Appin Gas Drainage Project

Section 75W Modification Application (Mod # 2): Additional Gas Drainage

Project Approval: MP 08_0256

LJ2966/R2726

Prepared for BHP Billiton Illawarra Coal

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Cardno (NSW/ACT) Pty Ltd
ABN 95 001 145 035

Level 3 910 Pacific Highway
Gordon NSW 2073
Australia

Level 1, 47 Burelli Street
Wollongong NSW 2500
Australia

Telephone: 02 9496 7700
Facsimile: 02 9499 3902
International: +61 2 9496 7700

sydney@cardno.com.au
www.cardno.com.au

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EXECUTIVE SUMMARY

BHP Billiton Illawarra Coal Pty. Ltd. (BHPBIC) owns Appin Colliery that operates under Consolidated Coal Lease (CCL) 767. On the 2nd of October 2009, the Project Approval (MP 08_0256) for the Appin Gas Drainage Project was granted by the Minister for Planning under Section 75(J) of the *Environmental Planning and Assessment Act 1979*. The Minister for Planning subsequently issued a set of approval conditions for the project, which were modified in December 2010 to relocate a Medium Radius Drilling (MRD) borehole, a vertical borehole and to provide an alternative access route that avoided traffic interactions with Douglas Park village and in particular Douglas Park Public School. The Project Approval allows BHPBIC to drill and utilise eight boreholes and associated infrastructure to drain gas from an approved underground mining domain located approximately two kilometres (km) to the north-east of Douglas Park in the Wollondilly Local Government Area (LGA).

BHPBIC intend to mine Appin Longwalls 704 and 705 and also undertake pre-mine drainage within a portion of CCL 767. The drainage of gas in these areas is required to ensure safe and efficient mining. Accordingly, BHPBIC propose to modify the Appin Gas Drainage Project Approval to include:

- The Mine Safety Gas Drainage Project - Drilling two steered horizontal wells from one site (Site # 1) to facilitate construction and operation of gas drainage wells. Construction and operation of an additional three vertical wells at a second site (Site # 2) to intercept one of the steered horizontal wells. Construction of temporary access tracks from Menangle Road. Construction, operation and rehabilitation of two fenced temporary infrastructure compounds approximately 100m x 100m in area, containing: water pumps; gas flares; water collection tanks; drilling sumps; gas fuelled generator and propane tank, site shed and parking.
- Longwall 704 goaf gas drainage – construction and operation of up to seven additional vertical gas drainage wells, with connecting trenched pipelines and access tracks.
- Longwall 705 goaf gas drainage – construction and operation of five vertical and up to six MRD gas drainage wells, with connecting trenched pipelines and access tracks.
- Extension of construction hours on Saturday from 8:00 am to 1:00pm, to 8:00am to 6:00pm.

This Environmental Assessment (EA) reviews and assesses the proposed project modification, in general accordance with relevant legislation and guidance documentation in New South Wales (NSW). The EA describes the existing environment and aspects of the proposed activities in order to assess potential environmental impacts at the designated locations.

The designated work sites are highly modified environments due to historical native vegetation clearing for pastoral and agricultural purposes. Existing vegetation is generally comprised of pasture grasses and weeds, growing in a thin layer of clayey topsoil derived from weathering Wianamatta Shale bedrock and Hawkesbury Sandstone outcrops. The topography is hilly formed by a plateau rising from east to west away from the incised Nepean River gorge. Surface waters generally flow towards the east, into and along ephemeral first order streams where the receiving surface water body is either one of many man-made dams or the Nepean River. High plasticity clays limit the rate of surface water percolation into perched groundwater within shallow horizons of the Wianamatta Shale, with further vertical migration restricted by the underlying geology.

Regionally significant aquifers are encountered approximately 100m below surface level in the Hawkesbury Sandstone, where regional groundwater flows under the hydraulic gradient from the plateau towards the Nepean River.

The designated work sites have been selected to minimise additional environmental impacts, meet safety requirements for methane gas drainage and to provide economic benefits through efficient mining. Native vegetation clearing is not required for the construction of the drilling compound pads and temporary access roads, with the exception of some minor works for the entrance to Site # 1 of the Mine Safety Gas Drainage Project. Niche Environment and Heritage (Niche) prepared an Ecology Assessment for the proposed work sites (**Appendix A)**. Niche reported that the sites are highly disturbed with no threatened flora, fauna or Endangered Ecological Communities (EEC) identified at the sites. The Ecology Assessment concluded that the proposed works are not likely to have a significant impact on any threatened species, population or ecological community. No State Environmental Planning Policy (SEPP) 44 Koala Habitat will be impacted, nor any important habitat features.

Niche also prepared a Cultural Heritage Assessment for the sites (**Appendix B)**, which indicated that the project works would not cause harm to Aboriginal sites or objects because of the extensive disturbance associated with historical agricultural practices at each site. Archaeological and Non-Aboriginal heritage constraints were not identified, however works should be undertaken in accordance with the mitigation measures in the Environment Management Strategy which has been updated. This will ensure avoidance of known heritage sites including a ridgeline to the north of LW705MRD C/D and LW704v5, Site Id 52-2-3674 (an open site artefact) and the Harris Creek Scarred Tree.

Due to the hilly topography, some cutting is required to provide level drilling pad compounds, while some minor filling is required to construct the temporary access tracks. This would result in a minor increase to the extent of impervious hardstand, however existing surface water flows are unlikely to be significantly altered nor flooding risks increased. Erosion and Sediment Controls to be implemented during construction and operation would mitigate potential water quality impacts as detailed in the Environmental Management Strategy – Noise, Water, Erosion and Sediment Control Management Plan (BHPBIC, 2011).

During borehole drilling, groundwater is likely to be encountered in shallow perched lenses within the Wianamatta Shale and in deeper aquifers (approximately 100m below ground level) in the Hawkesbury Sandstone. Boreholes will be drilled using appropriately qualified and experienced drillers. Boreholes will be cased and sealed to minimise the risk of cross contaminating aquifers. Localised temporary groundwater drawdown would occur in the Bulli Coal Seam at a depth of ~ 550m below the surface as part of the mine safety gas drainage program. Groundwater drawdown in the Bulli Coal Seam will not affect shallower regionally significant producing aquifers located in the Hawkesbury Sandstone. Extracted groundwater will be captured in sealed tanks, then transported offsite for reuse potentially at Appin West or West Cliff Mine, or disposed of at another licensed facility. Geoterra prepared a groundwater assessment of the proposed works (**Appendix E)** which concluded that an observable adverse reduction in groundwater quality or aquifer depressurisation is not anticipated based on the nature of the works and limited groundwater volume to be removed. Geoterra reported that adverse impacts to the groundwater regime or surrounding beneficial users was unlikely. Based on current regulations and existing approvals, an 'aquifer interference approval' or 'water access licence' under the Water Management Act (2000) would not be required.

The hilly and in parts steep terrain plus the distance to sensitive receivers provides some shielding from noise and visual impacts. The noise assessments undertaken by Wilkinson Murray (**Appendix C**) indicated that operational noise from the proposed modification works would meet the relevant noise criteria. Temporary construction noise generated from the drilling of vertical boreholes is predicted to be acceptable, however the use of temporary noise barriers is required to mitigate noise impacts from the drilling of MRD and horizontal steered wells. Construction hours would be as per the approved project during weekdays, with construction hours on Saturday extending to 6pm. Drilling of the MRD and horizontal steered wells would require continuous 24hr drilling due to technical requirements.

Visual impacts of the proposed modification are considered to be low given the temporary nature or the works, the size of the equipment and small extent of ground disturbance relative to existing predominantly cleared hilly terrain. The installation of screening and directional use of lighting during nightworks, will reduce visual impacts and the extent of light spill.

PAE Holmes prepared an assessment of air quality and greenhouse gas emissions (**Appendix D)** which predicted that minor additional air quality impacts would occur through dust generation during construction. PAE Holmes estimated that capturing and using the goaf gas for electricity generation would offset approximately 82kt CO_2-e / annum, and flaring gas from the remaining wells would offset approximately 221kt CO_2-e / annum.

Existing arterial roads (Picton Road, Moreton Park Road and Menangle Road) would primarily be used to convey traffic to the sites. Temporary impacts to local traffic are expected to occur during mobilisation and demobilisation of drilling equipment to the sites. Light vehicle movements would be required for operation and maintenance of the sites, which would occur within approved construction hours.

BHPBIC have consulted with and obtained written agreements from all landowners where the proposed works would occur. The results of these landowner negotiations have had a direct impact on the design and location of the above ground infrastructure. Illawarra Coal has also consulted with nearby neighbours and the broader Douglas Park community prior to making this application. Consultation with the community will also extend through the assessment period of this application and during the construction and operational phase of the project.

At the completion of the project, the sites will be decommissioned in accordance with the Approved Project conditions. These works include the removal of surface infrastructure, plugging and abandonment of boreholes, reinstatement of cut material from drilling compounds and seeding of surface soils to revegetate the existing landscape.

In summary, the potential environmental impacts and proposed mitigation measures are consistent with the Approved Project. The impacts are considered to be minor in scale resulting in minimal environmental impacts due to the temporary nature of the works, proposed management and mitigation measures, and long-term agricultural land use of the project area.

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ABBREVIATIONS

BHPBIC	BHP Billiton Illawarra Coal Pty Ltd
Cardno	Cardno (NSW/ACT) Pty Ltd
CCL	Consolidated Coal Lease
DoP	Department of Planning
DoPI	Department of Planning and Infrastructure
EA	Environmental Assessment
EEC	Endangered Ecological Community
EP&A	Environmental Planning and Assessment Act
EPL	Environmental Protection Licence
km	Kilometre
LGA	Local Government Area
MRD	Medium Radius Drilling
MSGD	Mine Safety Gas Drainage
MVA	Mine Ventilation Air
NSW	New South Wales
OEH	Office of Environment and Heritage
SEPP	State Environmental Planning Policy

1 INTRODUCTION

BHP Billiton Illawarra Coal (BHPBIC) engaged Cardno (NSW/ACT) Pty Ltd (Cardno) to prepare an Environmental Assessment (EA) as part of a s75W modification application under the *Environmental Planning and Assessment Act 1979* (EP&A Act) to the existing Appin Gas Drainage Project Approval (MP 08_0256). The proposed modification includes:

- future goaf gas drainage at Longwall 704 and 705;
- Mine Safety Gas Drainage Project; and
- extension of construction hours on Saturday from 8:00 am to 1:00 pm, to 8:00 am to 6:00 pm.

This EA reviews and assesses the proposed project modification in accordance with relevant legislation and guidance documentation in New South Wales (NSW). The EA describes the existing environment and aspects of the proposed activities in order to assess potential environmental impacts at the designated locations.

The report follows on from the original EA (Cardno, 2009), with additional assessment undertaken as required. Reports from specialist sub-consultants engaged by BHPBIC for the assessment of Noise, Air Quality and Greenhouse Gas, Flora and Fauna, Heritage and Groundwater impacts have been included in this EA.

1.1 Background

BHPBIC owns Appin Colliery that operates under Consolidated Coal Lease (CCL) 767. BHPBIC submitted an Environmental Assessment (EA) to the Department of Planning (DoP) now the Department of Planning and Infrastructure (DoPI) in 2009, as part of the development approval process under Part 3A of the EP&A Act for the Appin Gas Drainage Project. On the 2nd of October 2009, the Project Approval (MP 08_0256) for the Appin Gas Drainage Project was granted by the Minister for Planning under Section 75(J) of the EP&A Act. The Minister for Planning subsequently issued a set of approval conditions for the project, which were modified in December 2010 to relocate a Medium Radius Drilling (MRD) borehole and a vertical borehole as well as to provide an alternative access to the site which avoided traffic interactions with Douglas Park village and in particular Douglas Park Public School. The Project Approval allows BHPBIC to drill and utilise eight boreholes and associated infrastructure to drain gas from an approved underground mining domain located approximately two kilometres (km) to the north-east of Douglas Park in the Wollondilly Local Government Area (LGA), see **Figure 1**.

BHPBIC commenced construction and operation of the project soon after approval, which included the installation of temporary gas extraction boreholes, surface extraction plant and ancillary equipment to drain goaf gas. Goaf gas extraction from Longwall 703 and 704 has been successfully implemented and operated in accordance with the Project Approval.

1.2 Purpose of this Environmental Assessment

The purpose of this EA is to:

- identify the proposed modifications to the existing Project Approval;
- describe the proposed additional works and the existing environment of the affected area;
- assess the environmental impacts resulting from the proposed works in comparison to those identified in the Approved Project EA; and
- recommend any additional environmental management and mitigation measures to be undertaken to ameliorate potential impacts resulting from the proposed works.

1.3 Proposed Modification

The proposed modifications to the Appin Gas Drainage Project at Longwalls 704 and 705 comprise an increase in site infrastructure by up to twelve vertical wells and up to six MRD wells, including two contingency MRD wells. An additional two steered horizontal wells and three vertical wells are proposed for Mine Safety Gas Drainage. Assessment of the contingency wells has been included in the event that ground conditions restrict the effectiveness of the primary four MRD wells or the MRD well that has already been installed (under the existing Project Approval) for Longwall 704.

