further investigation is warranted if a receiver is significantly elevated relative to the source, as this situation would reduce the attenuation provided by barriers.

Noise emissions from the construction of pipelines and also from access roads were assessed qualitatively. On the basis of available information we consider that noise emissions from these sources will be acceptable.

In addition to the specific mitigation measures detailed in this report, we recommend that the general construction mitigation measures discussed in Section 8 be considered and, wherever possible, implemented.

Wilkinson Murray understands that DoP have included an approval condition permitting construction to occur outside permitted hours if noise agreements have been established with potentially receivers. Wherever such agreements have been established to the satisfaction of DoP, then the noise goals outlined in this report need not be achieved to permit works outside standard construction hours.

Note

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Quality Assurance

We are committed to and have implemented AS/NZS ISO 9001:2008 "Quality Management Systems – Requirements". This management system has been externally certified and Licence No. QEC 13457 has been issued.

AAAC

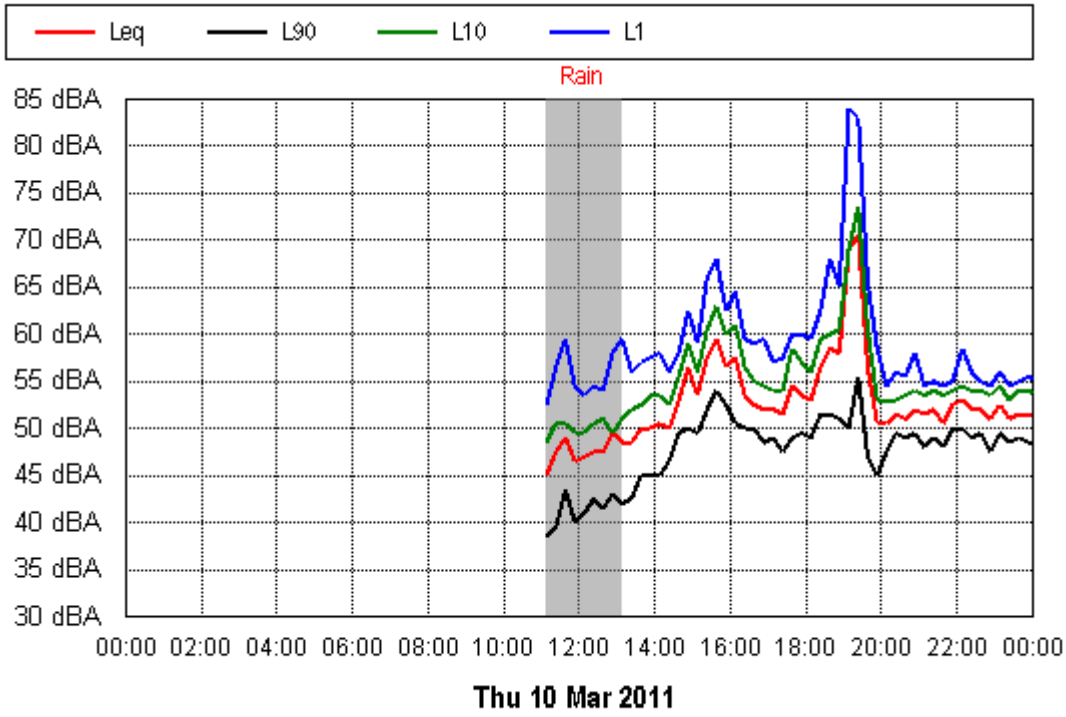
This firm is a member firm of the Association of Australian Acoustical Consultants and the work here reported has been carried out in accordance with the terms of that membership.

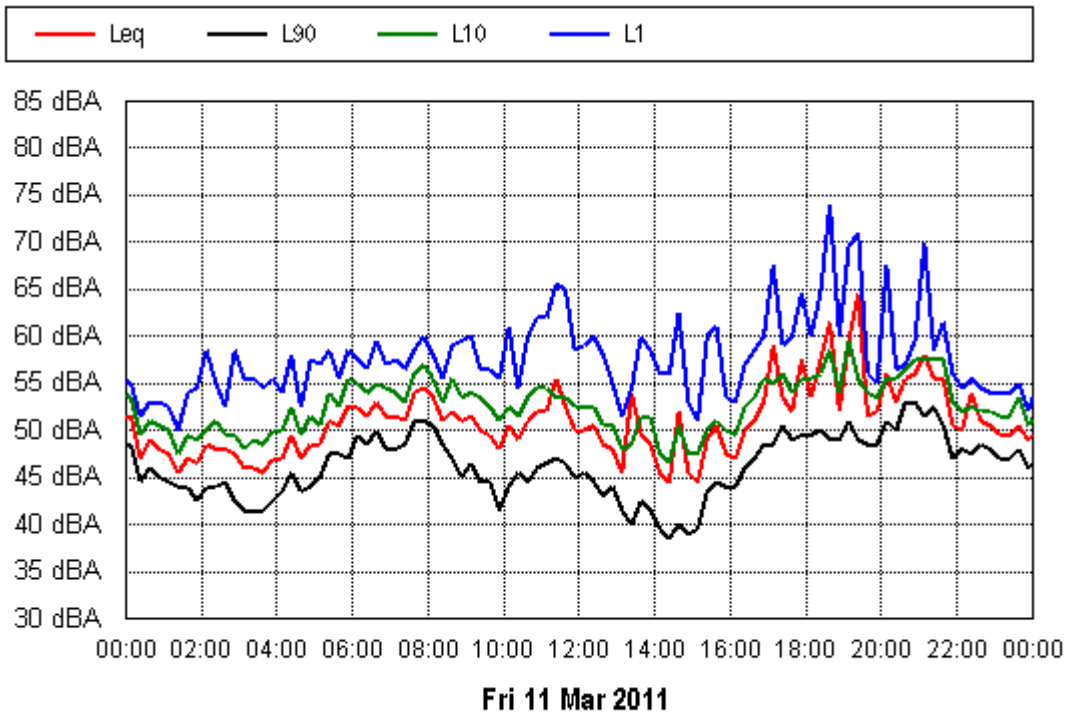
Version	Status	Date	Prepared by	Checked by
A	Final	4 May 2011	Adam Bioletti	Rob Bullen
B	Revised Final	5 May 2011	Adam Bioletti	

APPENDIX A

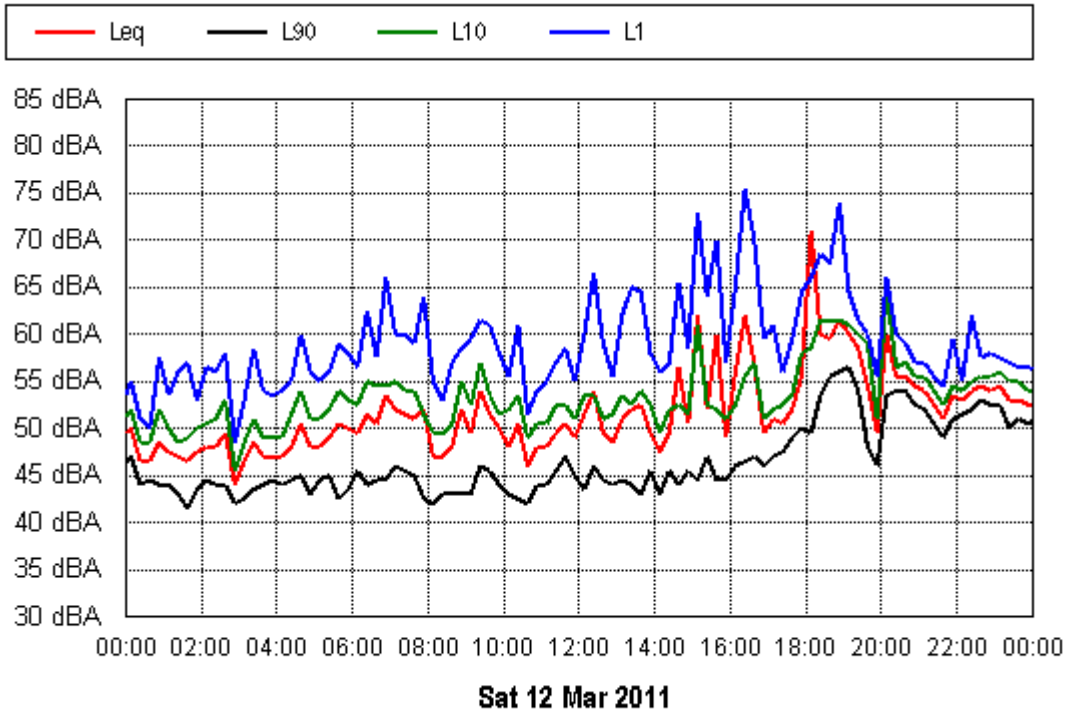
NOISE MEASUREMENT RESULTS

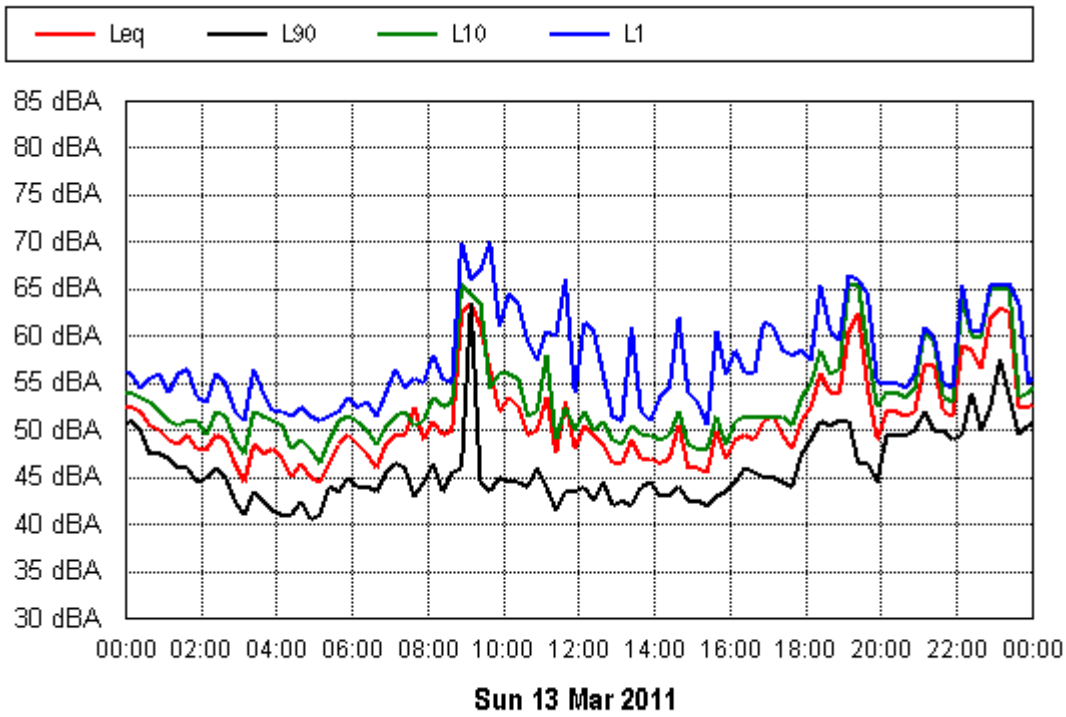
Project: 11041 West cliff Area 5
Location: A. 371 Appin Road
Filter: A
Criterion:



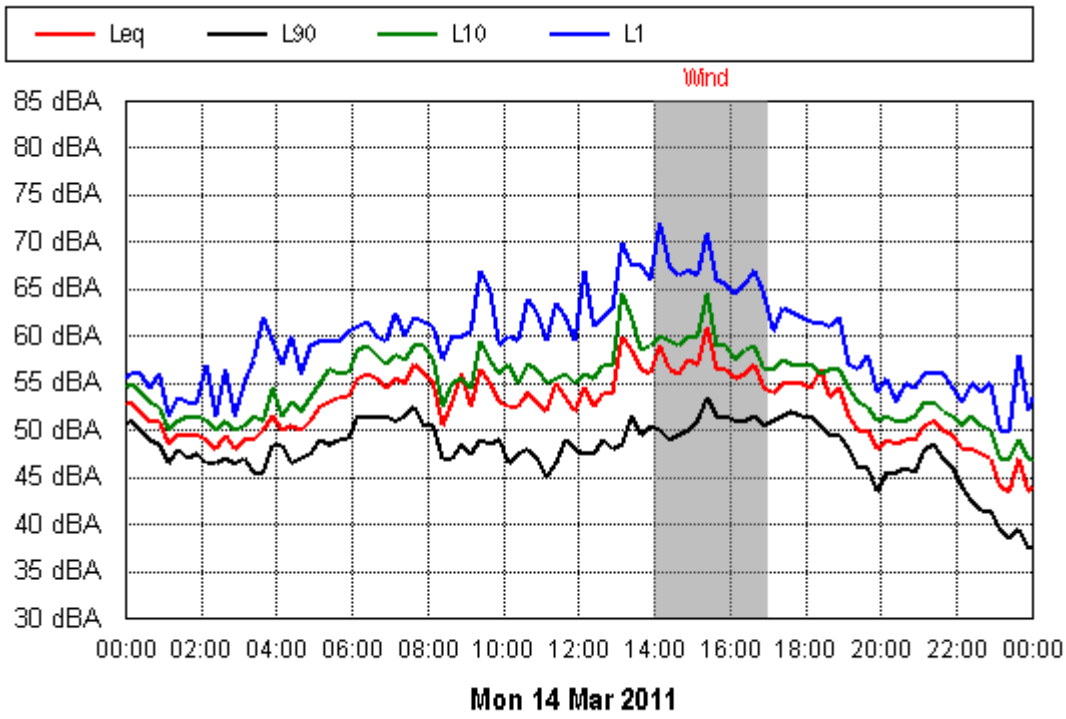


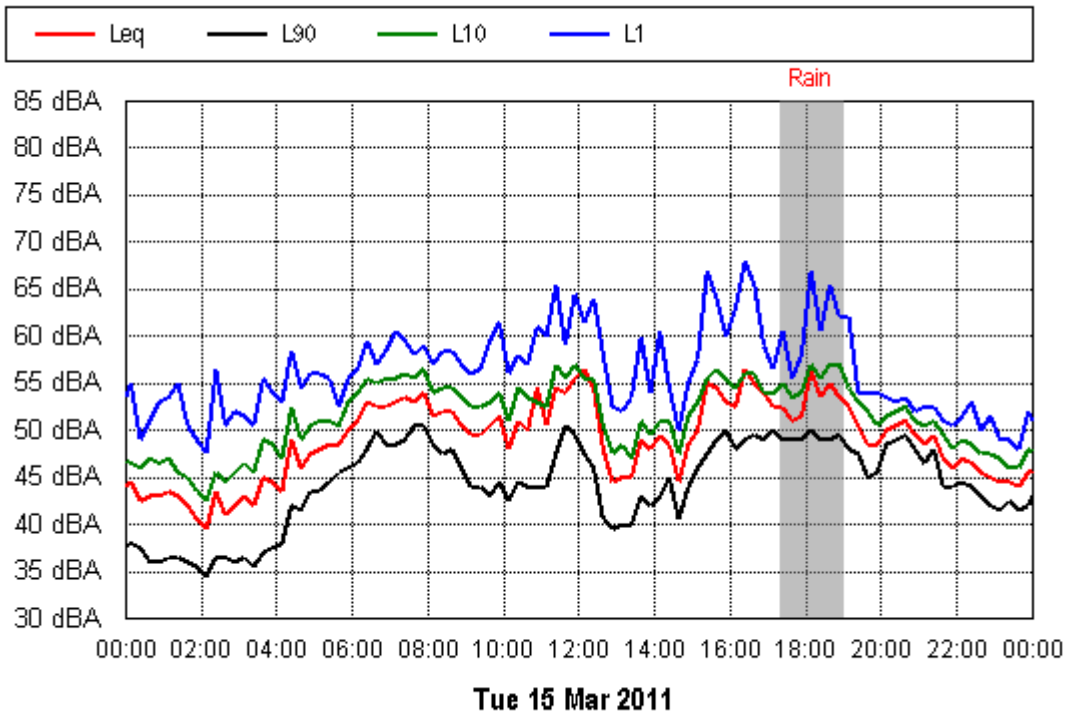
Project: 11041 West cliff Area 5
Location: A. 371 Appin Road
Filter: A
Criterion:



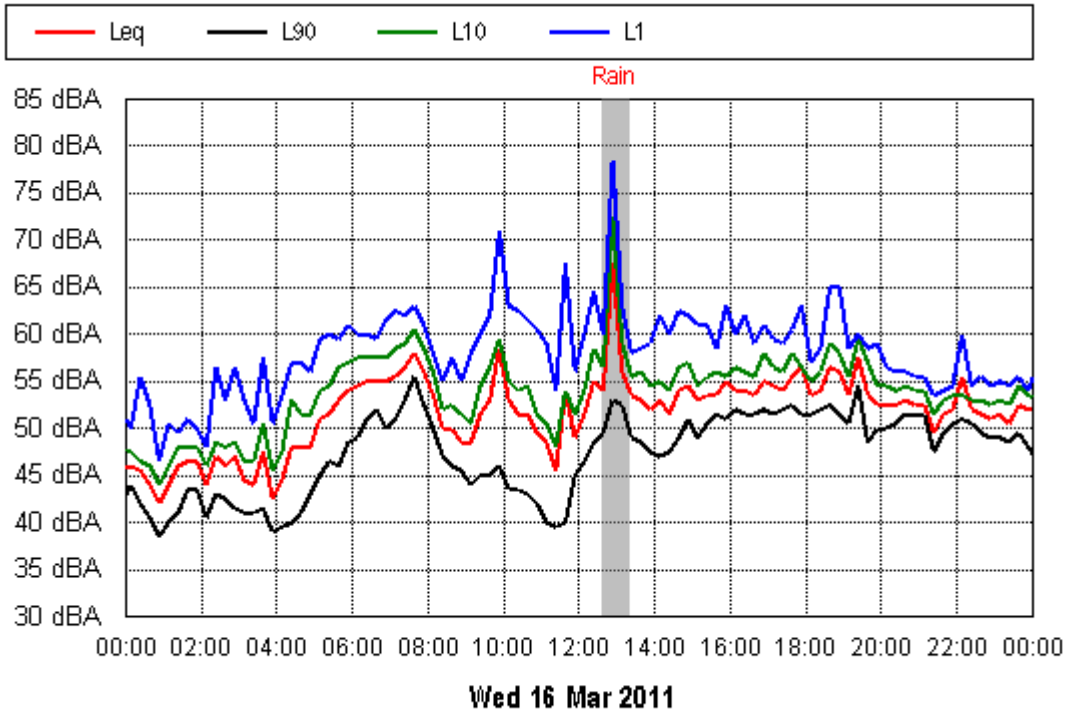


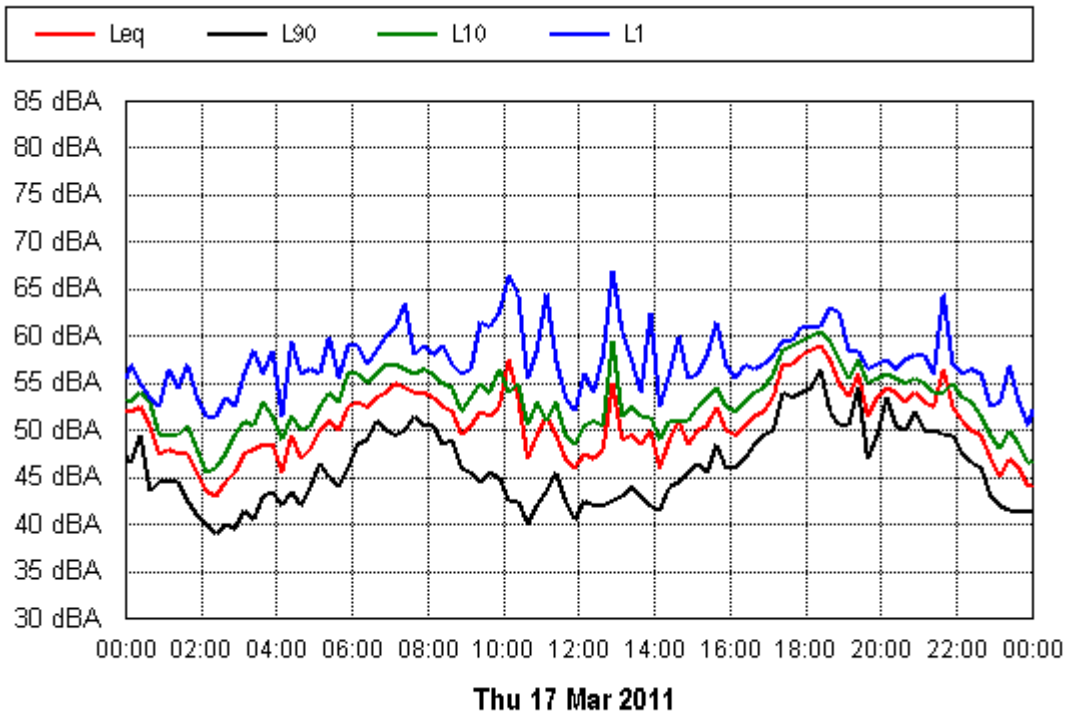
Project: 11041 West cliff Area 5
Location: A. 371 Appin Road
Filter: A
Criterion:



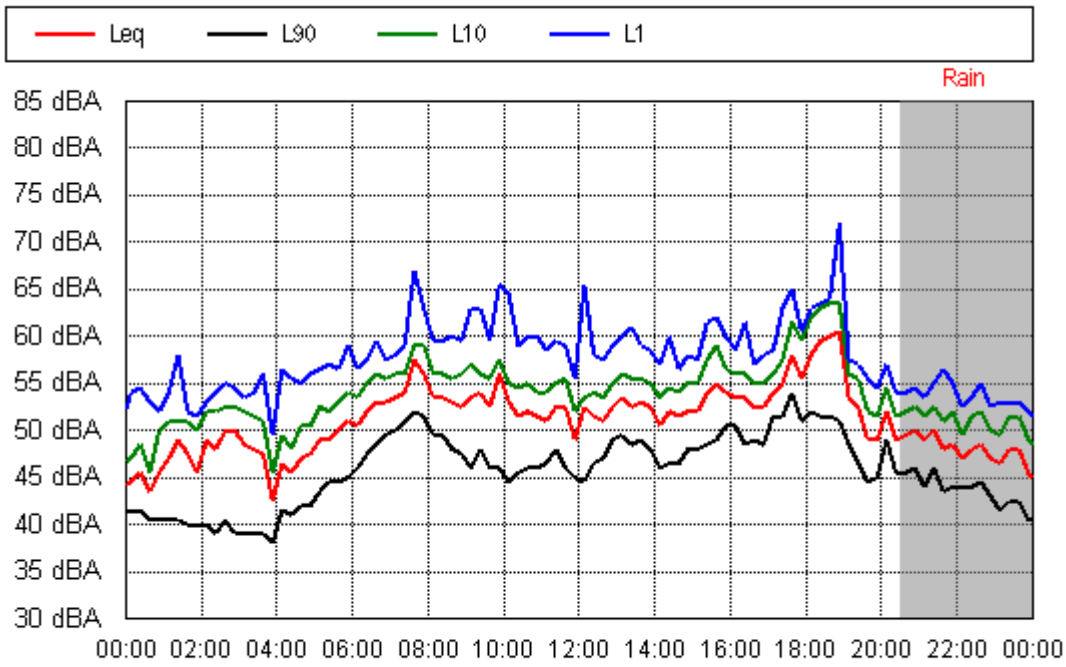


Project: 11041 West cliff Area 5
Location: A. 371 Appin Road
Filter: A
Criterion:

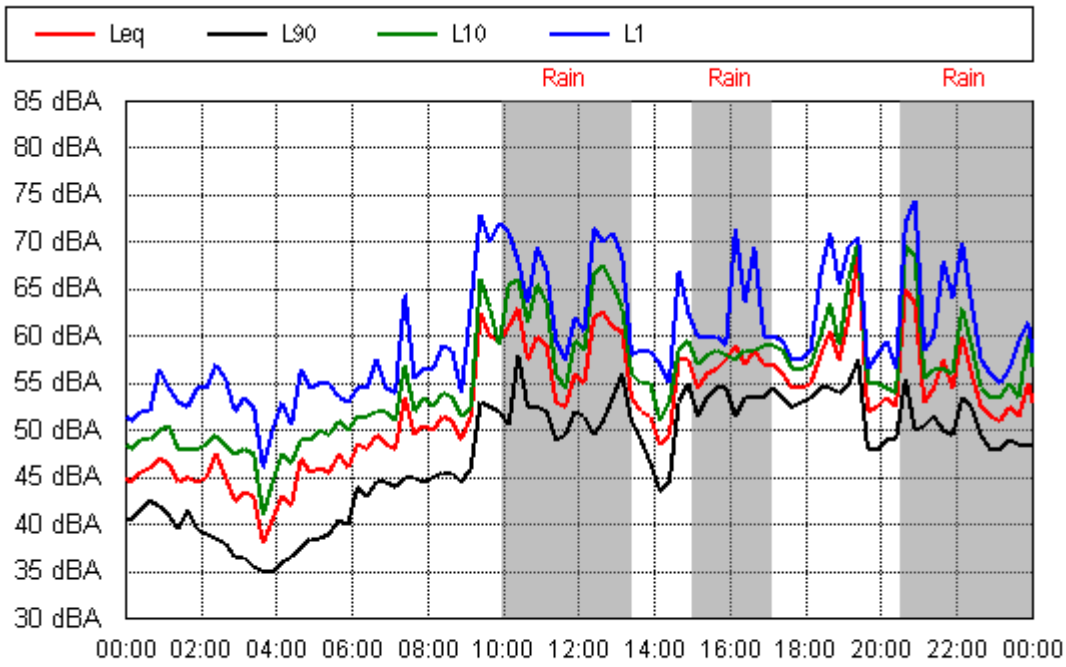




Project: 11041 West cliff Area 5
Location: A. 371 Appin Road
Filter: A
Criterion:

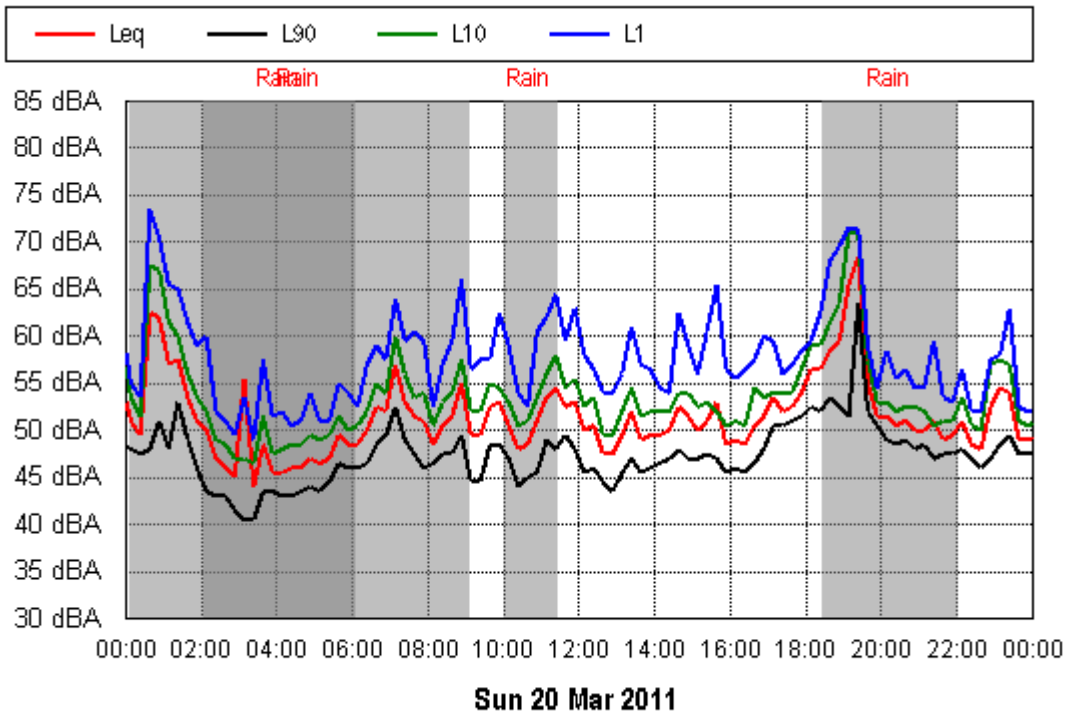


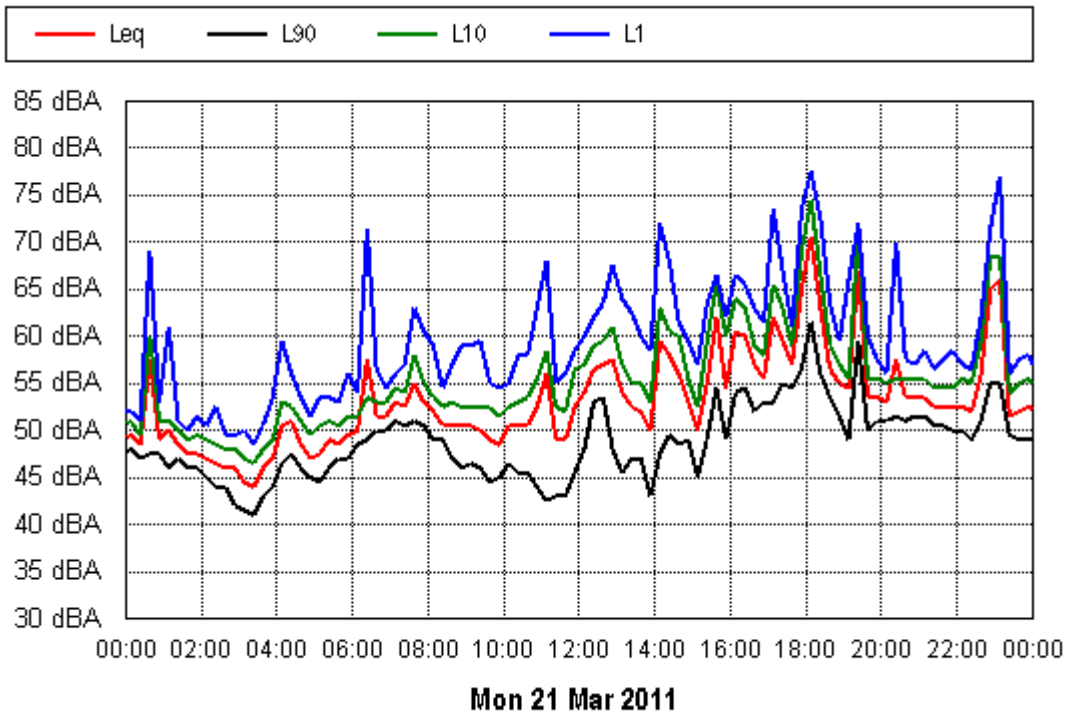
Fri 18 Mar 2011



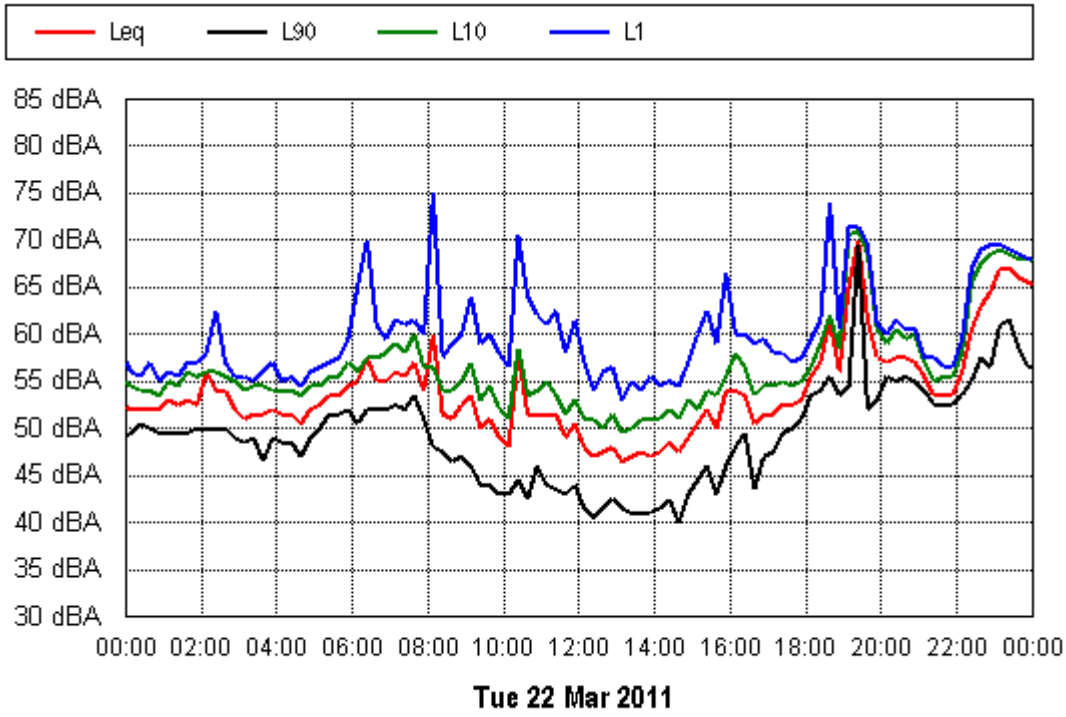
Sat 19 Mar 2011

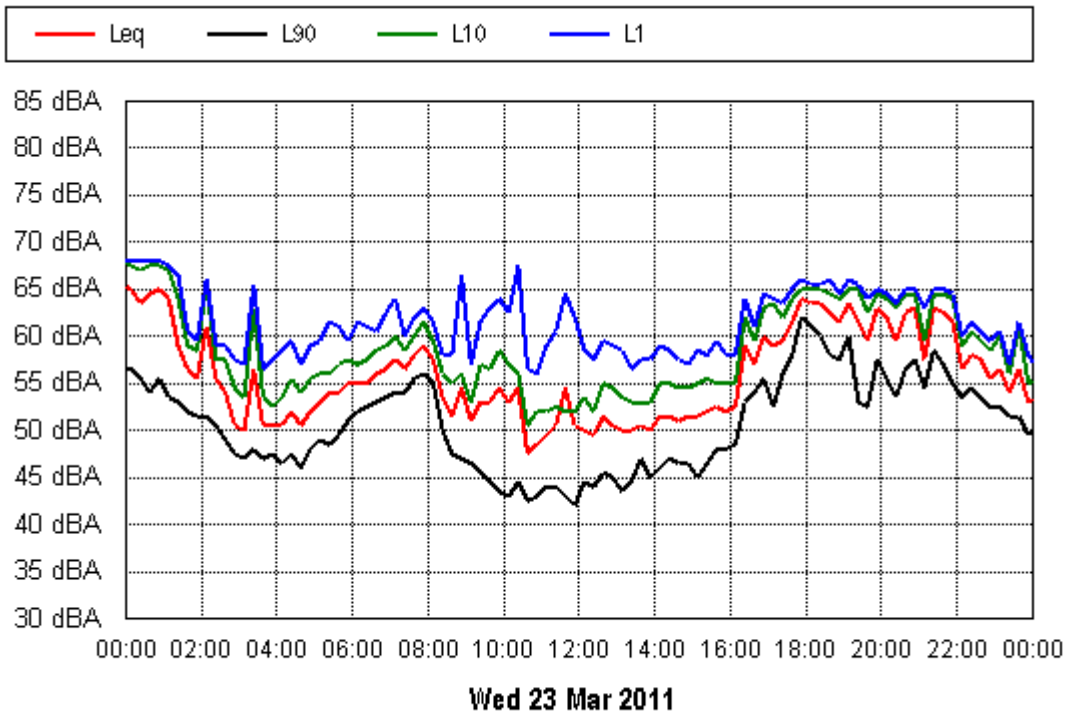
Project: 11041 West cliff Area 5
Location: A. 371 Appin Road
Filter: A
Criterion:



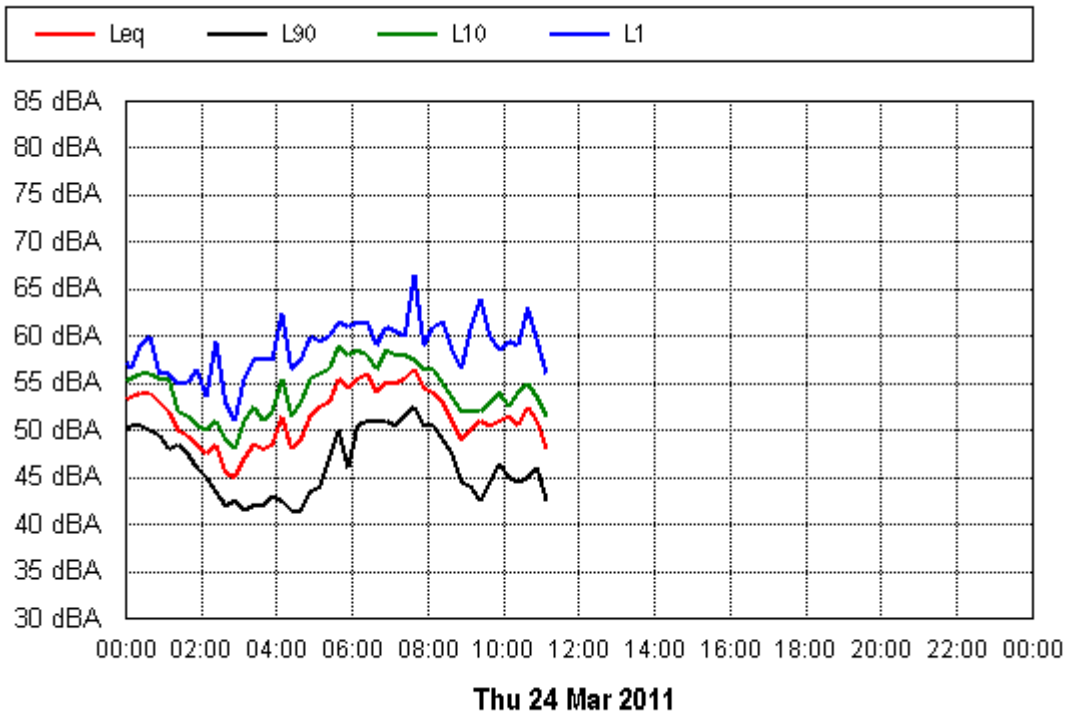


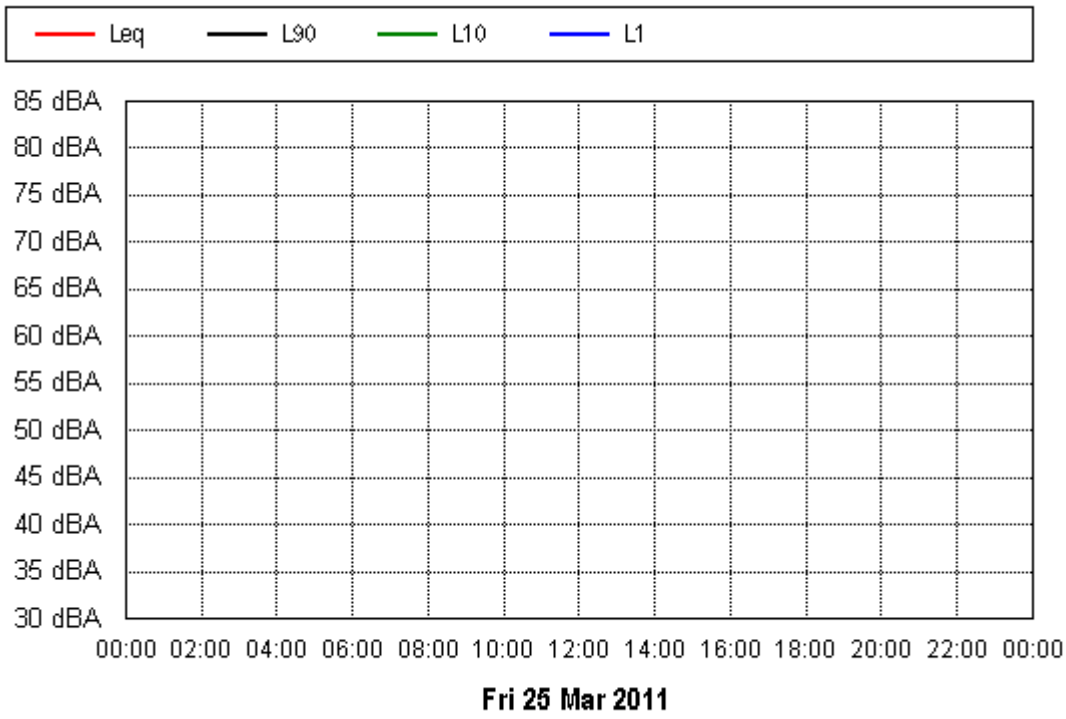
Project: 11041 West cliff Area 5
Location: A. 371 Appin Road
Filter: A
Criterion:



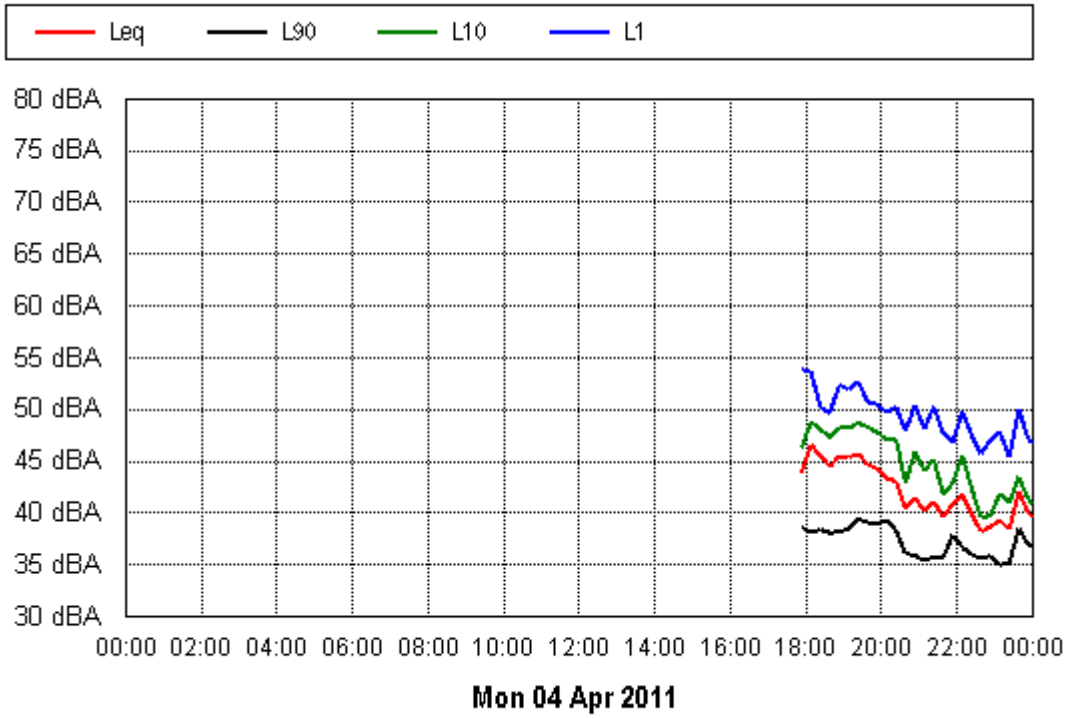


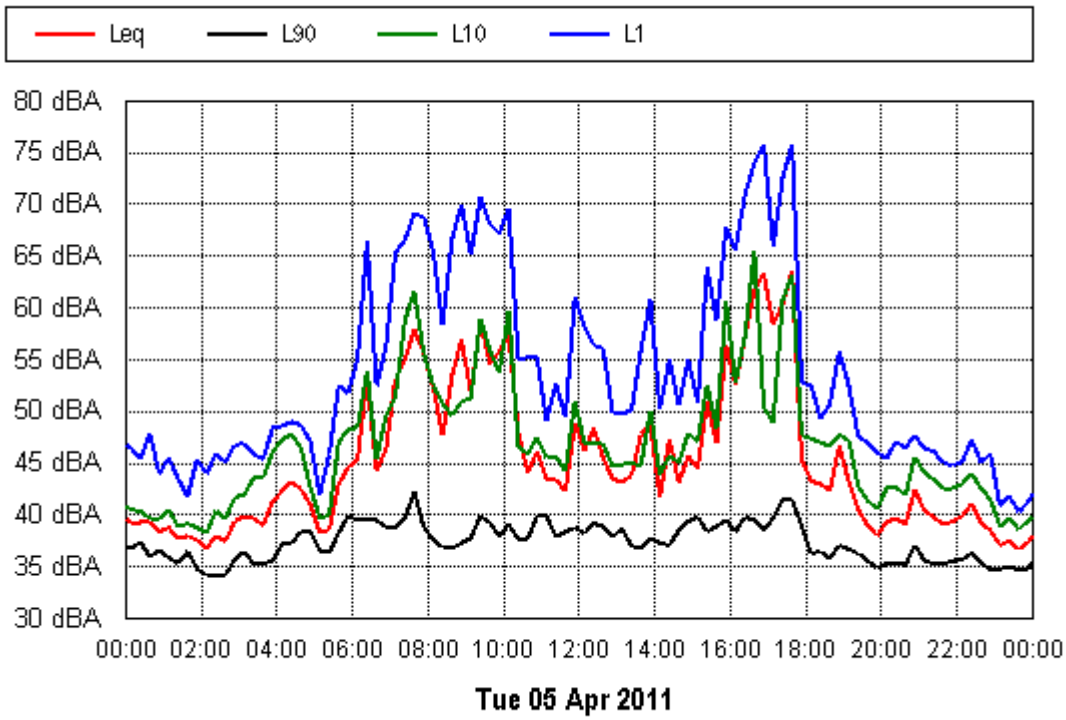
Project: 11041 West cliff Area 5
Location: A. 371 Appin Road
Filter: A
Criterion:



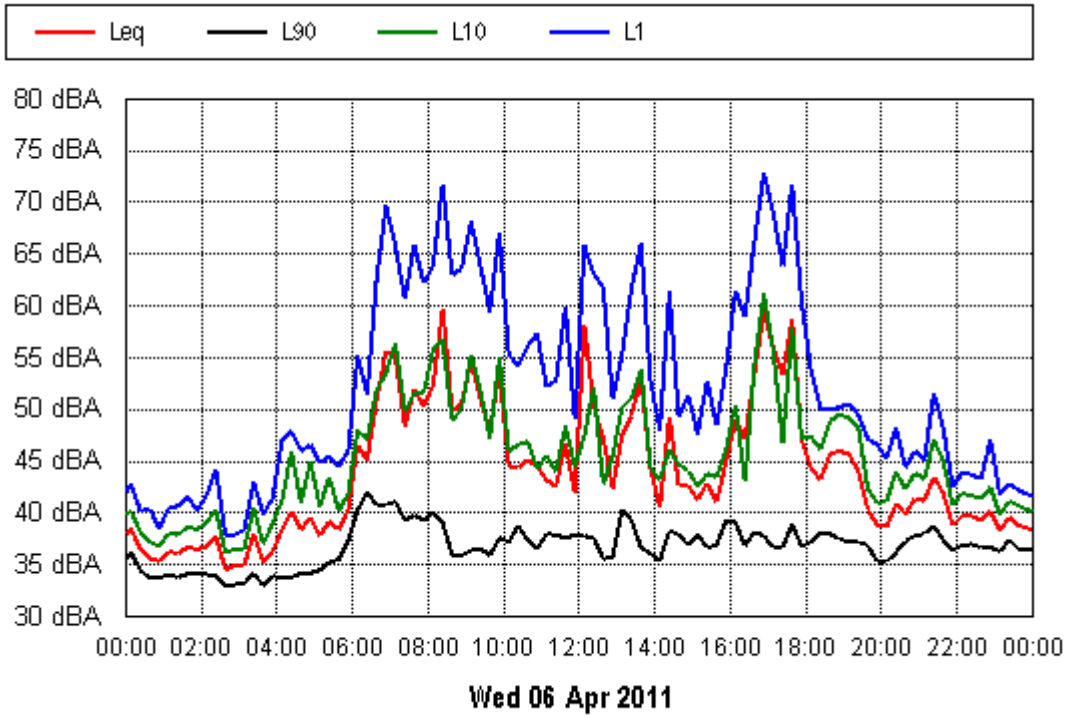


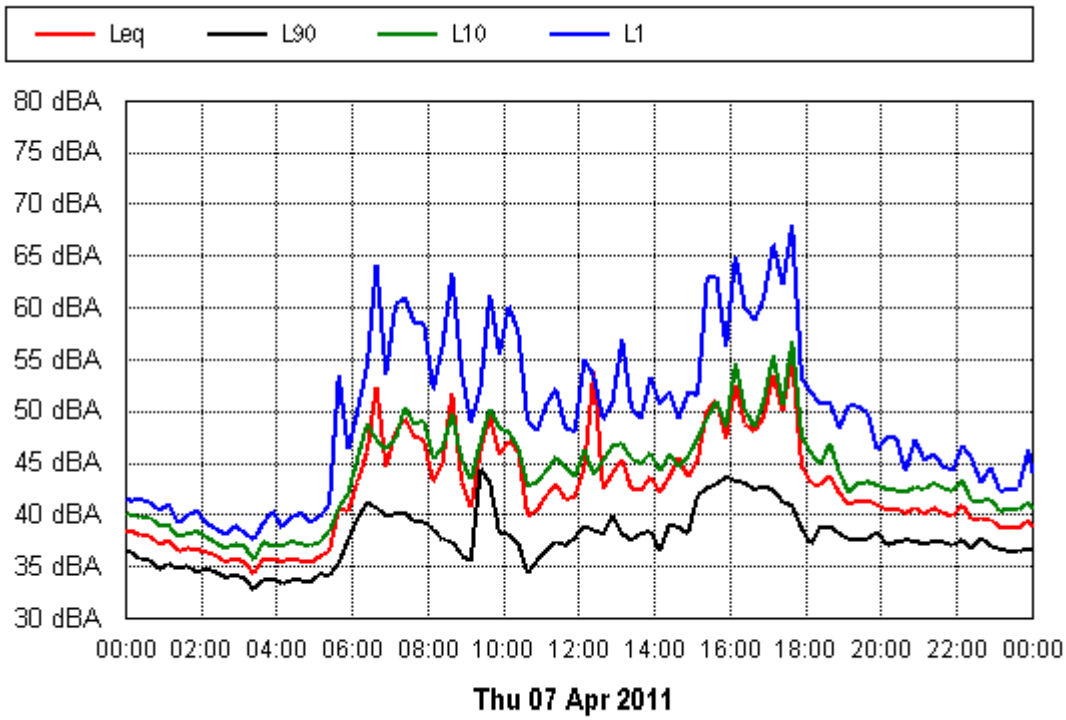
Project: 11041 West Cliff Area 5 Surface
Location: B. Mitchells Property
Filter: A
Criterion:



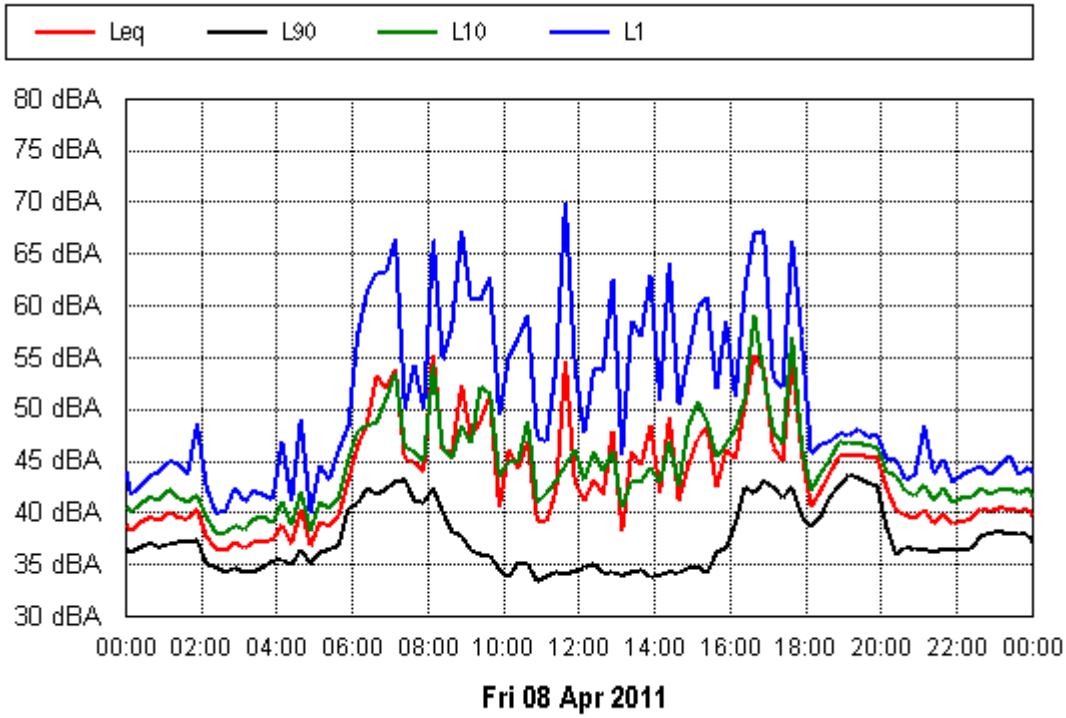


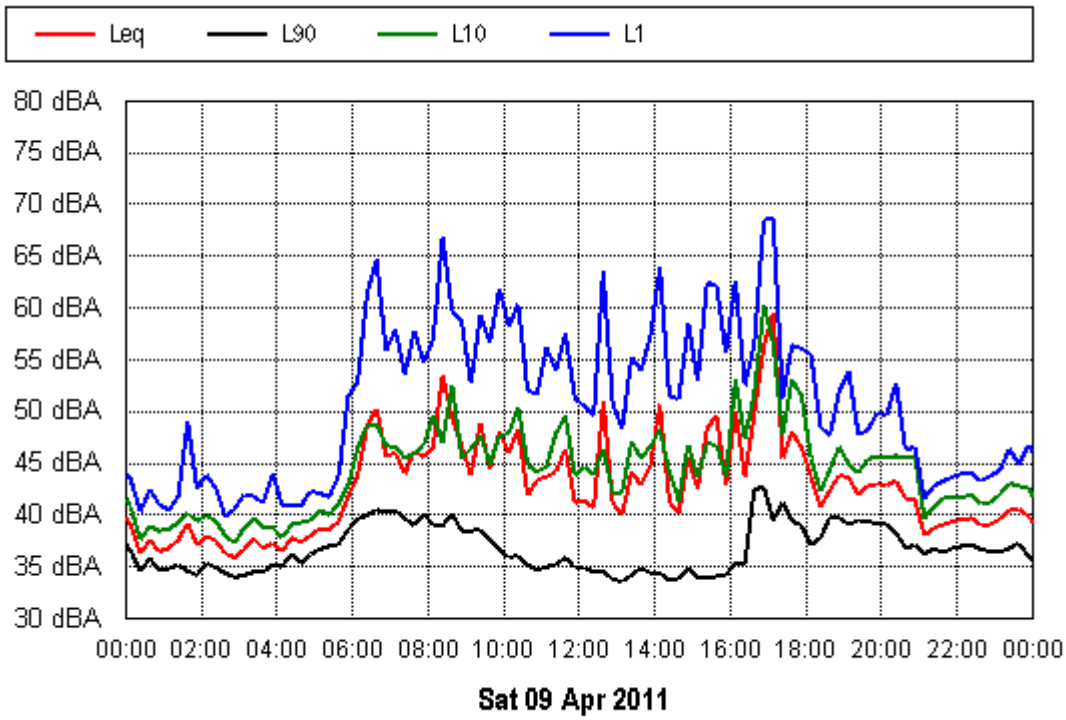
Project: 11041 West Cliff Area 5 Surface
Location: B. Mitchells Property
Filter: A
Criterion:



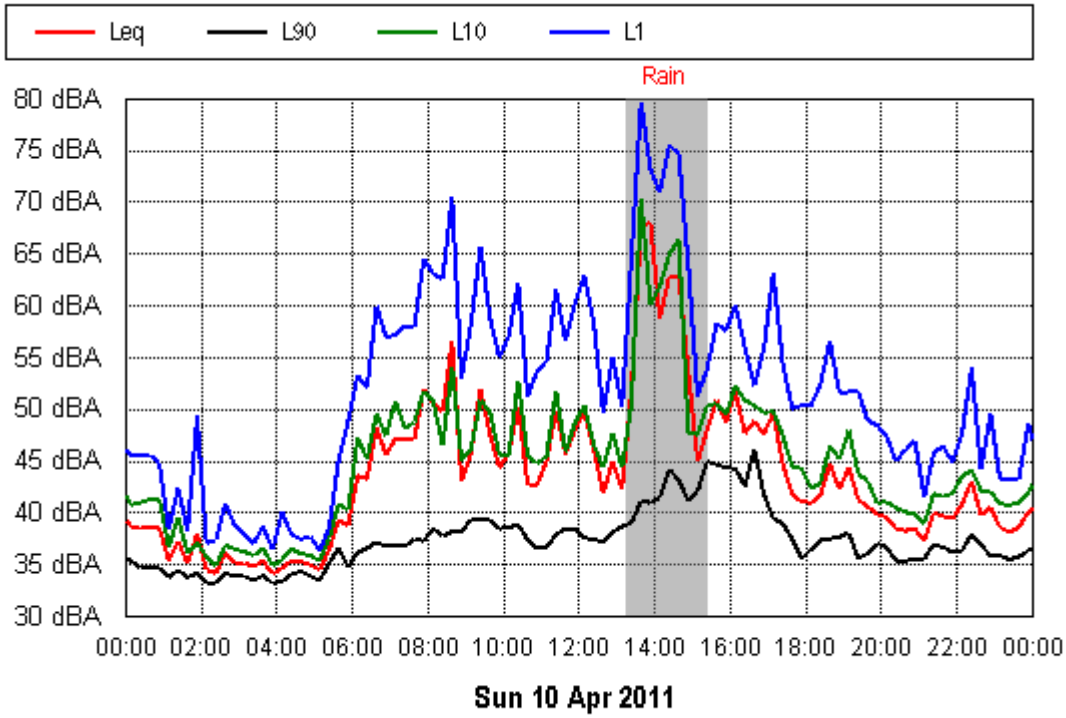


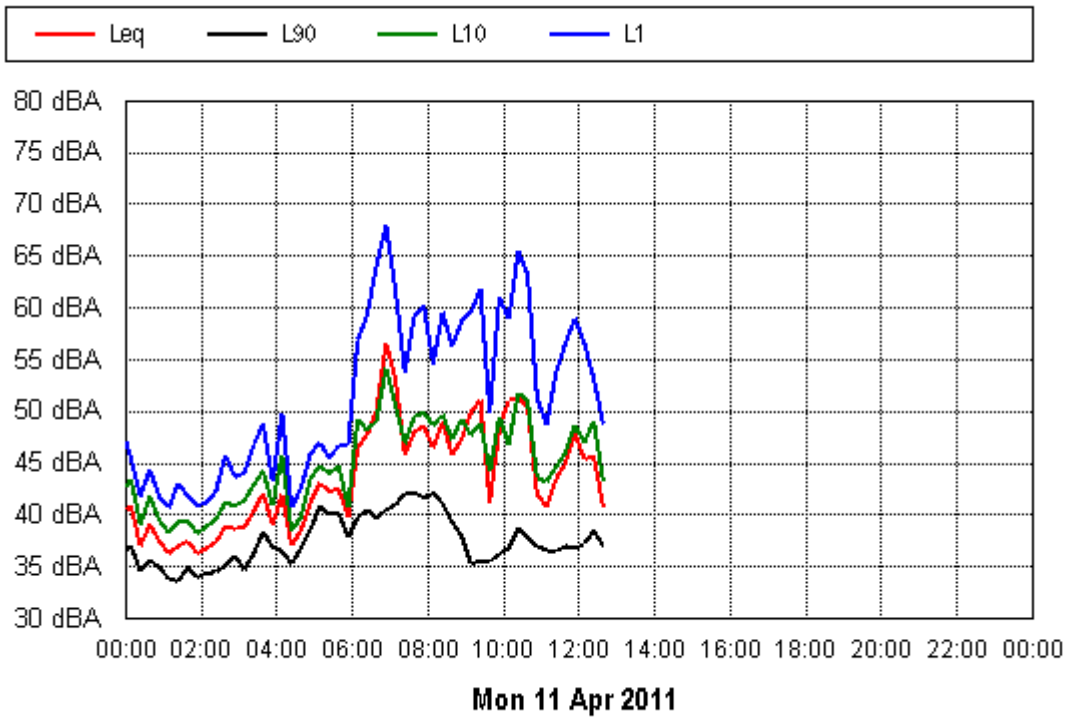
Project: 11041 West Cliff Area 5 Surface
Location: B. Mitchells Property
Filter: A
Criterion:





Project: 11041 West Cliff Area 5 Surface
Location: B. Mitchells Property
Filter: A
Criterion:





APPENDIX B

GOAF NOISE PREDICTION RESULTS

Table 9-1 Summary of GOAF 34-1 Predicted Receiver Levels with No Mitigation Measures

No.	Predicted Level (dBA)												Criteria (dBA)		
	Autumn			Spring			Summer			Winter					
	Day	Evening	Night	Day	Evening	Night	Day	Evening	Night	Day	Evening	Night	Day	Evening	Night
1	16	16	17	12	16	16	14	12	13	15	16	17	48	45	40
2	26	26	27	25	26	26	25	25	25	27	28	27			
3	25	25	25	25	25	25	24	24	25	25	26	26			
4	21	21	22	20	21	21	19	20	20	23	23	23			
5	18	18	20	18	18	18	18	18	18	20	21	20			
6	20	20	21	18	20	20	18	18	18	22	22	22			
7	18	18	19	18	18	18	18	18	18	19	19	19			
8	19	19	20	19	19	19	19	19	19	20	20	20			
9	24	24	24	24	24	24	24	24	24	24	25	24			
10	20	20	20	20	19	20	19	19	19	22	23	20			
11	20	20	19	20	20	20	19	19	20	22	22	19			
12	17	17	16	17	17	17	17	17	17	20	20	16			
13	14	14	13	14	14	14	14	14	14	16	16	13			
14	14	14	12	15	14	14	14	14	14	17	17	13			
15	13	13	11	14	13	13	13	13	13	16	15	11	41	41	39
16	13	13	14	13	13	12	13	13	13	11	13	13			
17	13	14	15	13	14	13	14	13	13	11	13	14			
18	33	33	33	33	33	33	34	33	33	32	33	32			
19	26	27	25	27	26	25	28	25	27	25	25	23			

Table 9-2 Summary of GOAF 35-3 Predicted Receiver Levels with No Mitigation Measures

No.	Predicted Level (dBA)												Criteria (dBA)		
	Autumn			Spring			Summer			Winter					
	Day	Evening	Night	Day	Evening	Night	Day	Evening	Night	Day	Evening	Night	Day	Evening	Night
1	25	24	25	23	24	25	23	23	23	25	26	26	48	45	40
2	14	14	14	14	14	14	14	14	14	15	16	14			
3	14	14	13	14	14	14	13	13	14	16	16	13			
4	12	12	12	12	12	12	12	11	12	13	14	13			
5	10	10	10	10	10	10	10	10	10	11	12	11			
6	10	10	10	10	10	10	10	10	10	11	11	10			
7	10	10	10	10	10	10	10	10	10	11	12	10			
8	13	13	12	13	13	13	13	12	13	16	16	12			
9	11	11	10	11	11	11	11	11	11	16	16	10			
10	9	9	7	10	9	9	9	9	9	13	13	7			
11	8	8	5	9	8	8	8	8	8	12	12	6			
12	8	8	5	9	8	8	8	8	8	12	11	6			
13	8	8	5	9	8	8	8	8	8	11	11	6			
14	8	8	5	10	8	8	8	8	8	13	11	7			
15	9	8	5	10	8	8	8	8	8	14	13	7	41	41	39
16	26	27	27	27	27	25	27	26	26	24	26	25			
17	30	31	31	31	31	29	31	30	30	28	30	29			
18	20	20	19	21	20	20	21	20	20	21	20	18			
19	21	20	17	22	19	19	22	19	20	22	20	15			

Table 9-3 Summary of GOAF 35-7 Predicted Receiver Levels with No Mitigation Measures

No.	Predicted Level (dBA)												Criteria (dBA)		
	Autumn			Spring			Summer			Winter					
	Day	Evening	Night	Day	Evening	Night	Day	Evening	Night	Day	Evening	Night	Day	Evening	Night
1	17	17	18	15	17	17	16	15	16	16	18	18	48	45	40
2	31	31	32	29	31	31	30	29	29	30	31	32			
3	31	31	32	30	31	31	30	30	30	31	32	32			
4	26	26	28	24	26	26	24	24	24	27	28	28			
5	25	25	26	24	25	25	24	24	24	26	27	27			
6	26	25	27	25	25	26	25	25	25	26	27	27			
7	25	25	26	24	25	25	24	24	24	26	26	26			
8	27	27	28	26	27	27	26	26	26	28	28	28			
9	30	30	30	30	30	30	29	29	30	31	32	31			
10	27	27	27	27	27	27	27	27	27	30	30	27			
11	32	32	32	32	32	32	32	32	32	33	33	32			
12	25	25	24	25	25	25	25	25	25	26	26	24			
13	24	24	23	24	24	24	24	24	24	26	25	23			
14	22	22	21	22	22	22	22	22	22	24	23	21			
15	23	22	19	23	22	22	22	22	22	24	23	19	41	41	39
16	12	14	15	14	14	10	16	13	13	8	12	10			
17	12	13	14	13	13	10	15	13	13	9	12	10			
18	25	26	25	26	25	25	26	25	25	25	25	24			
19	15	16	15	16	16	15	17	16	16	15	15	14			

APPENDIX C

MRD NOISE PREDICTION RESULTS

Table 9-4 Summary of MRD 35-7 Predicted Receiver Levels with No Mitigation Measures

No.	Predicted Level (dBA)												Criteria (dBA)	
	Autumn			Spring			Summer			Winter			Standard	Outside Standard
	Day	Evening	Night	Day	Evening	Night	Day	Evening	Night	Day	Evening	Night	Hours	Hours
1	36	36	39	31	36	36	35	32	33	33	37	38	53	47
2	53	53	54	51	53	53	52	51	51	52	53	54		
3	52	52	53	51	52	52	51	51	51	52	53	53		
4	48	47	49	45	48	48	45	45	46	48	49	49		
5	46	46	48	44	46	46	44	44	44	47	48	48		
6	46	46	48	45	46	46	45	45	45	47	48	48		
7	45	45	47	43	45	45	43	43	43	46	47	47		
8	47	47	49	46	47	47	46	46	46	48	49	49		
9	51	51	52	51	51	51	51	51	51	52	53	52		
10	48	48	48	48	48	48	48	47	48	51	51	48		
11	53	53	52	53	53	53	53	53	53	54	54	52		
12	46	46	45	46	46	46	46	46	46	47	47	45		
13	44	44	42	45	44	44	44	44	44	46	45	43		
14	43	42	40	43	42	42	42	42	42	44	43	40		
15	44	42	37	44	42	42	43	42	42	45	44	37	46	39
16	32	36	37	36	36	29	37	34	33	26	32	29		
17	32	37	38	37	37	30	38	33	33	26	32	30		
18	44	45	44	45	45	44	45	45	45	43	44	43		
19	28	30	28	30	29	28	30	29	29	28	28	27		

Table 9-5 Summary of MRD 35-7 Predicted Receiver Levels with Barrier (Height 5m, Setback 5m)

No.	Predicted Level (dBA)												Criteria (dBA)	
	Autumn			Spring			Summer			Winter			Standard	Outside Standard
	Day	Evening	Night	Day	Evening	Night	Day	Evening	Night	Day	Evening	Night	Hours	Hours
1	23	23	24	22	23	23	23	22	23	22	24	24	53	47
2	34	34	35	33	34	34	33	33	33	33	34	35		
3	34	34	35	34	34	35	34	34	34	35	35	35		
4	30	30	31	29	30	30	29	29	29	30	31	31		
5	31	31	32	31	31	31	31	31	31	31	32	32		
6	32	32	33	31	32	32	31	31	31	32	33	33		
7	32	32	33	31	32	32	31	31	31	32	33	33		
8	33	33	34	32	33	33	32	32	32	33	34	34		
9	33	33	33	33	33	33	32	32	33	34	34	33		
10	33	33	33	33	33	33	33	33	33	34	34	33		
11	36	36	35	36	35	36	36	35	36	36	36	35		
12	33	33	32	33	33	33	33	33	33	34	33	32		
13	31	31	30	31	31	31	31	31	31	32	32	30		
14	29	29	28	29	29	29	29	29	29	30	29	28		
15	28	27	26	28	27	27	27	27	27	29	28	26	46	39
16	32	36	37	36	36	29	37	34	33	26	32	29		
17	32	37	38	37	37	30	38	33	33	26	32	30		
18	24	25	25	25	25	24	26	25	25	24	24	24		
19	22	23	22	23	23	22	24	23	23	22	22	21		

APPENDIX D

VERTICAL WELL NOISE PREDICTION RESULTS

Table 9-6 Summary of Longwall 35 Vertical Well Predicted Receiver Levels without Mitigation

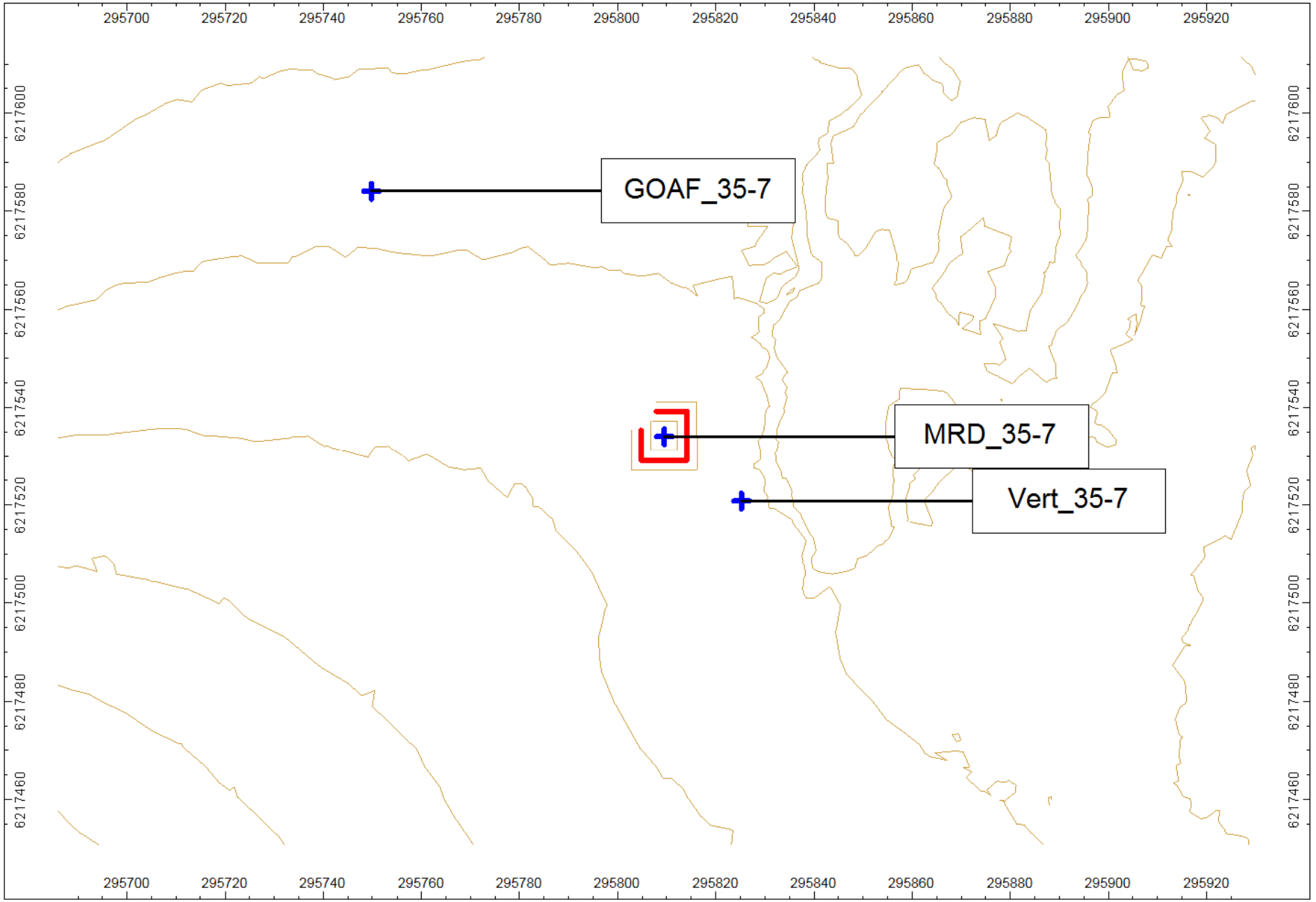
No.	Criteria (dBA)	Noise Level (dBA)											
		Vert 35-1	Vert 35-2	Vert 35-3	Vert 35-4	Vert 35-5	Vert 35-6	Vert 35-7	Vert 35-8	Vert 35-9	Vert 35-10	Vert 35-11	Vert 35-12
1	53	33	35	28	33	20	22	21	23	24	23	23	22
2		17	21	21	26	37	43	44	42	37	28	28	24
3		18	20	21	24	37	42	45	40	38	32	32	29
4		16	19	21	23	30	33	35	35	34	31	31	29
5		15	18	20	23	28	32	36	35	36	31	31	29
6		15	19	20	23	28	34	34	35	37	31	31	28
7		16	19	20	23	30	32	34	36	36	31	30	28
8		17	20	20	23	32	37	39	39	39	32	32	29
9		18	20	18	23	35	40	43	44	43	38	39	33
10		18	19	18	22	32	37	40	45	50	47	45	36
11		17	19	18	22	36	39	48	60	63	44	38	34
12		16	18	17	21	31	35	39	46	55	56	48	38
13		15	17	16	20	29	33	36	42	49	58	49	39
14		16	17	15	20	28	31	33	39	44	49	49	43
15		16	17	14	19	26	28	31	35	41	45	47	46
16	46	45	40	33	34	15	16	15	15	15	13	13	12
17		51	42	36	39	17	17	16	16	15	14	14	13
18		27	29	27	31	36	38	30	25	23	19	18	16
19		31	31	26	31	38	27	22	19	19	18	16	16