The proposed wells are located between Menangle Road and the Hume Highway. Gas extracted from the LW704 and LW705 wells will be piped through trenched pipelines to the existing extraction plant, utilising equipment and technology consistent with the Approved Project. Gas extracted from the Mine Safety Gas Drainage wells will be flared onsite due to the absence of any nearby gas reticulation infrastructure. Construction of site accesses is expected to have a relatively short duration (less than 150 days), including some minor works at the entrance to the LW704 and LW705 sites from Moreton Park Road. Drilling and construction of each MRD and Mine Safety Gas Drainage borehole is likely to take approximately 13 weeks assuming continuous 24hr drilling per borehole, while construction of the vertical boreholes is expected to take between four to six weeks per borehole assuming the proposed construction site work hours. The location and an overview of the infrastructure associated with the proposed modifications are shown in **Figure** 2 and **Figure 3**.

A comparison between the approved project infrastructure and proposed modification is provided in **Table 1.1**, with further specific detail of site infrastructure and access provided in **Table 1.2**.

Table 1.1 Comparison between the Approved Project and Proposed Modification (red text shows the proposed modifications)

Aspect	Approved Project			Proposed Modification		
Project Summary	Construction and operation of 8 boreholes to extract goaf gas following mining and convey the extracted gas to EDL's (Energy Developments Limited) gas fired power stations at Appin Colliery to generate electricity.			Construction and operation of up to 26 boreholes in total to extract goaf gas following mining and convey the extracted gas to EDL's (Energy Developments Limited) gas fired power stations at Appin Colliery to generate electricity. Installation and operation of two steered horizontal wells and three vertical wells with flaring units at two locations for Mine Safety Gas Drainage.		
Project Location	At the surface above Longwalls 703 and 704, which are located within the Appin Gas Project domain, approximately 6km northwest of the township of Appin (see Figure 1).			At the surface above Longwalls 704 and 705 plus Mine Safety Gas Drainage Site 1 and Site 2, which are located within the Appin Gas Project domain, approximately 6km northwest of the township of Appin (see Figure 1).		
Hours of Operation	Activity	Hours	Timeframe	Activity	Hours	Timeframe
	Construction – Site establishment of drilling compounds	Monday to Friday 7am – 6pm, Saturday 8am – 1pm and at no time on Sundays or Public Holidays	Approximately 1 week	Construction – Site establishment of drilling compounds	Monday to Friday 7am – 6pm, Saturday 8am – 6pm and at no time on Sundays or Public Holidays	Approximately 4 weeks
	Construction – Drilling vertical boreholes and downhole		Approximately 3 weeks per borehole	Construction – Drilling vertical boreholes and downhole		Approximately 4-6 weeks per borehole
	Construction – Site establishment for extraction plant/s and surface pipeline reticulation system works		Approximately 8 weeks	Construction – Site establishment for extraction plant/s and surface pipeline reticulation system works		Approximately 8 weeks
	Construction – Under-bore of Hume Highway and Main Southern Rail Line	7:00am – 6:00pm, 7 days per week	Approximately 2 weeks	Construction – Under-bore of Hume Highway and Main Southern Rail Line Main plus an additional 2	7:00am – 6:00pm, 7 days per week	Approximately 2-4 weeks

Aspect	Approved Project			Proposed Modification		
				underbores under Main Southern Rail Line.		
	Construction – Drilling MRD borehole 1 and 2	24 hours a day, 7 days per week	Approximately 6 weeks per borehole	Construction – Drilling MRD borehole 1 and 2, plus LW705 A, B, C, D, with contingency wells E and F. Drilling Site 1 (two steered horizontal) and Site 2 (three vertical) wells.	24 hours a day, 7 days per week	Approximately 13 weeks per borehole
	Operation – Goaf gas drainage phased including extraction plant operation	24 hours a day, 7 days per week	Approximately 2 years – 4 to 12 weeks for vertical boreholes: and 44 weeks for MRD boreholes	Operation – Goaf gas and Mine Safety Gas Drainage phased including extraction and flaring plant operation, extraction of water.	24 hours a day, 7 days per week	Approximately 2 years – 4 to 12 weeks for vertical boreholes: 44 weeks for MRD boreholes; and Mine Safety Gas Drainage wells up to 22 months.
Project Life	Up to 3 years for drilling and up to 10 years for extraction			Up to 5 years for drilling and up to 10 years for extraction		
Project Details	The project would involve the drilling of 8 boreholes; consisting of 6 vertical boreholes and 2 MRD boreholes (there are also 2 contingency MRD and Vertical wells approved), a downhole, extraction plant(s) and a surface pipeline reticulation system. Both vertical and MRD boreholes would comprise a 250mm borehole, drilled to a depth of approximately 500m. The vertical boreholes would finish 5m above the Bulli coal seam, whereas the MRD boreholes would start vertically and be steered horizontally within the Scarborough Sandstone (the section of strata above the			The project would involve the drilling of up to 31 boreholes; consisting of 8 previously approved boreholes with an additional 12 vertical boreholes, up to 6 MRD boreholes and 2 steered horizontal and 3 vertical wells, a downhole, extraction plant(s) and a surface pipeline reticulation system. Both vertical and MRD boreholes would comprise a 250mm borehole, drilled to a depth of approximately 500m. The vertical boreholes would finish 5m above the Bulli coal seam, with the exception of 8 vertical boreholes above Longwalls 704 and 705 which would finish in the Bulgo sandstone unit. The MRD		

Aspect	Approved Project	Proposed Modification
	Bulli coal seam) where a number of branches would extend from the main borehole, to approximately 5 m above the top Bulli coal seam, to improve gas flow. A vertical downhole would be drilled over the workings of Longwall 704, not for goaf gas drainage, but to convey the extracted gas back underground to the existing connection to the EDL's gas fired power stations (see Figure 1[in Major Project Assessment, as amended in Figure 2]). An extraction plant would be assembled on the western side of the highway (see Figure 1 [in Major Project Assessment, as amended in Figure 2]). The extraction plant was originally located approximately 150 m northeast of the current location (see Figure 1 Option A [in Major Project Assessment, as amended in Figure 2]). However, 'Dial Before You Dig' investigations identified Telstra fibre optic cables in that location, and hence in its' Response to Submissions document Illawarra Coal relocated the extraction plant, and associated vertical borehole and MRD borehole 1, to the location on Figure 1 (Option B [in Major Project Assessment, as amended in Figure 2]). The location of the extraction plant requires boring under the Hume Highway and the Main Southern Rail Line to connect the boreholes servicing Longwall 703 (on the eastern side of the Highway). The gas would be extracted via a surface pipeline reticulation system to the extraction plant. From the extraction plant the majority of the methane gas would be piped back underground using the downhole to the existing underground connection to EDL's gas fired power stations location at Appin West Pit Top and Appin No.2 Shaft. A small amount of goaf gas may be vented to the atmosphere via a remote vertical gas discharge stack, for emergency venting upon failure / shut down of gas surface management equipment or in the event that gas flow exceeds the capacity of the extraction plant. If approval for under-boring is not granted by the Roads and Traffic Authority, a contingency extraction plant would be constructed on the eastern side of the highway (see Figure 1 [in Major Project Assessment, as amended in Figure 2]). However, as there is no downhole available on the eastern side of the highway,	boreholes would start vertically and be steered horizontally within the Scarborough Sandstone (the section of strata above the Bulli coal seam) where a number of branches would extend from the main borehole, to approximately 5 m above the top Bulli coal seam, to improve gas flow. A vertical downhole would be drilled over the workings of Longwall 704, not for goaf gas drainage, but to convey the extracted gas back underground to the existing connection to the EDL's gas fired power stations (see Figure 1 [in Major Project Assessment, as amended in Figure 2]). An extraction plant would be assembled on the western side of the highway (see Figure 1 [in Major Project Assessment, as amended in Figure 2]). The extraction plant was originally located approximately 150 m northeast of the current location (see Figure 1 Option A [in Major Project Assessment, as amended in Figure 2]). However, 'Dial Before You Dig' investigations identified Telstra fibre optic cables in that location, and hence in its' Response to Submissions document Illawarra Coal relocated the extraction plant, and associated vertical borehole and MRD borehole 1, to the location on Figure 1 (Option B [in Major Project Assessment, as amended in Figure 2]). The location of the extraction plant requires boring under the Hume Highway and the Main Southern Rail Line to connect the boreholes servicing Longwall 703 (on the eastern side of the Highway). Two underbores under the Main Southern Railway Line will also be required pipe gas to the extraction plant from LW704v3, LW705v1/2 and LW705MRD A/B. The gas would be extracted via a surface pipeline reticulation system to the extraction plant. From the extraction plant the majority of the methane gas would be piped back underground using the downhole to the existing underground connection to EDL's gas fired power stations location at Appin West Pit Top and Appin No.2 Shaft. A small amount of goaf gas may be vented to the atmosphere via a remote vertical gas discharge stack, for emergency venting upon failure / shut down of

Aspect	Approved Project	Proposed Modification
	the gas drained from Longwall 703 would be flared via enclosed flaring units, which would be located within the contingency extraction plant compound.	gas surface management equipment or in the event that gas flow exceeds the capacity of the extraction plant. If approval for under-boring is not granted by the Roads and Traffic Authority, a contingency extraction plant would be constructed on the eastern side of the highway (see Figure 1 [in Major Project Assessment, as amended in Figure 2]). However, as there is no downhole available on the eastern side of the highway, the gas drained from Longwall 703 would be flared via enclosed flaring units, which would be located within the contingency extraction plant compound. Mine Safety Gas Drainage wells will comprise a ~250mm borehole, drilled to a depth of approximately 550m into the Bulli Coal Seam. Two steered wells are proposed to be constructed from a single location (Site 1). An additional three vertical wells will be constructed and operated at Site 2. Gas extracted from the Mine Safety Gas Drainage wells will be flared from onsite enclosed flaring units, with the small volumes of extracted groundwater stored in tanks for removal offsite to licensed receiving facilities. The wells used for the Mine Safety Gas Drainage may require periodic maintenance to remove any blockages or build up of coal fines in the well. Such maintenance will require a small work over rig to operate on the wells during daylight hours.
Associated Facilities	Access road, gas wellheads, to be located at the top of each borehole, and a surface reticulation system consisting of, polyethylene pipeline buried just below the ground surface, to transfer gas to the extraction plant and then onto the down hole.	Access roads, gas wellheads, to be located at the top of each borehole, and a surface reticulation system consisting of, polyethylene pipeline buried just below the ground surface, to transfer gas to the extraction plant and then onto the down hole. Power to the Mine Safety Gas Drainage sites will be provided by gas fuelled generators and include a propane storage tank or via mains power.
Borehole and Extraction Plant	Vertical Borehole ▪ Each vertical borehole would be located within a 40m by 50m fenced compound, which would contain the well head, drill rig,	Vertical Borehole ▪ Each vertical borehole would be located within a 50m by 50m fenced compound, which would contain the well head, drill rig,

Aspect	Approved Project	Proposed Modification
Site Disturbance	sump and site shed. MRD Borehole ▪ Each MRD borehole would be located within a 30m by 40m fenced compound, which would contain the well head, drill rig, sumps, mud pumps and site office. Extraction Plant ▪ Mobile, semi-trailer mounted extraction plant(s) would be located within a 30 m by 40 m fenced compound, which would contain the well head, cooling water tanks, pumps, transformer, gas analyser and control room; as well as a 5 m by 5 m area 100 m outside the extraction plant compound for the discharge stack, and flaring units, if required. Based on the locations chosen for the 8 boreholes, downhole, extraction plant(s) and surface reticulation system, clearing of the following vegetation would be required: ▪ 1.2 hectares (ha) of cleared paddocks; and ▪ 0.16ha of Cumberland Plain Woodland	sump and site shed. The three vertical wells at Site 2 for the Mine Safety Gas Drainage will be located on a single pad that is approximately 100 m x 100 m. MRD and MSGD Boreholes ▪ Each MRD or MSGD borehole would be located within a 100m by 100m fenced compound, which would contain the well head, drill rig, sumps, mud pumps and site office. Extraction Plant ▪ Mobile, semi-trailer mounted extraction plant(s) would be located within a 30 m by 40 m fenced compound, which would contain the well head, cooling water tanks, pumps, transformer, gas analyser and control room; as well as a 5 m by 5 m area 100 m outside the extraction plant compound for the discharge stack, and flaring units, if required. A small liquid ring suction pump may also be located at Sites 1 and 2 of the Mine Safety Gas Drainage Project to facilitate extraction of gas. Based on the locations chosen for the total of 31 boreholes, downhole, extraction plant(s) and surface reticulation system, clearing of the following vegetation would be required: ▪ Approximately 9 hectares (ha) of cleared paddocks; and ▪ 0.16ha of Cumberland Plain Woodland
Employment	Require a total of 10 employees and would create 2 construction jobs	Require a total of 10 employees and would create 10 construction jobs
Residential Receivers	There are 16 residential receivers within 500m of the proposed project	There are 25 residential receivers within 500m of the proposed project
Capital Cost	$5,000,000	$15,000,000

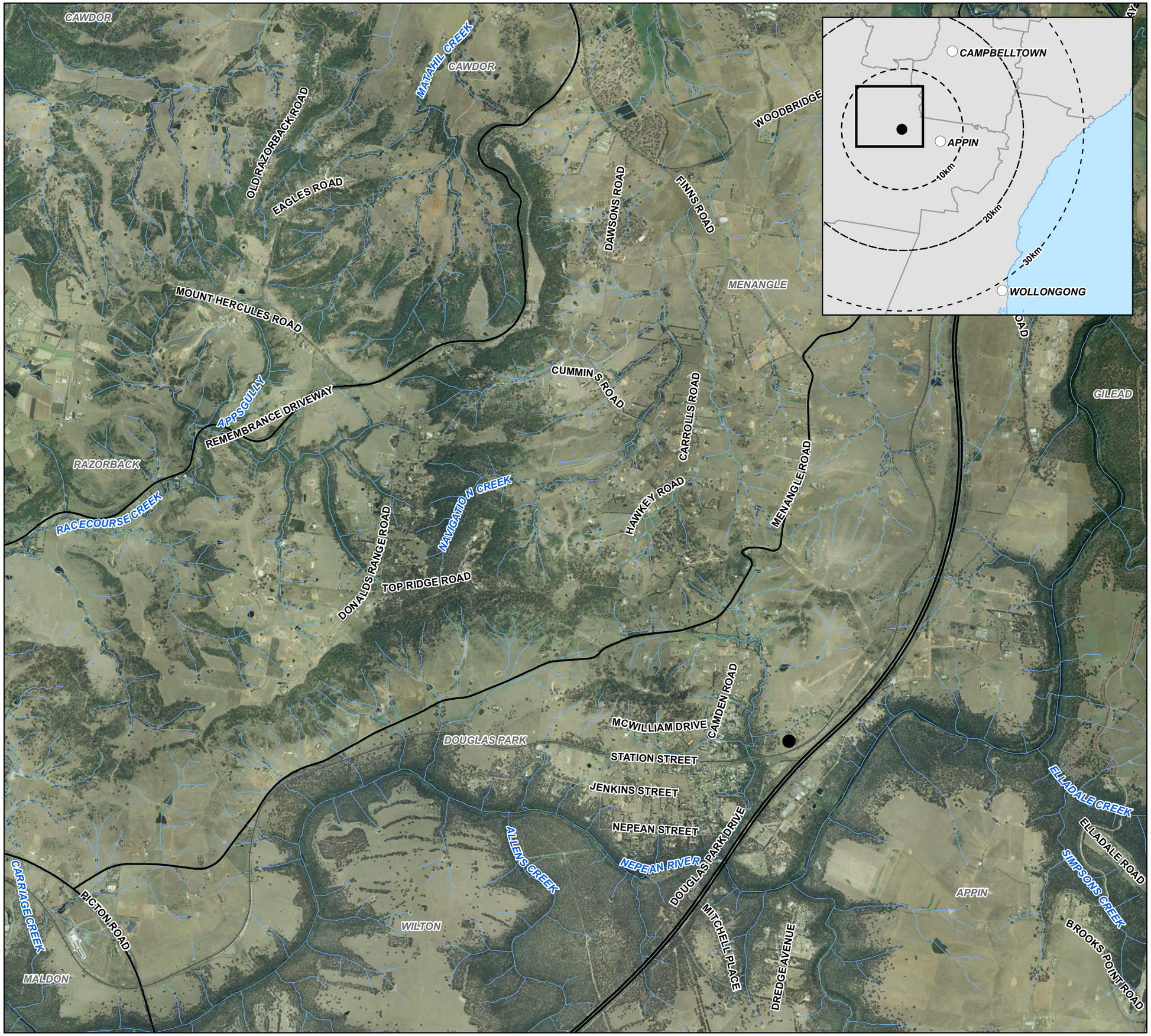
Aspect	Approved Project	Proposed Modification
Rehabilitation	Each borehole would be decommissioned in accordance with EDG01 Borehole Sealing Requirements on Land (DMR, 1997). Upon decommissioning, the surface site associated with each borehole and extraction plant would be rehabilitated to the previous land use with the respreading of topsoil, seeding with native vegetation and weed control.	Each borehole would be decommissioned in accordance with EDG01 Borehole Sealing Requirements on Land (DMR, 1997). Upon decommissioning, the surface site associated with each borehole and extraction plant would be rehabilitated to the previous land use with the respreading of topsoil, seeding with native vegetation and weed control.

Table 1.2 : Summary of Proposed Modification Works

Location	Infrastructure	Access
MSGD Site 1 (Lot 2 / DP747563)	The Mine Safety Gas Drainage would include the construction of two steered horizontal wells. Site infrastructure would include: ▪ Approximately 100m x 100m fenced temporary drilling pad compound with some minor cut/fill of the gently sloping hill to create a level drilling pad. ▪ Drill rig for the construction of the wells. Drill rig equipment includes compressors, water tanks, grout tanks, mud sump/ponds and mud pumps. ▪ Temporary fencing during the drilling / construction phase, with the footprint of the temporary fencing to be reduced to around the well heads/flaring units during the operational phase. ▪ Site Shed. ▪ Pumping equipment including Water/Gas separator, with Flaring Unit for gas and holding tanks with associated piping for water. ▪ Gas generator and propane tank. A contingency option for mains power from Menangle Road running along the access track to Site 1 has also been assessed as part of the proposed modification. ▪ Erosion and sediment controls.	Access to Site 1 via temporary unsealed access track approximately 250m long and up to 7m wide. Access is required for establishment of the site compound, mobilisation of the drilling rig and equipment, operation and maintenance including vehicle movements for removal of produced water and demobilisation. Upgrades to an existing access track have been included as a contingency.
MSGD Site 2 (Lot 3 / DP553170)	The Mine Safety Gas Drainage would include the construction of three vertical wells. Site infrastructure would include: ▪ 100m x 100m fenced temporary drilling pad compound, cut into the gently sloping hill. ▪ Drill rig for the construction of the wells. Drill rig equipment includes compressors, water tanks, grout tanks, mud sump/ponds and mud pumps. ▪ Temporary fencing during the drilling / construction phase, with the footprint of the temporary fencing to be reduced to around the well heads/flaring units during the operational phase. ▪ Site Shed. ▪ Pumping equipment including Water/Gas separator, with Flaring Unit for gas and holding tanks for water. Water may be reticulated closer to Menangle Road to minimise water truck	Access to Site 2 via unsealed access track approximately 700m long and up to 7m wide, with turning circle off Menangle Road. Access is required for establishment of the site compound, mobilisation of the drilling rig and equipment, operation and maintenance including vehicle movements for removal of produced water and demobilisation

Location	Infrastructure	Access
	access to the site. This may include a water pipeline within the access track footprint and a water tank need the site entrance from Menangle Road. ▪ Gas generator and propane tank. ▪ Erosion and sediment controls.	
Longwall 704 –	▪ Construction of vertical wells (LW704 v3 to v9), each within a 50m x 50m fenced temporary drilling pad compound, cut into the gently sloping hill. ▪ Drill rig and ancillary equipment for the construction of a vertical borehole including compressors, water tanks, grout tanks, mud sump/ponds and mud pumps. ▪ Temporary fencing during the drilling / construction phase, with the footprint of the temporary fencing to be reduced to around the well head during the operational phase. ▪ Site Shed. ▪ Trenching (approximately 650mm wide by 1400mm deep) for the installation of pipeline to connect the wells in the shortest feasible distance to the existing surface pipeline reticulation system and extraction plant. ▪ Erosion and sediment controls. (Note - vertical wells 704V1-2 have been deleted from the project for scheduling reasons).	Access to LW704v3 via upgrade to existing access track on property (Lot 1 DP802151) entering from Moreton Park Road (as per access to LW705 MRD – A/B sites). Some minor earthworks and modifications would be required at the entrance from Moreton Park Road to allow semi-trailer access. Access to LW704v4 via access track along the rail corridor (as approved in Mod.1). Access to LW704v5 to LW704v9 via approved Vent Shaft 6 access road currently under construction from Menangle Road. Minor (<50m) temporary connecting tracks between drilling pad sites.
Longwall 705	▪ LW705 MRD A and B wells within a 100m x 100m fenced temporary drilling pad compound cut into the gently sloping hill. ▪ Contingency option – Additional LW705 MRD E and F bores would be drilled from the MRD A and B pad. ▪ LW705 MRD C and D wells within a 100m x 100m fenced temporary drilling pad compound cut into the gently sloping hill. ▪ LW705 v1 to v5 vertical wells within 50m x 50m fenced temporary drilling pad compounds cut into the gently sloping hill. ▪ Underboring the Main Southern Rail Line at two locations to connect all wells on property (Lot 1 DP802151) to the existing	Access to LW705 MRD A, B, E, F and LW705v1 and LW705v2 via upgrade to existing access track on property (Lot 1 DP802151) entering from Moreton Park Road. Minor filling would be required of the void at the junction with the existing access track, Moreton Park Road and the Main Southern Rail Line, to facilitate heavy vehicle movements. Access to LW705v3 to LW705v5 and MRD C, D via

Location	Infrastructure	Access
	piped reticulation system and extraction plant on the Mount Batten (Lot 1 DP 121322) side of the Main Southern Rail Line. ▪ Various trenched pipelines. ▪ Drilling equipment for the vertical wells as per the LW704 equipment, and drilling equipment for the MRD wells as per the MSGD drilling equipment.	approved Vent Shaft 6 access road currently under construction from Menangle Road. Minor (<100m) temporary connecting tracks between drilling pad sites LW705v3 and LW705v4. The temporary track to LW705v5 would be approximately 500m.
Extension of construction hours on Saturday from 8:00am to 1:00pm, to 8:00am to 6:00pm.		



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ILLAWARRA COAL

Location Plan

APPIN GAS DRAINAGE PROJECT

Legend

- Approved Appin No 6 Vent Shaft
- Railway (LPI)
- Major Roads (LPI)
- Watercourses (LPI)

FIGURE 1

N
W E
S

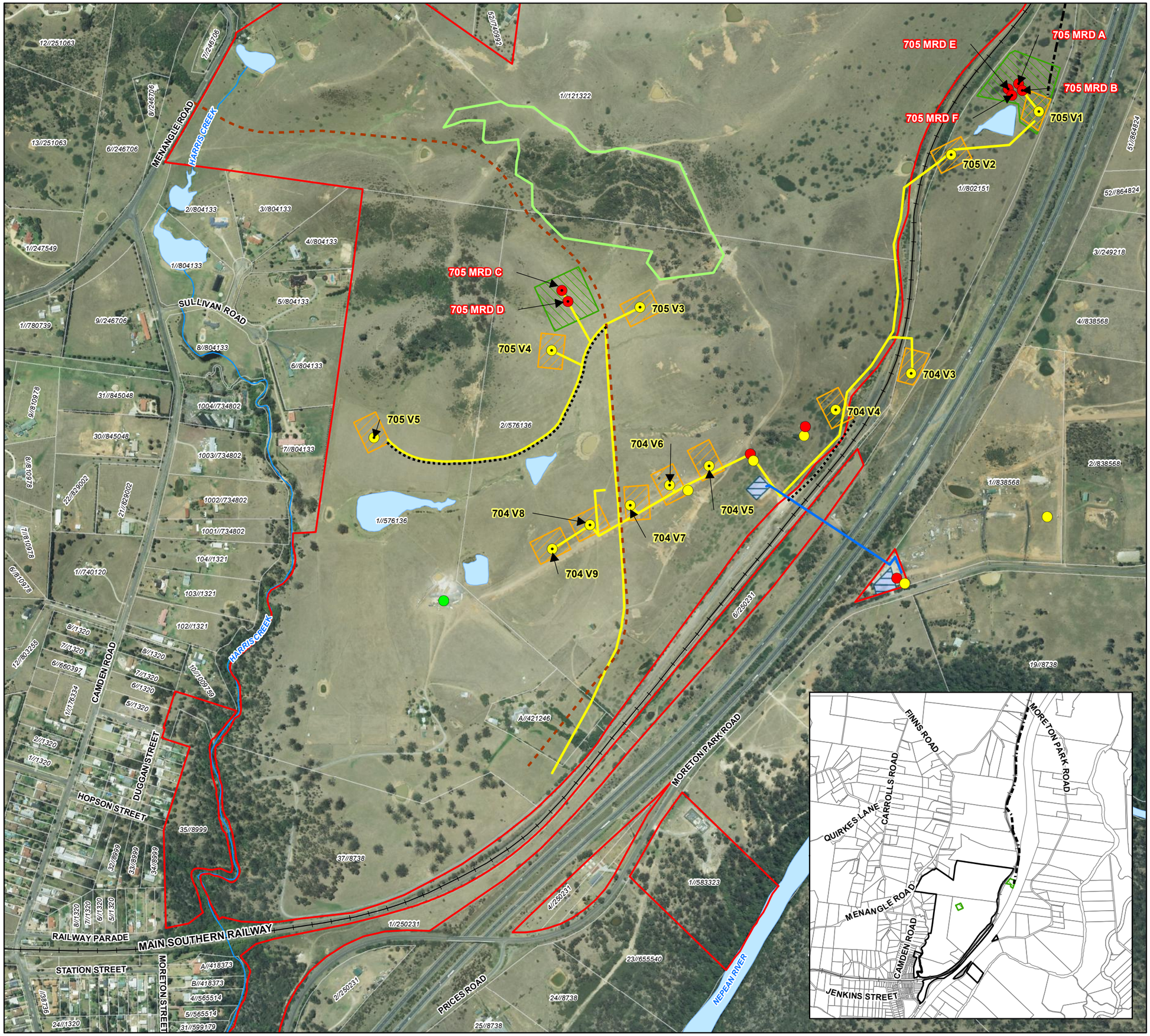
1:35,000 Scale at A3

Metres
0 500 1,000 1,500 2,000

Cardno

Map Produced by Cardno NSW/ACT Pty Ltd (WOL)
Date: 2011-11-01
Coordinate System: GDA 1994 MGA Zone 56
Project: 212055-001
Map: G1004_LocationPlan.mxd 04

Aerial imagery supplied by BHPBIC (2007/2009)



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ILLAWARRA COAL

LW704 and 705 Goaf Gas Drainage Works

APPIN MINE GAS DRAINAGE PROJECT

- BHPBIC Land
- Railway (LPI)
- Cadastre (LPI)