Table 9-7 Summary of Longwall 35 Vertical Well Predicted Receiver Levels with Mitigation

No.	Criteria (dBA)	Noise Level (dBA)											
		Vert 35-1	Vert 35-2	Vert 35-3	Vert 35-4	Vert 35-5	Vert 35-6	Vert 35-7	Vert 35-8	Vert 35-9	Vert 35-10	Vert 35-11	Vert 35-12
1	53	33	35	28	33	20	22	21	23	21	17	23	22
2		17	21	21	26	37	43	44	42	28	22	28	24
3		18	20	21	24	37	42	45	40	30	32	32	29
4		16	19	21	23	30	33	35	33	28	31	31	29
5		15	18	20	23	28	32	36	34	29	31	31	29
6		15	19	20	23	28	34	34	34	30	31	29	28
7		16	19	20	23	30	32	34	36	30	31	30	28
8		17	20	20	23	32	37	39	39	32	32	32	28
9		18	20	18	23	35	40	43	44	36	38	39	33
10		18	19	18	22	32	37	40	39	51	47	45	36
11		17	19	18	22	36	39	48	48	49	35	38	34
12		16	18	17	21	31	35	39	39	47	43	48	38
13		15	17	16	20	29	33	36	37	41	44	49	39
14		16	17	15	20	28	31	33	39	36	39	49	43
15		16	17	14	19	26	28	31	35	31	33	47	46
16	46	39	40	33	34	15	16	14	15	14	12	13	12
17		44	42	36	39	17	17	15	16	15	13	14	13
18		27	29	27	31	36	38	30	25	23	17	18	16
19		31	31	26	31	38	27	22	19	19	16	16	16

APPENDIX E

MRD NOISE BARRIER PLANS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295780
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295880
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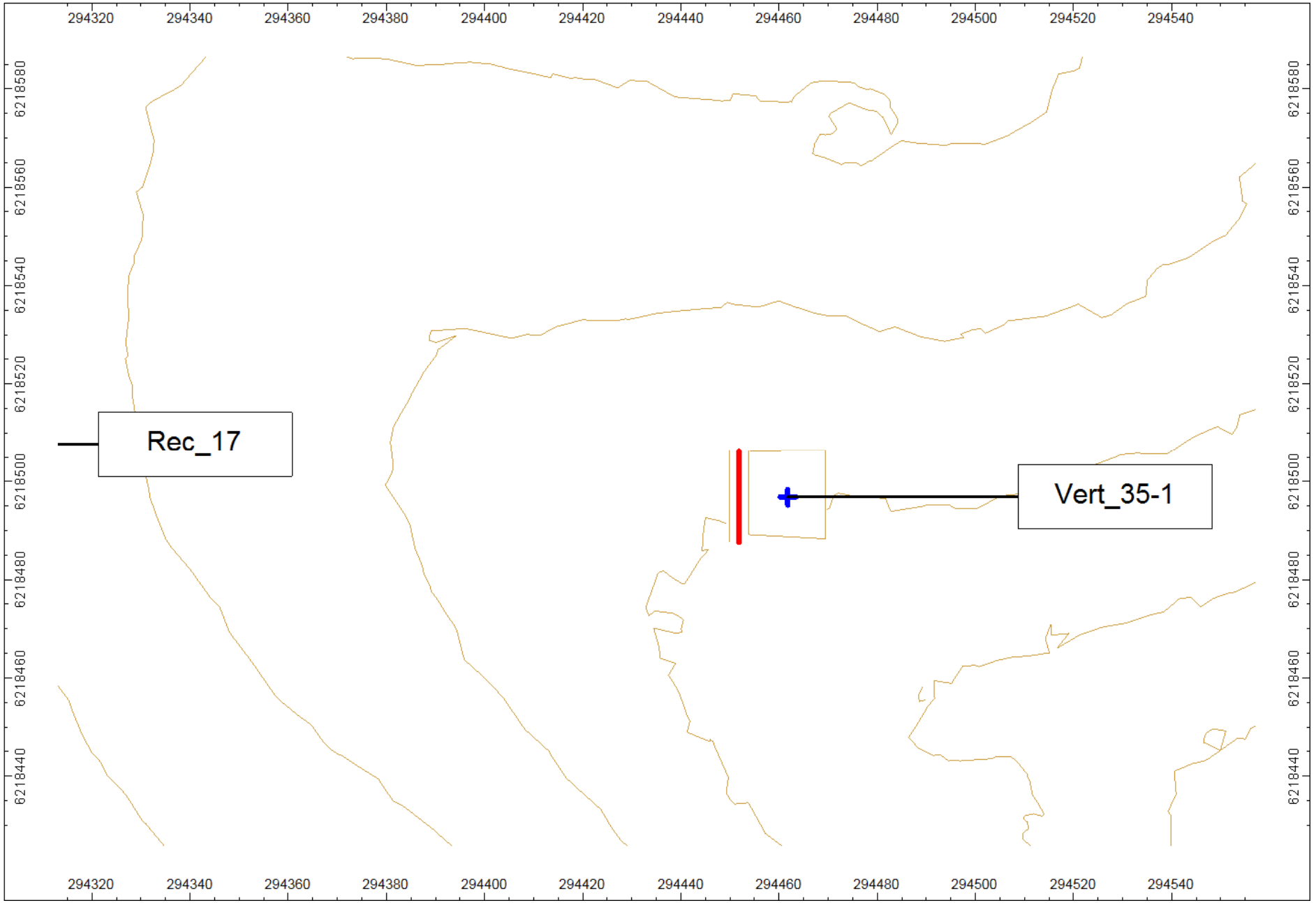
6217580
6217560
6217540
6217520
6217500
6217480
6217460
GOAF_35-7
MRD_35-7
Vert_35-7

APPENDIX F

VERTICAL WELL NOISE BARRIER PLANS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294500
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6218540
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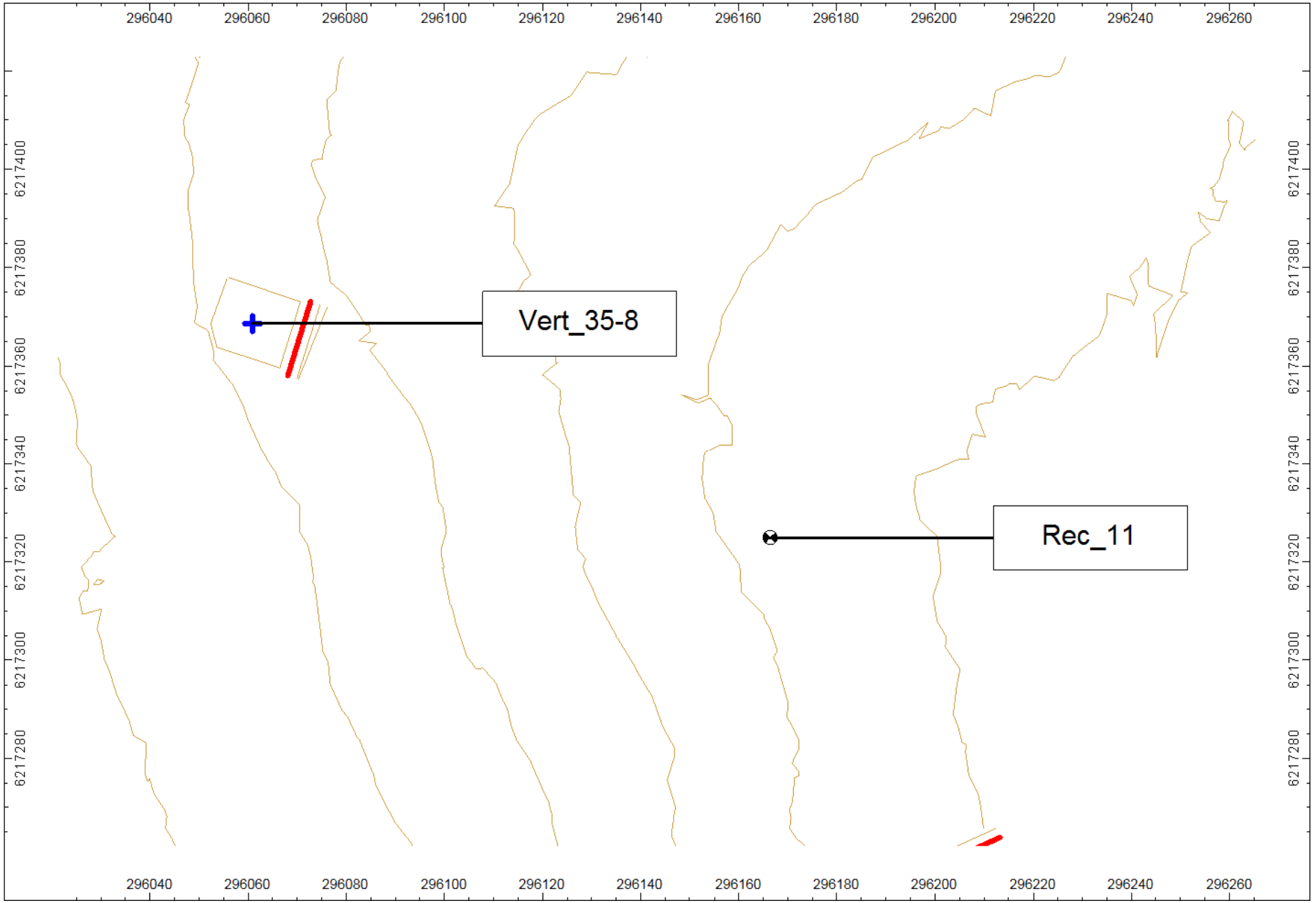
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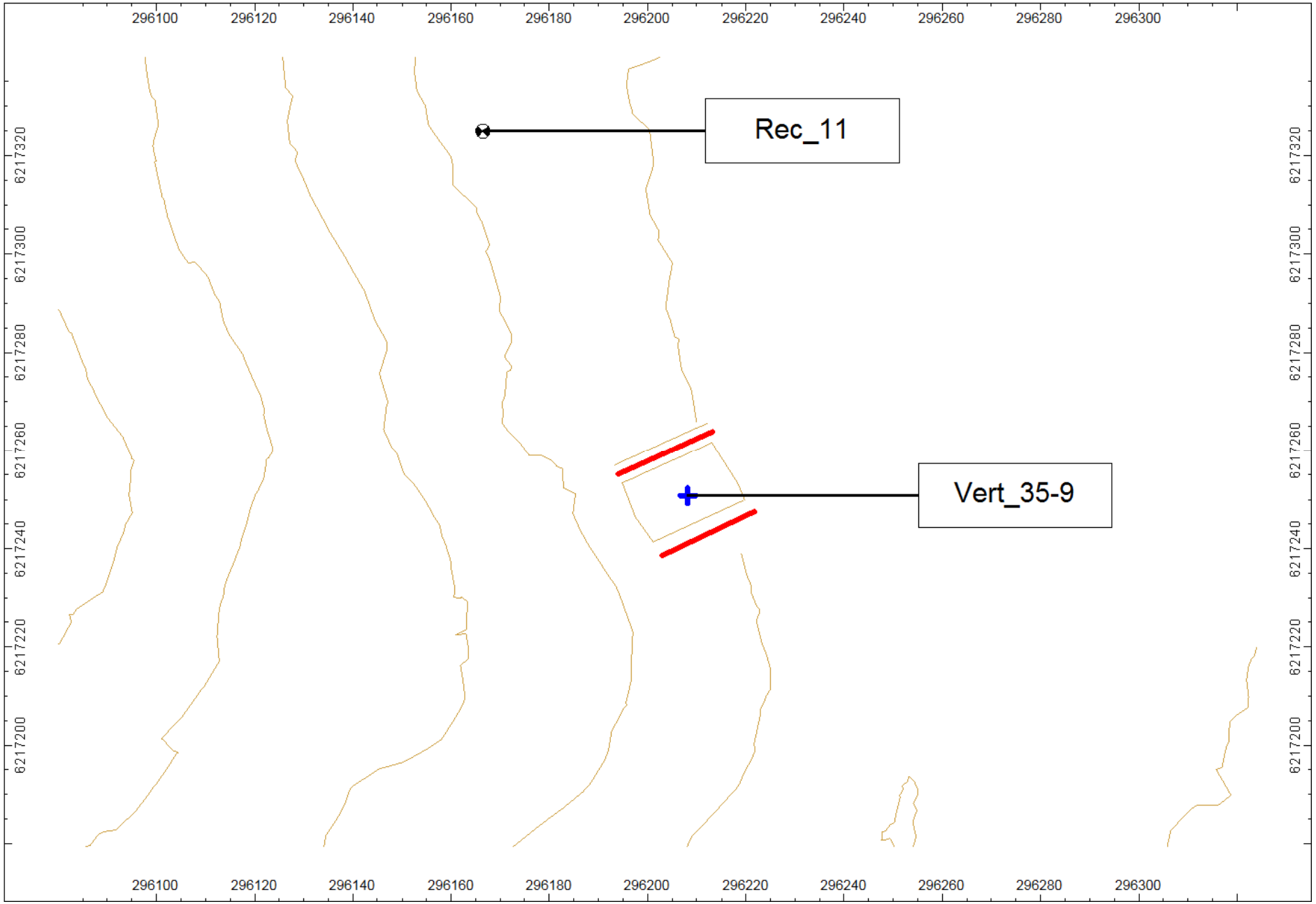
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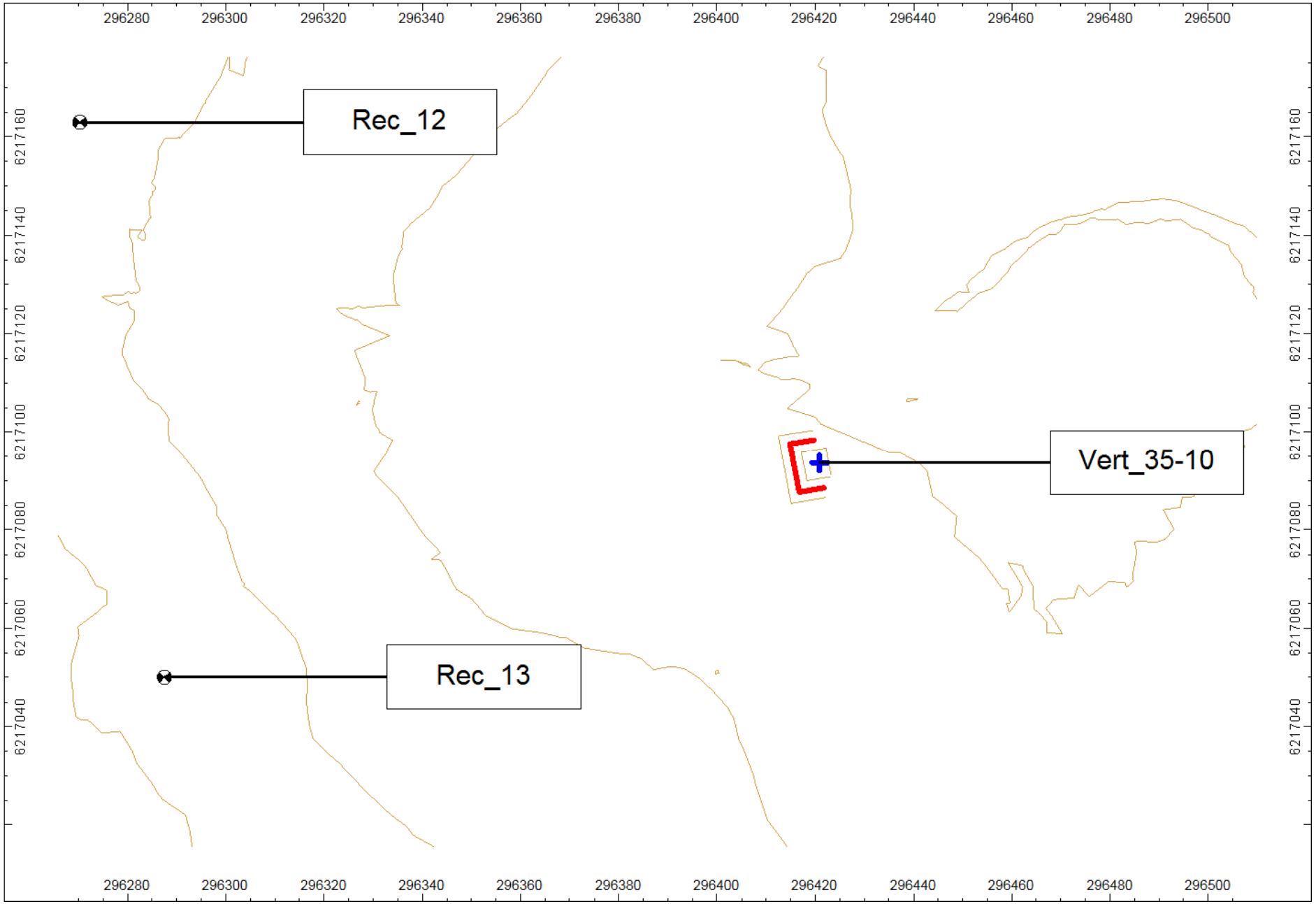
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A.5 ENVIRONMENTAL MANAGEMENT PLANS

West Cliff Area 5
Goaf Gas Drainage Project

Environmental Management Plans

Vegetation Clearing and Rehabilitation
Noise
Water
Erosion and Sediment Control
Cultural Heritage

Review History

Revision	Description of Changes	Date	Approved
R0	New Document	September 2009	BB
R1	Minor mods – request of DoP	December 2009	BB
R2	Minor Mods relevant to Mod #2 for wells 34-11 and 34-12	December 2010	BB
R3	Modified relevant to Mod #3 for Longwall 35 infrastructure	May 2011	BB

Table of Contents

1 INTRODUCTION

1.1 Background

BHP Billiton Illawarra Coal (BHPBIC) currently operates West Cliff Colliery, near the township of Appin, NSW, within the Wollondilly Local Government Area (LGA).

In September 2006 the Department of Primary Industries (now Industry and Investment NSW) granted BHP Billiton Illawarra Coal BHPBIC Subsidence Management Plan (SMP) approval for West Cliff Area 5 Longwalls 31-33. In May 2009 the Department of Primary Industries (DPI) granted BHP Billiton Illawarra Coal BHPBIC Subsidence Management Plan (SMP) approval for West Cliff Area 5 Longwalls 34-36. An application to vary (shorten) the length of Longwall 34 was approved by the DPI on 26 May 2009.

BHPBIC has mined Longwalls 32 and 33 in West Cliff Area 5 in accordance with SMP approval. Longwall 34 commenced in January 2010. In order to ensure safe and efficient mining, BHPBIC require surface equipment to drain methane gas from the goaf area of the mine. This methane gas is referred to as “goaf gas”.

As a result, an application was prepared and submitted to the Department of Planning and Infrastructure (DoP) for the proposal to install temporary gas extraction boreholes and mobile surface extraction plants and ancillary equipment to drain goaf gas from Longwalls 32-34. The project was approved by the Director General of Planning on 8 December 2008 with a modification to the project (Modification #1) approved on 7 December 2009.

Construction of the vertical wells, collector pipelines, goaf gas extraction plant and ancillary equipment for goaf gas extraction associated with Longwall 34 commenced in December 2009. Operation of the goaf gas extraction system commenced soon after the commencement of mining of Longwall 34.

A modification to the approval (Modification #2) for an additional two goaf gas extraction boreholes above Longwall 34 (and associated goaf gas extraction infrastructure) was submitted to the NSW DoP in December 2010 and was approved on 29 April 2011. A further modification to the approval (Modification #3) has been submitted for goaf gas extraction infrastructure associated with Longwall 35.

This Environmental Management Plan (EMP) details the proposed environmental management activities that will be undertaken during construction and operation of the West Cliff Area 5 Goaf Gas Drainage Project and has been updated to include the gas drainage wells, a gas extraction unit and surface pipelines associated with Longwall 35. This document is a module of the

Environmental Management Strategy (EMS). It is envisaged that this management plan will be updated for future goaf drainage operations for the remainder of West Cliff Area 5 once the Bulli Seam Operations Part 3A application has been approved.

1.2 Scope

The proposed goaf gas drainage surface facilities will be located across a number of paddocks on private landholdings. BHPBIC has consulted with and obtained written agreements from all landowners on which the proposed goaf gas drainage activities will take place.

The scope of this document covers the following allotments within the Wollondilly and Campbelltown LGAs, formally described as:

- Lot 1 DP 595956;
- Lot 1 DP70208;
- Lot 101 DP716209;
- Lot 24 DP700072;
- Lot 11 DP744101;
- Lot 1 DP744101;
- Lot D DP377759;
- Lot 1 DP595956.

2 OBJECTIVES

The objectives of this plan are to:

- Comply with all regulatory requirements set out in the West Cliff Coal Mine - Surface Goaf Gas Drainage Project Approval and other legislation with regards to vegetation clearing and rehabilitation, noise, water and erosion and sediment control management and monitoring;
- Ensure BHP Billiton's environmental and other relevant Strategies and Policies are met and upheld;
- Identify activities that could cause noise impacts to nearby receivers;
- Identify activities that could cause impacts to surface and groundwater;
- Identify activities that could cause soil erosion and generate sediment;
- Identify the extent of vegetation clearing;
- Describe measures to minimise and monitor potential noise impacts;
- Describe measures to minimise and monitor potential water impacts;
- Describe measures to minimise soil erosion and the potential for transport of sediment to downstream waters;
- Describe measures to manage vegetation clearing and rehabilitation;
- Develop a program/inspection regime to ensure the rehabilitation, noise, water and erosion and sediment controls for the project are performing in a satisfactory manner;
- Describe measures to manage and protect any cultural heritage features in the event such features are unearthed or identified during works; and
- Detail the procedures associated with reporting the results of the monitoring.

3 RESPONSIBILITIES

It is the responsibility of all employees and contractors to undertake practices to manage and minimise potential environmental impacts according to this Environmental Management Plan.

The West Cliff Mine Health, Safety, Environment and Community (HSEC) Manager is responsible for coordinating the implementation of this Management Plan and for the periodic review of the Plan.

The HSEC Manager will also be responsible for ensuring the commitments contained within this management plan are met. This will include:

1. Overseeing the operation and maintenance of the vegetation clearing (not required for works associated with Modification #3), site water management and sediment and erosion control system;
2. Overseeing the operation and maintenance of the noise monitoring and mitigation measures;
3. Production and dissemination of reports and appropriate summaries of information in reports.

4 LEGISLATIVE AND OTHER REQUIREMENTS

4.1 Legislative Requirements

Legislation applicable to noise, water, cultural heritage, erosion and sediment control management includes but is not limited to:

- Protection of the Environment Operations Act 1997 (POEO Act);
- Environmental Planning and Assessment Act 1979;
- Soil Conservation Act 1938;
- Water Management Act 2000;
- Water Act 1912;
- National Parks and Wildlife Act 1974.

The NSW Industrial Noise Policy, Office of Environment and Heritage Construction Noise Guidelines and NSW Minerals Industry Due Diligence Code of Practice for the Protection of Aboriginal Objects (NSW Minerals Council 2010), are also relevant.

4.2 Project Approval Conditions

Project Approval for the West Cliff Goaf Gas project was granted by the Minister for Planning on 8 December 2008 and is available at www.planning.nsw.gov.au. The Approval was modified on 7 December 2009 to incorporate changes to the goaf drainage system layout for Longwall 34 (Modification #1). Modification #2 incorporates the addition of wells 34-11 and 34-12 and an extraction plant, for which approval was granted on 29 April 2011. A further modification (Modification #3) incorporating goaf gas infrastructure for Longwall 35 has recently been submitted (May 2011) and is reflected in this Environmental Management Plan.

Various Environment Management Plans are required as conditions of Project Approval (and are expected to be required as conditions of Project Approval for Modification #2 and #3). These include:

- Noise Monitoring Plan;
- Water Management Plan;
- Vegetation Clearing and Rehabilitation Protocol;
- Environment Management Strategy.

This document has been prepared in accordance with the conditions of this Project Approval.

4.2.1 Noise

The proponent shall construct and operate the project in accordance with the hours listed in Table 1 below.

Table 1. Construction and operation hours of the project

Activity	Hours
Construction - Site establishment of borehole and extraction plant sites, including vegetation clearing and drill assembly/setup - Drilling of vertical boreholes - Surface pipeline reticulation system works	Monday to Friday 7:00am to 6:00pm.
Operation - Extraction plant, flaring, venting, maintenance and rehabilitation	24 hours 7 days per week

The proponent shall ensure that the noise generated by the project does not exceed the noise impact assessment criteria set out in Table 2 below at any residence on privately owned land, or on more than 25 per cent of any privately owned land.

Table 2. Noise Impact Assessment Criteria

Location	Day/Evening	Night	
		$L_{Aeq\ (15\ min)}$	$L_{A1\ (1\ min)}$
All privately owned residents	36	36	46

However if the proponent has a written negotiated noise agreement with the landowner, and a copy has been forwarded to the Department of Planning and Infrastructure and Office of Environment and Heritage, then the proponent may exceed the noise limits in accordance with the negotiated noise agreement.

The proponent shall prepare and implement a Noise Monitoring Plan for the project to the satisfaction of the Director General. This plan must:

1. Be submitted to the Director General for approval prior to the commencement of construction activities;
2. Use attended noise monitoring measures to monitor the performance of the project; and
3. Describe how compliance with the noise impact assessment criteria would be established.

4.2.2 Soil and Water

Except as may be expressly provided by a Office of Environment and Heritage Environment Protection Licence, the proponent shall comply with section 120 of the Protection of the Environment Operations Act 1997 (POEO Act 1997) during the carrying out of the project.

The proponent shall prepare and implement a Water Management Plan for the project to the satisfaction of the Director General. This plan must:

1. Be submitted to the Director General for approval prior to the commencement of construction;
2. Include an Erosion and Sediment Control Plan, which must:
    - be consistent with the requirements of Managing Urban Stormwater: Soils and Construction manual (Landcom 2004 or its latest version);
    - identify activities that could cause soil erosion and generate sediment;
    - describe measures to minimise soil erosion and the potential for transport of sediment to downstream waters;
    - describe the location, function and capacity of erosion and sediment control structures; and
    - Describe what measures would be implemented to monitor and maintain the structures over time.

4.2.3 Vegetation

The proponent shall prepare and implement a Vegetation Clearing and Rehabilitation Protocol for the project to the satisfaction of the Director General. Note: Native vegetation clearing will not occur as a component of works associated with Modification #2 and #3. This plan must:

1. Be submitted to the Director General for approval prior to the commencement of construction;
2. Delineate the areas of vegetation to be cleared;
3. Describe the procedures that would be implemented for;
4. Protection of Shale Sandstone Transition Forest and Cumberland Plain Woodland, as far as is practicable;
5. Conserving, stockpiling and reusing disturbed material;
6. Describe the procedures for revegetating and rehabilitating the areas of disturbance; and
7. Provide completion criteria, including a monitoring timetable, and measures that would be implemented to ensure the criteria are achieved.

4.3 BHP Billiton and Other Policies and Strategies

BHP Billiton operates in accordance with the Health, Safety, Environment and Community (HSEC) Management Standard (STA.009) which covers all operational aspects and activities of its business and the Environment Standard (STA.020) which prescribes the mandatory environmental performance requirements that support the aspiration of zero harm across BHP Billiton.

The HSEC Management System framework is consistent with internationally recognised standards. It aims to set benchmarks for the Company's diverse range of businesses to develop and implement their own HSEC Management Systems, to provide auditable criteria for these systems and to provide a basis from which to drive continuous improvement.

The Environmental Management Plan has been developed consistent with the principles of the HSEC Management Standard and Environment Standard.

West Cliff Mine maintains an environmental management system which is certified to ISO14001 standard.

4.4 Reporting

The details of the construction and operation of the West Cliff Goaf Gas Drainage Project and the performance of its vegetation, noise, water and erosion and sediment controls will be reported in the West Cliff Mine Annual Environmental Management Report. The reporting requirements relating to this project are detailed in the Environmental Management Strategy.

5 CONSULTATION PLAN

5.1 Landholder Agreements

Illawarra Coal will seek an Agreement with all landholders whose property will be accessed for the purpose of conducting the surface goaf gas drainage program.

Illawarra Coal will also seek an Agreement with all landholders whose principal place of residence is located within 200m of a proposed gas well or extraction/flaring plant location.

The Agreements will detail:

- Periods during which Illawarra Coal may access the land;
- Indicative location, size and details of works proposed on the property and any land to be utilised;
- Any conditions to be adhered to by IC at the request of the landholder;

- Any compensation to be paid to any landholder;
- The manner of resolving any dispute arising in connection with the arrangement;
- And any other matters agreed to between IC and the landholder.

5.2 Communication and Consultation Plan

5.2.1 Background:

Goaf gas is the accumulation of coal seam methane in the area of collapsed rock strata associated with the extraction of coal by the longwall mining method. If unmanaged, goaf gas can enter the ventilation system within the mine and cause underground safety and operational issues. Ultimately it leaves the mine in the ventilation air – resulting in a contribution to the greenhouse gas emission issue.

The company proposes to use plant to draw the goaf gas to the surface to limit the potential for gas build up in the Mine Ventilation Air (MVA) and ultimately its emission to the atmosphere. Goaf gas primarily consists of methane, which is a Greenhouse Gas.

This will be done by establishing units on individual properties on properties situated to the west and east of Appin Road, north of Appin and south of Campbelltown – the units will be in place for up to 18 months.

While the Company's preference is generally to capture the gas and direct it to the EDL power plants for electricity generation, this will not be possible given the position of the gas wells. To this end, onsite flaring is proposed.

Implementation of the project will enable Illawarra Coal to safely and efficiently extract coal from West Cliff Mine.

The design and location of the surface units on each property will be finalised in consultation with the relevant landowners or occupiers in order to address their individual needs and reduce environmental impact.

Issues:

Discussions with the relevant landowners have not revealed any significant issues, however, the location of the units and their flaring may in some cases be visible from the Appin Road and therefore to the broader community. While drilling is taking place there will be some noise during the day time period. A Medium Radius Drilling (MRD) gas extraction well is proposed for Longwall 35 to minimise disturbance to nearby residents and environmental features. The MRD well will be

required to be drilled on a 24 hours per day, seven day per week basis. The MRD drilling will take up to two months to construct.

While noise mitigation barriers are proposed to minimise noise impacts in nearby receivers, some people may still be concerned with the potential for this impact. Other issues based on past goaf drainage experience may arise in relation to access issues – contractors, drillers, sub-contractors accessing properties. To manage this it is proposed that the External Affairs team participate and/or provide input to the induction of all site-based contractors.

Purpose:

This communication and consultation plan aims to provide effective and timely communication of key messages to support the approval process and to provide opportunity for stakeholder input to design and operation.

Key Messages

- The company proposes to draw the goaf gas to the surface to limit the potential for gas build up in the Mine Ventilation Air (MVA) and ensure the safety of its employees. (The goaf is the void which is created behind the longwall equipment after the coal has been cut away from the coal seam.)
- The methane gas is extracted from the area of the underground workings that has already been broken up by the mining process. There is no “fraccing” involved in this process.
- The only chemicals used in this drilling process are those which are internationally recognised as appropriate for drilling in drinking water catchments.

5.2.2 Stakeholders

- Affected landowners/occupiers.
- Appin Area Community Working Group.
- Elected representatives of the Appin/Campbelltown district.
- Campbelltown City Council.
- Illawarra Coal employees.
- The wider Illawarra Coal community (Wollondilly).
- CSG External Affairs.

Preferred Stakeholder notification sequence

All communication will occur in a sequence which aims to maintain and secure relationships with all key stakeholders.

1. Affected landowners/occupiers.

2. AACWG.
3. Elected representatives.
4. Campbelltown City Council.
5. The wider Illawarra Coal community in the Wollondilly region.
6. Media.
7. Illawarra Coal employees.
8. CSG External Affairs.

5.2.3 Communication and Consultation

Aim of initial communication: *To provide timely information to key stakeholders regarding the preparation of the management plan for submission and to incorporate input from key stakeholder to design and operation where practicable.*

The following steps will occur in the order as listed.

- Meetings with affected landowners – input received and agreement reached and signed – April to July 2011.
- Briefing note and holding statement to be prepared for internal approval.
- Meeting with Campbelltown City Council – briefing provided on Illawarra Coal including. goaf drainage and other issues – input received and incorporated in submission of application/assessment – April 2011 – completed.
- AACWG notified of preparation of management plan – May - July 2011.
- Letter to Elected Officials – meeting organised if requested – May - July 2011.
- Possible advertisement to be placed in local papers as required by NSW DoP.
- Coalition News article – June - July 2011.

Refer **Table 3** - Communications Schedule.

Ongoing Communication

Aim of communication: *To keep key stakeholders informed of the approval and construction process (as required).*

- Updates to AACWG.
- Letters to Campbelltown City Council.
- Letters to Elected Officials.
- Coalition News.

Table 3 - Communications Schedule

	Letter	Coalition News	Briefing note and Holding Statement	Presentation Slides	Meeting	Public notice Advertisement	Email
AACWG				May - July 11			Updates as required
Campbelltown City Council	April 11				April 11		
Elected Officials	May - July 11						
Illawarra Coal community		June - July 11					
Landowners/ Occupiers					April - July 11		
Employees							May - July 11
Broader public						As Required	
CSG External Affairs			April - May11				

6 VEGETATION CLEARING AND REHABILITATION PROTOCOL

6.1 Area of clearing

The vertical goaf gas extraction well compounds for wells 34-2 to 34-12 and connecting pipelines are located on agricultural land consisting of improved pasture. Two discrete goaf drainage extraction plants over Longwall 34 will be co-located with wells 34-4 and 34-5 to avoid disturbance of Shale Sandstone Transition Forest in and adjacent to Mallatty Creek. A further discrete goaf drainage extraction plant will be located on pasture to service wells 34-11 and 34-12. Up to three discrete extraction plants may be established to service the planned boreholes in Longwall 35.

Disturbance of pasture by well/extraction plant compounds, trenching and pipe laying operations will be short term, and the disturbed areas will be returned to pasture as soon as construction and/or decommissioning is complete. No native vegetation will be cleared as a result of works associated with Modification #2 or Modification #3.

The construction of the well 34-1 compound will require clearing of approximately 0.2 ha of highly degraded Shale Sandstone Transition Forest. The area of 'good condition' Shale Sandstone Transition Forest surrounding the borehole named PA03 in Biosis Research (2007) has been avoided, and well 34-1 has been located in accordance with the recommendations of Biosis Research (2007 – see pages 32-33) to minimise disturbance of 'good condition' Shale Sandstone Transition Forest.

Figures 1-4 show; an overview of the stand of Shale Sandstone Transition Forest vegetation and surrounds, the well 34-1 site and pipeline route, drill rig entry to the well 34-1 site, and aerial overview of well 34-1, respectively.

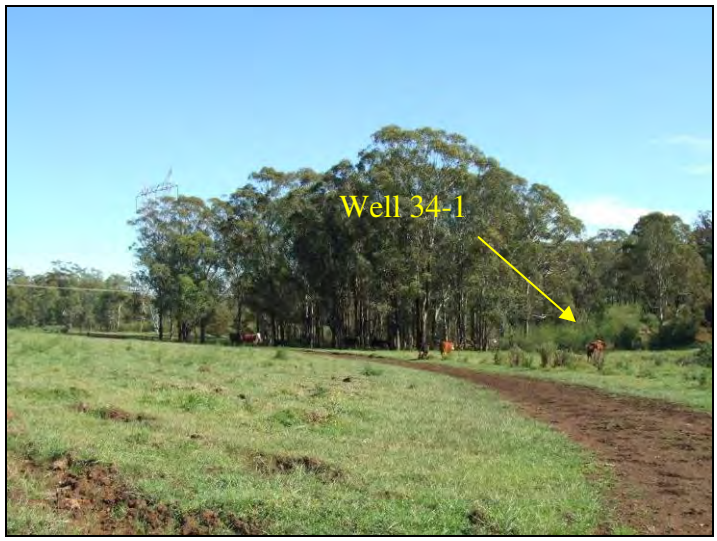


Plate 1: Overview of the stand of Shale Sandstone Transition Forest vegetation

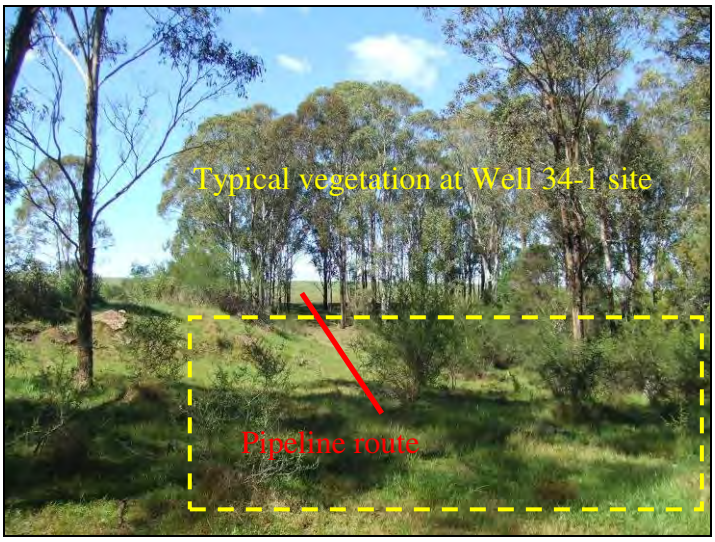


Plate 2: General location of Well 34-1.

Plate 3: Drill rig access to Well 34-1

6.2 Procedure to minimise clearing of native vegetation

In order to optimise gas extraction at the commencing end of Longwall 34, and to enable the mandatory safety stand off distances for the drill rig from the Transgrid 330 kV transmission line, construction of the well 34-1 compound will require disturbance of approximately 0.2 ha of Shale Sandstone Transition Forest. Site investigations have identified that less than 10 individual trees will required to be cleared. The drilling site will be located on an area that is a pre-existing track that is cleared/weedy-pasture to minimise clearing.

The pipeline connecting well 34-1 to the extraction plant will be routed along a pre-existing track to avoid any further disturbance to the vegetation.

All clearing and rehabilitation works will be undertaken in accordance with the Illawarra Coal – Resource and Exploration Procedure – Clearing and Rehabilitation. This procedure is available on iPick at http://ipick.bhpbilliton.net/IC/viewer.php?docID=302.

6.3 Conserving, stockpiling and reusing disturbed material

At the commencement of site establishment for well 34-1, the boundary of the well compound will be marked with barrier tape. No vegetation beyond the tape will be cleared. All vegetation that will be cleared will be felled into open or already cleared areas to avoid damage to the adjacent vegetation that will not be cleared.

Vegetation selected for clearing will be felled by excavator and/or manual techniques (e.g., chain saw). Large vegetation (i.e., trees) will be cut into manageable size lengths. All vegetation will be stockpiled within cleared areas away from the Transgrid 330 kV transmission line. If it is practical and feasible to do so, seed from the cleared vegetation will be collected and stored for use in rehabilitation of well 34-1.

Once the well 34-1 site is cleared, temporary security fencing will be erected around the perimeter of the compound to prevent access and to avoid further disturbance of the surrounding vegetation.

6.4 Procedures for revegetating and rehabilitating the disturbed area

Revegetation and rehabilitation of the area cleared of native vegetation will be guided by DECC (2005) Recovering Bushland on the Cumberland Plain – Best Practice Guidelines for the Management and Restoration of Bushland (available at http://www.environment.nsw.gov.au/threatenedspecies/CumberlandPlainManagementGuidelines.htm) and DITR (2006) Mine Rehabilitation (available at http://www.ret.gov.au/resources/Documents/LPSDP/LPSDP-MineRehabilitationHandbook.pdf).

Once all site infrastructure is decommissioned and removed, the well compound area will be lightly tilled. Any seed collected during initial site clearing will be incorporated into the surface top soil. The stockpiled vegetation suitable for brush matting will be laid on the soil surface. Larger logs will be strategically placed on the soil surface to provide microclimate for seed entrapment and germination. The rehabilitation area will be temporally fenced to exclude stock (depending upon approval of the land owner – note the site is grazed by cattle prior to this project).

6.5 Completion criteria and monitoring

A completion criteria for well 34-1 site rehabilitation is the establishment of non-erodible, self supporting vegetated land surface. The existing surface is predominantly grazed pasture species.

It is intended that Shale Sandstone Transition Forest type native vegetation will regenerate from the placement of brush matting, direct seeding (if applicable) and natural re-establishment from adjacent vegetation across the area that was cleared.

Monitoring to determine the success of the establishment of Shale Sandstone Transition Forest type native vegetation at the well 34-1 site will take place after three and six months from the completion of the rehabilitation works. Photo points will be established to assist with qualitative assessment of the rehabilitation.

Where monitoring of the rehabilitated well 34-1 site indicates poor establishment of native vegetation, then the following action(s) will be considered:

- Weed control if invasive weeds are restricting establishment of native vegetation;
- More robust fencing if damage to emerging vegetation by stock is occurring (dependent on landowner agreement);
- Planting of locally sourced tubestock;
- Seeking the advice of qualified bush regeneration experts.

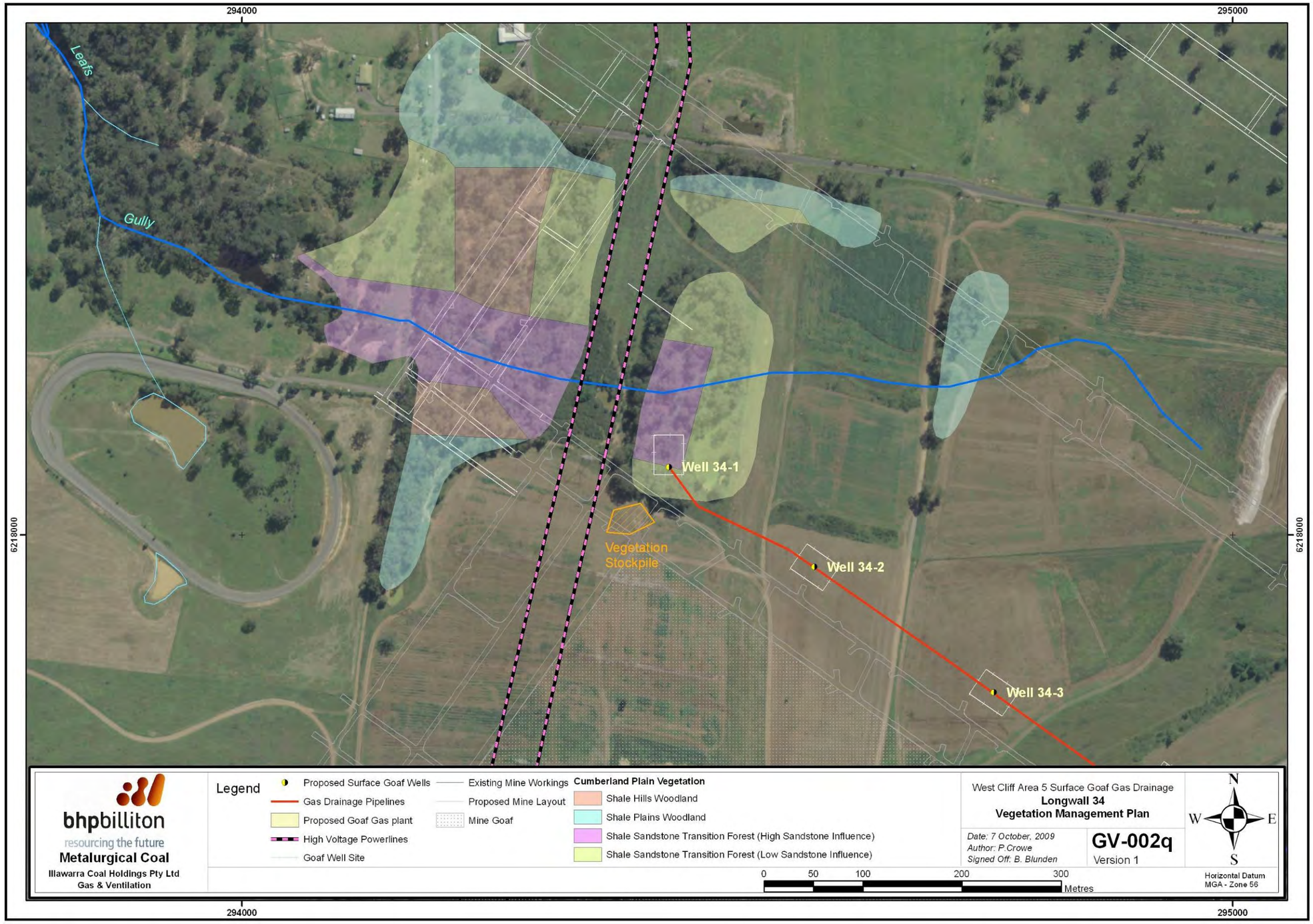
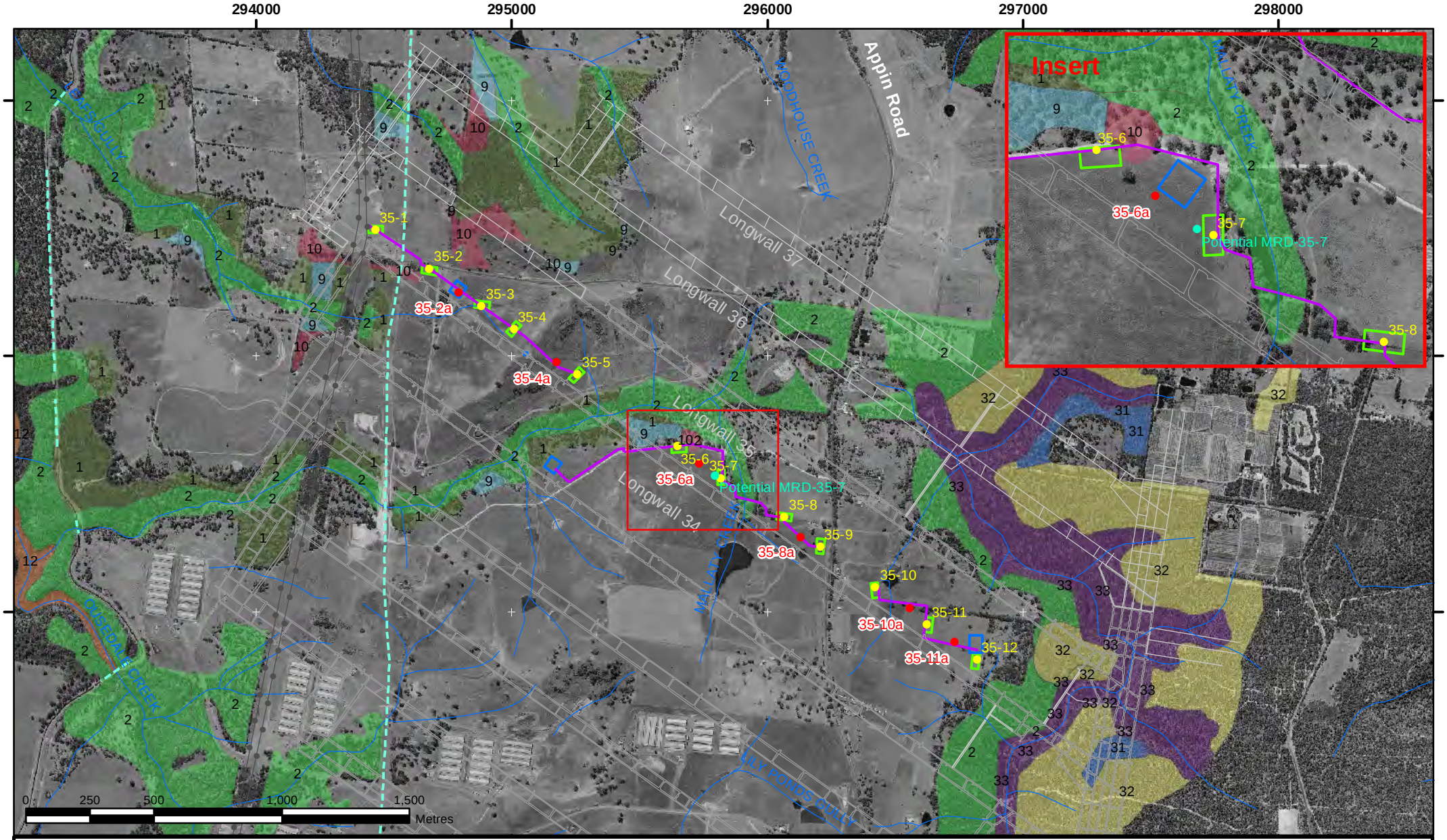


Figure 1: **Well 34-1 compound and vegetation**



bhpbilliton
resourcing the future
Illawarra Coal

MRD Wells

SGW Vertical Wells
- Contingency
- Proposed

Electricity Transmission Line

Natural Gas Pipeline

SGW Pipelines

SGW Surface Sites
- Drill compounds
- Extraction Plants

Cumberland Plain Vegetation
- 1 - Shale Sandstone Transition Forest (Low Sandstone Influence)
- 10 - Shale Plains Woodland
- 12 - Riparian Forest
- 2 - Shale Sandstone Transition Forest (High Sandstone Influence)
- 31 - Sandstone Ridgetop Woodland
- 32 - Upper Georges River Sandstone Woodland
- 33 - Western Sandstone Gully Forest
- 9 - Shale Hills Woodland

Aerial Photography 2007

West Cliff Area 5 Surface Goaf Gas Drainage

Longwall 35

Figure 2: Vegetation Management Plan

Date: 5 May, 2011
Author: R. Jenkins
Signed Off: C. McEvoy

Version 1
Horizontal Datum
MGA - Zone 56

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7 NOISE MANAGEMENT STRATEGIES

7.1 Site Description

The layout of the West Cliff goaf drainage project has been revised via Modification #1 to minimise noise impacts on nearby residential receivers by connecting goaf drainage boreholes via a collector pipeline to centralised extraction plants and flare systems (at wells 34-4 and 34-5) that are located in excess of 1km from the nearest residence.

As per Modification # 2, a further discrete goaf drainage extraction plant will be located on the eastern side of Appin Road to service wells 34-11 and 34-12. This has been located approximately 500m from the nearest residence in order to minimise noise impacts.

As per Modification # 3, up to three further discrete goaf drainage extraction plants will be centrally located to service the wells above Longwall 35. These extraction plants have been located approximately 500m from the nearest residence in order to minimise noise impacts. Refer **Figure 3**.

7.2 Noise Management Strategies

The greatest noise generating activities for Longwall 35 are:

- the drilling of an MRD borehole which is required to be drilled on a 24 hr/day basis;
- the drilling of vertical boreholes; and
- the operation of the extraction plants.

Wilkinson Murray (2011) have predicted that the potential MRD borehole 35-7 and vertical boreholes 35-1, 35-8, 35-9 and 35-10 will require noise mitigation by sound barriers in order to reduce construction noise to acceptable levels.

The extraction plants to service Longwall 35 have been located in excess of 500m from the closest residence in order to minimise noise impacts. A noise assessment has determined operational noise levels are predicted to be within the relevant operational noise criteria (Wilkinson Murray 2011).

The following table summarises barrier configurations that were predicted to mitigate construction noise levels to acceptable levels.

Table 4. Summary of Modelled Barrier Heights and Setbacks

Well	Barrier Height (m)	Barrier Setback (m)
MRD35-7	5	5
35-1	3	10
35-8	4	10
35-9	4	10
35-10	4	5

The specific noise management strategies are:

1. For the abovementioned borehole sites, BHPBIC have committed to installing temporary noise barriers (see **Figure 3**) around the drilling compounds in order to minimise noise impacts on the affected residences. Noise barriers are estimated to reduce noise levels by 10-15dB (Wilkinson Murray 2011);
2. The construction and operation of vertical drilling is restricted to Monday-Friday between 7am to 6pm and is expected to take approximately two weeks;
3. The drill rig and equipment will be oriented so that the quietest side (identified as being up to 9dB quieter than the loudest side) is faced toward the nearest receivers;
4. Impacted neighbours will be contacted and informed of the likely duration of work.

Note that the DoP has agreed that if BHPIC has a written negotiated agreement with all affected landholders and a copy of this agreement has been forwarded to the Department of Planning and Infrastructure and Office of Environment and Heritage, then construction activities are permitted outside of the permitted hours

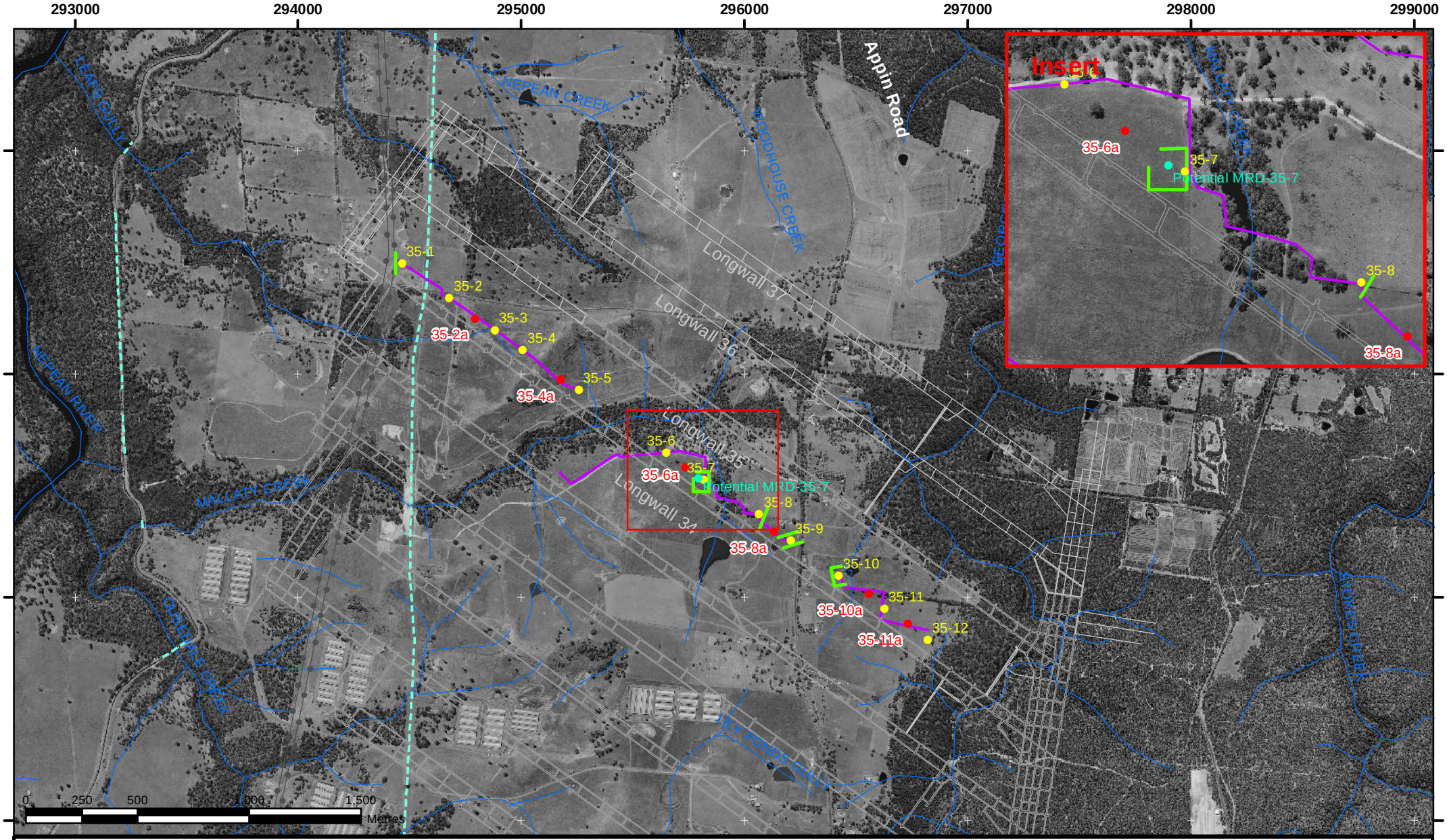
If neighbours complain of noise impacts from sites not specifically addressed above, then BHPBIC will consider the installation of temporary noise barriers (see **Plate 4**) around the drilling or extraction plant compounds.

7.3 Noise Monitoring and Determination of Compliance

Due to the short term nature of the construction program at each vertical well (i.e. approximately two weeks), and the significant mitigation measures already proposed (i.e. installation of temporary sound barriers) it is not proposed to conduct attended noise monitoring for any boreholes unless complaints are received.

If any noise complaints are received by BHPBIC in regard to construction or operational aspects of this project, then attended noise monitoring will be undertaken to determine if additional mitigation measures will be implemented.

Plate 4. Noise Mitigation Barriers



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8 WATER MANAGEMENT STRATEGIES

8.1 Site Description

The project sites and associated activities that water management strategies pertain to are as follows:

1. The site establishment and drilling of vertical boreholes and potentially, MRD borehole 35-7;
2. Site establishment and operation of up to three goaf gas extraction plants and flare systems. One goaf gas extraction plant for Longwall 35 is planned to be located at an existing extraction plant location (boreholes 34-4 and 34-5) to minimise site disturbance.

These sites can be described as unoccupied rural blocks consisting of undulating to hilly topography, which has been previously cleared of native vegetation to support agriculture. Improved pasture is the dominant vegetation within the paddocks but there are also a variety of weeds and exotic plant species.

8.2 Proposed Management Strategies

The operation of the extraction plant requires water cooling and a small water tank will be located within the extraction plant compound/s. Potable water supplied by a Sydney Water Authorised user will be brought onsite and used for this cooling process. Approximate cooling water volumes would be less than 2,000L and this will be pumped through a continuous recirculation system between the extraction plant and water tank. Small amounts (<100 L/day) of pipeline condensate will be collected in water traps in the pipeline, and discharged onto adjacent pasture.

For the drilling of each vertical borehole, a single pond will be excavated within each drilling compound to act as a drilling sump. The approximate dimensions of the pond are 15m length x 5m width x 3m depth and the approximate volume of water used throughout the drilling process is 10,000L per vertical borehole over a drilling period of approximately two weeks.

These works have the potential to impact both surface and groundwater at the abovementioned sites and thus require the implementation of management measures to mitigate or minimise these impacts. BHPBIC propose the following management strategies in relation to water management:

1. Water used for drilling and extraction plant operations will be from a Sydney Water Authorised user or sources from on-site farm dams in accordance with landowner approval;
2. The walls of ponds will be of an appropriate height to provide adequate freeboard to prevent inflow or overflow during rainfall;
3. The vertical boreholes will be cased with steel and grouted in place from the ground surface of the well to the top of the Bulgo Sandstone section of the strata above the coal seam (refer Figure 8) to prevent any cross contamination of groundwater;
4. The water used in the extraction plant cooling process and borehole drilling will be removed and reused at West Cliff Mine or irrigated onto nearby pasture well away from drainage lines or farm dams.

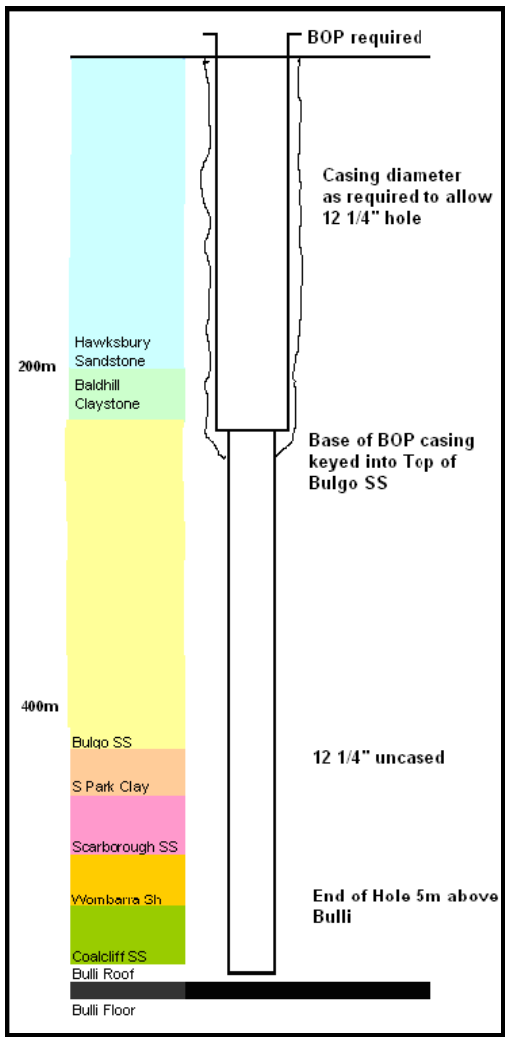


Plate 5. Example of Grout in Vertical Borehole

8.3 Maintenance/Monitoring of Water Management Structures

The drilling water sumps will be inspected on a weekly basis as well as after every significant storm and rainfall event (i.e. >10mm in a 24hour period) to ensure the sumps continue to operate satisfactorily and to perform any maintenance work and repairs that may be required. Regular maintenance will include:

- Repairs of areas which may become unstable following periods of high rainfall; and
- Checks on sump wall and liner integrity to ensure no leakage of water.

9 EROSION AND SEDIMENT MANAGEMENT STRATEGIES

9.1 Site Description

The Longwall 35 project sites and associated activities that erosion and sedimentation management strategies pertain to are as follows:

1. Establishment of at least twelve vertical drilling compounds approximately 30m x 40m;
2. Establishment of up to three goaf gas extraction and flare compounds at:

- between well 35-3 and 35-4,

- near existing goaf plant 34-4 (to minimise site disturbance), and

- 35-12.

If an MRD is viable, an extraction plant will be located at 35-7 (negating the need for a plant between 35-3 and 35-4;

3. Trenching works to burry the pipeline connecting the vertical gas extraction wells only where required (pipes will generally be placed on the land surface).

Drainage from sites west of Appin Road can be generally described as falling from the east to the west, within the Nepean River catchment. Drainage from sites east of Appin Road can be generally described as falling from the west to east, within the Georges River catchment.

9.2 Proposed Management Strategies

The civil works described above have the potential to generate sediment laden runoff and erosion and thus management measures are proposed to be implemented to minimise these impacts. An Erosion and Sediment Control Plan has been prepared for the project outlining specific soil and water management measures as shown in **Figure 4**.

Erosion and sedimentation control measures will be implemented in accordance with the above mentioned Soil and Water Management Plans and the requirements of the “Blue Book” (Soils and Construction, Volume 1, 4th edition March 2004, Landcom). The following types of management strategies are proposed:

1. Weekly inspection of site drainage and erosion/sediment controls and implementation of maintenance as needed;
2. Identification of drainage channels and effective management of surface water during construction and operational phases of work (refer **Plates 6** & **7**);
3. Disturbed areas will be revegetated and stabilised to minimise erosion and scour;

4. Reducing the amount and velocity of any water flows over the construction site;
5. Sediment filters or fences downslope of disturbed areas (refer **Plate 7**);
6. Clean water diversion drains;
7. Minimising the length and duration of exposed excavations during pipe line laying operations. Where trenches and soil stockpiles are exposed for more than one week then silt fences will be deployed immediately adjacent to the disturbed areas on the downslope side. Soil stockpiles will be placed on the uphill side of any excavated trench so that any sediment flows into the trench during runoff;
8. Maintain pasture adjacent to any disturbed areas and direct runoff to flow through pasture prior to any flow to waterways.
9. Maintain drilling sumps by disposing of sediment laden water at the West Cliff Colliery dirty water management system or on well vegetated pasture away from drainage lines

Plate 6: Erosion and Scour Control Structure

Plate 7 Sedimentation Control Structure

Drilling compounds will be leveled to accommodate safe drilling operations. Small cut/fill operations of generally less than 200 m3 may occur. No import or export of earth is envisaged.

Crushed sandstone or gravel may be used to create non-erodible surface working areas within the drill and extraction plant compounds.

All sediment control structures will have sufficient capacity to trap sediment mobilised from cleared areas and sump overflows during 'normal' rainfall events. Any overflow from sediment control structures will be directed to grassed paddocks.

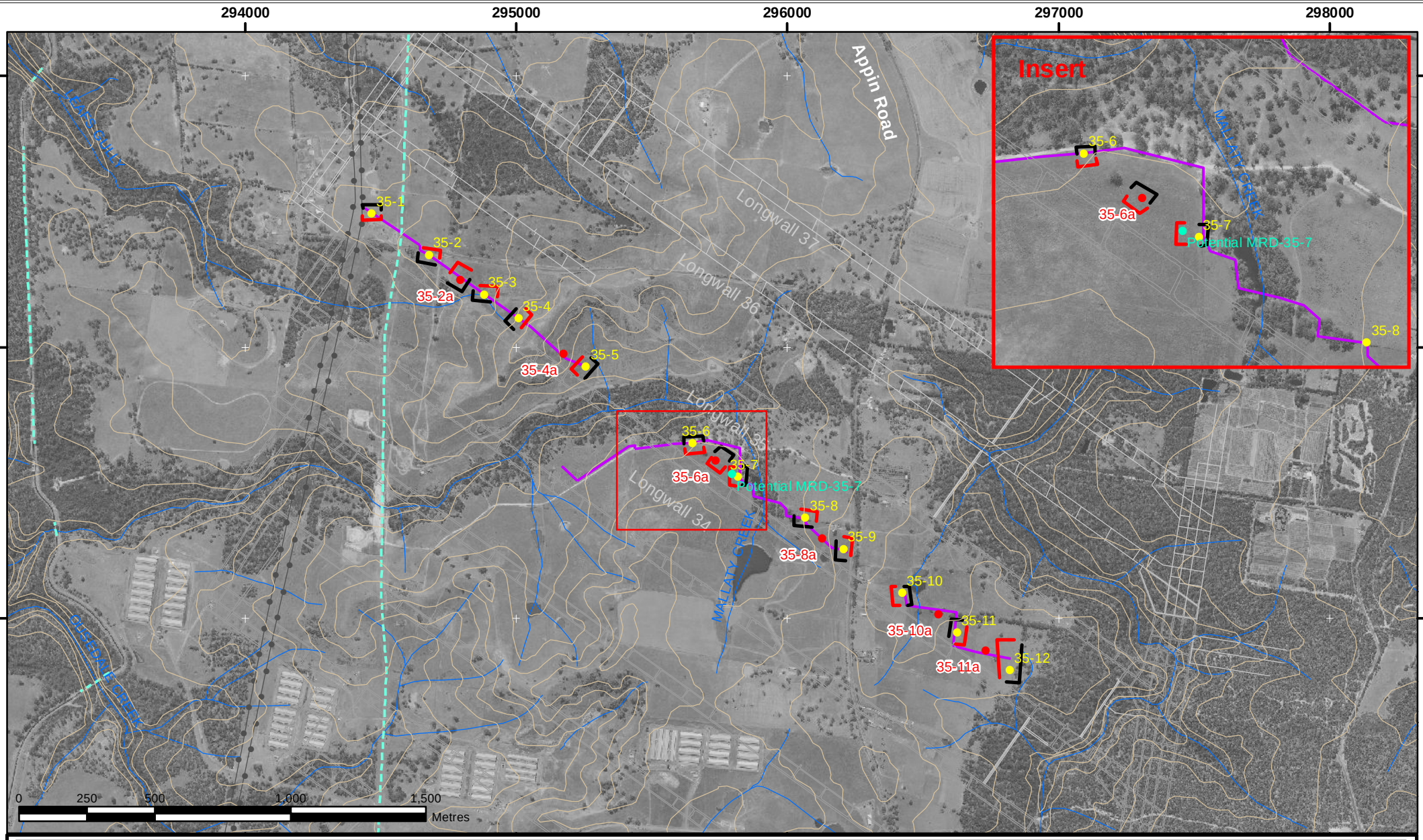
Pipelines will be constructed to relevant extraction plants concurrently. Access will be via formed roads or farm tracks already on site, and then follow the pipeline route for construction of the goaf drainage wells, extraction plant compounds/flares, and pipelines. Pasture will be re-established on disturbed areas such as buried pipelines, drilling compounds and access routes (where it is reasonable and practical to do so) after construction is complete to minimise potential for sediment runoff.

At the end of effective gas extraction, the extraction plant compounds, well heads and pipelines will be decommissioned, removed and rehabilitated. The boreholes will be rehabilitated in accordance with Department of Industry and Investment requirements. Any cut/fill areas will be reshaped to the original land surface unless requested by the landowner to leave as it is. The extraction plant and drilling compounds as well as the pipelines will be rehabilitated in accordance with the Vegetation Clearing and Rehabilitation Protocol within one month of completion of the site decommissioning.

9.3 Maintenance/Monitoring of Sediment and Erosion Control Structures

The erosion and sediment control structures (i.e. drainage lines and silt fencing) associated with the construction of the project will be inspected on a weekly basis, as well as after every significant storm and rainfall event (i.e. >10mm in a 24hour period) to check that they are operating satisfactorily and to perform any maintenance work and repairs that may be required. Regular maintenance will include:

- Sediment removal from sediment traps;
- Repairs of areas, which become unstable following periods of high flow; and
- Checks on bund integrity and diesel fuel/chemical storage to ensure compliance with the appropriate standards.



MRD Wells

SGW Vertical Wells
- Contingency
- Proposed
- Contour

Sediment and Erosion Control
- Diversion berm
- Sediment fence

Electricity Transmission Line

Natural Gas Pipeline

SGW Pipelines

Aerial Photography 2007

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Illawarra Coal

West Cliff Area 5 Surface Goaf Gas Drainage
Longwall 35
Figure 4: Sediment and Erosion Control Plan

Date: 5 May, 2011
Author: R. Jenkins
Signed Off: C. McEvoy

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10 CULTURAL HERITAGE

10.1 Site Description and Assessment

In addition to the original archaeological assessment conducted for the project in 2007 by Biosis, an Aboriginal objects due diligence assessment was undertaken by Niche Environment and Heritage (2011) to assess potential impacts of Project Modification #3 (Longwall 35 gas infrastructure).

The due diligence assessment concluded that the West Cliff Colliery Goaf Gas Drainage Project for Longwall 35 was not going to harm or cause harm to Aboriginal objects because of extensive disturbance, associated with previous farming and grazing on the site. However to ensure that no harm was to occur to Aboriginal objects, the following two constraints were placed on the Project activities:

1. Avoidance of gas drainage activities on the crest and mid and upper slopes of the ridgeline that runs north east to south west across the western end of Longwall 35 (refer **Figure 5**), due to the assessed archaeological sensitivity of this ridgeline.

2. A 100m radius avoidance buffer to be maintained about Archaeological site BS 11 (AHIMS Site # 52-2-3691) so as to ensure that it will not be disturbed during the proposed works. Refer **Figure 5**.

Works may proceed with caution.

10.2 Proposed Management Strategies

In response to the due diligence assessment referred to above, the following strategies will be implemented in order to avoid impacts on Aboriginal objects:

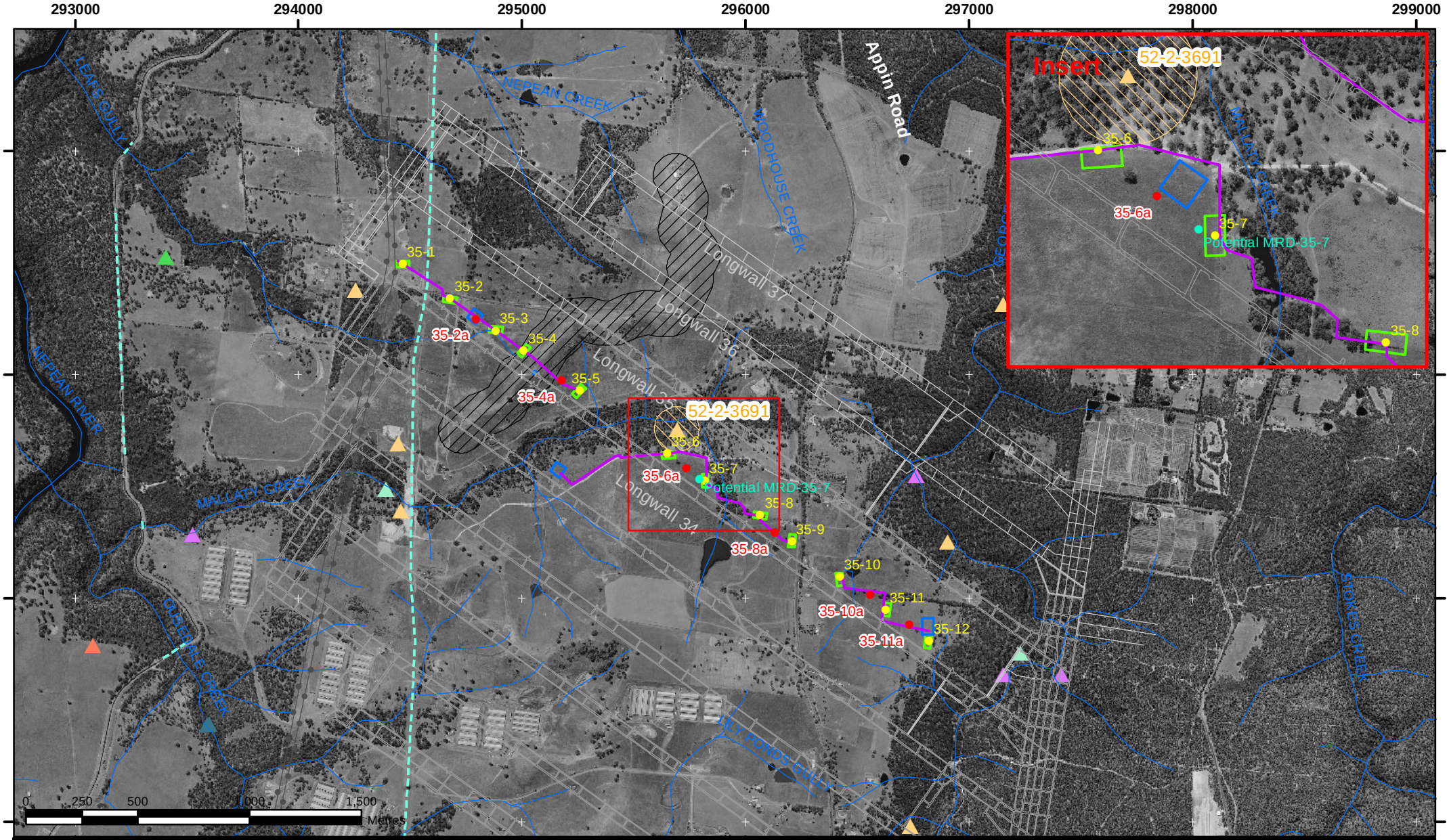
1. Borehole 35-4 has been relocated 60 metres to the north west of the preferred location to avoid potential impacts on the archaeologically sensitive ridgeline. Refer **Figure 5**).