Borehole Infrastructure

- MRD Borehole (Approved)
- Vertical Borehole (Approved)
- Downhole (Approved)
- MRD Borehole (Proposed)
- Vertical Borehole (Proposed)
- Drainage Pipelines
- Vegetation Offset Area (Niche and Cardno)
- Extraction Plant Locations
- 705 MRD Well Sites
- 704-705 Vertical Well Sites (BHPBIC)

Access Roads and Tracks

- Access Track
- Approved VS#6 Access Road (under construction)

Water Features and Infrastructure

- Possible Water Supply
- Major Watercourses (LPI)
- Waterbodies (LPI)

N
W E
S

FIGURE 2

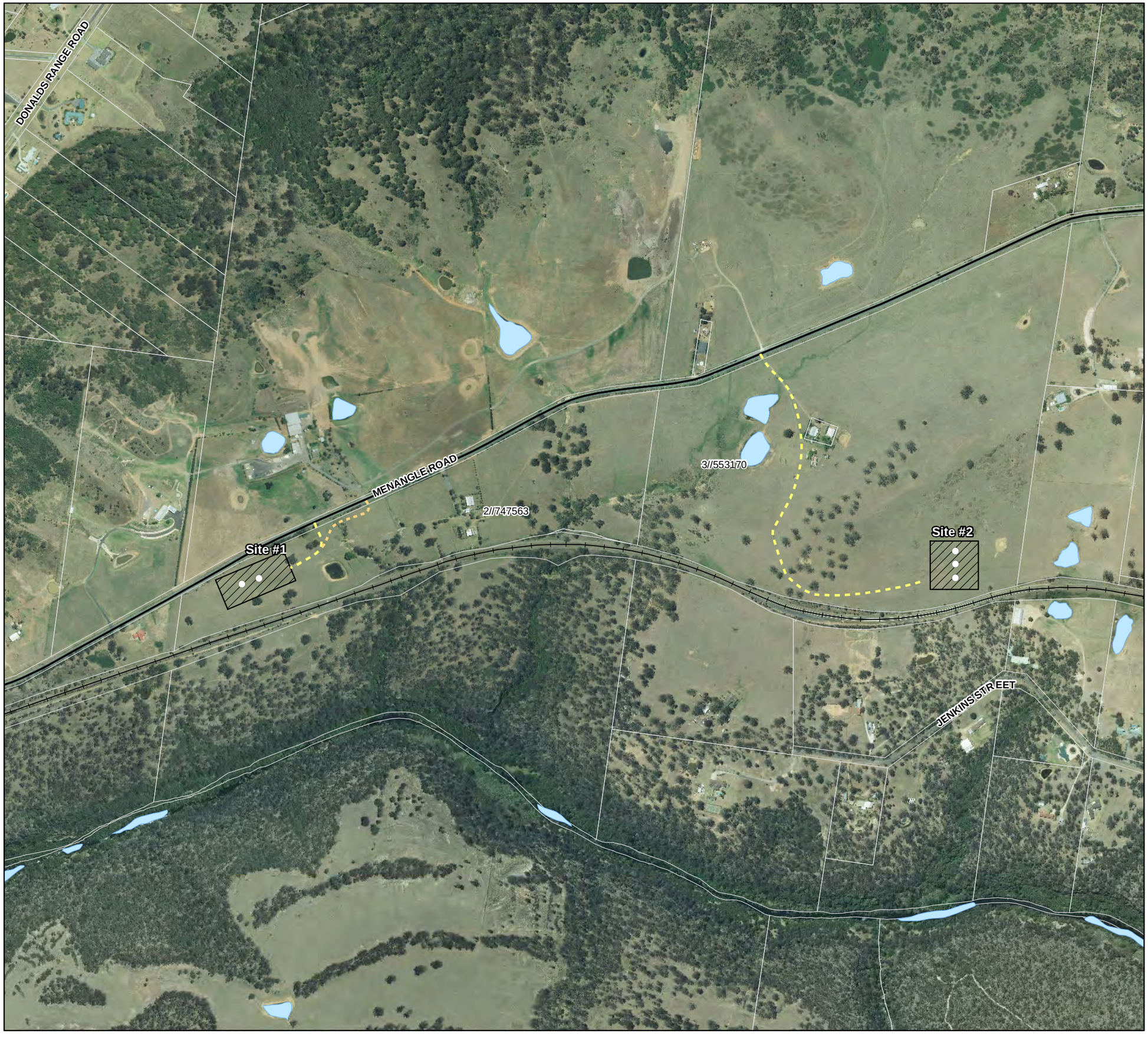
1:7,500 Scale at A3

Metres
0 100 200 300 400 500

Cardno

Map Produced by Cardno NSW/ACT Pty Ltd (WOL)
Date: 2011-11-01
Coordinate System: GDA 1994 MGA Zone 56
Project: 212055-001
Map: G1005_SitePlanDrainageWorks.mxd 06

Aerial imagery supplied by BHPBIC (2009)



bhpbilliton
ILLAWARRA COAL

Mine Safety
Gas Drainage Site Plan

APPIN MINE
GAS DRAINAGE PROJECT

Legend

- Proposed Well Locations
- Contingency Access (Indicative)
- Access Road (Indicative)
- Railway (LPI)
- Major Roads (LPI)
- Cadastre (LPI)
- Waterbodies (LPI)
- Drilling Pad

N
W E
S

FIGURE 3

1:7,500 Scale at A3

Metres
0 100 200 300 400 500

Cardno

Map Produced by Cardno NSW/ACT Pty Ltd (WOL)
Date: 2011-11-08
Coordinate System: GDA 1994 MGA Zone 56
Project: 212055-001
Map: G1002_STIS_Layout.mxd 09

Aerial imagery supplied by BHPBIC (2009)

2 SITE DESCRIPTION AND CONTEXT

The proposed modification involves the construction of additional gas extraction wells and associated infrastructure at Longwall 704 /Longwall 705 and Area 9 of the Appin Colliery. This section of the EA details the site location, justification for the works and potential timing of the works.

2.1 Site Location

The project area is within Consolidated Coal Lease (CCL) 767 located in the South Campbelltown Mine Subsidence District in the Southern Coalfield of NSW. The sites are located on several different properties as listed in **Table 2.1**, which are situated adjacent to Douglas Park, NSW. The general location of the works is shown on **Figure 1**. The purpose of the gas drainage is to provide a safe working environment and to facilitate efficient mining operations. The arrangement of the proposed boreholes and temporary access tracks are shown on **Figure 2** and **Figure 3**

BHPBIC has access agreements for all temporary infrastructure sites. The property descriptions are provided in **Table 2.1** below:

Table 2.1 : Property Descriptions for Modified Part of Project

Activity	Property Description (Lot / DP)
Installation of MSGD Site 1 and temporary access track	Lot 2 / DP747563
Installation of MSGD Site 2 and temporary access track	Lot 3 / DP553170
Installation of LW705 MRD A and B incl. temporary access track	Lot 1 / DP802151
Installation of LW705 MRD C and D incl. temporary access track	Lot 2 / DP576138
Installation of LW705 MRD E and F (existing temporary access)	Lot 1 / DP802151
Installation of vertical wells LW705 V1-5 (existing temporary access)	Lot 1 / DP802151 (V1 and V2), Lot 2 / DP576138 (V3 and V4), Lot 1 / DP576138 (V5)
Installation of vertical wells LW704 V3-9 (existing temporary access)	Lot 2 / DP576138 (V4 to V9), Lot 1 / DP802151 (V3)

2.2 Site description

The designated work sites are highly modified environments due to historical native vegetation clearing for pastoral and agricultural purposes. Timber and wire fences currently divide the sites into paddocks used for cattle and horse grazing, with some man-made farm dams also present. Access to the sites is generally via Menangle or Moreton Park Roads. Access tracks traverse the paddocks, however in general these tracks do not provide direct access to the proposed drilling sites.

Existing vegetation is comprised of grasses and weeds with some nearby scattered trees, growing in a thin layer of clayey topsoil. The topography is hilly and generally slopes downwards towards the east and the incised Nepean River gorge. Surface water bodies are primarily man made dams, with the exception of some minor drainage lines.

The key infrastructure present within the project area includes the existing coal mine infrastructure, the Hume Highway, Moreton Park Road, Menangle Road, Douglas Park, Trig Station, the Main Southern Rail Line, local access roads, rural residential dwellings, farm dams and utilities such as overhead powerlines and telecommunication cables.

2.3 Current and Surrounding Landuse

The designated work sites are currently used for cattle and horse grazing, with some mixed agriculture and man-made farm dams also present. The surrounding land use for the goaf wells is similar as follows:

- North – pastoral land and the township of Menangle (approximately 3km away).
- South – pastoral land and the township of Douglas Park (approximately 1-2km away).
- East – pastoral land, the Hume Highway then the Nepean River (approximately 2km away).
- West – Menangle Road, pastoral land and Razorback Mountain (approximately 4km away).

The surrounding land use for the MSGD wells is similar as follows:

- North – pastoral land and steep vegetated land associated with the Razorback Range.
- South – pastoral land, the Main Southern Rail Line and the Nepean River.
- East – pastoral land.
- West – pastoral land and rural residential properties.

2.4 Development Constraints

The borehole drilling sites have been cleared of native vegetation. Although outside the drilling pad footprints, the proximity of residential dwellings and associated driveways, farm buildings and farm dams to the proposed temporary access tracks present a constraint to the development.

Site access from local roads (including sightlines for safe access, primarily along Menangle Road for entry to the MSGD Site 1), the proximity of Main Southern Rail Line (primarily to MSGD and 704 v4) and utilities constrain the development sites.

The depth to intersect the gas and availability of suitable drilling technologies also constrain the development. It is proposed to undertake two steered horizontal wells from the single site (Site 1) for the MSGD, with an additional three vertical wells from Site 2. Due to the hilly and in parts steep terrain, access is restricted to the drilling sites with earthworks required to cut level pads to meet geotechnical requirements to take the load from the drilling equipment.

The layout of the gas drainage infrastructure has been designed to accommodate the development constraints, minimise disruption to nearby landholders, minimise impact to the environment and maximise the gas drainage capability.

2.5 Justification

The Bulli Coal Seam mined by BHPBIC within the Appin Colliery contains gas (with methane comprising approximately 95% of the gas composition) that is released during the longwall mining process. The goaf is formed by the stratum that collapses after the progress of the longwall machinery through the longwall mine, as shown on **Figure 4** below.

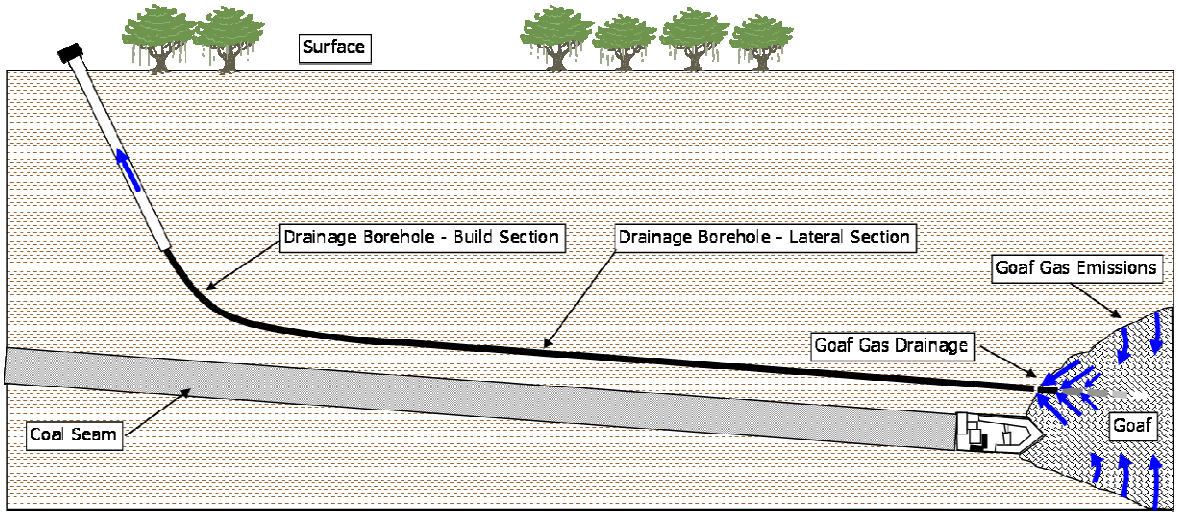


Figure 4 – Schematic of Goaf Gas formation during longwall mining

Fractured earth in the goaf gives rise to the potential for methane to rapidly flow into the Mine Ventilation Air (MVA). The presence of methane gas within the MVA, depending upon its concentrations, can pose a significant safety risk.

In the event that concentrations of gas in the ventilation air increase, mining operations may have to slow or cease altogether to enable adequate ventilation. Additionally, methane may escape from the seam and associated strata into the atmosphere via the emission of MVA, thereby contributing to greenhouse gas

emissions of the project. As such, the presence of methane gas impacts on the safety and efficiency of mining operations.

The Bulli Coal Seam has high concentration of methane in the coal. In order to undertake safe first workings development, the high level of methane in the coal must be reduced. The proposed infrastructure will drain the Bulli Seam of methane prior to the commencement of any mining.