2. Borehole 35-6 has been located approximately 115m from Archaeological site BS 11 (52-2-3691) and an 100 m radius avoidance buffer has been set about the site so as to ensure that it will not be disturbed during the proposed works. Refer **Figure 5**.

10.3 Response Procedure

The following emergency response procedure will be implemented if Aboriginal objects are discovered during the construction of the project:

1. In the event that suspected Aboriginal objects are encountered during construction, all work in the area, and all work that may cause further harm, must cease immediately;
2. If there is doubt about the item encountered being an Aboriginal object, a professional archaeologist should be briefed to attend the site and determine this;
3. If there is no doubt about the items being Aboriginal objects the following people must be contacted:
   - An archaeologist
   - Tharawal LALC
4. The archaeologist, Tharawal LALC and any other identified Aboriginal stakeholders must determine the objects' significance, the extent of harm, and whether or not the harm will continue if construction proceeds;
5. The following agencies must be advised of the discovery, and any plans for mitigation or avoidance of further harm should be also outlined in the advice:
   - Office of Environment and Heritage
   - Department of Planning and Infrastructure
6. Steps to avoid or mitigate further harm should be formulated in writing, in an object/site specific management plan, which must at least include an appropriate level of recording and documentation of the object/site;
7. Work at the site can only resume once a site specific management plan is in place, and written advice from the archaeologist and project manager is completed.



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MRD Wells

SGW Vertical Wells
- Contingency
- Proposed

Electricity Transmission Line

Natural Gas Pipeline

SGW Pipelines

SGW Surface Sites
- Drill compounds
- Extraction Plants

Potentially Archeologically Sensitive Ridgeline

Archaeological Avoidance Buffer

Archaeological Sites
- Axe Grinding Groove
- Open Camp Site
- Potential Archaeological Deposit
- Scarred Tree
- Shelter with Art
- Shelter with Art and Artefact

Aerial Photography 2007

West Cliff Area 5 Surface Goaf Gas Drainage

Longwall 35

Figure 5: Cultural Heritage Management Plan

Date: 5 May, 2011
Author: R. Jenkins
Signed Off: C. McEvoy

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Horizontal Datum
MGA - Zone 56

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11 SCHEDULE

The goaf drainage system for Longwall 35 will be constructed and operated in three parts. The first component consists of wells 35-1 to 35-5 and associated pipelines and extraction plant/flares. Each well will take approximately 2-3 weeks to construct. Overall construction of the 35-1 to 35-5 system will take approximately four months. This construction is expected to commence in August 2011.

The second system comprising wells 35-6 to 35-9 will take approximately three months to construct and is expected to commence in early 2012.

The third system comprising wells 35-10 to 35-12 will take approximately two months to construct and is expected to commence around May 2012.

The operation of the goaf drainage system is linked to the rate of longwall retreat. It is expected that Longwall 35 extraction will take approximately 15 months commencing in September 2011 with completion around December 2012. It may also be possible to extract goaf gas for a longer period after longwall extraction has occurred. It is expected that the goaf drainage system would be fully rehabilitated within four years of its implementation.

12 REFERENCES

Biosis Research (2007) Flora and Fauna Impact Assessment: West Cliff Colliery Surface Gas Drainage.

Olsen Environmental Consulting (2008) *Environmental Assessment West Cliff Mine Surface Goaf Gas Drainage Project.*

Department of Planning (2008) *Project Approval – West Cliff Mine Surface Goaf Gas Drainage Project*

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NSW Minerals Council, 2010. NSW Minerals Industry Due Diligence Code of Practice for the Protection of Aboriginal Objects, Sydney, September 2010.

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Wilkinson Murray *(2011). West Cliff Goaf Gas Drainage Longwall 35 Noise Assessment Report No. Report 11041-LW35 VerB AB.*

A.6 FLORA AND FAUNA ASSESSMENT

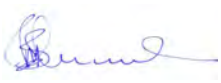
niche
Environment and Heritage

WEST CLIFF COLLIERY GOAF GAS PROJECT LONGWALL 35 ECOLOGY ASSESSMENT

FOR BHP BILLITON ILLAWARRA COAL

MAY 2011

DOCUMENT CONTROL

Business Unit	**Niche Environment and Heritage, Illawarra/Southern NSW**		
Project No.	10-114		
Document Description	Ecology Assessment West Cliff Longwall 35 Gas Goaf Drainage Modification		
	Name	**Signed**	**Date**
Supervising Manager	Matthew Richardson		6 May 2011
Author(s) of This Document	Luke Baker/Matthew Richardson		
External Review			
Document Status	Final Report		
Date	6 May 2011		

Prepared for:

Dr Bruce Blunden
Environmental Approvals Manager
Sustainable Development
BHP Billiton Illawarra Coal
PO Box 514
Unanderra NSW 2526

Cover Photo: View north west in an area over Long wall 35.

LIST OF CONTENTS

1 SCOPE OF WORKS

1.1 Background

Niche Environment and Heritage (Niche) has been commissioned to undertake an assessment of the ecological constraints and potential impacts for the modified West Cliff Longwall 35 Goaf Gas Drilling Project. This involved the assessment of:

- Twelve goaf gas extraction wells above Longwall 35;
- The proposed route of a connecting pipeline (placed on ground, not trenched); and
- The access tracks to the sites across farm paddocks.

Table 1, along with Figure 1 and 2, have been provided to define the location of the sites.

This assessment supports a modification under Section 75W of the *Environmental Planning Assessment Act* 1979 (EP&A Act) to an existing approval for similar works associated with West Cliff Colliery.

Table 1: Gas Well and Extraction Flaring Unit Locations

Site	Easting (MGA)	Northing (MGA)
Longwall 35		
35-1	294466	6218495
35-2	294677	6218343
35-3	294881	6218197
35-4	295008	6218106
35-5	295257	6217928
35-6	295649	6217648
35-7	295818	6217525
35-8	296066	6217370
35-9	296207	6217256
35-10	296422	6217095
35-11	296626	6216950
35-12	296820	6216811

1.2 Site Assessment

A site assessment of the proposal was undertaken on the 16 and 17th of March 2011 and again on the 4th April 2011. Adam West of BHP Billiton Illawarra Coal was present at the site assessment to discuss the extent of works required.

Locations for the gas and extraction flaring locations, along with associated access tacks and pipeline, were inspected for ecological constraints, such as proximity to native vegetation, creeks and habitat features. If the original locations were situated in areas that may involve ecological constraints, the sites were moved to a location that would not cause ecological impacts.

The area of possible impact for each of the gas and extraction flaring locations was relatively small, approximately 30m by 40m per location. Due to the small size, and the highly disturbed nature of the area to be impacted, no detailed data collection techniques (such as vegetation quadrats) were employed. Rather, the entire area of possible disturbance was inspected as part of the field assessment. The access tracks and pipeline route were all within farm paddocks or on existing roads/access tracks. No threatened plant or animal species were recorded from the area of possible disturbance. Species lists have not been prepared for this report as the location of the gas wells and the extraction units were located in highly modified pastures and contained minimal native vegetation or fauna habitat values.

1.3 Existing Environment

The proposed location for the gas wells, connecting pipeline, extraction/flaring units and the proposed access tracks to the sites are located within a modified and disturbed environment. The proposed locations are in areas which are cleared of all native vegetation and supports pasture grasses and weed species only (see Plates). Recommendations and mitigation measures proposed in the report have further ensured the impacts to the environment are negligible. The proposed area of impact does not support any important habitat for native flora or fauna.

2 IMPACT ASSESSMENT

2.1 Endangered Ecological Communities

The vegetation of the study area and locality has been mapped by DECCW (NPWS 2002) as part of the vegetation mapping of the Cumberland Plain. Endangered Ecological Communities (EECs) mapped within a 10 km radius of the study area include (Figure 3):

- Shale Sandstone Transition Forest (Low Sandstone Influence) and Shale Sandstone Transition Forest (High Sandstone Influence), which are both equivalent to the Shale Sandstone Transition Forest listed under both NSW *Threatened Species Conservation Act* 1995 (TSC Act) and Commonwealth *Environment Protection and Biodiversity Conservation Act* 1999 (EPBC Act).
- Riparian Forest which is equivalent to the TSC Act listed River-Flat Eucalypt Forest on the Coastal Floodplains of the NSW North Coast, Sydney Basin, and South East Corner Bioregions; and,
- Shale Plains Woodland and Shale Hills Woodland, equivalent to the Cumberland Plain Woodland which is listed under both the TSC and EPBC Acts;

None of these EECs will be impacted by the proposal, the area to be impacted being devoid of native vegetation. Further, the extensive disturbance of the area and the absence of native species confirms a complete lack of ecosystem resilience. Therefore, no EEC occurs, or is likely to regenerate in the proposed impact area. The proposal will not impact any EECs listed on the TSC or EPBC Acts. EECs have not been considered further in this assessment.

2.2 Threatened Species

A total of 21 threatened flora and 42 threatened fauna have previously been recorded within a 10 km radius of the study area (Figures 4 & 5). Records have been derived from both the Atlas of NSW Wildlife, and the EPBC Act Protected Matters Search tool. A table identifying the habitat requirements for each of the species listed can be provided upon request.

No clearing of native vegetation is required for the proposal. The highly disturbed nature of the area to be impacted for the proposal does not support any significant habitat for native flora or fauna. As a general rule, it is possible for threatened plant species to remain in the soil stored seed bank for some time. However, given the highly disturbed nature of the subject site this is considered highly unlikely.

No potential habitat for threatened plant or animal species would be impacted by the proposal. The proposal is not likely to impact any threatened species listed on the TSC or EPBC Acts. Threatened species have not been considered further in this assessment.

3 CONCLUSION

The proposal is not likely to have a significant impact on any threatened species, population or ecological community. Potential impacts from the proposal are confined to areas within a modified and disturbed environment. No potential habitat exists for any threatened flora or fauna, and no EEC will be impacted by the proposal.

3.1 Recommendations

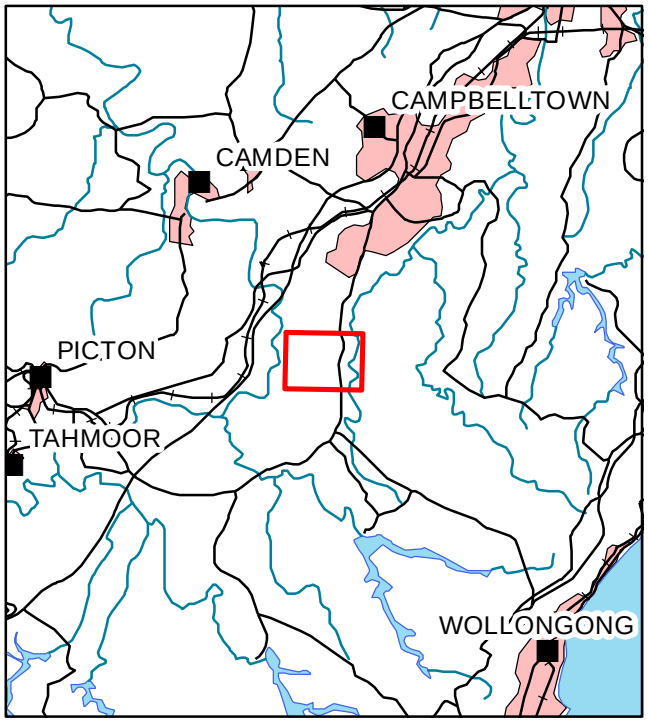
Given the nature of the proposal it is considered unlikely that any significant ecological values will be impacted. However, the following recommendations have been included in the assessment to ensure that the impacts from the proposed activities remain negligible.

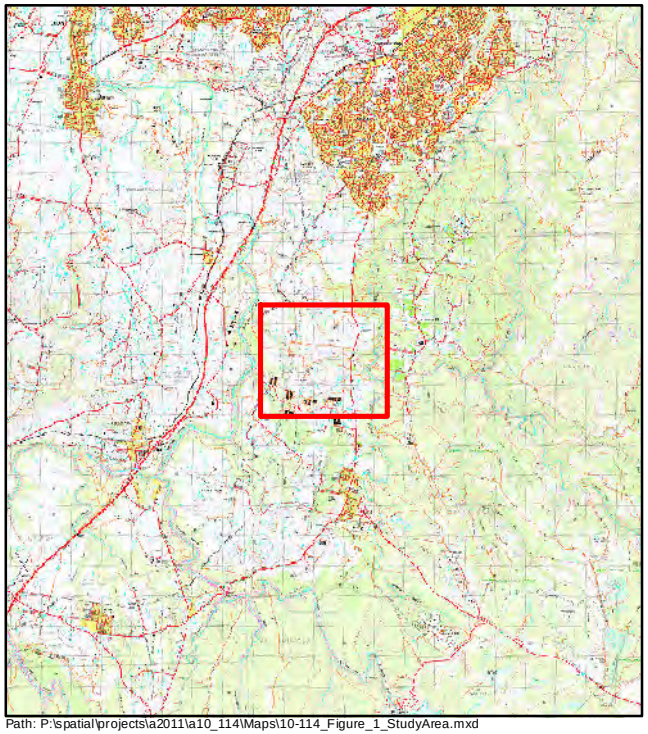
- Appropriate sediment erosion and drainage control measures, such as silt fencing, should be erected around any area where soil is deposited or disturbed to contain sediment laden runoff. This should be done prior to the commencement of works.
- All vehicles and machinery should be restricted to the proposed access tracks and sites, and avoid shrubs, trees and fallen timber.
- Any soils disturbance or vegetation clearing, other than that described in this assessment, will require further assessment.

4 REFERENCES

NSW National Parks and Wildlife Service (2002) *Interpretation guidelines for the native vegetation maps of the Cumberland Plain, Western Sydney*, Threatened Species Unit, Hurstville

ATTACHMENT A - FIGURES





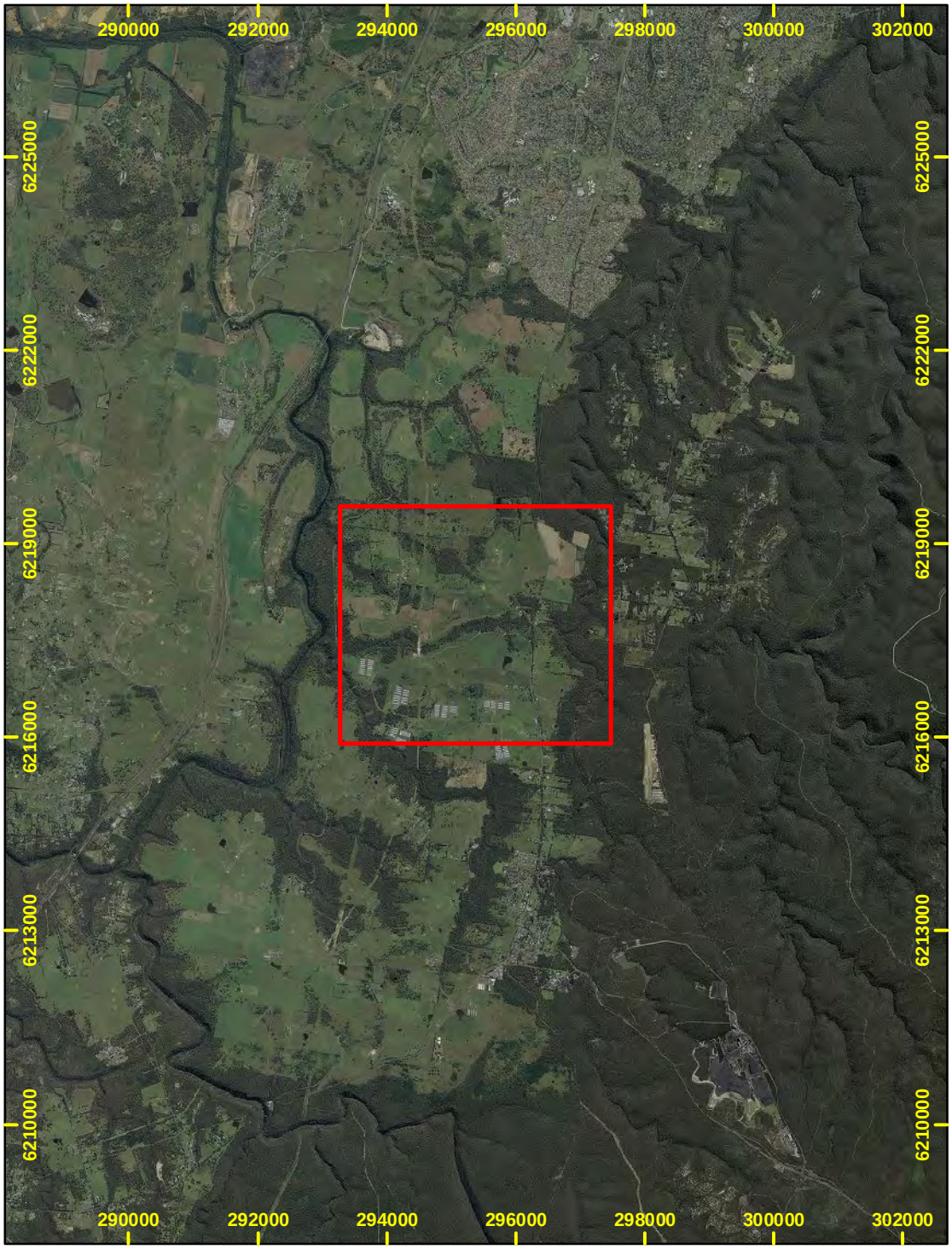


Figure 1: Study Area

10-114 West Cliff
LW 35 Goaf Gas Drainage

Drawn by: RJ

Project Mgr: MR

Date: 06/05/2011

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Figure 2: Site Plan

10-114 West Cliff LW 35 Goaf Gas Drainage

Drawn by: RJ

Project Mgr: MR

Date: 06/05/2011

MRD Wells

SGW Vertical Wells

- Contingency
- Proposed

Boreholes Complete

Compounds

SGW Assessment Areas

SGW Pipelines

Access Tracks

Proposed Mine Layout

Existing Mine Workings

Mine Goaf

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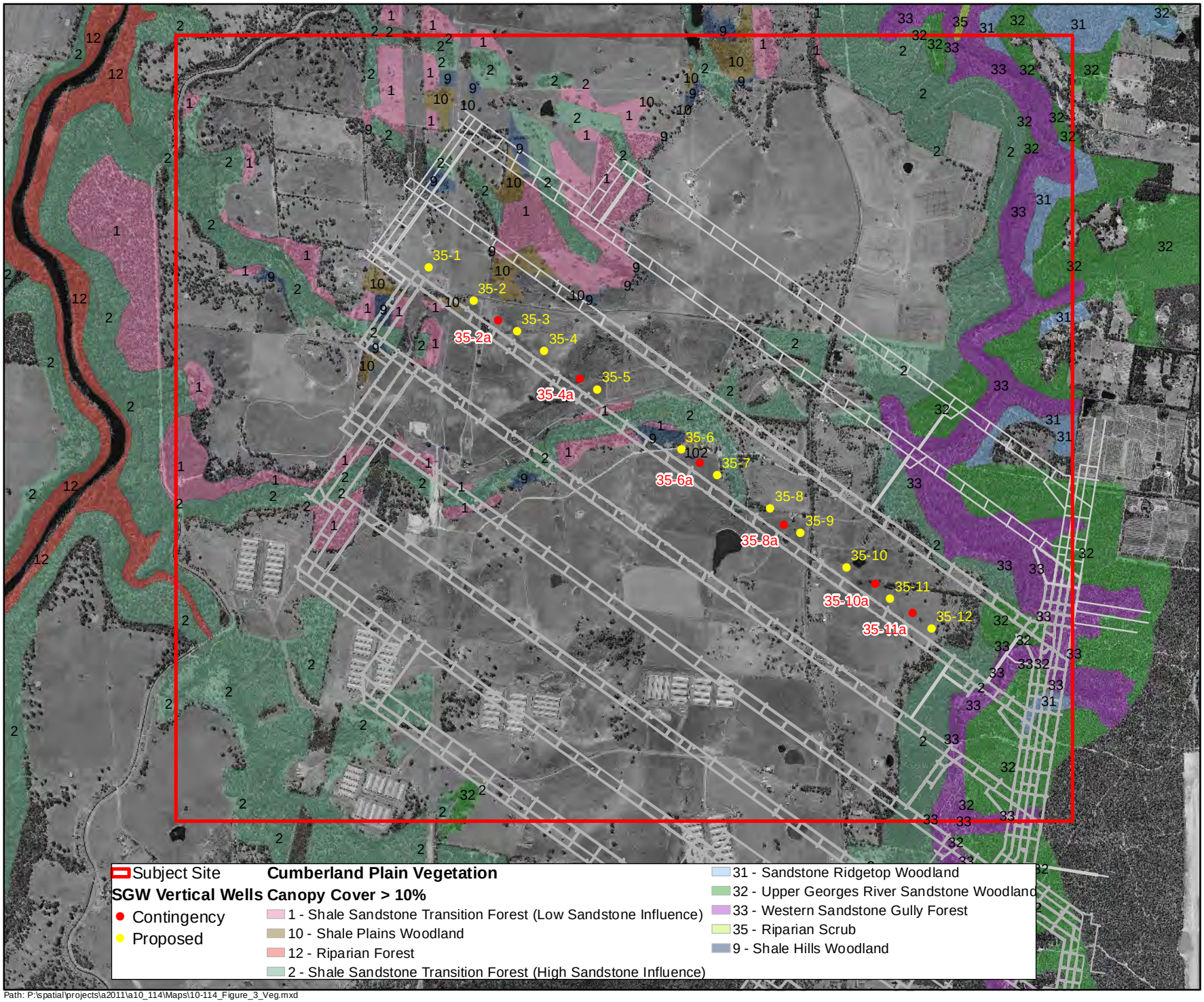

Figure 3: Vegetation Communities Occurring Within the Study Area

10-114 West Cliff LW 35 Goaf Gas Drainage

Drawn by: RJ

Project Mgr: MR

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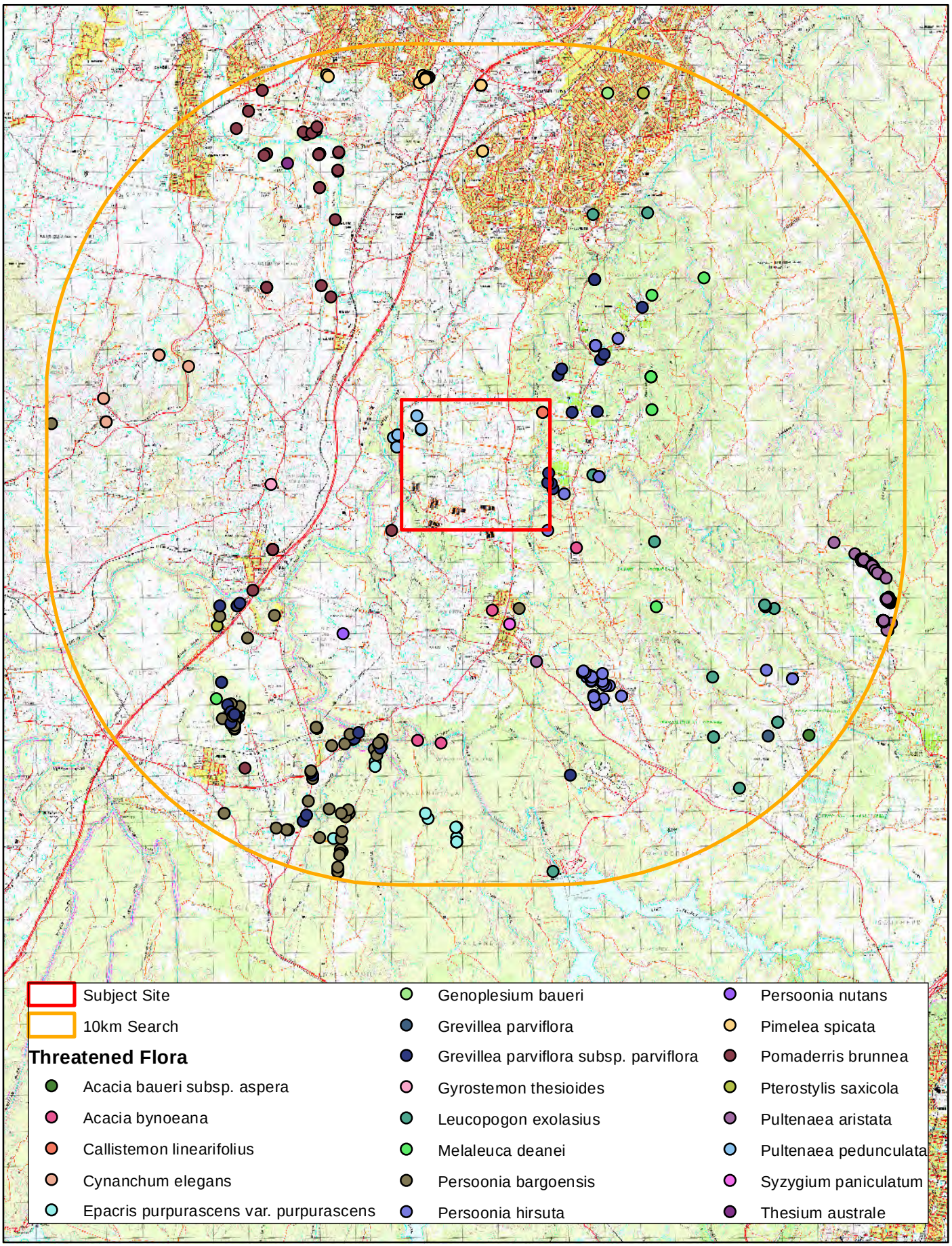

Figure 4: Threatened Flora Previously Recorded Within 10km of the Study Area
10-114 West Cliff LW 35 Goaf Gas Drainage

Drawn by: RJ

Project Mgr: MR

Date: 06/05/2011

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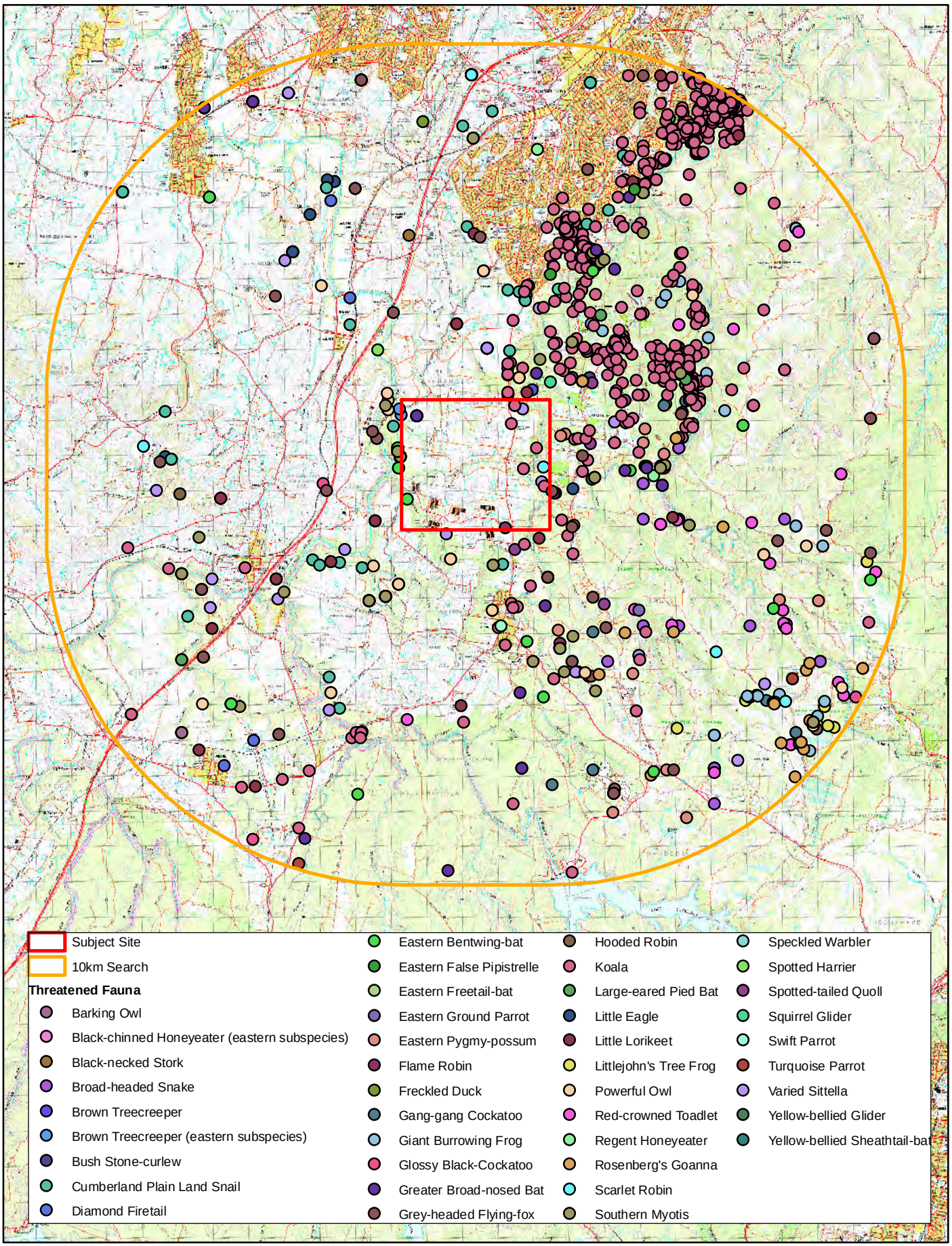

Figure 5: Threatened Fauna Previously Recorded Within 10km of the Study Area
10-114 West Cliff LW 35 Goaf Gas Drainage

Drawn by: RJ

Project Mgr: MR

Date: 06/05/2011

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ATTACHMENT B – SITE PHOTOGRAPHS

Plate 1: Gas well 35-1 location

Plate 2: Gas well 35-2 location

Plate 3: Gas well 35-3 and Flare Extraction Unit site

Plate 4: Gas well 35-4 location

Plate 5: Gas well 35-5 location looking north

Plate 6: Gas well 35-6 location

Plate 7: Gas well 35-7 location

Plate 8: Gas well 35-8 location

Plate 9: Gas well 35-9 beyond the pipes,

Plate 10: Gas well 35-10

Plate 11: Gas well 35-11 – location east

Plate 12: Gas well 35-12 location west

A.7 CULTURAL HERITAGE ASSESSMENT

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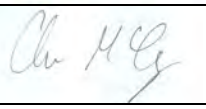
ABORIGINAL OBJECTS DUE DILIGENCE ASSESSMENT

West Cliff Colliery Longwall 35
Goaf Gas Drainage Project
BHP Billiton Illawarra Coal

May 2011

Document Controls

Project No.	10-115		
Document Description	Aboriginal Objects Due Diligence Assessment Longwall 35 West Cliff Goaf Gas Drainage Project BHP Billiton Illawarra Coal		
	Name	**Signed**	**Date**
Niche Project Manager(s)	Matthew Richardson		7-5-2011
	Chris McEvoy		7-5-2011
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Date	7 May 2011		
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Cover Photo:
Borehole 35-3 looking East

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Summary

This report presents a Due Diligence Assessment for Aboriginal Objects in accordance with the *Minerals Council Due Diligence Code of Practice for the Protection of Aboriginal Objects in New South Wales* 2010 and the *National Parks and Wildlife Regulation 2009*. The due diligence assessment is for proposed West Cliff Colliery Goaf Gas Drainage Project for Longwall 35.

The purpose of the assessment was to:

- Determine whether there are any Aboriginal objects that do or are likely to occur within the proposed Project area;
- Determine whether the activities proposed to occur under the auspices of the Project has any likelihood of causing harm to any Aboriginal objects.
- Determine whether or not further investigation is required to evaluate the nature, extant and likelihood of harm to any Aboriginal objects that do/may occur within the Project area;
- Determine whether or not an Aboriginal Heritage Impact Permit under s.90 of the *National Parks and Wildlife Act 1974* (NSW) is required; and
- Provide a documentary record of the due diligence assessment process undertaken including all evidence and decision support mechanisms used to ensure adherence to e the Due Diligence Code of Practice and the NP&W Regulation.

The due diligence assessment involved a consideration of background and contextual information and an inspection of the project site.

The due diligence assessment concluded that the West Cliff Colliery Goaf Gas Drainage Project for Longwall 35 was not going to harm or cause harm to Aboriginal objects because of extensive disturbance associated with previous farming and grazing on the site. However to ensure that no harm was to occur to Aboriginal objects the following two constraints were placed on the Project activities:

1. Avoidance of drainage emplacement activities on the crest and mid and upper slopes of the ridge line that runs north east to south west across the western end of Longwall 35 (Figure 2), due to the assessed archaeological sensitivity of this ridge line
2. A 100m radius avoidance buffer to be maintained about Archaeological site BS 11 (52-2-3691) so as to ensure that it will not be disturbed during the proposed works.

1 Introduction

This report presents the results of an Aboriginal objects due diligence assessment for BHP Billiton Illawarra Coal's West Cliff Colliery Longwall 35 Goaf Gas Drainage Project. The risk assessment considered the potential for the gas drainage project to harm or cause harm to Aboriginal objects.

Niche Environment and Heritage Pty Ltd was commissioned by BHP Billiton Illawarra Coal (BHPBIC) to conduct the Aboriginal object due diligence assessment. The brief from BHPBIC was to conduct background research and site inspections to a level of detail appropriate to satisfy the *National Parks and Wildlife Regulation* 2009 and the Due Diligence Code of Practice for the Protection of Aboriginal Objects in New South Wales 2010, and discharge obligations under these instruments and the *National Parks and Wildlife Act* 1974 with regard to harming Aboriginal objects.

This Aboriginal objects due diligence assessment was prepared by Renée Regal of Niche Environment and Heritage and has been prepared in support of a project modification application under Section 75W of the *Environmental Planning and Assessment Act 1979*.

2 Location

The proposed BHPBIC works are located north west of the township of Appin, NSW (Figure 1).

The study area is bordered in the north by Woodhouse Creek and in the south by Ingham's poultry farm. The area is typically open grazed pasture with native vegetation surrounding the tributaries of Woodhouse and Myrtle Creeks. Native vegetation also surrounds the Nepean River in the east.

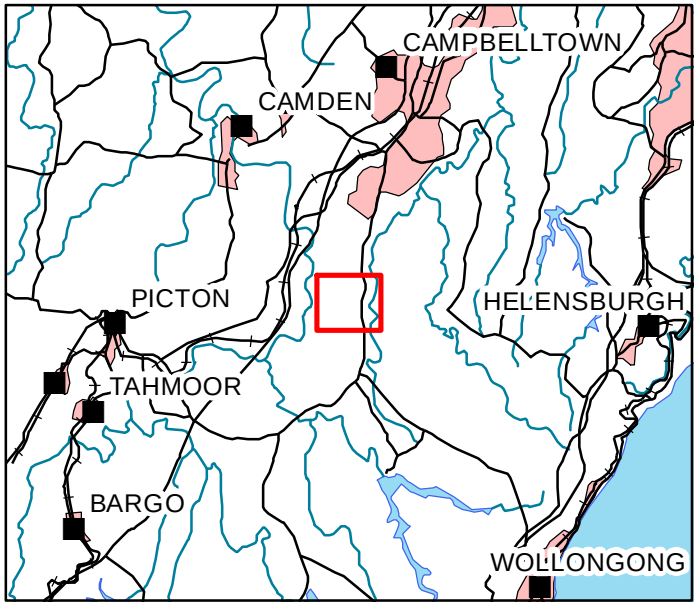
The study area for this Aboriginal objects due diligence assessment is defined as the area within which the proposed BHPBIC works are likely to result in surface disturbance – generally this is the proposed area of each drill site required for the gas extraction wells and their immediate surrounds.

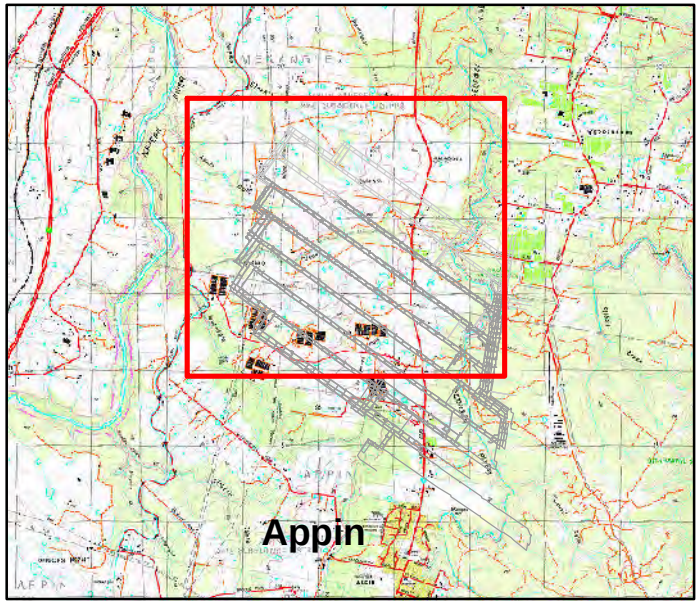
3 Proposed Works

The proposal involves the construction of up to 18 goaf gas drainage boreholes, and up to three gas extraction/flaring units. Generally these sites will require the following construction and on site activities:

- Development of a 30 x 40m drilling compound which will allow for the temporary installation of drilling equipment, gas drainage pipes and, gas extraction and flaring units
- Temporary Installation of site facilities including toilet/washroom facilities at each site
- Movement on site of various vehicles.

A larger (eg. 40x70m) medium radius drilling (MRD) compound may be located adjacent borehole 35-7 if viable.





295000 296000 297000

6219000 6218000 6217000

Appin Road

GEORGES RIVER

Longwall 37

Longwall 36

Longwall 35

Longwall 34

MYLLAN CREEK

35-1 35-2 35-2a 35-3 35-4 35-4a 35-5 35-6 35-6a 35-7 Potential MRD-35-7 35-8 35-8a 35-9 35-10 35-10a 35-11 35-11a 35-12

0 250 500 1,000 Metres

bhpbilliton resourcing the future

Illawarra Coal

Legend

MRD Wells

SGW Vertical Wells

Contingency

Proposed

Electricity Transmission Line

Natural Gas Pipeline

SGW Surface Sites

Drill compounds

Extraction Plants

Aerial Photography 2007

West Cliff Area 5 Surface Goaf Gas Drainage

Longwall 35

Figure 1: Location and Scope of Project Modification # 3

Date: 4 May 2011

Author: R. Jenkins

Signed Off: C. McEvoy

Version 1

Horizontal Datum MGA - Zone 56

N W E S

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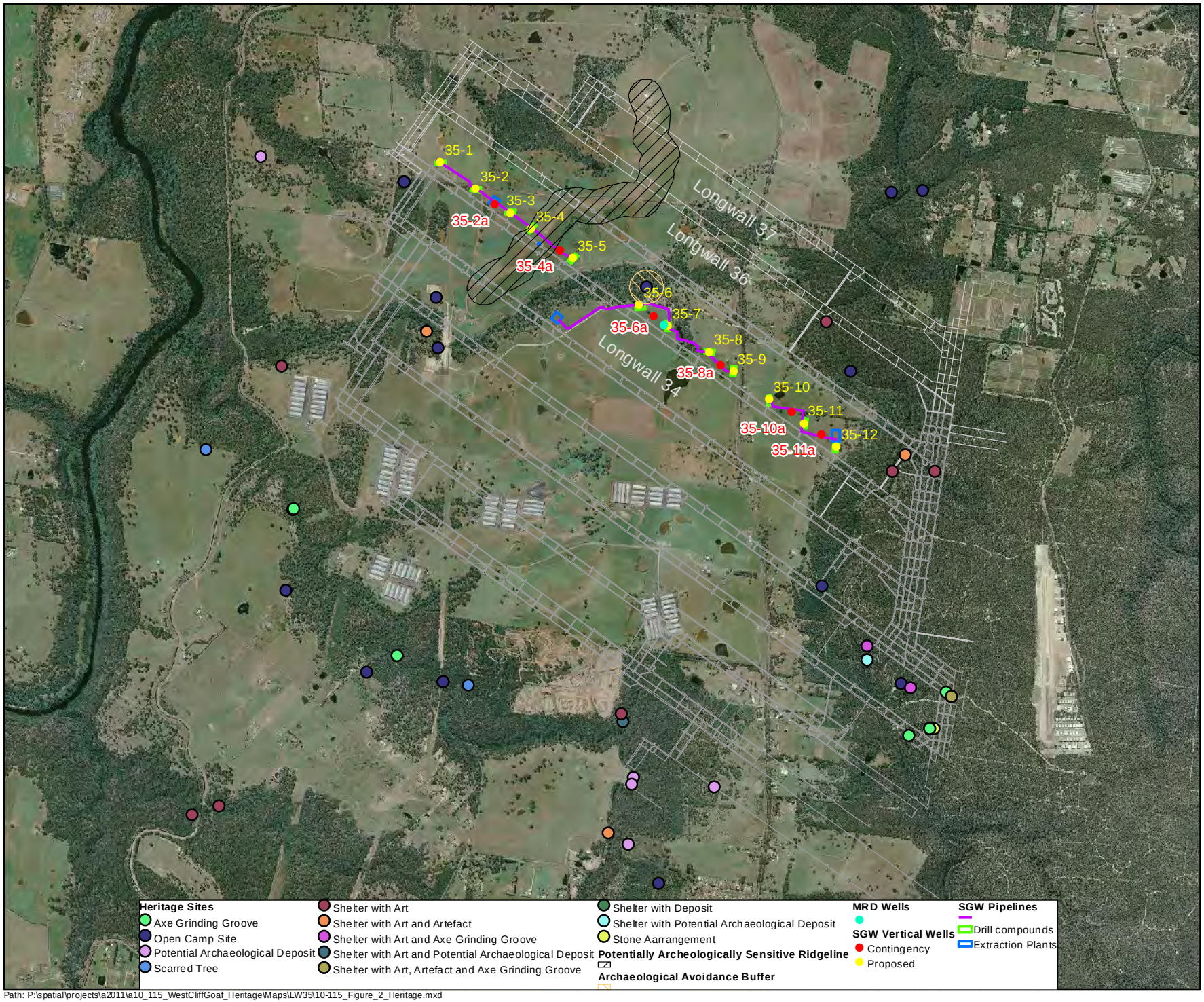

Figure 2: Heritage Sites Previously Recorded in Close Proximity to the Study Area.

10-115 West Cliff LW 35 Goaf Gas Drainage

Drawn by: RJ

Project Mgr: CM

Date: 06/05/2011

niche Environment and Heritage

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4 Environmental and Aboriginal Cultural Contexts - A Summary

Environmental Contexts

The assessment area lies within the Sydney Basin, in the hilly southern margins of the Cumberland Lowlands. This physiographic region generally consists of low lying, gently undulating plains and low hills (Hazelton and Tille 1990: 2). The sandstone plateau, gorges and associated landforms of the Woronora Plateau are present approximately 15 km east of the assessment area, whilst the deep, narrow gorge of the Nepean River is less than 1 km east of the assessment area. The soil landscape of the study area is the Blacktown soil landscape. The A horizon of this landscape is typically up to 60cm in depth and is characterised by friable to hard-setting greyish brown loam to sandy loam. Inclusions in this soil formation include rounded stones, iron indurated stones (laterite), fine shale and occasionally charcoal. The soils are developed from *insitu* weathering of parent materials (Hazelton and Tille, 1990). The climate is warm temperate, with unremarkably warm summers and cool winters. Whilst mean annual rainfall at nearby Picton is around 800 mm (Bureau of Meteorology 2011, Hazelton and Tille 1990: 4) the Blue Mountains to the west does exert a rain shadow effect across the general area.

Prior to European settlement and land clearing the native vegetation in the assessment area would have consisted of eucalypt woodland (DECCW 2010c; Hazelton and Tille 1990: 27-28). Running south west through the assessment area Mallaty Creek is a shallow sandstone drainage line. Although small, Mallaty Creek would have been a reliable water source, especially as the sandstone channel will have formed pools and ponds in times between rains. South east of the assessment area the Nepean River was fed by a large catchment off the Woronora Plateau (which is now dammed by the Avon, Cataract, Cordeaux and Bargo Reservoirs) and would have been a permanent water supply. In all, the assessment area and its surrounds—the Nepean River and western part of the Woronora Plateau—would have provided a suite of locally diverse landscapes and biological communities, providing a rich resource for the Aboriginal people living there prior to European arrival, as is typical for the Hawkesbury-Nepean area of the Sydney Basin (Attenbrow 2010: 37). The climate would have provided no seasonal restriction to year-round occupation of the area. However there is likely to have been differing seasonal use of the region due to the taking advantage of resource abundance, or conducting social and cultural activities (Attenbrow 2010: 79-81). The nearby Mallaty Creek and the Nepean River also contain rock-shelters which were used for art and occupation (Biosis Research 2006a, Sefton 1998).

Aboriginal cultural contexts

The Appin area is the traditional country of the Tharawal people. Tindale has identified the Tharawal boundaries as being from the south side of Botany Bay to north of the Shoalhaven River, and running inland to the Campbelltown and Camden area (Attenbrow 2010: 34, SA Museum 2010). The records and histories of the Tharawal and their country at the time of contact with Europeans are subject to bias and are generally fragmented, providing nothing like a complete picture of the way Aboriginal people were living prior to European interference. Nevertheless, we know the Tharawal regularly communicated, moved, traded and participated in ceremonies between their country and neighbouring areas. It is most likely family groups or clans would 'intermingle and interact along both physical and social boundaries' rather than be strictly confined to the 'tribal' borders that were to be artificially imposed by European anthropologists (Organ 1990: xliii).

The first European documented to have visited the general area was Francis Barrallier, a Frenchman assigned with the New South Wales Corps. In 1802 Governer King tasked Barrallier with exploring a route across the Blue Mountains. In November 1802 Barrallier forded the Nepean River near Menangle (Barrallier 1975). He counted 162 head of feral cattle near here, and reported an abundance of eels, fish, possums, "squirrels" and kangaroo and noted these as all being food resources for the Aborigines (Barrallier 1975: 3-4). However, by the time Barrallier crossed this country the traditional life of the local Aboriginal populations would likely have been catastrophically impacted by European arrival. The smallpox epidemic of April 1789 is known to have decimated Aboriginal populations in the Sydney area and surrounds, including the western Cumberland Plains (Attenbrow 2010: 21).

The township of Appin was named in 1811 and very soon after land grants in the Appin district began to be taken up by European settlers, who arrived and stayed (DEC 2005a). This period was a time of drought, and the competition for resources between the Europeans and the Tharawal, who were adapting to the massive changes that were so quickly brought to them, led to several years of conflict. Organ (1990) documents the various skirmishes, killings and reprisals between Europeans and the Tharawal during 1814 – 1815 in the Cowpastures, Camden and Appin districts. Eventually this sporadic bloodshed would lead to larger scale all out conflict, with Governor Macquarie implementing a sustained punitive action against the Aboriginal population in the district. This resulted in the Appin Massacre of 17 April 1816, in which Aboriginal people were shot and driven over the steep cliffs (probably near Broughtons Pass) to their death during a surprise attack by a detachment of the 46th Regiment, in the middle of the night. The detachments leader, Captain James Wallis, recorded the massacre in his journal:

> I formed line ranks, entered and pushed on through a thick brush towards the precipitous banks of a deep rocky creek. The dogs gave the alarm and the natives fled over the cliffs. A smart firing now ensued... I regret to say some had been shot and others met their fate by rushing in despair over the precipice (quoted in Organ 1990: 77).

Surveying the carnage later that morning Wallis concluded fourteen Aborigines, including women and children, had been killed. By the end of 1816 most of the Aboriginal population had been forcibly removed from the Cowpastures and Appin area, and Macquarie ceased hostilities in the district in November 1816 (Organ 1990: 55; 92). The process of dislocating the Tharawal people from their traditional lands continued as pastoralists and European settlers increasingly took hold. With so many people killed or institutionalised the traditional and adaptive systems of kinship and land use, which had held on throughout Macquarie's war, were broken with the Aboriginal population reduced to a marginal and tenuous existence in a world turned upside down. Despite all this the Tharawal continue as custodians of the land, and many continue to live in Tharawal tribal country today.

Predictive models for Aboriginal Archaeology

In 2010 White and Mcdonald (2010) published the first peer reviewed analysis of the distribution of Aboriginal stone artefacts within the Cumberland Plain/Lowlands region. The focus of their analysis was the Rouse Hill Development Area, a 5km^2 land parcel in western Sydney. White and McDonald (2010) analysed several landscape variables against the results of sub-surface investigations (a database containing 4429 stone artefacts) and concluded that stream order (the size of a drainage line) and landform were the most important factors in determining artefact density and distribution across the Cumberland plain. In summary they concluded that:

Factors influencing artefact density include (1) stream order, with higher order streams tending to have higher artefact densities and more continuous distributions than lower order streams; (2) landform, with higher densities occurring on terraces and lower slopes, and with sparse discontinuous scatters on upper slopes; (3) aspect on lower slopes associated with larger streams, with higher artefact densities occurring on landscapes facing north and northeast; and (4) distance from water, with higher artefact densities occurring 51-100m from 4th order streams, and within 50m of 2nd order streams. (White and McDonald 2010: 36)

5 Regulatory and Assessment Framework

The *National Parks and Wildlife Act* 1974 (NSW)

Part 6 of the *National Parks and Wildlife Act* 1974 (NSW) (the NPW Act) is dedicated to the management and protection of Aboriginal objects and Aboriginal places in New South Wales. The NPW Act establishes three tiers of offence for harming Aboriginal objects:

1. Knowing desecration or harm of an Aboriginal object (s.86(1))
2. Harm of an Aboriginal object - strict liability (s.86(2))
3. Desecration or harm of an Aboriginal place – strict liability (s.86(4)).

Section 87 of the NPW Act establishes defences against prosecution under s.86(1), (2) or (4). The defences are as follows:

1. An Aboriginal Heritage Impact Permit (AHIP) authorising the harm (s.87(1))
2. Exercising due diligence to establish Aboriginal objects will not be harmed (s.87(2)) Due diligence may be achieved by compliance with requirements set out in the National Parks and Wildlife Regulation 2009 (the NPW Regulation) or a code of practice adopted or prescribed by the NPW Regulation (s.87(3))
3. Undertaking "low impact" activities (s.87(4)).

In addition Section 87A(c) establishes an exemption to the section 86(1)-(4) offences of harm outlined in the *National Parks & Wildlife Amendment Act, 2010* relating to emergencies in which threats to life and property are actual or imminent.

The National Parks and Wildlife Amendment Regulation 2010 (NSW)(The NP&W Regulation)

In Section 80A of the NPW Regulation 2010 (s.80A) the *NSW Minerals Industry Due Diligence Code of Practice for the Protection of Aboriginal Objects* (NSW Minerals Council, 2010)(the Minerals Code) is described as one of the codes of practice that can be complied with pursuant to s.87 of the NP&W Act as a defence against prosecution for harm caused to Aboriginal objects. In terms of compliance and certification, the Minerals Code is almost identical in content to the generic *Due Diligence Code of Practice for the Protection of Aboriginal Objects in NSW* (the Code) (NSW Department of Environment, Climate Change and Water 2010).

In addition section 80B of the NP&W Regulation describes "certain low impact activities" that may be carried out without the need to demonstrate/undertake due diligence. For the minerals industry s80B(1) describe industry specific low impact activities associated with mineral exploration. These include non-invasive geophysical survey methods and hand sampling ((s.80B(1)(g)) and invasive works on 'disturbed land' (s.80B(1)(e), (f), (i) and (j)). Disturbed land is defined by s.80B(4) as "disturbed if it has been the subject of a human activity that has changed the land's surface, being changes that remain clear and observable".

Examples given in the notes to s.80B(4) include the construction of roads, trails and tracks, installation of utilities, substantial grazing involving the construction of rural infrastructure and earthworks.

The Generic Due Diligence Code of Practice for the Protection of Aboriginal Objects in New South Wales 2010 and the Industry Specific Minerals Code, 2010

Both the generic and the Industry specific Codes of Practice for the protection of Aboriginal Objects describe the process that must be followed and the actions that must be taken by a proponent, and the site conditions that must be satisfied, to show due diligence in the consideration of potential harm to Aboriginal objects.

The process set out in the Codes involves consideration of harm to Aboriginal objects at increasing levels of detail, with increasing levels of information used to support the decisions being made. The considerations result in a determination of whether or not:

- Harm to Aboriginal objects is likely to occur and hence further approval (an AHIP) under the NPW Act is required before Project activities can be undertaken, or;
- Harm is unlikely and hence the proponent has met and discharged all due diligence obligations for the protection of Aboriginal objects under the Code.

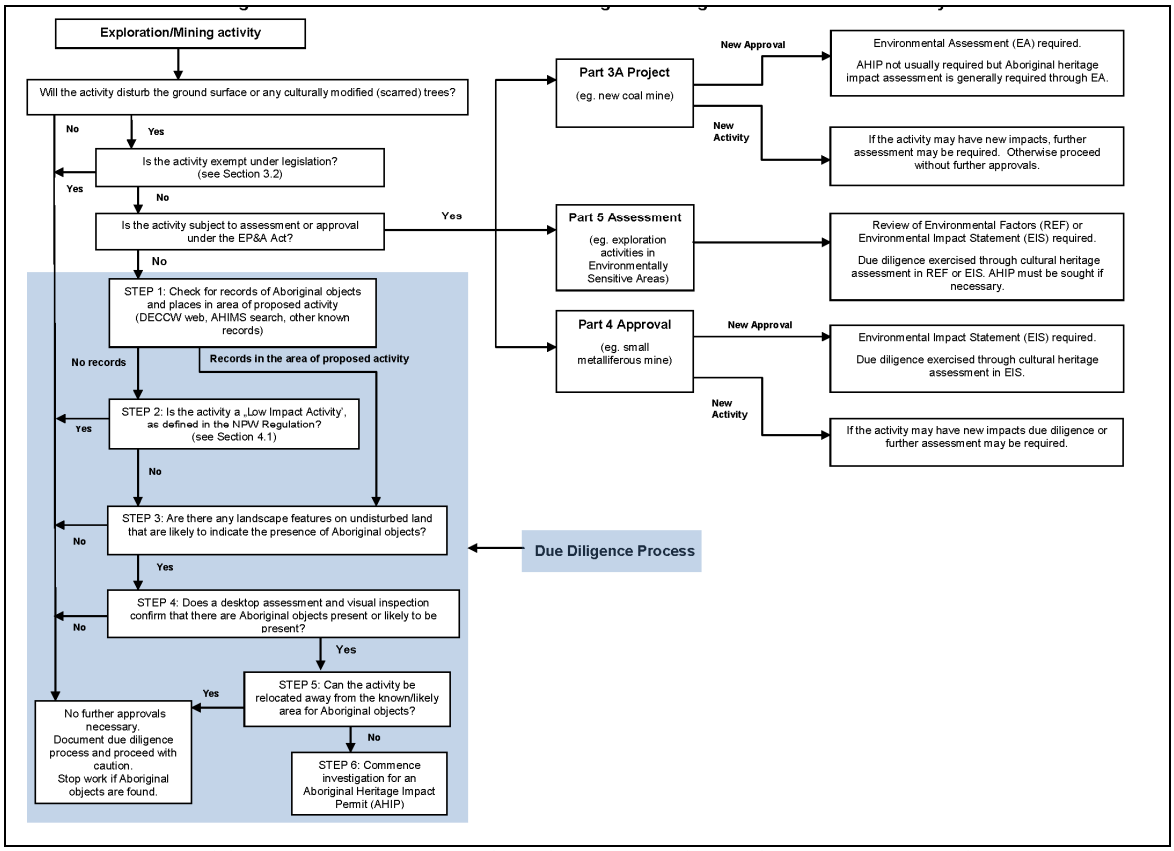

Figure 3. Due diligence process under the Minerals Code (NSW Minerals Council 2010).

6 Aims

This Aboriginal objects due diligence assessment aims to:

- ❒ Conduct a desktop review and archaeological site inspection of the proposed Project area to determine whether there are any Aboriginal objects that do or are likely to occur within it;
- ❒ Determine whether the gas drainage activities proposed have any likelihood of causing harm to any Aboriginal objects that do or are likely occur within the Project area and where applicable propose measures to avoid harming such objects;
- ❒ Determine whether or not further investigation is required to evaluate the nature, extant and likelihood of harm to any Aboriginal objects that do or are likely to occur within the Project area;
- ❒ Determine whether or not an Aboriginal Heritage Impact permit under s90 of the NSW *National Parks and Wildlife Act* 1974 is required;
- ❒ Provide BHPBIC with an Aboriginal objects due diligence assessment compliant with the *National Parks and Wildlife Regulation* 2009 and the *NSW Minerals Industry Due Diligence Code of Practice for the Protection of Aboriginal Objects* 2010;
- ❒ Where applicable advise BHPBIC of the requirements and obligations under the *National Parks and Wildlife Act* 1974 (NSW).

7 Consultation with the Aboriginal Community

There has been no consultation with the Tharawal Local Aboriginal Land Council (TLALC) or other Aboriginal representative groups in regards to the proposed works to be carried out by BHPBIC.

8 Due Diligence Assessment

In accord with clause 80B of the NP&W Regulation, 2009, the due diligence assessment process documented below first considers whether or not the activities expected to occur are low impact activities. With this consideration made the assessment moves to the step-wise consideration of the risk of harm being caused to Aboriginal objects as a result of any or all of the proposed Project related activities.

Is the proposed activity a low impact activity as defined by the Regulation?

No. The proposed 13 Goaf Gas drainage boreholes and 3 gas extraction plants with flaring units are not classified as a low impact activity by the regulation.

Step 1. Will the activity disturb the ground surface?

Yes. The activity involves targeted deep drilling into coal seams to evacuate methane gas prior to the commencement of longwall mining. Ground surface disturbance is likely only within the 30m x 40 m area of drilling compounds to be emplaced about each gas well and the installation of gas transmission pipelines.

Step 2a.Are there any relevant confirmed site records or other associated landscape feature information on AHIMS?

An extensive AHIMS search was conducted on 18 March 2011. The search covered an area that encompassed the West Cliff Colliery Goaf Gas Drainage Study Area. There are 51 previous recordings of Aboriginal archaeological sites in the area surrounding the Project Area.

However of these 51 records four site cards duplicate prior site registrations. Elimination of these duplicates reduces the total number of Aboriginal sites within the near vicinity of the Project Area to 47. The AHIMS search results are presented in Table 1 and shown in Figure 2.

Three of the existing records are for Potential Archaeological Deposits (PAD). It is important to note that PADs are not records of *Aboriginal objects* as defined by the NPW Act, but are areas where the recorder believes Aboriginal objects (usually stone artefacts) are likely to occur, particularly in sub-surface contexts.

The closest recorded site to the proposed Longwall 35 Goaf gas drainage works is Bulli Site 11 (52-2-3691). This is an open camp site situated approximately 115 metres north east of proposed goaf gas drainage well # 35-6. Activities associated with the emplacement and use of well site #35-6 will have no impact on this stone artefact scatter.

There is also a prominent ridge line that runs north east to south west above the western end of Longwall 35 which has been determined (to have the potential to yield Aboriginal objects, and hence is considered to be archaeologically sensitive (Figure 2). Essentially this is because the Blacktown soil landscape that is characteristic of the study area where coupled with sensitive landforms such as this ridge line have been shown to accumulate Aboriginal objects such as stone artefacts (Niche 2010). The area of the ridge line that runs along Longwall 35 has been subject to disturbance from farming associated activities, but the soil profile appears from the surface to be largely intact. A number or areas of exposure from cattle movement and an unpaved access track were surveyed for possible artefact exposure but none were identified.

Table 1. AHIMS search results within 200m of gas well 35-6

AHIMS site number	Site Features
52-2-3691	Artefact(s)

Step 2b. Are there any other sources of information of which a person is already aware?

A brief outline of the environmental and Aboriginal cultural heritage contexts of the subject area, as understood by Niche, is provided in Section 4 above. This has been derived both from relevant literature sources and from prior aboriginal cultural heritage assessments conducted by Niche in similar landscapes of the Cumberland Plain and adjacent Illawarra Escarpment.

In addition historic aerial photographic interpretation (API) has been used to assess previous disturbance to the area. This indicates that native vegetation has been cleared across all of the proposed Goaf gas drainage well sites. Soil ploughing is also likely to have occurred both for cropping and pasture improvement. These disturbances are likely to have been minor in nature and may only have affected the soil horizon to a depth of between 10 and 30 cm (Niche 2010). Current land use at all well sites includes grazing.

With these known disturbances, and the archaeological expectation for the general area that Aboriginal objects (primarily stone artefacts) are considered most likely to have been located either in the top soil, or at the boundary of the topsoil and more compact lower horizons, it is not expected that *in situ* traces of past Aboriginal land use – Aboriginal objects - will remain in the lower slopes and previously ploughed areas where topsoil has been removed.

Step 2c. Are there landscape features that are likely to indicate the presence of Aboriginal objects?

Yes. On the Cumberland Plain the margins of larger creeks and streams are considered to be archaeologically sensitive to a distance of 200 m from each drainage line (White and McDonald 2010).

Also, as identified at Step 2a above, the ridge line that runs north east to south west along the western end of Longwall 35 has been identified as archaeologically sensitive as it is likely to contain intact topsoil. For this ridge line the presence of intact topsoil coupled with its near vicinity to the identified open camp site [AHIMS Site # 52-2-3691] make it likely that Aboriginal stone objects are still present within its upper slope and crest. This identification of archaeological sensitivity accords with the Minerals Code recognition that further investigation of landscape features such as ridgelines may be required because of *Aboriginal people's use of those features in their every day lives for traditional activities* (Minerals Council, 2010:17).

Step 3: Can the harm or the activity be avoided?

There is limited scope to relocate the proposed works.

As far as practicable the works have been located within areas that have previously been disturbed through land clearance and pasture improvement practices. Goaf gas well location 37-5 has also been moved off the ridge top, since the generic due diligence code identifies that ridge tops can be areas of potential archaeological sensitivity.

Step 4: Desktop assessment and visual inspection

The desktop assessment has been presented above.

A site inspection was undertaken by Renée Regal on 17 March and 4 April 2011. The notes from the visual inspection are summarised below for each goaf gas well, extraction well and MRD footprint area.

Site Name	Archaeological assessment notes	Recommendations
35-1	• Area previously cleared for agriculture. Horses currently grazing in the paddock. • No remnant vegetation. • No visibility due to long length of grass. • Gently sloping location.	No further archaeological assessment required.
35-2	• Area previously cleared for agriculture. • No remnant vegetation. • No visibility due to long length of grass. • Gently sloping location.	No further archaeological assessment required.
35-2a Goaf Gas Extraction borehole and three flaring units	• Area previously cleared for cattle grazing. • No remnant vegetation. • The assessment of this borehole location was through desktop research only.	No further archaeological assessment required.

35-3	• Area previously cleared for agriculture. • No remnant vegetation. • No visibility due to long length of grass. • Gently sloping location.	No further archaeological assessment required.
35-4	• Area previously cleared for agriculture. • No remnant vegetation. • No visibility due to long length of grass. • Gently sloping location. This borehole has been moved north west of its original location to avoid the archaeologically sensitive ridge line.	No further archaeological assessment required.
35-4a	• Are Area previously cleared for agriculture. • No remnant vegetation. • No visibility due to long length of grass. • Gently sloping location.	No further archaeological assessment required.
35-5	• North off an existing farm access track. • Area previously cleared for agriculture. • No remnant vegetation. • No visibility due to long length of grass. • Gently sloping location.	No further archaeological assessment required.
35-6	• Area previously cleared for agriculture. • 40 metres off tributary of Mallaty Creek. • Remnant vegetation around tributary of Mallaty Creek. • Limited visibility due to long length of grass.	No further archaeological assessment required. However it is recommended that site personnel at site 35-6 be made aware that there is one registered Aboriginal site- Open Camp Site (52-2-3691) approximately 115 m north east of the proposed goaf gas borehole location, and that this is to be avoided.
35-6a Contingency Extraction borehole and extraction plant	• Area previously cleared for agriculture. • 40 metres off tributary of Mallaty Creek. • Remnant vegetation around tributary of Mallaty Creek. • Limited visibility due to long length of grass.	No further archaeological assessment required. However it is recommended that those working at site 35-6 be made aware that there is one registered Aboriginal site- Open Camp Site (52-2-3691) approximately 190m north east of the proposed extraction plant location, and that this site is to be avoided.
35-7	• Area previously cleared for agriculture. • 40 metres off tributary of Mallaty Creek. • Remnant vegetation around tributary of Mallaty Creek. • Limited visibility due to long length of grass.	No further archaeological assessment required.

35-8	• Area previously cleared for agriculture. • 40 metres off tributary of Mallaty Creek • Remnant vegetation around tributary of Mallaty Creek. • Limited visibility due to long length of grass.	No further archaeological assessment required.
35-8a Contingency Borehole	• Area previously cleared for agriculture. • 80 metres off tributary of Mallaty Creek • Remnant vegetation around tributary of Mallaty Creek. • The assessment of this borehole location was through desktop research only.	No further archaeological assessment required.
35-9	• Area previously cleared for agriculture. • 120 metres off tributary of Mallaty Creek. • Remnant vegetation around tributary of Mallaty Creek. • Area previously disturbed due to the implementation of a Telstra fibre optic cable. • Limited visibility due to the length of the grass.	No further archaeological assessment required.
35-10	• Area previously cleared for agriculture. • Borehole located within close proximity to a dam. • Limited visibility due to the length of the grass.	No further archaeological assessment required.
35-10a Contingency Borehole	• Area previously cleared for agriculture. • Limited native vegetation remaining. • The assessment of this borehole location was through desktop research only.	No further archaeological assessment required.
35-11	• Area previously cleared for agriculture. • Limited native vegetation remaining. • Limited visibility due to the length of the grass.	No further archaeological assessment required.
35-11a Contingency Borehole	• Area previously cleared for agriculture. • Limited native vegetation remaining. • The assessment of this borehole location was through desktop research only.	No further archaeological assessment required.
35-12 Goaf Gas Extraction borehole and three flaring units	• Area previously cleared for agriculture. • Limited native vegetation remaining. • Limited visibility due to the length of the grass.	No further archaeological assessment required.

Step 5. Further investigations and impact assessment

It is the conclusion of this due diligence assessment that Aboriginal objects are not present within the area assessed, therefore further work and investigation is not required.

9 Conclusion

The proposed project areas have been assessed in accordance with the *National Parks and Wildlife Regulation* 2009 and the Due Diligence Code of Practice for the Protection of Aboriginal Objects in New South Wales 2010.

The due diligence assessment concluded that the project was not going to harm or cause harm to Aboriginal objects because of extensive disturbance, associated with previous farming and grazing throughout the area.

There are two identified constraints to the proposed Longwall 35 goaf Gas Drainage project. They are:

1. The ridge line running north east to south west across the western end of Longwall 35 (Figure 2) which is to be avoided due to archaeological sensitivity, and
2. Archaeological site BS 11 (52-2-3691) which is to have a buffer of avoidance of 100 metres so as not to be disturbed during the proposed works.

10 Recommendations

Having found no Aboriginal objects within the proposed impact area for this Project, and having found that there are no grounds with which to support the conduct of any further investigation of the development area it is recommended that:

- No further archaeological or Aboriginal assessment is required for this Project to proceed;
- During emplacement and use of each gas well and its associated drainage and flaring infrastructure BHPIC adopt a risk management strategy to ensure that - despite the low likelihood of Aboriginal objects being situated upon or within the ground of the proposed activities - an appropriate cessation of work protocol is established should any such objects be exposed during construction works. This protocol should include timely and appropriate consultation with the Office of Environment & Heritage[1];
- It is recommended that the ridge line on the western end of Longwall 35 be avoided due to archaeological sensitivity and that there be a buffer of 100 metres placed around site BS 11 (52-2-3691) to avoid any adverse effects during the development of this goaf gas drainage proposal.
- This Aboriginal archaeological due diligence assessment report be recognised as providing the documentary evidence that the proponent has adopted a precautionary approach with respect to Aboriginal objects; and in so doing has met and discharged all due diligence obligations with respect to such objects.

[1] Formerly the Department of Environment Climate Change and Water (DECCW).

- ❒ This Aboriginal archaeological due diligence assessment report be retained by the proponent as evidence of compliance with the *Due Diligence Code of Practice for the Protection of Aboriginal Objects in NSW*.

BHPBIC standard work instructions for emergency response procedures for Aboriginal cultural heritage will adequately manage any residual risks, and should be implemented.

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A.8 AIR QUALITY ASSESSMENT

REPORT

WEST CLIFF AREA 5 GAS DRAINAGE PROJECT – AIR QUALITY ASSESSMENT & MANAGEMENT

BHP Billiton Illawarra Coal

Job No: **5618**

11 May 2011

PROJECT TITLE:	**BULLI SEAM GAS DRAINAGE PROJECT – AIR QUALITY ASSESSMENT AND MANAGEMENT PLAN**
JOB NUMBER:	**5816**
PREPARED FOR:	Bruce Blunden **BHP BILLITON ILLAWARRA COAL**
PREPARED BY:	R. Kellaghan
APPROVED FOR RELEASE BY:	R. Kellaghan
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ES1 EXECUTIVE SUMMARY

Overview

Additional gas drainage infrastructure is required to ensure ongoing safe and efficient mining in West Cliff Mine's Area 5 Longwall (LW) 35. The purpose of this assessment is to consider the air quality impacts of gas drainage infrastructure including goaf wells, extraction sites, pipelines, extraction plant and flares.

Existing Environment

Local meteorological data is collected at the Energy Developments Limited (EDL) Appin Power Station, located approximately 4.5 km south of the West Cliff Area 5 site and used to describe and characterise the dispersion meteorology for the area. Ambient air quality around Appin can be assumed to be a relatively clean semi-rural environment, with ambient levels of key pollutants all well below the impact assessment criteria.

Emissions and Modelling Approach

This project involves the installation of 12 vertical extraction wells installed above LW35 connected via pipeline to one of six mobile extraction plant locations. Gas is either flared or vented at the extraction plant locations. Emissions to air will result from:

- Mobile goaf extraction plant including diesel powered compressor;
- Enclosed flares for combustion of goaf gas and destruction of methane, a potent greenhouse gas (GHG); and
- A remote vent stack for the venting of excess goaf gas.

The pollutants considered for the assessment are NO_x and PM_{10} from the extraction plant and flaring of the goaf gas and odour from the venting of excess goaf gas. These key pollutants are the most significant limiting pollutants in terms of the establishing appropriate offset distances from residences. Dispersion modelling is performed for all emission sources for the proposed project to determine the required offset distances where applicable air quality impact assessment criteria can be safely achieved.

Results & Assessment

Modelling of emissions from the operation of the proposed goaf gas extraction plant indicates air quality impacts at 150 m from the extraction plant are minimal. The 1-hour NO_2 concentrations are predicted to be approximately 20% of the impact assessment criteria and the 24-hour PM_{10} concentrations are predicted to be less than 5% of the impact assessment criteria at 150 m from each site. Odour impacts are predicted to be minimal. Even when background concentrations are taken into account, there appears to be reasonable level of flexibility in the final chosen location for the goaf gas extraction plant. The minimum setback distance recommended from the gas extraction plant is 100 m.

Existing goaf gas capture and flaring at LW34 is estimated to offset approximately 73 kt CO_2-e / annum of GHG emissions. If 3 flares operate for LW35, this is estimated to increase to 93 kt CO_2-e / annum. Air quality impacts during the construction phase will be minor, short lived and easily controlled through commonly applied dust management measures.

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1 INTRODUCTION

BHPBilliton Illawarra Coal Pty. Ltd. (BHPBIC) operates the West Cliff Mine, an underground longwall mining operation in the Bulli Seam of the Illawarra Coal Measures in the Southern Coalfield area of NSW, approximately 25 km north-west of Wollongong.

As part of the continued development of underground mining within Area 5 of the West Cliff Mine, additional gas drainage infrastructure is required to ensure ongoing safe and efficient mining in Longwall (LW) 35. BHPBIC has mined Longwalls 32 and 33 in West Cliff Area 5 in accordance with existing approvals and mining of Longwall 34 commenced in January 2010. The operation of the associated goaf gas extraction system commenced soon after, consisting of vertical goaf gas drainage wells connected via pipeline to a centralised extraction plant where the venting and flaring of the gas takes place.