Two horizontally steered wells for MSGD will be drilled from Site 1, with one of the MSGD wells connecting to a vertical well on Site 2. Gas will be extracted and flared at site 1 as shown by **Figure 5.** For the well with the vertical connection, gas will be extracted and flared at site 2 as shown in **Figure 6.**

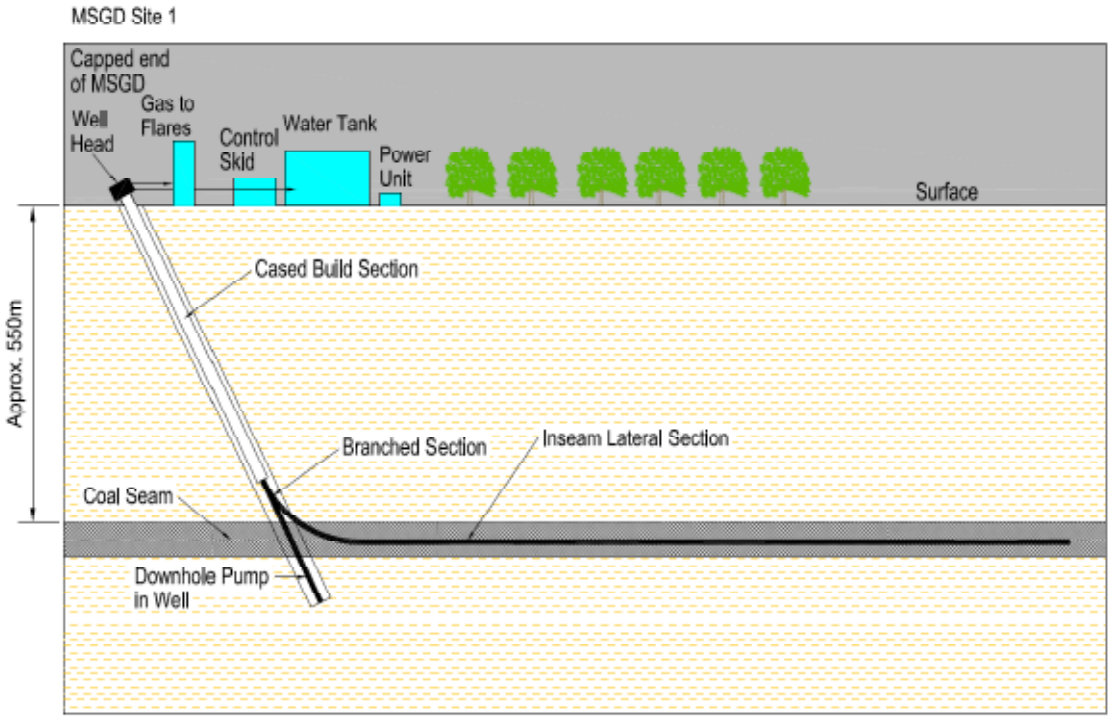


Figure 5 – Schematic of MSGD well # 1

Figure 6 shows the general arrangements of the second MSGD well.

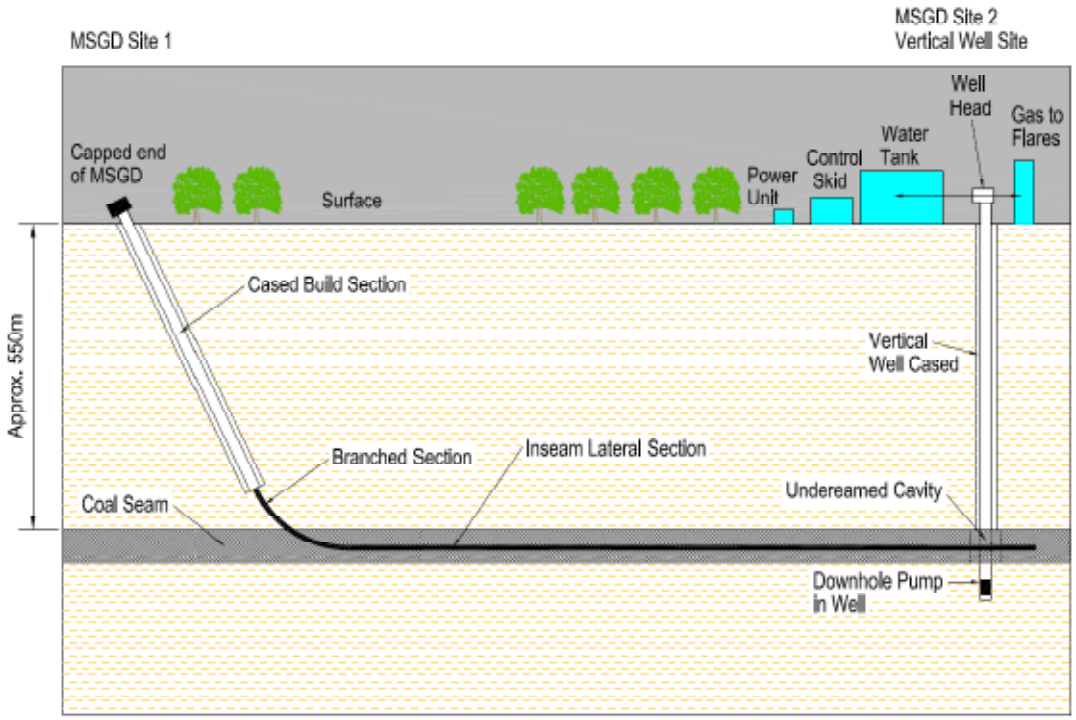


Figure 6 – Schematic of MSGD well #2

The MSGD wells and Longwalls 704 and 705 goaf gas extraction wells are required to allow safe and efficient mining in these areas. Accordingly the proposed modification is justified for the following reasons:

1. It will allow continued safe mining in the Appin Colliery.
2. It will increase the efficiency of mining in the Appin Colliery, by reducing the risk of downtime delays due to high gas levels within the mine.
3. It will allow BHPBIC to continue to meet customer demand for coal from the Appin Colliery.
4. The boreholes and gas extraction plants will be temporary in nature, small in footprint, fully fenced to restrict access and located in significantly disturbed, cleared pastoral areas.
5. Fugitive emission of Greenhouse Gas would be significantly reduced through the oxidation of methane (flaring at MSGD) and piping of goaf gas into the existing electricity generation plants.

2.6 Alternatives Considered

There are a limited number of alternatives to the management of gas during mining due to the inherent safety and operational risks. The alternatives considered for the management of the gas are as follows:

1. Re-use for electricity generation at the EDL Power Station at Appin Colliery;
2. Onsite flaring; and
3. Onsite venting to the atmosphere.

These options were assessed as part of the Preliminary EA (Cardno, 2008), whereby Option 1 was the preferred outcome. Due to distances and logistical issues at the MSGD sites, Option 1 alone is not feasible for the proposed works. Hence, Option 2 (Onsite flaring) is the preferred option for the MSGD sites, while Option 1 is the preferred option for the goaf gas drainage at Longwalls 704 and 705, where existing infrastructure is present.

2.7 Consequences of Not Proceeding

Not proceeding or in this case the "do nothing" approach involves not installing goaf gas drainage wells at Longwalls 704 and 705 or installing MSGD wells. The consequences of this are increased safety risks to mining in these areas, and in turn reduced efficiency in mining. The extraction of underground coal reserves in these areas is necessary to ensure continuity of coal supply to customers, consistent with BHPBIC business requirements. This includes significant ongoing operating investment in the Southern Coalfields of NSW, with flow on benefits including continuity of employment, expendable income, export earnings and government revenue.

2.8 Timing

Works are currently being undertaken in accordance with the existing Project Approval. The works proposed in this modification are anticipated to commence in early 2012 subject to receipt of the Project Approval modification or as soon as the modification is approved. Accordingly installation works are anticipated to be completed around mid-late 2012, with ongoing operation and maintenance in the following years.

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

3 REGULATORY FRAMEWORK

The proposed works fall under the provisions of the EP&A Act. On the 2nd of October 2009, the Project Approval (MP 08_0256) for the Appin Gas Drainage Project was granted by the Minister for Planning under Section 75(J) of the EP&A Act. The Minister for Planning subsequently issued a set of approval conditions for the project. Section 75W of the EP&A Act regulates modifications to Minister's Approval, where by the proponent (BHPBIC) may request the Minister to modify the Minister's approval for a project. An s75W modification application was lodged and the proposed approval conditions modified in December 2010 to relocate a Medium Radius Drilling (MRD) borehole and a vertical borehole as well as providing for a new access to the site to minimise traffic interaction with Douglas Park village.

This EA forms part of the application for a further modification under Section 75W of the EP&A Act to the existing project approval for the Appin Gas Drainage Project (MP 08_0256). As detailed in this EA, the temporary infrastructure required for the proposed modification works is considered to be consistent with that detailed in the Approved Project. The geographic location of the proposed works is based on geological features identified in the EA of the Approved Project. Accordingly, the proposed works are considered to be an extension of development under an approved project in an existing environment which is highly modified. Hence, modification of the Approved Project is likely to have limited environmental consequences beyond the project's original environmental assessment and is not considered to be a separate project.

An overview of the regulatory framework as it relates to the Appin Gas Drainage Project is set out in the original EA for the Project Approval. The proposed modification is consistent with the regulatory framework detailed in the original EA for the Project Approval and additional legislation or planning instruments introduced since this time, as summarised in **Table 3.1** below.

Table 3.1 : Summary of Regulatory Framework

Regulatory Instrument	Summary
Environment Protection and Biodiversity Conservation Act 1999	The proposed modification works will not have a significant impact on the seven matters of national environmental significance. No approval under the EPBC Act is required.
Environmental Planning and Assessment Act 1979	The development relates to the mining of a natural resource with the proposed additional gas drainage development in accords with the objects of the Act.
Environmental Planning and Assessment Amendment (Part 3A Repeal) Act 2011	The Act is influencing planning within NSW, including State Significant Development in respect of mining operations. Existing Part 3A Projects (including the Appin Gas Drainage Project as approved) become 'Transitional Part 3A Projects'. Hence, Part 3A will continue to apply to the Appin Gas Drainage Project, including modifications under Section 75W.
Environmental Planning & Assessment Regulation 2000	The project is progressing in accordance with the clauses in Part 1 A of this regulation.

Regulatory Instrument	Summary
Mining Act 1992	Appin Colliery operates under various leases granted under Part 6 of the Mining Act 1992 including the terms and conditions of Consolidated Coal Lease CCL 767 and Exploration Licence No. A396. The proposed modification works are consistent with these documents.
Water Management Act 2000	The WM Act governs water licensing and approvals in NSW in circumstances where a water sharing plan has commenced for that particular area. The "*Greater Metropolitan Region Unregulated River Water Sources*' Water Sharing Plan commenced on 1 July 2011 and includes the project area. The Geoterra Groundwater Assessment (refer Annex **Appendix E**) concluded that an 'aquifer interference approval' and 'water access licence' would not be required based on current regulations and existing approvals.
Pipelines Act 1967	The *Pipelines Act 1967* (Pipelines Act) regulates the construction and operation of pipelines within NSW. The requirement for a licence in relation to a petroleum pipeline (one which conveys naturally occurring hydrocarbons in gaseous state) generally relates to high pressure trunk lines and does not extend to the proposed connecting lines from the wells. Construction and operation of the proposed gas connecting lines within the project area would not require a licence under Part 3 of the *Pipelines Act 1967*.
Protection of the Environment Operations Act 1997	Appin Colliery requires an Environmental Protection Licence (EPL) as it meets the criteria to be declared a 'scheduled activity' as per Schedule 1 of the POEO Act. The drainage of gas is not listed in Schedule 1, however the proposed modifications would be in general accordance with the existing EPL's for Illawarra Coal's Bulli Seam Operations (EPL No. 2504), and Energy Developments Limited EPL No.'s 5357 and 5482.
National Parks & Wildlife Act 1974	This Act does not affect the proposed modification works, because the modification works will not be in a park, reserve, or heritage area designated under Part 4 of the Act. Provisions of the NPW Act that regulate Aboriginal Cultural Heritage are incorporated into the Project Approval granted in accordance with the EP&A Act.
Threatened Species Conservation Act	Endangered species, populations or communities listed in Schedule 1 of the TSC Act were not identified in the areas subject to the modification works. Critically endangered species or ecological communities listed in Schedule 2 of the TSC Act were not identified in the areas subject to the modification works. Vulnerable species or ecological communities listed in Schedule 3 of the TSC Act were not identified in the areas subject to the modification works.

Regulatory Instrument	Summary
State Environmental Planning Policy (Mining, Petroleum, Production & Extractive Industries) 2007	As per the EA for the Approved Project.
State Environmental Planning Policy (Infrastructure) 2007	SEPP Infrastructure aims to aid the delivery of infrastructure within NSW. Clause 104 of the SEPP (traffic generating development) states that certain traffic generating development is required to be referred to the RTA for comment as per Schedule 3 of the SEPP. The proposed works fall within Column 1 of Schedule 3 "Any other purpose", however as per Column 2 the proposed works are unlikely to generate traffic greater than 200 vehicles per day and therefore is not subject to this clause or Policy.
Regional Environmental Plan No. 20 Hawkesbury Nepean River	As per the EA for the Approved Project.
Wollondilly Local Environment Plan 2011	The Wollondilly LEP has been updated since the initial EA. The subject land is still zoned rural, however the nomenclature has been changed to RU2 Rural Landscape from A1. Based on advice provided by Council's Strategic Planners included in Section 3.5.2 of the EA for the Approved Project, the change in zoning nomenclature is not considered to change the permissibility of the project under the new LEP.

4 CONSULTATION

BHPBIC has developed and implemented a Communication and Consultation program, which details the communication and consultation process for the proposed works. The plan considers the issues and communications associated with the Bulli Seam Operations Project, No. 6 Ventilation Shaft, Mine Safety Gas Drainage Projects and Area 7 mine plan.