1.1 Objectives of the Study

The purpose of this assessment is to consider the air quality impacts of future gas drainage infrastructure proposed for Longwall (LW) 35, including associated access routes, pipelines, extraction plant and flares. The air quality assessment forms part of the overall Gas Drainage Management Plan and provides an indication of the potential air quality impacts from goaf gas extraction plants and the required management and minimisation measures (including required buffer area) to avoid significant impacts.

2 PROJECT DESCRIPTION

An overview of the West Cliff Area 5 Surface Goaf Gas Drainage plan for LW35 is shown in **Figure 2.1**.

Goaf gas extraction and flaring associated with mining LW35 will occur using the same techniques and technologies as current operations, viz. drainage of goaf gas immediately after coal removal, with the gas extracted to the surface via a cased borehole installed prior to mining and the linking of gas extraction wells to a centralised extraction plant with 2 operating flares and a remote vent stack.

Goaf gas drainage for LW35 involves the installation of 12 vertical extraction wells installed above LW35 connected via pipeline to mobile extraction plants.

Following the extraction of the gas, the gas is either flared on the surface or vented to the atmosphere. Flaring of the goaf gas will be via two or three enclosed flares with an approximate combined capacity of up to 350 L/s. Any remaining gas is vented direct into the atmosphere.

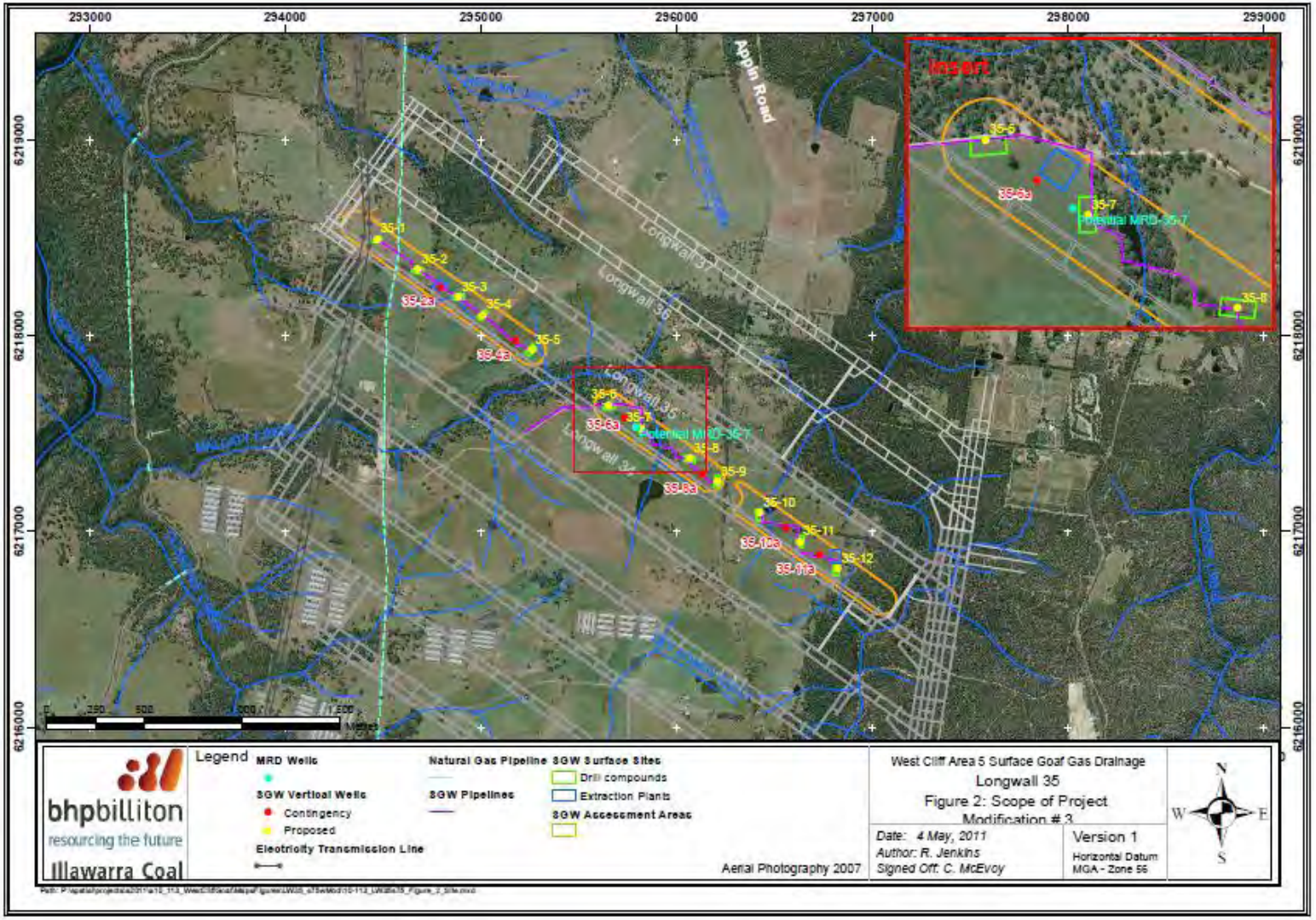


Figure 2.1: Longwall 35 Proposed Goaf Gas Drainage Plan

3 LOCAL SETTING

An overview of the West Cliff Area 5 Goaf Gas Drainage infrastructure for LW35 is shown in **Figure 2.1** including the three potential extraction plant locations. The infrastructure is on land located approximately 4 km to the north of the township of Appin, NSW. The existing landscape for the area on which the infrastructure is proposed can be described as mostly, urban agricultural land, mostly cleared with undulating to hilly topography.

Rural residential properties exist across the project area, mostly along Bulli Appin Road. For the purposes of assessing air quality impacts the sensitive receptor locations are selected consistent with the noise assessment report (refer **Figure 3.1**).

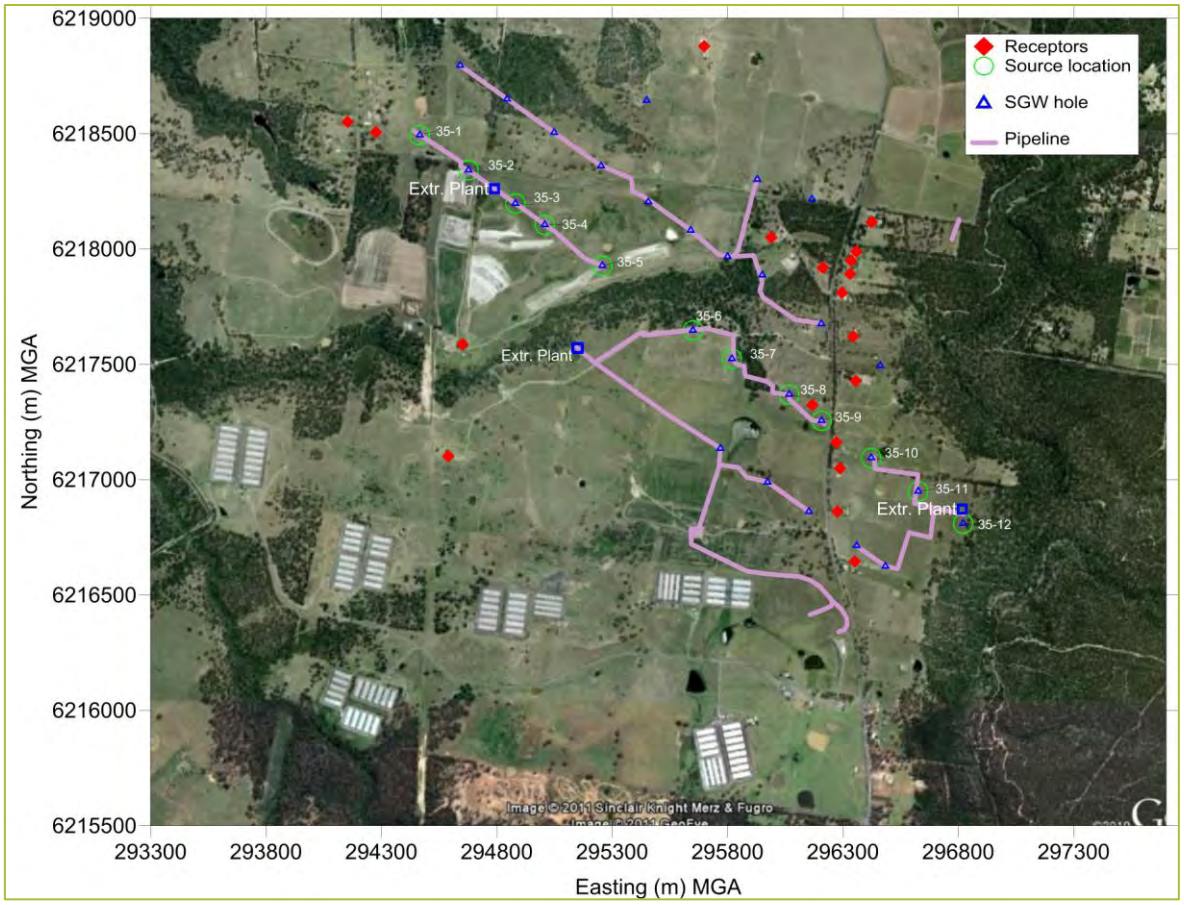


Figure 3.1: Local Setting and Receptor Locations

4 AIR QUALITY CRITERIA

Operation of the West Cliff Area 5 LW35 goaf gas drainage project will result in emissions to air from the extraction system, the vent stacks and the flares. Emissions to air are summarised as follows:

- the flaring of coal seam methane and combustion of diesel in generators will result in emissions of oxides of nitrogen (NO_x), carbon monoxide (CO), particulate matter (PM_{10}) and volatile organic compounds (VOCs).
- emissions from the free venting stack will be mostly methane (~90%) with smaller amounts of nitrogen, carbon dioxide (CO_2), ethane, and other hydrocarbons; and
- fugitive dust emissions can be expected during construction. However these emissions are expected to be limited in scale and duration and easily controllable by conventional means. In addition, emissions from diesel-powered construction equipment are also typically too small and too widely dispersed to give rise to significant off-site concentrations.

4.1 Particulate Matter

Emissions of particulate matter are generally considered in three separate size fractions. These are described as total suspended particulate matter (TSP), particulate matter with equivalent aerodynamic diameters 10 μm or less (PM_{10}) and particles with equivalent aerodynamic diameters of 2.5 μm and less ($PM_{2.5}$). Particulate matter has the capacity to affect health and to cause nuisance effects. The extent to which health or nuisance effects occur, relates to the size and/or by chemical composition of the particulate matter. The human respiratory system has in-built defensive systems that prevent particles larger than approximately 10 μm from reaching the more sensitive parts of the respiratory system. Particles with aerodynamic diameters less than 10 μm are referred to as PM_{10}.

Particles larger than 10 μm, while not able to affect health, can soil materials and generally degrade aesthetic elements of the environment. For this reason air quality goals make reference to measures of the total mass of all particles suspended in the air. This is referred to as Total Suspended Particulate matter (TSP). In practice, particles larger than 30 to 50 μm settle out of the atmosphere too quickly to be regarded as air pollutants. The upper size range for TSP is usually taken to be 30 μm. TSP includes PM_{10}.

4.2 Oxides of Nitrogen

The key pollutant released from combustion and flaring of coal seam methane, will be oxides of nitrogen (NO_x). NO_x is comprised of nitric oxide (NO) and nitrogen dioxide (NO_2), however NO is not generally considered harmful to human health and not considered an air pollutant at the concentrations that are typically found in ambient environments. Effects of NO_2 include respiratory infections, asthma and chronic lung disease.

4.3 Carbon Monoxide

Emissions of Carbon Monoxide (CO) can be expected from the combustion and flaring of coal seam methane. Carbon monoxide is a colourless, odourless gas, formed from the incomplete or inefficient combustion of fuels containing carbon. Exposure to CO can cause a reduction in the oxygen-carrying capacity of the red blood cells, resulting in decreased oxygen supply to vital organs such as the heart and brain.

4.4 Volatile Organic Compounds (VOCs)

Volatile Organic Compounds is a term given to various organic chemical components, several of which are considered air toxics. Methane itself is a common VOC but is often distinguished from other VOCs using the term non-methane VOCs or NMVOCs. Methane is not generally considered a pollutant in ambient air quality, however it is a potent greenhouse gas.

Air toxins are present in the air in low concentrations, however characteristics such as toxicity or persistence means they can be hazardous to human, plant or animal life. There is evidence that cancer, birth defects, genetic damage, immuno-deficiency, respiratory and nervous system disorders can be linked to exposure to occupational levels of air toxics.

4.5 Odour

The determination of air quality goals for odour and their use in the assessment of odour impacts is recognised as a difficult topic in air pollution science. The topic has received considerable attention in recent years and the procedures for assessing odour impacts using dispersion models have been refined considerably. There is still considerable debate in the scientific community about appropriate odour goals as determined by dispersion modelling. There are two factors that need to be considered:

- what "level of exposure" to odour is considered acceptable to meet current community standards in NSW; and
- how can dispersion models be used to determine if a source of odour meets the goals which are based on this acceptable level of exposure.

The term "level of exposure" has been used to reflect the fact that odour impacts are determined by several factors the most important of which are:

- the **F**requency of the exposure;
- the **I**ntensity of the odour;
- the **D**uration of the odour episodes; and
- the **O**ffensiveness of the odour (the so-called FIDO factor)

In determining the offensiveness of an odour it needs to be recognised that for most odours the context in which an odour is perceived is also relevant. Some odours, for example the smell of sewage, hydrogen sulfide, butyric acid, landfill gas etc., are likely to be judged offensive regardless of the context in which they occur. Other odours such as the smell of jet fuel may be acceptable at an airport, but not in a house, and diesel exhaust may be acceptable near a busy road, but not in a restaurant.

In summary, whether or not an individual considers an odour to be a nuisance will depend on the FIDO factors outlined above and although it is possible to derive formulae for assessing odour annoyance in a community, the response of any individual to an odour is still unpredictable. Odour goals need to take account of these factors.

4.6 Summary of Air Quality Goals

The NSW Office of Environment and Heritage (OEH)[a] prescribe ambient impact assessment criteria which are outlined in their "Approved Methods for Modelling and Assessment of Air Pollutants in NSW (**NSW DEC, 2005**).

The impact assessment criteria refer to the total pollutant load in the environment and impacts from new sources of these pollutants must be added to existing background levels for compliance assessment. **Table 4.1** summarises the air quality goals that are relevant to this study.

Table 4.1: Air quality Goals for Particulate Matter

Pollutant	Standard	Averaging Period
PM_{10}	50 µg/m3	24-hour maximum
	30 µg/m3	Annual mean
	50 µg/m3	24-hour average
Nitrogen Dioxide	246 µg/m^3	1-Hour
	62 µg/m^3	Annual
Carbon Monoxide	30 mg/m^3	1-Hour
	10 mg/m^3	8-Hour

The Approved Methods include impact assessment criteria for complex mixtures of odorous air pollutants. They have been refined to take account of population density in the area. **Table 4.2** lists the odour impact assessment criterion to be exceeded not more than 1% of the time, for different population densities.

Table 4.2: Impact Assessment Criteria for the Assessment of Odorous air pollutants

Population of affected community	Impact Assessment Criteria for Complex Mixtures of Odorous Air Pollutants (OU, nose-response-time average, 99th percentile)
≤ ~2	7
~10	6
~30	5
~125	4
~500	3
Urban (2000) and/or schools and hospitals	2

The difference between odour goals is based on considerations of risk of odour impact rather than differences in odour acceptability between urban and rural areas. For a given odour level there will be a wide range of responses in the population exposed to the odour. In a densely populated area there will therefore be a greater risk that some individuals within the community will find the odour unacceptable than in a sparsely populated area.

[a] The NSW EPA exists as a legal entity operated within the Office of Environment and Heritage (OEH) which came into existence in April 2011. OEH was previously part of the Department of Environment, Climate Change and Water (DECCW). The DECCW was also recently known as the Department of Environment and Climate Change (DECC), and prior to that the Department of Environment and Conservation (DEC). The terms NSW EPA, OEH, DECCW, DECC and DEC are interchangeable in this report.

5 EXISTING AMBIENT AIR QUALITY

Air quality standards and goals are used to assess the total pollutant level in the environment, including the contribution from new projects with existing sources. To fully assess impacts against all the relevant air quality standards and goals it is necessary to have information on the background concentrations to which the project is likely to contribute.

The NSW DECCW operates a number of monitoring stations in South West Sydney , as follows:

- MacArthur (UWS Campbelltown Campus) located approximately 15 km south of Appin;
- Bargo (Silica Road) located approximately 22 km southwest of Appin; and
- Oakdale (Ridge Road) located approximately 31 km northwest of Appin.

Although these stations are located at a reasonable distance from the project site they can be used to provide an indication of existing ambient air quality for the area around Appin.

Based on the data presented in **Table 5.1**, the area around Appin can be assumed to be a relatively clean semi-rural environment, with ambient levels of key pollutants all well below the impact assessment criteria. It is noted that the 24-hour average PM_{10} concentration at MacArthur did exceed the impact assessment criteria on one occasion during 2010. The 24-hour average PM_{10} concentrations can be highly variable and, in many parts of NSW, it is common for the impact assessment criteria to be exceeded on several occasions each year due to widespread events such as bushfires or dust storms. The annual average PM_{10} concentrations are consistent with a relatively clean semi-rural environment.

Table 5.1: Existing Ambient Air Quality

Pollutant	Reporting Statistic	Bargo	MacArthur	Oakdale	Air Quality Objective
NO_2 (µg/m^3)	1 Hour Max	110.9	79.0	43.2	246 µg/m^3
	Annual Average	8.8	16.0	3.9	62 µg/m^3
CO (mg/m^3)	8 Hour Max	-	1.0	-	10 mg/m^3
SO_2 (µg/m3)	1 Hour Max	21.0	26.2	-	570 µg/m^3
	24 Hour Max	2.6	7.9	-	228 µg/m^3
	Annual Average	0.2	0.9	-	60 µg/m^3
PM_{10}	24 Hour Max	-	58.7	33.3	50 µg/m^3
	Annual Average	-	14.0	10.7	30 µg/m^3

5.1 Odour

It is not always practical to assess the cumulative odour impact of all odour sources that may impact on discrete receptors, although in a rural area such as Appin, the number and type of odour sources may be more easily identified. However it is common in odour assessment to assess the incremental increase in odour from a proposed development against the assessment criteria, particularly where no other sources of similar odour character are present.

6 PREVAILING METEOROLOGY

6.1 Prevailing Winds

Local meteorological data are collected at the EDL Appin Power Station, located approximately 4.5 km south of the West Cliff Area 5 site. Annual and seasonal wind roses for 2009 are presented in **Figure 6.1**. On an annual basis, the most common winds are from the southeast, south-southwest and south. This pattern is reflected in most seasons except during winter when strong winds from the west also dominate. The predominant winds blow away from the closest township of Appin, which is located to the south. The average wind speed recorded at Appin is 3.5 m/s and calm conditions (<= 0.5 m/s) are infrequent, occurring for approximately 1.2% of the time.

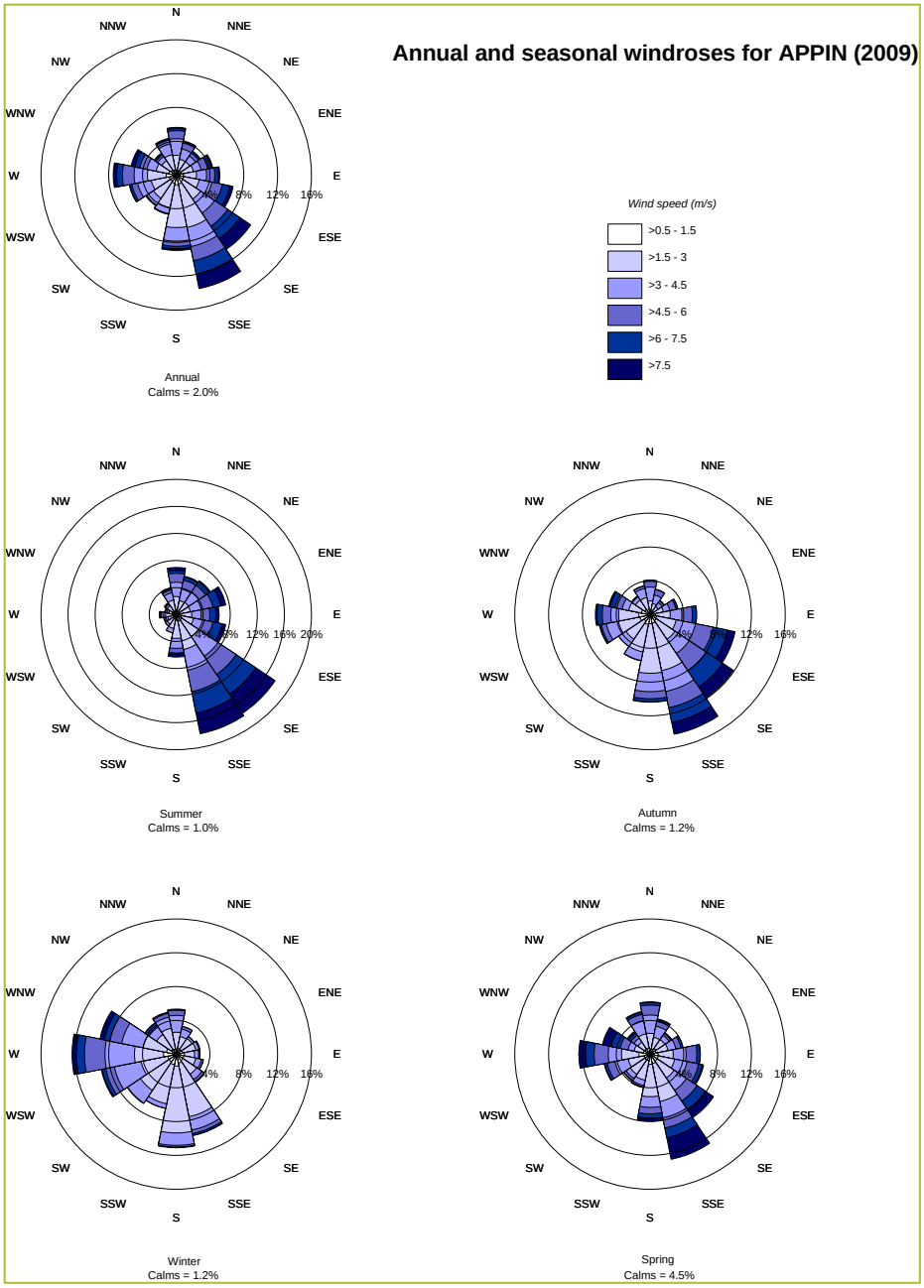


Figure 6.1: Wind Roses for Appin- 2009

The wind data for 2009 is consistent with long term monitoring data at Appin, including 2007-2008 data analysed for the Bulli Seam project (**PAEHolmes, 2009**), 2008 data analysed for the Appin Area 7 Goaf Gas Drainage Project (**PAEHolmes, 2009a**) and 1995 data analysed for the Endeavour Project at West Cliff Colliery (**HAS, 2006**).

6.2 Meteorological Modelling

The CALMET/CALPUFF modelling system was chosen for this study. CALMET is a meteorological pre-processor that includes a wind field generator containing objective analysis and parameterised treatments of slope flows, terrain effects and terrain blocking effects. The pre-processor produces fields of wind components, air temperature, relative humidity, mixing height and other micro-meteorological variables to produce the three-dimensional meteorological fields that are utilised in the CALPUFF dispersion model. CALMET uses the meteorological inputs in combination with land use and geophysical information for the modelling domain to predict gridded meteorological fields for the region. CALPUFF is a multi-layer, multi-species non-steady state puff dispersion model that can simulate the effects of time and space varying meteorological conditions on pollutant transport, transformation and removal (**Scire *et al*., 2000**). The model contains algorithms for near-source effects such as building downwash, partial plume penetration, sub-grid scale interactions as well as longer-range effects such as pollutant removal, chemical transformation, vertical wind shear and coastal interaction effects. The model employs dispersion equations based on a Gaussian distribution of pollutants across the puff and takes into account the complex arrangement of emissions from point, area, volume, and line sources. CALPUFF is endorsed by the US EPA, and has been extensively used in Australia.

CALMET was initially run for a coarse outer grid domain of 100 km x 100 km with a 0.4 km resolution. The reason for modelling an outer meteorological domain to feed the inner grid was to allow cloud data from distant Bureau of Meteorology (BoM) monitoring sites to be incorporated, in the absence of any available local data at a finer modelling resolution.

Observed hourly data from the EDL Appin Power Station, plus the Bureau of Meteorology (BoM) sites located at Camden Airport AWS, Campbelltown Airport AWS and Bellambi AWS were used as input for CALMET. Cloud amount and cloud heights were sourced from observations at Camden Airport and Bellambi. Upper air data were also extracted from TAPM[b] to provide the necessary upper air files.

CALMET outputs from the outer grid were then used as input into the finer resolution inner grid domain of 12 km x 10 km, centred on the project site to capture any meteorological features dependant on the topography either side of the site. The inner grid modelling was used to create a fine resolution three-dimensional meteorological field that covered LW 35 at the West Cliff Area 5 site. The performance of the CALMET model is compared with observations made at Appin based on the annual and seasonal wind roses extracted for a point in the middle of the domain (**Figure 6.2**). The CALMET annual wind rose displays similar characteristics to the measured wind speeds at the Appin site with moderate to strong wind speeds dominating from a south-southeast direction. The estimated mean wind speed at the site is 3.0 m/s with an estimated percentage of calm conditions (< 0.5m/s) occurring for 1.4% of the time.

[b] The Air Pollution Model, or TAPM, is a three dimensional meteorological and air pollution model developed by the CSIRO Division of Atmospheric Research. A detailed description of the TAPM model and its performance is provided elsewhere, (Hurley, 2002a, 2002b;Luhar & Hurley, 2003). TAPM was set up with 4 domains, with a resolution of 30 km, 10 km, 3 km and 1 km respectively.

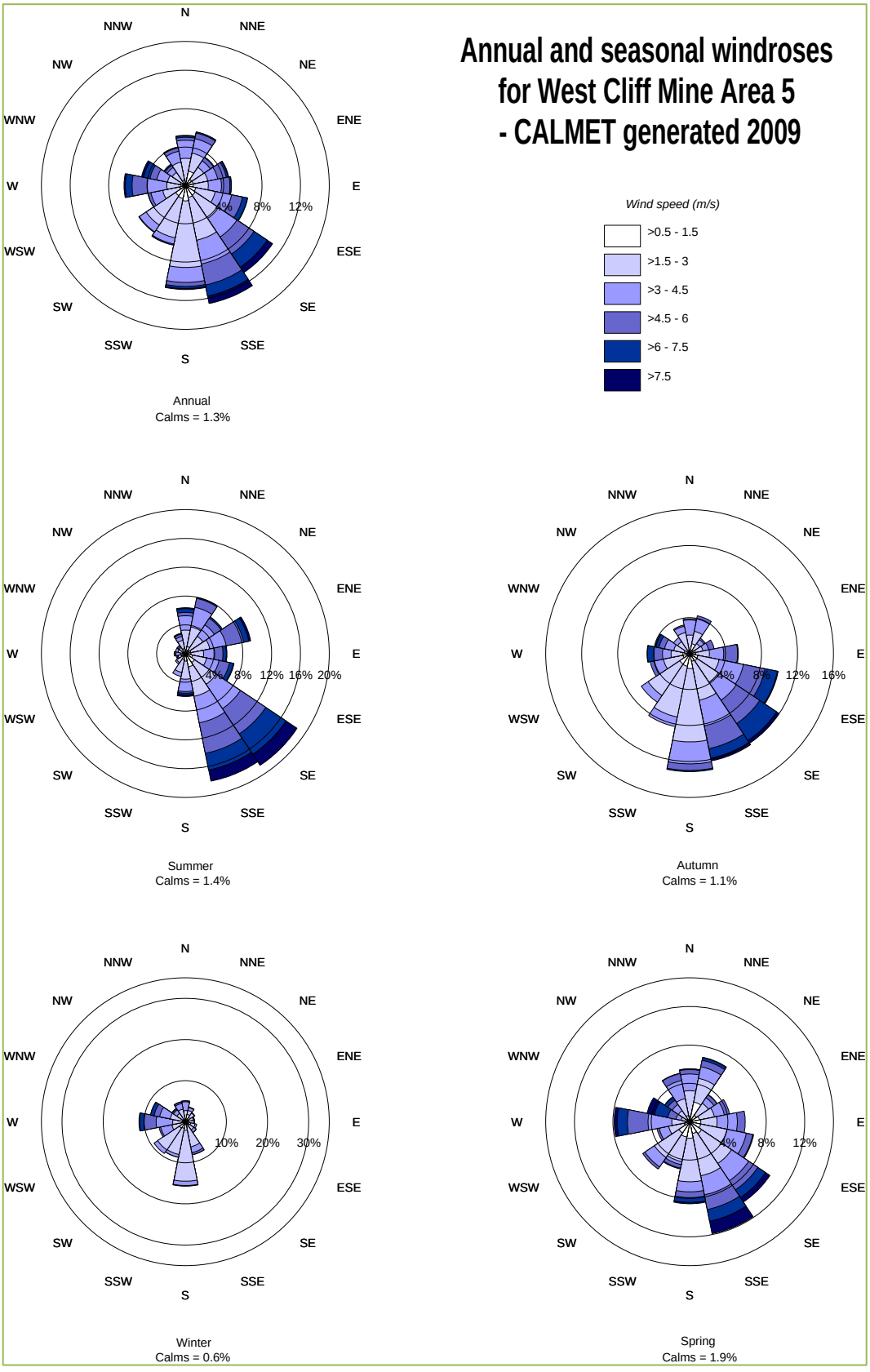


Figure 6.2: Wind Roses generated for West Cliff Mine Area 5 – Calmet 2009

6.3 Atmospheric Stability

An important aspect of pollutant dispersion is the level of turbulence in the atmosphere near the ground. Turbulence acts to dilute or diffuse a plume by increasing the cross-sectional area of the plume due to random motion. As turbulence increases, the rate of plume dilution or diffusion increases. Weak turbulence limits diffusion and is a critical factor in causing high plume concentrations downwind of a source. Turbulence is related to the vertical temperature gradient, the condition of which determines what is known as stability, or thermal stability. For traditional dispersion modelling using Gaussian plume models, categories of atmospheric stability are used in conjunction with other meteorological data to describe the dispersion conditions in the atmosphere.

The best known stability classification is the Pasquill-Gifford scheme, which denotes stability classes from A to F. Class A is described as highly unstable and occurs in association with strong surface heating and light winds, leading to intense convective turbulence and much enhanced plume dilution. At the other extreme, class F denotes very stable conditions associated with strong temperature inversions and light winds, such as those that commonly occur under clear skies at night and in the early morning. Under these conditions plumes can remain relatively undiluted for considerable distances downwind. Intermediate stability classes grade from moderately unstable (B), through neutral (D) to slightly stable (E). Whilst classes A and F are closely associated with clear skies, class D is linked to windy and/or cloudy weather, and short periods around sunset and sunrise when surface heating or cooling is small. The CALMET-generated meteorological data can be used to estimate stability class for the site and the frequency distribution of estimated stability classes is presented in **Figure 6.3**. The data show a high proportion of stable conditions (class F).

It is noted that a more accurate turbulence based scheme within CALMET was used in the modelling and the Pasquill-Gifford stability class frequency is shown for information only.

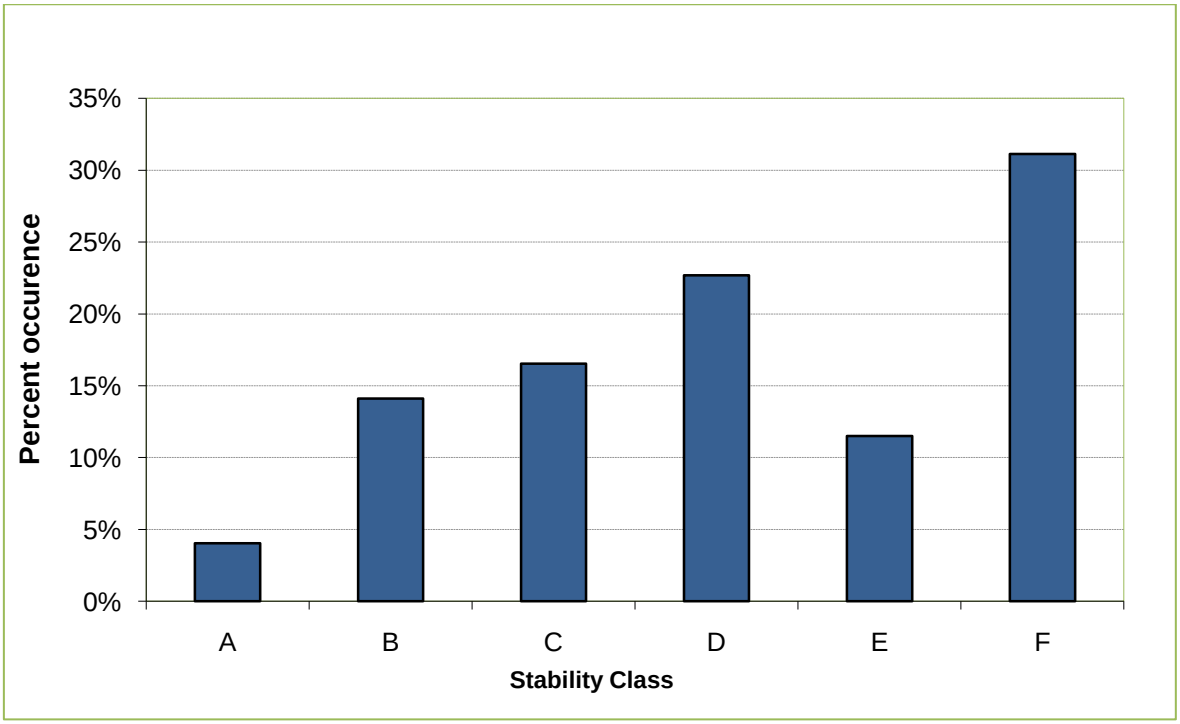


Figure 6.3: Stability Class Frequency (2009)

6.4 Mixing Height

Mixing height is defined as the height above ground of a temperature inversion or statically stable layer of air capping the atmospheric boundary layer. It is often associated with, or measured by, a sharp increase of temperature with height, a sharp decrease of water-vapour, a sharp decrease in turbulence intensity and a sharp decrease in pollutant concentration. Mixing height is variable in space and time, and typically increases during fair-weather daytime over land from tens to hundreds of metres around sunrise up to 1–3 km in the mid-afternoon, depending on the location, season and day-to-day weather conditions.

Mixing heights show diurnal variation and can change rapidly after sunrise and at sunset. Diurnal variations in the minimum, maximum and average mixing depths, based on the CALMET-generated meteorological data for the site, are shown in **Figure 6.4**. As expected, mixing heights begin to grow following sunrise with the onset of vertical convective mixing with maximum heights reached in mid to late afternoon.

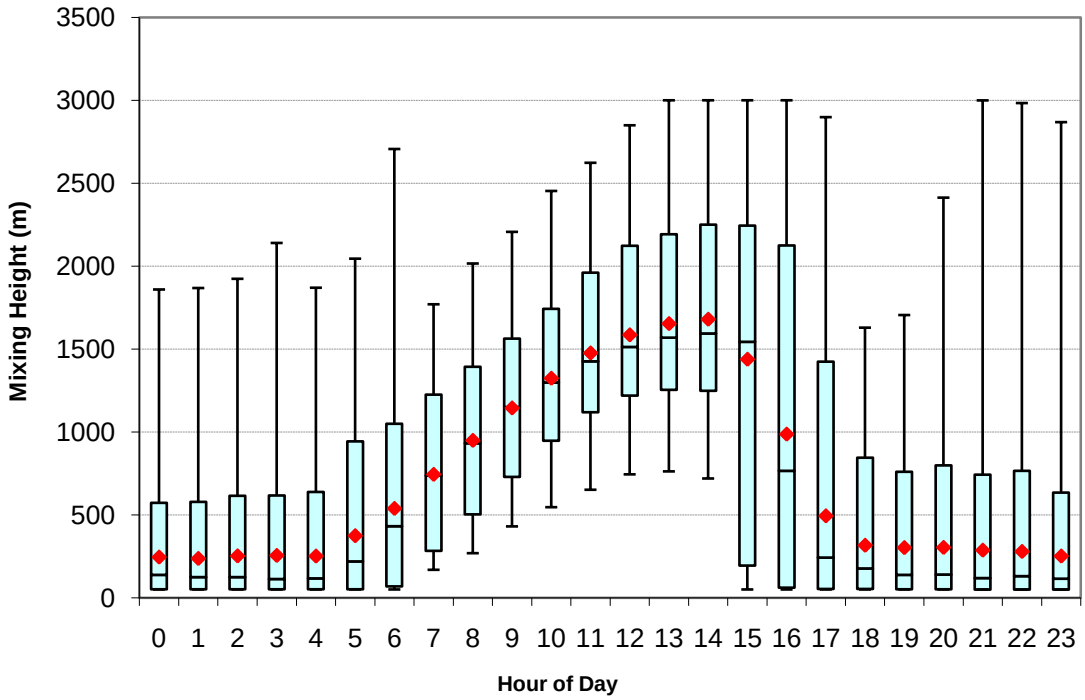


Figure 6.4: Average Daily Diurnal Variation in Mixing Layer Depth

7 APPROACH TO ASSESSMENT

The assessment follows a conventional approach commonly used for air quality assessment in Australia and outlined in the NSW DECCW "*Approved Methods for the Modelling and Assessment of Air Pollutants in NSW*". Dispersion modelling is performed for new emission sources for the proposed project and compared to air quality impact assessment criteria.

7.1 Emissions to Air

The following emission sources have been considered for the extraction plant:

- A mobile goaf extraction plant including diesel powered compressor;
- Two to three enclosed flares for combustion of goaf gas and destruction of methane, a potent greenhouse gas (GHG); and
- A remote vent stack for the venting of excess goaf gas.

The pollutants considered for the assessment are NO_x and PM_{10} from the combustion of diesel fuel at the extraction plant and the flaring of the goaf gas and odour from the venting of excess goaf gas. These key pollutants are chosen as the most significant limiting pollutants in terms of the establishment of appropriate buffer zones.

Destruction efficiency for hydrocarbons, including methane, of significantly greater than 90% is expected from the flares and emissions of VOCs are not therefore important limiting pollutants for the buffer areas.

Also, the emissions of CO from both flaring and diesel generators are lower than emissions for NO_2, however the air quality goals for CO are higher than NO_2. Therefore, if the project complies with the NO_2 criteria, it will also comply with the CO criteria and NO_2 is therefore the better indicator for establishing the required off-set distances from extraction plant locations.

7.2 Power Generation Units

The emission parameters adopted for the assessment for the diesel generator are shown in **Table 7.1** and taken from the Appin Mine Area 7 Goaf Gas Drainage Project (**PAEHolmes, 2009a**). Emissions were estimated using the NPI Emission Estimation Technique Manual for Combustion Engines (**NPI, 2008**) for an uncontrolled stationary diesel engine. Calculations are based on estimated diesel fuel usage of 3500 L/week and assume that the generator will operate continuously.

Table 7.1: Emissions and Stack Parameters – Diesel Generator

Parameter	Value
Stack Height	3.3 m
Stack Diameter	0.12 m
Exit Velocity	28 m/s
Temperature	300 ^oC
Mass Emission Rates	
NO_x Emission Rate	0.4155 g/s
PM_{10} Emission Rate	0.0294 g/s

7.3 Emissions from Flaring

Modelling flare emissions differs from conventional plumes in that the buoyancy flux is affected due to radiative heat lose during plume rise. Flare emissions can be modelled by replacing Briggs plume rise with numerical plume rise to better account for radiative heat loss, vertical wind shear and ambient temperature stratification, with the "no stack tip downwash" option chosen (**Robe, 2009**).

The emission parameters adopted for the assessment are given in **Table 7.2**. Emission concentrations for the flares have been taken from the manufacturer specifications for typical emissions from flares. The volume of flue gas formed by each flare has been derived stoichiometrically based on the composition of the goaf gas measured from the LW34-9 vent stack and the estimated gas flow rate to the flare (maximum of 400 L/s). The estimated volumetric flow rate (Am^3/s) was then used to derive emission rates (g/s) for flaring.

The effective stack height and effective stack diameter have been taken as the actual stack height and diameter. This is due to the fact that the proposed flare is enclosed within a flare stack, and the assumption is made that the flare stack dimensions will reflect, on a reasonable basis, the effective release height and plume diameter. The effective exit velocity is set to 20 m/s and the effective exit temperature is set to 1273 K in accordance with typical approaches for modelling flare emissions.

Table 7.2: Emissions and Stack Parameters – Flares

Parameter	Value
NO_x Emission Concentration	150 mg/Nm^3
Stack Height	7 m
Stack Diameter	1.5 m
Exit Velocity	20 m/s
Temperature	1000 ^oC
Mass Emission Rates	
NO_x Emission Rate	2.98 g/s

7.4 Vent Stack

A gas analysis report for a sample taken from LW 34-9 (BHPBIC, 2011) indicate concentrations of methane of approximately 89% by volume with smaller concentrations of nitrogen (4.5%), carbon dioxide (2%) and ethane (2%) (Refer **Appendix A**). Odorous hydrocardons (propane, n-butane, i-butane, n-pentane, i-pentane) were also detected in low concentrations (< 0.2%).

Odour concentrations (OU) were not available for the goaf gas vent stack. An equivalent odour concentration (OU) has been determined based on the measured concentration (% v/s) for each of the odorous compounds and the equivalent odour detection threshold for each compound.

The odour detection threshold for an individual compound is equivalent to 1 OU. Therefore if the mass concentration of an individual compound is known, this can be divided by the odour detection threshold to determine the odour concentration. The mass concentration was derived from the measured concentration (% by volume) and the molar mass for each individual compound. The derived odour concentrations were summed to get an odour concentration from the vent stack.

Vent stack characteristics and emissions estimates are listed in **Table 7.3**. Modelling assumes excess goaf gas venting at 50 L/s.

Table 7.3: Emissions and Stack Parameters – Vent Stack

Parameter	Value
Stack Height	9 m
Stack Diameter	0.25 m
Flow (m^3/s)	0.05 m^3/s
Exit Velocity	1 m/s
Temperature	25 ^oC
Emission Rates	
Derived Odour Concentration from Vent Stack	785 OU
Derived Odour Emission Rate (Stabilities A, B C) [1]	471 $OU.m^3/s$
(Stabilities D, E F) [1]	981 $OU.m^3/s$

Note: [1] The instantaneous perception of odours by the human nose occurs over very short time scales (~ 1 second) but dispersion model predictions are typically made for time scales equivalent to one hour averaging periods. To estimate the effects of plume meandering and concentration fluctuations perceived by the human nose, it is possible to multiply dispersion model predictions by a correction factor called a "peak-to-mean ratio". The peak to mean ratio (P/M60) is defined as the ratio of peak 1-second concentrations to mean 1-hour average concentrations. A Peak-to-Mean Ratio (P/M60) of 12 for unstable conditions and 25 for stable conditions has been applied to the emission rates, for a surface wake-free point source.

7.5 Greenhouse Gas Emissions

Carbon Dioxide (CO_2) and methane (CH_4) are the most significant greenhouse gas (GHG) emissions from goaf gas extraction. Gas is extracted from the goaf wells at flow rates in the range of 200 L/s to 400 L/s, comprising approximately 90% methane and 2% CO_2. The forced extraction of goaf gas reduces the amount of dilute methane released via mine ventilation shafts.

An estimate has been made of the GHG emissions associated with the operation of the goaf gas extraction system currently in place (i.e. using two operational flares) and compared with the estimated GHG emissions if this gas is vented to direct to atmosphere (through the mine ventilation system or direct goaf gas venting). A comparison is also made with the estimated GHG emissions from the operation of an additional flare, should this be required for LW35. The following assumptions have been made:

- The goaf gas flow rate ranges from 200 L/s to 400 L/s. The maximum flow rate (400 L/s) occurs for 10% of the time and a more typical flow rate (200 L/s) occurs for 90% of the time, on an annual basis;
- The capacity of 2 flares is 200 L/s to 250 L/s and the capacity of 3 flares is 300 L/s - 350 L/s;
- With 2 flares operating, gas flaring occurs for 70% of the time and excess goaf gas is vented 30% of the time;
- With 3 flares operating, gas flaring occurs for 90% of the time and excess goaf gas is vented 10% of the time; and
- The destruction efficiency of the flare (methane to CO_2) is assumed to be 100%;

The estimated GHG emissions (tonnes (t) CO_2-e / annum) are presented in **Table 7.4**. With two flares operating, the existing goaf gas capture and flaring is estimated to offset approximately 73 kt CO_2-e / annum. With 3 flares operating, this is estimated to increase to 93 kt CO_2-e / annum.

Table 7.4: Estimated GHG emissions from Goaf Gas Drainage

Scenario	Estimated t CO_2-e from venting / annum	Estimated t CO_2-e from flaring / annum	Total Estimated t CO_2-e / annum
Without Area 5 goaf gas extraction	117,627	N/A	117,627
With goaf gas extraction and 2 Flares	35,288	9,764	45,052
With goaf gas extraction and 3 Flares	11,763	12,554	24,317
GHG Offset with 2 flares operating			**72,575**
GHG Offset with 3 flares operating			**93,310**

GHG emissions would also occur from the combustion of diesel in the compressor used at the extraction plant, however these emissions are minor compare to goaf gas emissions (refer **Table 7.5**).

Table 7.5: GHG Emissions from diesel

Emission Factor (kg CO2-e/GJ		Energy Content (GJ/kL)	Diesel Consumption (l/wk)	Emissions (t co2-e / annum)		
Scope 1	**Scope 3**			**Scope 1**	**Scope 3**	**Total**
69.5	5	38.6	3500	469	36	**505**

7.6 Modelling Approach and Scenarios

Preferred sites have been identified for the goaf gas extraction plants at LW 35, as indicated in **Figure 2.1**, however flexibility in the final site locations is required. The approach to this assessment is to undertake dispersion modelling to determine the required offset distances around these preferred locations, where the applicable air quality impact assessment criteria can be safely achieved. These offset distances can then be compared to the distance to sensitive receptor locations to facilitate management and mitigation of air quality impacts.

Modelling results are presented for the extraction plant at LW 35-12. The derived offset distances can be applied to goaf gas extraction at any of the proposed locations as the meteorological conditions are not expected to differ significantly across the entire extraction area.

Therefore the offset distances presented can be applied to any proposed location and allow the flexibility for final site selection for the extraction plant.

Modelling results are presented for worst case short term impacts for NO_2, PM_{10} and odour, as these are expected to be the key limiting pollutants for air quality impacts.

8 MODELLING RESULTS

Modelling results are presented for the extraction plant LW 35-12, however the offset distances can be applied to goaf gas extraction at any of the proposed locations.

The closest residence to the proposed Longwall 35 extraction plants is at a distance of approximately 500 m. The closest residence to any future proposed goaf extraction points is anticipated to be no closer than 150 m. Modelling results are presented at this distance for each of the pollutants considered. Modelling results are also used to determine minimum offset distance required for the extraction plant where applicable air quality impact assessment criteria can be safely achieved (refer **Section 8.4**).

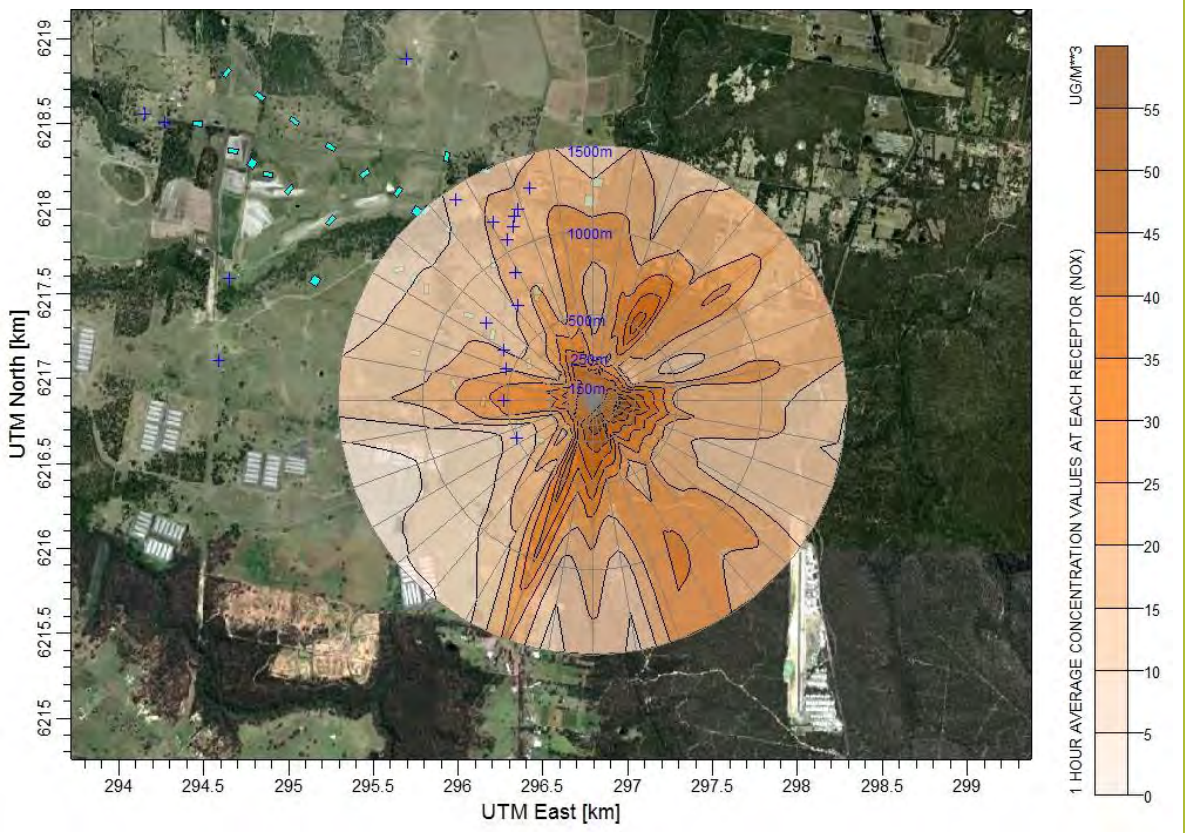
8.1 Nitrogen Dioxide (NO_2)

Generally, at the point of emission NO will comprise the greatest proportion of the emission with 95% by volume of the NO_x. The remaining 5% will be mostly NO_2. Ultimately, however, all nitric oxides emitted into the atmosphere are oxidised to NO_2 and then further to other higher oxides of nitrogen. Generally, for plumes impacting close to the source, the time interval for oxidation is not sufficient to have converted a large proportion of the plume to the more harmful NO_2.

Maximum 1-hour average NO_x concentrations have been predicted due to emissions from the diesel-powered generator and flaring and are shown in **Figure 8.1**. It is conservatively assumed that 20% of the NO_x was NO_2 at the point of maximum ground-level concentration. The results indicate that at 150 m, the maximum predicted 1-hour NO_2 is 51.9 µg/m^3 which is 21% of the impact assessment criteria of 246 µg/m^3.

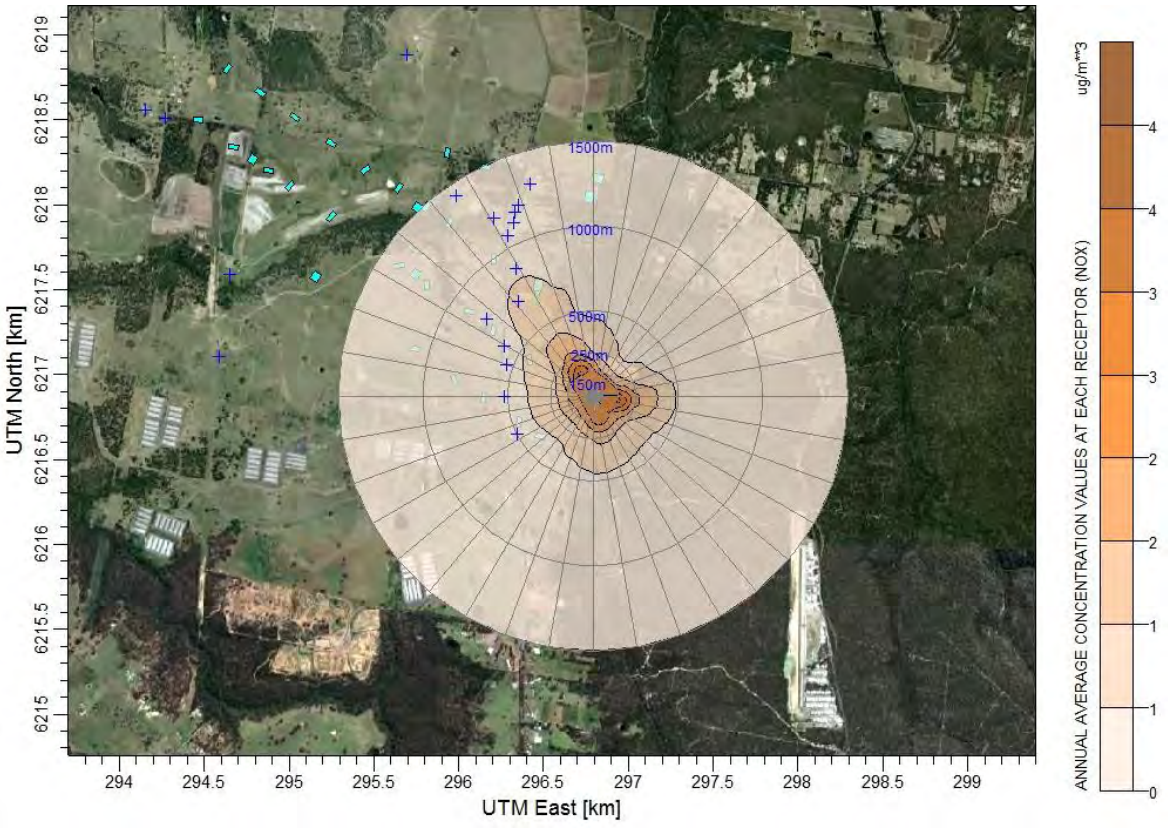
Annual average NO_x concentrations have also been predicted and are shown in **Figure 8.2**. The results indicate that at 150 m, the predicted annual NO_2 is less than 3.3 µg/m^3, compared to impact assessment criteria of 62 µg/m^3.

It is also important to consider background NO_2 levels. However, even assuming a background level of 79 µg/m^3 for 1-hour NO_2 and 15 µg/m^3 for annual average, concentrations at 150 m are still significantly below the relevant impact assessment criteria. There is also a reasonable amount of flexibility in these predicted levels for finalising locations for the extraction plant.



Species: NO_2	**Location:** West Cliff Area 5	**Scenario:** Goaf Extraction Plant 35-12	**Percentile:** Maximum	**Averaging Time:** 1-Hour
Model Used: CALPUFF v6.262	**Units:** µg/m3	**Guideline:** 246 µg/m^3	**Met Data:** CALMET Generated(2009)	**Plot:** R. Kellaghan

Figure 8.1: Predicted 1-hour NO_2 from LW35-12



Species:	**Location:**	**Scenario:**	**Percentile:**	**Averaging Time:**
NO_2	West Cliff Area 5	Goaf Extraction Plant 35-12	N/A	Annual
Model Used:	**Units:**	**Guideline:**	**Met Data:**	**Plot:**
CALPUFF v6.262	µg/m3	62 µg/m^3	CALMET Generated(2009)	R. Kellaghan

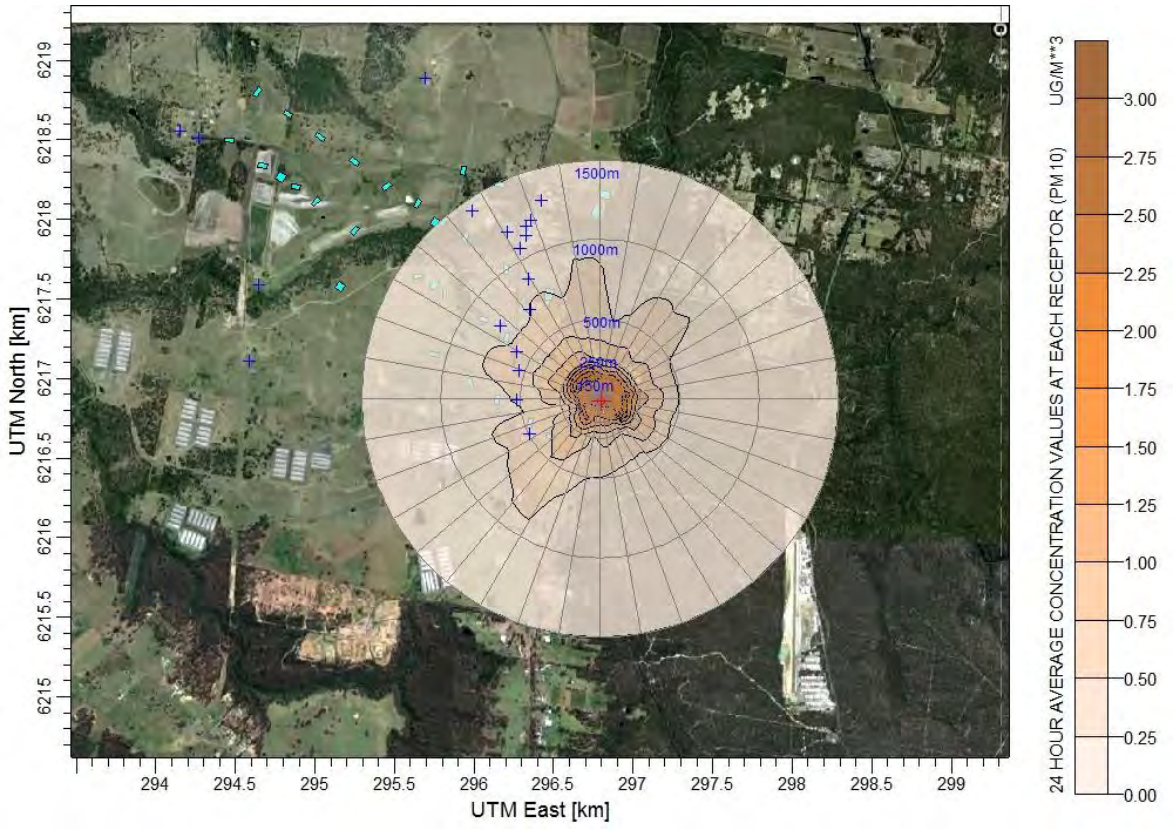
Figure 8.2: Predicted Annual Average NO_2 from LW35-12

8.2 Particulate Matter (PM_{10})

Maximum 24-hour average PM_{10} concentrations have been predicted and are shown in **Figure 8.3**. The results indicate that at 150 m, the maximum predicted 24-hour PM_{10} concentrations is of the order of 2.2 µg/m^3 which is 4.4% of the impact assessment criteria of 50 µg/m^3.

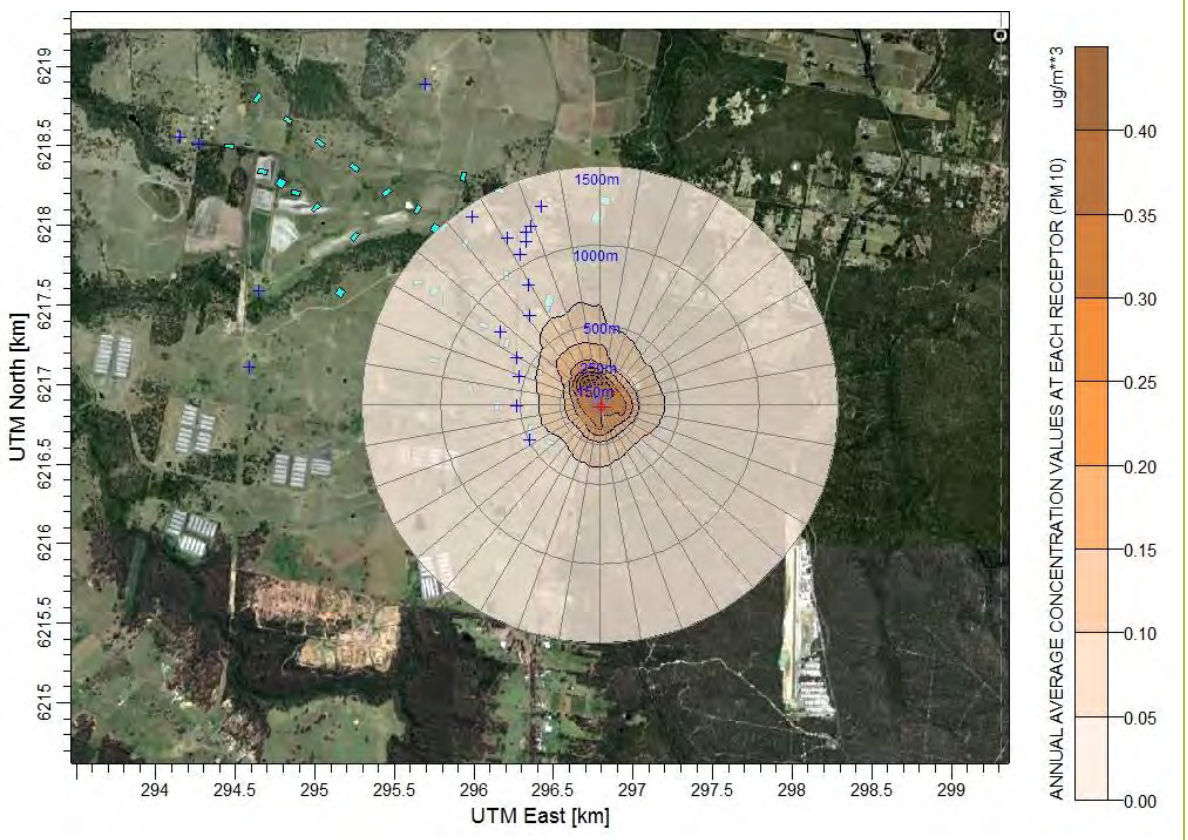
Annual average PM_{10} concentrations have also been predicted and are shown in **Figure 8.4**. The results indicate that at 150 m, the predicted annual PM_{10} is less than 0.4 µg/m^3, compared to impact assessment criteria of 30 µg/m^3.

It is also important to consider background levels, however based on the minor incremental increase in PM_{10} the cumulative impacts are also expected to be minor.



Species:	**Location:**	**Scenario:**	**Percentile:**	**Averaging Time:**
PM_{10}	West Cliff Area 5	Goaf Extraction Plant 35-12	Maximum	24-hour
Model Used:	**Units:**	**Guideline:**	**Met Data:**	**Plot:**
CALPUFF v6.262	µg/m3	50 µg/m^3	CALMET Generated(2009)	R. Kellaghan

Figure 8.3: Predicted 24-hour PM_{10} from LW35-12



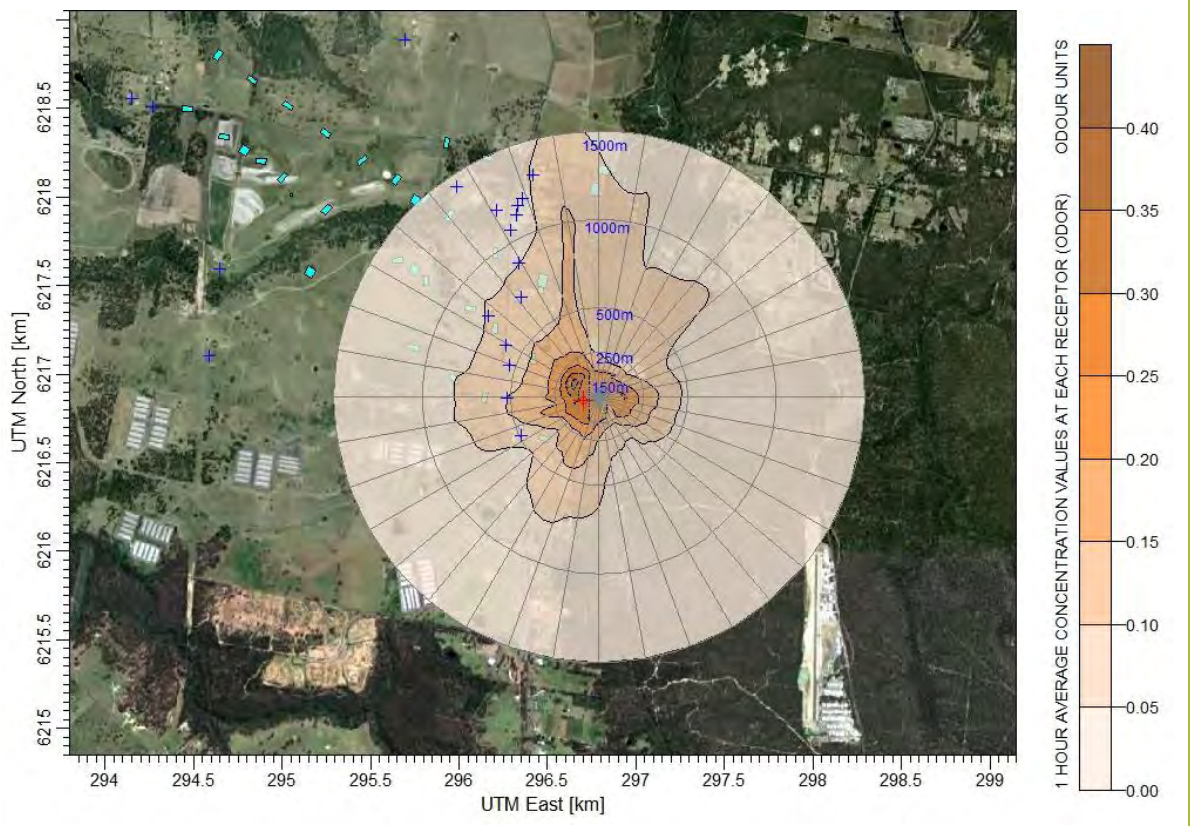
Species:	Location:	Scenario:	Percentile:	Averaging Time:
PM_{10}	West Cliff Area 5	Goaf Extraction Plant 35-12	N/A	Annual
Model Used:	**Units:**	**Guideline:**	**Met Data:**	**Plot:**
CALPUFF v6.262	µg/m3	50 µg/m^3	CALMET Generated(2009)	R. Kellaghan

Figure 8.4: Predicted Annual Average PM_{10} from LW35-12

8.3 Odour

The relevant odour criterion for a single rural residence is 7 odour units (OU). Contour plots of the predicted odour concentration, at the 99th percentile level and expressed as a nose response average (1-second) value, are presented in **Figure 8.5**. The plots are indicative of the concentrations that could potentially be reached for 1% of the time, under the conditions modelled.

The results indicate that the predicted odour concentration at 150 m is predicted to be less than 1 OU, which is the theoretical level at which odour can be detected. The modelling results are supported by the lack of complaints to date received from the community for existing operations, which include excess venting of goaf gas.



Species:	**Location:**	**Scenario:**	**Percentile:**	**Averaging Time:**
Odour	West Cliff Area 5	Goaf Extraction Plant 35-12	99th	Nose response
Model Used:	**Units:**	**Guideline:**	**Met Data:**	**Plot:**
CALPUFF v6.262	OU	7 OU	CALMET Generated(2009)	R. Kellaghan

Figure 8.5: Predicted 99th Percentile Odour Concentration (OU) from LW35-12

8.4 Minimum Recommended Set back distance

The maximum predicted impacts for each of the key pollutants at various distances are presented in **Table 8.1**. Based on these results, the minimum recommended set back distance is 100 m. At this distance, it is considered that the air quality impact assessment criteria can be safely achieved even when background concentrations of key pollutants are considered.

Table 8.1: Maximum Predicted Impacts

Distance (m)	PM_{10} (24 hr)	PM_{10} Annual	NO_2 (1 hr)	NO_2 (Annual)	Odour (Nose Response 99th %)
50	14.7	1.9	263.3	9.4	0.4
100	4.5	0.8	95.6	5.3	0.4
150	2.2	0.4	51.9	3.3	0.3
250	1.	0.2	44.3	1.7	0.2
500	0.5	0.06	39.2	0.7	0.1
1000	0.2	0.04	30.7	0.4	0.1
1500	0.2	0.02	23.2	0.2	0.1

9 CONSTRUCTION PHASE IMPACTS

The construction of vertical wells, the potential MRD directional well (35-7) and extraction pads would be progressively completed. The construction and drilling phases of the drainage wells will require minimal disruption to the environment. A level pad will be cleared for the drilling, which will require the use of trucks to hold and secure the drilling equipment plus several light transport vehicles.

The construction will be undertaken during daylight hours over a 2.5 week period for each of the proposed drainage wells. The potential MRD well (35-7) would take 6 weeks to complete and for operational reasons would be conducted 24 hours a day. Pipelines would be either laid on the surface or buried in trenches and typically would take 1 – 3 weeks to complete for each well. The goaf gas extraction plant will require clearing a small area and the construction of a level pad with security fencing.

The primary emissions during construction will be dust and particulate matter. The majority of the particulate matter (PM) emissions generated from construction will be in the coarse size fractions, generally referred to as PM_{10}. Particulate matter (PM) emissions in the fine size fractions, generally referred to $<PM_{2.5}$ are typically associated with combustion sources.

Construction will result in dust emissions from:

- Trucks and light vehicles travelling on existing unpaved roads or construction of additional tracks where necessary;
- Front end loaders for clearing / pad construction; and
- Drilling of the gas wells.

Air quality impacts during the construction phase will be minor. They would be short lived (1-3 weeks per location) and are expected to be easily controlled through commonly applied dust management measures. There would be some minor emissions as a result of construction vehicles (exhaust emissions) which would include oxides of nitrogen (NO_x), carbon monoxide (CO), sulfur dioxide (SO_2) and organic compounds. However these emissions are typically minor for projects of this scale and too widely dispersed to give rise to significant off-site concentrations.

Mitigation measures employed to control dust generation during construction would include, but not necessarily limited to the following:

- Emissions from vegetation stripping and topsoil clearing, particularly during dry and windy conditions, can be effectively controlled by increasing the moisture content of the soil / surface with a water truck;
- When conditions are excessively dusty and windy, the use of a water truck (for water spraying of travel routes) can be used;
- Limiting the extent of clearing of vegetation and topsoil to the designated footprint required for pads;
- Minimising the number of stockpiles on-site and minimising the number of work faces on stockpiles;
- All vehicles should be confined to a designated route with a speed limit enforced; and
- Trips and trip distances should be controlled and reduced where possible, for example by coordinating delivery and removal of materials to avoid unnecessary trips.

10 CONCLUSIONS

Modelling of emissions from the operation of the proposed goaf gas extraction plant indicates air quality impacts within 150 m from the extraction plant are minimal.

The 1-hour NO_2 concentrations are predicted to be approximately 20% of the impact assessment criteria at 150 m from each site. The 24-hour PM_{10} concentrations are predicted to be less than 5% of the impact assessment criteria at 150 m from each site. Even when background concentrations are taken into account, there appears to be reasonable level of flexibility in the final chosen location for the goaf gas extraction plant. Modelling of odour from the vent stack indicates that risk of odour impacts are minimal, and supported by the lack of complaints received for existing operations.

Modelling results are also used to determine minimum offset distance required for the extraction plant where applicable air quality impact assessment criteria can be safely achieved. Considering impacts from all pollutants and background, the minimum recommended setback distance, from each gas extraction plant, is 100 m.

Air quality impacts during the construction phase are expected to be short lived and easily controlled through commonly applied dust management measures.

Existing goaf gas capture and flaring is estimated to offset approximately 73 kt CO_2-e / annum of GHG emissions. With 3 flares operating, this is estimated to increase to 93 kt CO_2-e / annum.

11 REFERENCES

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APPENDIX A

Gas Analysis Report

Cordeaux Gas Laboratory

Gas Analysis Report: 1104048

Attention: Clive pickering

bhpbilliton

Illawarra Coal Holdings
Cordeaux Mine Site
Picton Road Mt Kiera West NSW 2500
PO Box 514 Unanderra NSW 2526
Ph: +61 2 4224 6298 Fax: +61 2 4224 6259

Sample Details: GWE - LW 34-9 From Vent Stack

Sampled By: Scott **Sampling Date / Time: 06-04-2011 @ 0900 hrs**

Analyte	As Received Basis	Air Free Basis
oxygen	1.04 %v/v	0.00 %v/v
argon	0.178 %v/v	0.009 %v/v
nitrogen	4.53 %v/v	0.69 %v/v
methane	88.8 %v/v	93.6 %v/v
hydrogen	0.168 %v/v	0.177 %v/v
carbon monoxide	Not Detected	Not Detected
carbon dioxide	2.06 %v/v	2.17 %v/v
ethane	2.071 %v/v	2.182 %v/v
ethylene	Not Detected	Not Detected
propane	0.593 %v/v	0.625 %v/v
propylene	Not Detected	Not Detected
n-butane	0.2094 %v/v	0.2206 %v/v
i-butane	0.1587 %v/v	0.1673 %v/v
n-pentane	0.0717 %v/v	0.0756 %v/v
i-pentane	0.0974 %v/v	0.1027 %v/v
	Air Contamination:	4.97 %v/v

Comments:
All results analysed as received, dry basis. Results calculated on an air-free basis. Results normalised to 100%
Argon determined by difference

Signed: ..... Date: 7/04/2011

Sal Castiglo