Communications for this project aim to ensure all local stakeholders are informed of the proposed works, and the importance of mine safety. Accordingly BHPBIC identified and has engaged in discussions with individual landholders potentially affected by the proposed works. BHPBIC has spoken to and visited these landholders which includes tenants and landowners plus residents along transport routes and adjacent residents within 500-800m of the project.

BHPBIC has also engaged with the other community stakeholders in the broader Douglas Park area through meetings of the Douglas Park Advisory Panel (established by BHPBIC in April 2010) and provision of a Community Update to all residents in Douglas Park in mid October 2011 that described Illawarra Coal's current and future activities in the area. Leaflets describing the MSGD works are available upon request and at BHPBIC's Douglas Park information spots.

The project has been discussed with elected officials and office bearers representing the local community, while consultation with relevant local and State government agencies is ongoing as part of the existing approvals process.

An example of the communications material provided to the community is provided in Appendix G.

5 ASSESSMENT OF ENVIRONMENTAL IMPACTS

5.1 Flora and Fauna

Niche Environment and Heritage prepared an Ecology Assessment for the proposed modification sites, which is included in **Appendix A**. The sites were inspected as part of the field assessment, however no detailed data collection techniques (such as vegetation quadrats) were undertaken, as the sites are located in highly disturbed pastures. The dominant vegetation is pasture grasses and weed species in paddocks where native vegetation has been cleared, to support grazing animals including cattle and horses. **Table 5.1** below provides a summary of the impacts to flora and fauna when comparing the approved project to the proposed modifications and mitigation measures.

Table 5.1 : Flora and Fauna Impact Comparison and Mitigation Measures

Approved Project (as per the Original EA and Modification #1)	**Proposed Modification Additional Impacts and Mitigation Measures**
Disturbance of 1.2ha of cleared paddocks, where the vegetation is highly disturbed due to previous agricultural practices. Minimal disturbance of habitat for native flora and fauna, with the exception of the clearing of 0.16ha of Cumberland Plain Woodland. Modification 1 - The relocated positions including access roads would result in the loss of a very small area of highly degraded Shale Sandstone, however was not likely to significantly impact any threatened species, population or ecological community.	Disturbance of approximately 8ha of additional cleared paddocks, where the vegetation is highly disturbed due to previous agricultural practices. The proposed area of impact does not support any important habitat for native flora or fauna. In general native vegetation clearing is not required, with the exception of one young *Eucalyptus moluccana* along the Menangle Road edge for the proposed entrance to the MSGD site 1. These works would also include the trimming of weed species within a narrow patch (approximately 60 metres by 3 metres) of vegetation along the road corridor of Menangle Road near the property fence. The extensive historical disturbance of the area and the absence of native species confirm a complete lack of ecosystem resilience. Therefore, no EEC occurs, or is likely to regenerate at the sites. The proposed works are not likely to have a significant impact on any threatened species, population or ecological community. No SEPP 44 Koala Habitat will be impacted, nor any important habitat features. ***Mitigation Measures –*** As per the Approved Project.

5.2 Cultural Heritage

Niche Environment and Heritage prepared a Heritage Assessment for the proposed modification sites, which is included in **Appendix B.** The existing environment has been highly disturbed due to historical native vegetation clearing and agricultural land use practices. Previous extensive ground disturbance often destroys archaeological or aboriginal artefacts, resulting in a low potential for items to be present, or for the areas to contain evidence of Aboriginal cultural heritage. The project sites are located away from ridgelines and watercourses. **Table 5.2** below provides a summary of the impacts to Cultural Heritage when comparing the approved project to the proposed modifications and mitigation measures.

Table 5.2 : Heritage Impact Comparison and Mitigation Measures

Approved Project (as per the Original EA and Modification #1)	**Proposed Modification Additional Impacts and Mitigation Measures**
There are no known Aboriginal archaeological sites within close proximity of the sites. The area has been highly modified and presents a low risk of impact to Aboriginal heritage	The Heritage Assessment (Niche, 2011) indicated that the project works would not cause harm to Aboriginal objects because of the extensive disturbance associated with historical agricultural practices at the site. Archaeological and Non-Aboriginal heritage constraints were not identified as being present. ***Mitigation Measures –*** Avoidance of known heritage sites including a ridgeline to the north of LW705MRD C/D and LW704v5, Site Id 52-2-3674 (an open site artefact) and the Harris Creek Scarred Tree. The existing Environment Management Strategy has been updated.

5.3 Noise

Wilkinson Murray prepared a Noise Assessment for the proposed modification sites, which is included in **Appendix C**. The surrounding noise receivers are sparsely located due to the rural environment. The Hume Highway is considered to be the dominant background noise source with no significant industrial noise in the area. Previous noise level measurements indicated that the highest sound power level for the MRD borehole drilling, vertical borehole drilling and MSGD steered horizontal wells drilling to be 113dBA, 109dBA and 108dBA respectively. **Table 5.3** below provides a summary of the noise impacts when comparing the approved project to the proposed modifications and mitigation measures.

Table 5.3 : Noise Impact Comparison and Mitigation Measures

Approved Project (as per the Original EA and Modification #1)	**Proposed Modification Additional Impacts and Mitigation Measures**
Noise would be generated through the establishment of drilling compounds, extraction plants, drilling of boreholes, assembling the surface pipeline reticulation system and underboring the Hume Highway and Main Southern Rail Line. Construction activities would generally be undertaken between the hours of 7am and 6pm, Monday to Friday, 8am and 1pm Saturday and at no time on Sundays or Public Holidays, with the exception of: ▪ underboring activities– 7:00am to 6:00pm 7 days per week; ▪ drilling of MRD holes – 24hours 7 days per week; and ▪ operation of extraction plant, flaring and venting – 24hours, 7 days per week. Proposed mitigation measures involved the installation of temporary noise barriers between the operations and potentially affected residents. Modification 1 – Recommended the use of a 5m high temporary noise mitigation barrier on the western and southern sides of MRD drilling rig at MRD Borehole #1.	704 – Noise emissions from most vertical well sites are predicted by Wilkinson Murray to be acceptable at all receivers during standard construction hours. The greatest predicted noise levels from vertical wells sites exceed relevant criteria by only 1 dB, which is considered negligible. Qualitative assessment of noise emissions from the construction of pipelines and access tracks indicated that noise emissions from these sources will be acceptable. 705 – Noise levels from the LW705MRD A/B drilling site are predicted to exceed the night time noise criteria at Several Receiver Numbers 32 and 34-40, to the east of the site, without the use of noise barriers. Noise levels from the LW705MRD C/D drilling site are predicted to exceed the night time noise criteria at two Sensitive Receiver Numbers 25 and 26 to the east of the site, without the use of noise barriers. Noise emissions from most vertical well sites are predicted to be acceptable at all receivers during standard construction hours. The greatest predicted noise levels from vertical wells sites exceed relevant criteria by only 1 dB, which is considered negligible. Qualitative assessment of noise emissions from the construction of pipelines and access tracks indicated that noise emissions from these sources will be acceptable. MSGD Site 1 – Noise levels from the MSGD drilling site are predicted to exceed the night time noise criteria at

Approved Project (as per the Original EA and Modification #1)	Proposed Modification Additional Impacts and Mitigation Measures
	several Sensitive Receiver Numbers 44-46, 48, 70 and 76-77, without the use of noise barriers. MSDG Site 2 – Noise levels from the MSGD vertical well drilling site are predicted to exceed the noise criteria at two Sensitive Receiver Numbers 1 and 4, without the use of noise barriers Extension of the construction hours on Saturday from 8:00 am to 1:00 pm, to 8:00 am to 6:00 pm is not predicted to result in the generation of noise in excess of the relevant criteria. ***Mitigation Measures –*** Mitigation measures specified in the Approved Project should continue to apply, including orientation of equipment away from sensitive receivers and undertaking specific construction activities within the approved construction times. Installation of a 3.5m high noise barrier at a setback of 10m from the noise source at drilling sites LW705MRD A/B and LW705MRD C/D is required to mitigate potential night time noise impacts at nearby sensitive receivers. Installation of a 5m high noise barrier at a setback of 5m from the noise source at the MSGD Site # 1 drilling site is required to mitigate potential night-time noise impacts at nearby sensitive receivers, except one Sensitive Receiver Number 45. The highest predicted 10th percentile night time noise level with the barrier is 37 dBA at Sensitive Receiver Number 45, which represents a 1 dB exceedance and is considered negligible. Installation of a 4m high noise barrier at a setback of 10m from the noise source at MSGD Site # 2 drilling site is required to mitigate potential noise impacts at nearby sensitive receivers, Noise barriers will be positioned relative to the orientation of the drill rig at each borehole location. Noise levels from the MRD and MSGD drilling site are predicted to comply with the night time noise criteria where these mitigation

Approved Project (as per the Original EA and Modification #1)	Proposed Modification Additional Impacts and Mitigation Measures
	measures are implemented.

5.4 Air Quality

PAE Holmes prepared an Air Quality Impact Assessment for the proposed modification sites, which is included in **Appendix D**. PAE Holmes documents the existing air quality environment as semi-rural, set in undulating to hilly topography, where the predominant wind direction is from the south-southeast in most seasons, except winter where strong winds from the west also dominate. The average wind speed recorded at Appin was 3.5 m/s. Ambient levels of key pollutants such as nitrogen dioxide (NO_2), sulfur dioxide (SO_2), carbon monoxide (CO) and PM_{10} recorded at nearby stations in Bargo (approximately 22km south west of Appin), MacArthur (approximately 15km south of Appin) and Oakdale (approximately 31km northwest of Appin) are generally below impact assessment criteria.

Ten receptor locations have been assessed within the vicinity of the MSGD sites 1 and 2. **Table 5.4** below provides a summary of air quality and greenhouse gas impacts when comparing the approved project to the proposed modifications and mitigation measures.

Table 5.4 : Air Quality Impact Comparison and Mitigation Measures

Approved Project (as per the Original EA and Modification #1)	Proposed Modification Additional Impacts and Mitigation Measures
Generation of dust and particulate emissions during construction of compound pads, access roads, borehole drilling, spoil management, vegetation clearing and trenching works were predicated to comply with adopted air quality assessment criteria. Odour levels, NO_2 and CO concentrations predicted at nearby residences were within adopted assessment criteria. Emissions at the EDL power stations were predicted to continue to comply with existing EPL requirements.	704 – Minor additional fugitive dust emissions during construction. Minor additional particulate, CO, NO_2 and SO_2 emissions from diesel powered plant / equipment and vehicle movements. Gas extracted to be reticulated back through the existing gas management system for electricity generation. There would be no change to the existing approvals at these plants. 705 – Minor additional fugitive dust generation during construction. Minor additional particulate, CO, NO_2 and SO_2 emissions from diesel powered plant / equipment and vehicle movements. Gas extracted to be reticulated back through the existing gas management system for electricity generation. There would be no change to the existing approvals at these plants. It is estimated that capturing and using the goaf gas for electricity generation would offset approximately 82kt CO_2-e / annum that would otherwise be released without mitigation.

Approved Project (as per the Original EA and Modification #1)	**Proposed Modification Additional Impacts and Mitigation Measures**
	MSGD Site 1 - Minor additional fugitive dust generation during construction. Additional emissions to air of CO, NO_x and VOCs through flaring, however predicted ground concentration levels for all pollutants assessed are well below the relevant OEH impact assessment criteria. MSGD Site 2 – Minor additional fugitive dust generation during construction. Additional emissions to air of CO, NO_x and VOCs through flaring, however predicted ground concentration levels for all pollutants assessed are well below the relevant OEH impact assessment criteria. It is estimated that flaring the gas drained from the MSGD wells would offset approximately 221kt CO_2-e / annum that would otherwise be released without mitigation. Emissions from diesel-powered construction equipment and truck movements would be small and widely dispersed, hence significant off-site concentrations are unlikely. ***Mitigation measures –*** As per the approved project. Staging of works will result in potential impacts being relatively short lived and more easily controlled.

5.5 Groundwater

Geoterra prepared a Groundwater Assessment for the proposed modification sites, which is included in **Appendix E**. Groundwater is encountered in shallow perched lenses within the Wianamatta Shale, before more significant aquifers are encountered in the Hawkesbury sandstone approximately 100m below the ground surface. Groundwater flows under the plateau floor following the hydraulic gradient to the Nepean River, with flow being predominantly horizontal. Groundwater recharge is generally through lateral migration, with limited vertical migration. Groundwater quality in the area ranges from brackish to saline, with salinity generally increasing with depth. **Table 5.5** below provides a summary of groundwater impacts when comparing the approved project to the proposed modifications and mitigation measures.

Table 5.5 : Groundwater Impact Comparison and Mitigation Measures

Approved Project (as per the Original EA and Modification #1)	**Proposed Modification Additional Impacts and Mitigation Measures**
No groundwater would be extracted as part of the project. Potential cross contamination of aquifers would be managed through casing and grouting of boreholes.	LW704 – As per the Approved Project. LW075 – As per the Approved Project. MSGD Site 1 - The volume of groundwater expected to be produced from the gas extraction boreholes is likely to be less than 3ML/year, with a decline in produced water over time. MSGD Site 2 - The volume of groundwater expected to be produced from the gas extraction boreholes is likely to be less than 3ML/year, with a decline in produced water over time. Geoterra concluded that there would be no adverse impacts to the groundwater regime or surrounding beneficial users of the groundwater resources nor is an adverse reduction in groundwater quality or aquifer depressurisation anticipated. ***Mitigation Measures -*** Appropriately licensed and experienced drillers will be used. Casing and grouting of the boreholes to negate the potential for groundwater inflow and cross contamination of any aquifers. The wells will be plugged with cement at the cessation of gas extraction. Groundwater extracted would be tanked away from site for re-use or disposal in accordance with the Approved

Approved Project (as per the Original EA and Modification #1)	Proposed Modification Additional Impacts and Mitigation Measures
	Project.

5.6 Topography, Soils and Surface Water

The existing topography is hilly formed by a plateau rising from east to wet away from the incised Nepean River gorge. A thin layer of high plasticity clayey topsoil is present, derived from weathering Wianamatta Shale bedrock with some Hawkesbury Sandstone outcrops. Surface waters generally flow towards the east, into and along ephemeral first order streams where the final receiving surface water body is either man-made dams or the Nepean River. High plasticity clays limit the rate of surface water percolation into perched groundwater within shallow horizons of the Wianamatta Shale. **Table 5.6** below provides a summary of the topography, soils and surface water impacts when comparing the approved project to the proposed modifications and mitigation measures.

Table 5.6 : Topography, Soils and Surface Water Impact Comparison and Mitigation Measures

Approved Project (as per the Original EA and Modification #1)	Proposed Modification Additional Impacts and Mitigation Measures
Minor cut / fill of surface soils for construction of the temporary drilling sites/pads and access tracks. Trenching for surface pipelines. No surface water to be extracted. Development and implementation of a Water Quality Management Plan including erosion and sediment controls with regular maintenance to minimise soil erosion and sediment transport. Rehabilitation of temporary work areas at project completion including revegetation.	LW704 – Additional surface soil disturbance and cutting for construction and operation of up to seven additional 50m*50m vertical borehole drilling pads. Minor diversion of surface water flows, through bunds creating clean water diversions. Minor, localised increase in suspended solids in surface water flowing across temporary access tracks into pasture paddocks. LW705 – Additional surface soil disturbance and cutting for construction and operation of five additional 50m*50m vertical borehole drilling pads and up to six 100m*100m MRD drilling pads (some overlapping or co-located). Minor diversion of surface water flows, through bunds creating clean water diversions. Minor, localised increase in suspended solids in surface water flowing across temporary access tracks into pasture paddocks. MSGD Site 1 - Additional surface soil disturbance and cutting for construction and operation 100m*100m steered horizontal well drilling pad. Minor diversion of surface water flows, through bunds creating clean water diversions. Minor, localised increase in suspended solids in surface water flowing across temporary access tracks

Approved Project (as per the Original EA and Modification #1)	Proposed Modification Additional Impacts and Mitigation Measures
	into pasture paddocks. If contingency site access is required, minor disturbance of drainage line would be required for the creek crossing. Due to the existing highly modified environmental, no riparian vegetation clearing would be required. Provision of fish passage is not proposed given the highly modified environment and limited upstream connectivity due to Menangle Road. MSGD Site 2 – Additional surface soil disturbance for construction and operation 100m*100m vertical well drilling pad. Minor surface soil disturbance (approximately 50m*50m) in cleared paddock due to trucks turning at site entrance. Upgrade of existing culvert to facilitate crossing of drainage line. Minor diversion of surface water flows, through bunds creating clean water diversions. Minor, localised increase in suspended solids in surface water flowing across temporary access tracks. Illawarra Coal has been granted a Water Use Licence to extract water from the Nepean River for use in mining related purposes. This water may be used in the construction of goaf wells and for the operation of the extraction plant. ***Mitigation Measures –*** As per the Approved Project, including updating relevant management plans, implementing erosion and sediment controls, minimising the extent of vegetation clearance and ground disturbance and site rehabilitation.

5.7 Traffic and Transport

Existing transport infrastructure within the vicinity of the project area includes the Main Southern Rail Line, the Hume Highway and Picton Road. Access to the project area from these primary transport corridors is via a network of local access roads which include Menangle Road and Moreton Park Road. A series of unnamed access tracks also exist on private properties. It is considered that normal traffic volumes along these local roads are low, as per the Cardno Vent Shaft No. 6 traffic and transport study. **Table 5.7** below provides a summary of traffic and transport impacts when comparing the approved project to the proposed modifications and mitigation measures.

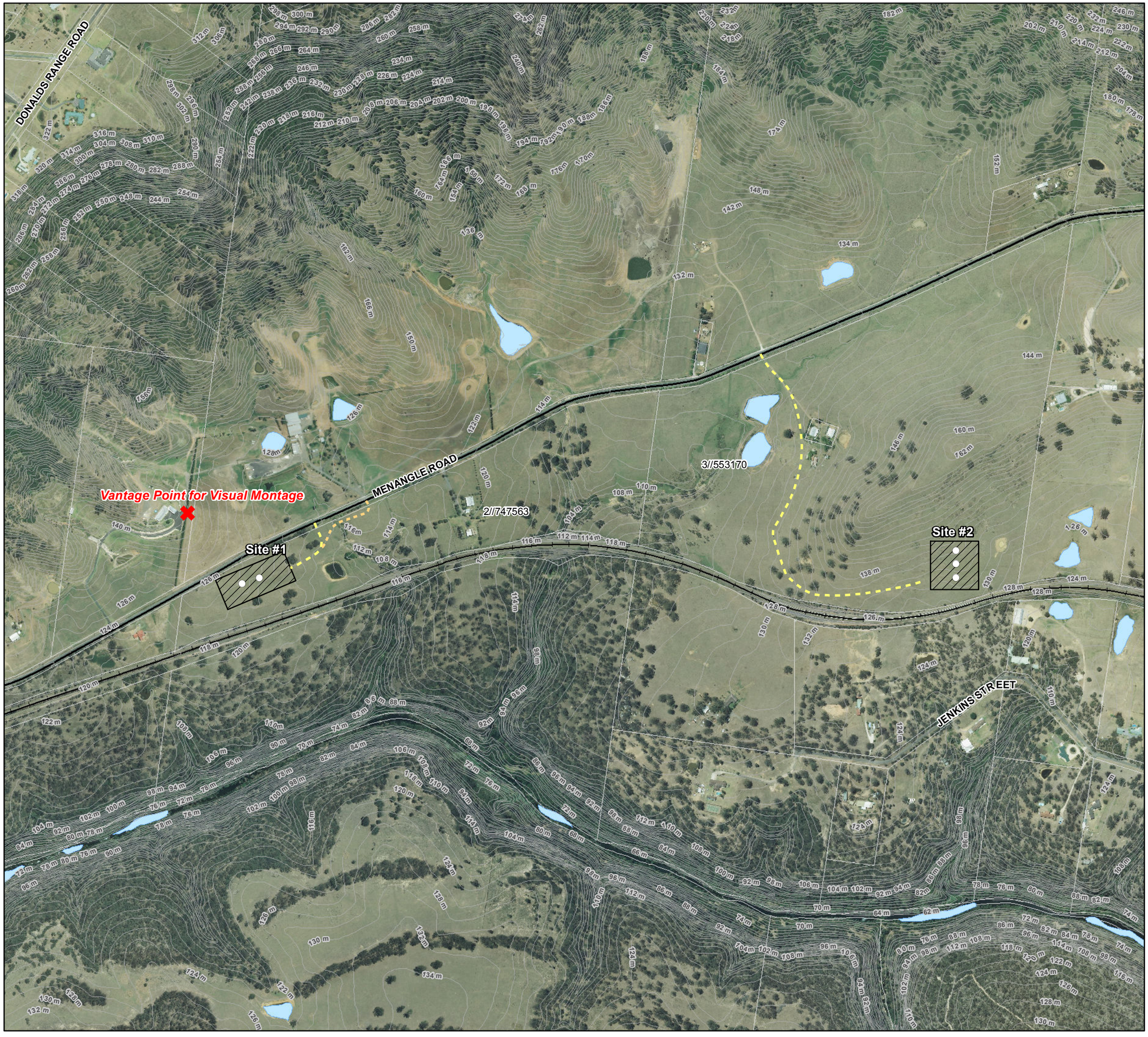
Table 5.7 : Traffic and Transport Impact Comparison and Mitigation Measures

Approved Project (as per the Original EA and Modification #1)	**Proposed Modification Additional Impacts and Mitigation Measures**
Establishment of boreholes under existing infrastructure including the Hume Highway and Main Southern Rail Line. Movement of construction traffic during mobilisation and demobilisation of equipment for borehole drilling, resulting in increased traffic times on local roads. Light commercial vehicle movement for operation and maintenance purposes. A minor increase in traffic volumes during the construction period. Modification 1 – A minor increase in traffic volumes on Railway Parade and Moreton Park Road during construction, to be accommodated through the use of appropriate warning signs and traffic control. Upgrade and use of existing Rail Crossing from Moreton Park Road.	LW704 – As per the approved project including access via the approved Vent Shaft 6 Access Road from Menangle Road. Proposed access to 704v4 is in part through the Main Southern Rail Line Corridor. Access to 703v3 via upgrade to existing access track on property (Lot 1 DP802151) entering from Moreton Park Road. Underboring the Main Southern Rail Line is also required to install a pipeline from 704v3 to connect with the existing pipeline reticulation system. LW705 – As per the approved project including access via the approved Vent Shaft 6 Access Road from Menangle Road to LW705v3-v5 and MRD – C and D. Approximately 3km of upgrade to existing access track on property (Lot 1 DP802151) from Moreton Park Road to take heavy vehicles for construction. Underboring the Main Southern Rail Line is also required to install a pipeline from LW705v1/v2 to connect with the existing pipeline reticulation system. A minor increase in local traffic volumes for a short duration on Menangle Road, and Moreton Park Road is expected. MSGD Site 1 – A minor increase in traffic volumes for a short duration along Menangle Road from Picton Road. Construction of a temporary access track (approximately 250m long) from Menangle Road to the site. MSGD Site 2 – A minor increase in traffic volumes for a short duration along Menangle Road from Picton Road. Construction of a temporary access track (approximately 700m long) from Menangle Road to the site. Increase in traffic volumes as a result of operational traffic (e.g. water tankers) is considered to be infrequent due to the volumes of water which the project is expected to generate, and is unlikely to have a significant impact on the local road network. ***Mitigation Measures –*** As per the approved project, including updating existing Journey and Traffic Management Plans, installation of traffic warning signs as appropriate and consultation as

Approved Project (as per the Original EA and Modification #1)	Proposed Modification Additional Impacts and Mitigation Measures
	required. Consultation with ARTC and RAILCON to ensure appropriate measures are in place to allow equipment access to LW704v4. Consultation with Wollondilly Shire Council for proposed design and construction of access off Menangle Road.

5.8 Visual Amenity

Visual amenity is primarily influenced by the visual character, the visual catchment (where the proposed works are visible from) and the visual sensitivity. The existing visual character is influenced by the undulating topography currently disturbed by Cut/Fill for the Main Southern Rail Line and Hume Highway. The visual catchment includes surrounding properties (including those on Top Ridge Road) used for agricultural and rural residential purposes, road traffic along the Hume Highway and Menangle Road, the Main Southern Rail Line and patches of remnant vegetation. The visual sensitivity includes the distance to the site, the frequency of the views and the composition of the views. A Photo Log of the sites is included in **Appendix F**, while **Figure 7** shows the vantage point for the closest, indicative receiver.



bhpbilliton
ILLAWARRA COAL

Mine Safety Gas Drainage - Vantage Point

APPIN MINE
GAS DRAINAGE PROJECT

Legend

- Vantage Point
- Proposed Well Locations
- Contingency Access (Indicative)
- Access Road (Indicative)
- Railway (LPI)
- 2m Contours (LPI)
- Major Roads (LPI)
- Cadastre (LPI)
- Waterbodies (LPI)
- Drilling Pad

N
W E
S

FIGURE 7

1:7,500 Scale at A3

Metres
0 100 200 300 400 500

Cardno

Map Produced by Cardno NSW/ACT Pty Ltd (WOL)
Date: 2011-11-16
Coordinate System: GDA 1994 MGA Zone 56
Project: 212055-001
Map: G1008_VantagePointPlan.mxd 02

Aerial imagery supplied by BHPBIC (2009)

Figure 8 and **Figure 9** below provide indicative three dimensional montages for the MSGD Site#1 during construction and operational phases respectively.

Table 5.8 below provides a summary of the visual impacts when comparing the approved project to the proposed modifications and mitigation measures.

Table 5.8 : Visual Impact Comparison and Mitigation Measures

Approved Project (as per the Original EA and Modification #1)	**Proposed Modification Additional Impacts and Mitigation Measures**
Minimal visual impacts due to the location away from visually sensitive receivers, screening from surrounding vegetation and the relatively small size of equipment. The works are temporary in nature, with lights for night works to be focussed within the drilling compound. Use of noise barriers will also reduce the visibility of the development.	704 – Minor temporary additional visual impact to residential dwellings looking north east to the drilling pad compounds, consistent with the visual impacts from the Vent Shaft 6 Access Road. 705 - Minor temporary additional visual impact to residential dwellings looking north east to the drilling pad compounds, consistent with the visual impacts from the Vent Shaft 6 Access Road. Minor visual impact to road users of the Hume Highway. MSGD Site 1 - Minor temporary additional visual impact to residential dwellings looking east and south east to the site. Consultation identified that shielding of light is required during night works due to the proximity of the Main Southern Rail Line. Minor visual impact to road users of Menangle Road. MSDG Site 2 - Minor temporary additional visual impact to residential dwellings looking north west to the site. Shielding of light during night works is required due to the proximity to the Main Southern Rail Line. ***Mitigation Measures –*** As per the Approved Project, including the use of noise barriers for visual shielding, where possible direction of lights away from sensitive receivers during night works and reinstatement of cuts. Enclosed horizontal flaring units will be used to reduce visual impacts including visible flaring.

Figure 8 – MSGD Visual Montage - Construction Phase

Figure 9 – MSGD Visual Montage - Operational Phase

5.9 Waste, Utilities and Hazards

Underground and overhead services in the form of telecommunication cables, electricity lines and gas reticulation pipelines currently exist in the project area. Potable water, sewage or stormwater infrastructure are not known to be located in the project areas. **Table 5.9** below provides a summary of the waste, utilities and hazards impacts when comparing the approved project to the proposed modifications and mitigation measures.

Table 5.9 : Waste, Utilities and Hazards Impact Comparison and Mitigation Measures

Approved Project (as per the Original EA and Modification #1)	**Proposed Modification Additional Impacts and Mitigation Measures**
Utilities are known to exist in the project area, however through consultation with utility owners potential impacts to utilities are expected to be minimal. - The risk of spills (fuel or drilling fluids) is to be managed through safe work practices and the use of spill kits. - Gas (primarily composed of methane) drainage. - Generation of spoil from drill cuttings and drilling fluids. Cuttings and drill muds reused as capping material at West Cliff emplacement, reused during site rehabilitation, or disposed of at appropriately licensed facility. Potential rubbish generation from site workers and excess construction materials	704 – As per the approved project, with additional low risk of intercepting utilities while drilling up to seven additional boreholes. Generation of additional spoil during drilling and drilling pad construction. Minor additional sewage from temporary portable toilets, additional general domestic waste onsite and potential excess construction materials. 705 – As per the approved project, with additional low risk of intercepting utilities while drilling additional boreholes. Generation of additional spoil during drilling and drilling pad construction. Minor additional sewage from temporary portable toilets, additional general domestic waste onsite and potential excess construction materials. MSDG Site 1 – As per the approved project, with additional low risk of intercepting utilities while drilling the steered horizontal wells. Generation of additional spoil during drilling and drilling pad construction. Minor additional sewage from temporary portable toilets, additional general domestic waste onsite and potential excess construction materials. Storage of fuel and waste water during construction and operation. Additional flaring of gas. MSGD Site 2 – As per the approved project, with additional low risk of intercepting utilities while drilling vertical wells. Generation of additional spoil during drilling and drilling pad construction. Minor additional sewage from temporary portable toilets, additional general domestic waste onsite and potential excess construction materials. Storage of fuel and waste water during construction and operation. Additional flaring of gas. Demolition of derelict farm sheds in accordance with AS 2601—2001*, The demolition of structures to address site safety.* Any waste generated will be recycled or disposed of at licensed landfill.

Approved Project (as per the Original EA and Modification #1)	Proposed Modification Additional Impacts and Mitigation Measures
	Mitigation Measures – As per the approved project.

5.10 Socio Economic

As described in **Section 2** surrounding areas are primarily used for agricultural purposes. Potential impacts to these areas resulting from the generation of dust and changes to surface water flows are unlikely as the scale of these potential impacts is small with mitigation measures to be implemented onsite. Significant impact to beneficial uses of groundwater by neighbouring properties is unlikely, given the drilling methods proposed and minimal groundwater volumes to be extracted. Where feasible, local contractors and suppliers will be used to support resourcing of the project, therefore having a positive socio-economic impact. Visual impacts associated with the project will be temporary. The installation of noise walls will minimise visual impacts during well construction. All drilling and infrastructure sites will be rehabilitated at the completion of the project.

5.11 Cumulative Impacts

Cumulative impacts involve compounding effects and interaction arising from developments proposed or under implementation within the locality or at a similar time. **Table 5.10** below provides a summary of the likely cumulative impacts.

Table 5.10 : Cumulative Impacts Summary

Aspect	Cumulative Impact
Flora and Fauna	Significant cumulative impacts to flora and fauna are considered unlikely given the highly disturbed existing environment at the proposed work sites and in the surrounding areas.
Cultural Heritage	Cumulative impacts to cultural heritage are considered unlikely given the highly disturbed existing environment at the proposed work sites and in the surrounding areas. All known cultural heritage site have been avoided.
Noise	The use of noise barriers and the staging of works relative to the Vent Shaft 6 access road construction are considered to mitigate cumulative noise impacts.
Air Quality	A level 1 cumulative assessment undertaken by PAE Holmes indicates that cumulative impacts would be well below the relevant impact assessment criteria for all pollutants and averaging periods.
Groundwater	Cumulative impacts to groundwater are unlikely as aquifer depressurisation has occurred previously, minor volumes of groundwater would be extracted and drilling

Aspect	Cumulative Impact
	methods would seal off potential connectivity with other aquifers.
Topography, Soils and Surface Water	A minor increase in the extent of disturbed surface soils and cuttings, with localised temporary changes to surface water flows.
Traffic and Transport	A minor increase to traffic volumes for a short duration on Menangle Road and Moreton Park Road, which may result in a temporary increase in travel times in these areas. Cumulative traffic and transport impacts due to the construction of the Vent Shaft 6 Access Road are unlikely due to the location and staging of works for the separate projects.
Visual Amenity	The cumulative impact to visual amenity is considered to be minor, due to the small scale and temporary nature of the proposed works relative to the existing environment where visual amenity is disturbed by the Hume Highway, Menangle Road and the Main Southern Rail Line.
Waste, Utilities and Hazards	Cumulative impacts are considered unlikely given the nature and scale of the works.

5.12 Summary of Mitigation Measures

Section 5 identifies and assesses environmental impacts from the proposed project modifications. Existing and proposed controls or mitigation and management measures are discussed as necessary in relation to the specific impacts. **Table 5.11** lists the existing and/or proposed mitigation and management measures that this EA identifies as required to minimise the environmental impacts from the proposed development. In general these measures are consistent with the Approved Project.

Table 5.11 : Overview of Mitigation Measures

Environmental Impact	Mitigation Measures
Flora and Fauna	As works are generally within existing highly disturbed cleared areas, mitigation measures are as per the Approved Project. All sites will be rehabilitated back to the pre-project landuse at the end of the project.
Cultural Heritage	Locations containing cultural heritage items will be avoided and protected when possible, as per the Environmental Management Strategy.
Noise	As per the Approved Project and Management Plan. Installation of a 3.5m high noise barrier at a setback of 10m from the noise source at drilling sites LW705MRD A/B and LW705MRD C/D is required to sufficiently mitigate potential night time noise impacts at nearby sensitive receivers. Installation of a 5m high noise barrier at a setback of 5m from the noise source at MSGD Site #1 required to sufficiently mitigate potential night time noise impacts at nearby sensitive receivers A 4m high noise barrier will be installed at a setback of 10m from the noise source at MSGD Site #2 to mitigate potential night time noise impacts at nearby sensitive receivers. Positioning of noise barriers relative to the orientation of the drill rig at each borehole location.
Air Quality	As per the Approved Project and Environment Management Strategy.
Groundwater	As per the Approved Project including casing and grouting boreholes to prevent connectivity between aquifers. At the completion of gas extraction, wells will be plugged with cement, capped and rehabilitated. Drilling by appropriately qualified and experienced drillers.
Topography, Soils and Surface Water	As per the Approved Project, including updating and implementation of approved management plans.
Traffic and Transport	As per the Approved Project, including updating existing Journey and Traffic Management Plans, erecting traffic warning signs and continuing consultation as

Environmental Impact	Mitigation Measures
	required.
Visual Amenity	As per the Approved Project, including the use of noise barriers and directing lighting away from sensitive receivers during night works to minimise light spill. Enclosed horizontal flaring units will be used to reduce visual impacts including visible flaring.
Waste, Utilities and Hazards	As per the Approved Project.

6 ENVIRONMENTAL RISK ASSESSMENT

This section identifies risks associated with the proposed development and the identified management measures.

6.1.1 Risk Assessment Overview

The basis for identification of environmental risks/impacts is an appreciation of the site location and an understanding of the technology utilised in the gas drainage process. This understanding is achieved through discussion with operational experts from BHPBIC and associated contractors. This environmental risk assessment provides direction and context for the identification of environmental impacts from the proposed project modification.

This risk assessment is based on an index formed from the perceived likelihood of an occurrence, and the subsequent consequence of that occurrence using the process outlined in the Australian Standard AS/NZS 4360:2004 Risk Management. Both likelihood and consequence are measured on a scale of 1 to 5 (with 1 corresponding to improbable/insignificant and 5 corresponding to frequent/catastrophic). A subsequent index was developed and all identified risks classified as belonging to either 'Low', 'Moderate' or 'High' risk categories in **Table 6.1**. This is a conservative index, emphasising the number of Moderate and High risks identified.

Table 6.1 : Environmental Risk Assessment Matrix

	Consequence				
Likelihood	**Insignificant**	**Minor**	**Moderate**	**Major**	**Catastrophic**
Improbable	Low	Low	Low	Moderate	Moderate
Remote	Low	Low	Low	Moderate	High
Occasional	Low	Moderate	Moderate	High	High
Probable	Moderate	Moderate	Moderate	High	High
Frequent	Moderate	High	High	High	High

6.1.2 Risk Categories

The risk categories and associated environmental risks are summarised in **Table 6.2**.

Table 6.2 : Environmental Risk Assessment

Environmental Impact	Process / Activity	Potential Impacts from Proposed Development	Risk (following application of mitigation measures identified in Section 5)
Flora and Fauna	Clearing of vegetation for site compound and access track establishment	Loss of significant flora and fauna habitat.	Low – the existing environment is highly disturbed.
Cultural Heritage	Disturbance of surface soils	Items or locations of cultural heritage may be damaged or destroyed during the works.	Low – surface soils have been highly disturbed by historical land uses. Known cultural heritage sites are avoided.
Noise	Vehicle movements during construction and operation and maintenance. Machinery use during drilling. Operational noise from pumps and vehicle movements.	Short term impacts primarily due to continuous drilling.	Moderate – the likelihood of the impact is probable, however mitigation measures will be implemented to reduce the consequence to minor impacts.
Air Quality	Flaring gas and use of gas for electricity generation. Pollutant emissions from diesel powered equipment. Construction activities.	Potential to increase the concentrations of greenhouse gases in the atmosphere. Dust generation during construction.	Low – the activities are temporary in nature and away from sensitive receivers.
Groundwater	Drilling through varied geological units and aquifers.	Creation of new preferential pathways between groundwater bodies, potentially resulting in cross contamination or groundwater drainage and depressurisation of aquifers.	Low – aquifer depressurisation has occurred previously and drilling methods will case the wells to prevent cross contamination of aquifers. Wells will be plugged at completion of gas extraction program.

Environmental Impact	Process / Activity	Potential Impacts from Proposed Development	Risk (following application of mitigation measures identified in Section 5)
Topography, Soils and Surface Water	Exposure of surface soils during earthworks. Unexpected finds of contamination.	Erosion and sedimentation resulting in offsite reduced water quality and siltation. Potential mobilisation of contaminants	Low – the surrounding environment is highly disturbed with the sites located away from ephemeral drainage lines. Previous land use indicates encountering contaminated material is unlikely.
Traffic and Transport	Construction, operation and maintenance traffic movements.	Temporary increased traffic volumes on local access roads.	Low – the number of vehicles required for construction and operation is low.
Visual Amenity	Visible temporary gas drainage infrastructure and associated accesses.	Reduction in visual quality.	Low – visual amenity is currently interrupted by roads and the proposed infrastructure is relatively small and temporary in nature.
Waste, Utilities and Hazards	Interception of utilities during earthworks / drilling. Generation of waste during site works.	Interruption of utilities. Waste not being contained and reused / recycled or disposed of appropriately.	Low – The waste streams expected are easily quantifiable, and the disposal options are well understood and available. .

7 STATEMENT OF COMMITMENTS

The statement of commitments made by BHPBIC for the Approved Project has been reviewed, and found to be relevant and directly applicable to the proposed modification works. The existing commitments have been reproduced in **Table 7.1**, and will be applied to the modification works along with additional commitments (shown in red) which are appropriate to the modification works.

Table 7.1 : Statement of Commitments, with additional commitments shown in red

Objective	Commitment
Greenhouse Gas Emissions	
▪ Minimise impacts to the environment associated with GHG emissions.	▪ Subject to obtaining RTA/ARTC approval and/or any unforseen construction delays to the under-bore beneath the road and rail corridor, BHPBIC will maximise the reticulation of goaf gas to EDL for electricity generation to minimise the emission of Greenhouse Gas emissions from the extraction of goaf gas associated with Longwall 703-705. (Note: this is the preferred option). ▪ BHPBIC will implement a temporary flaring system to minimise GHG emissions from the extraction of goaf gas associated with Longwall 703 after three months of commissioning the secondary extraction plant. Flaring will occur until the road and rail corridor can be completed and connected to the EDL reticulation system. ▪ BHPBIC will maximise the reticulation of goaf gas to the EDL to minimise the emission of GHG from the works associated with Longwall 704 and 705. ▪ If unplanned and prolonged goaf gas venting occurs, BHPBIC will investigate the implementation of a flaring capability to minimise GHG emissions. ▪ BHPBIC will flare methane gas drained from the MSGD sites.
Working Hours - Construction	
▪ Minimise impacts on the local area from construction and site implementation.	▪ BHPBIC will carry out vertical well drilling and Hume Highway under-boring six days per week during daylight hours. ▪ BHPBIC will drill the MRD and horizontal steered boreholes 24 hours per day, seven days per week until complete (approx. 13 week process for each well). ▪ BHPBIC will conduct construction of the goaf gas reticulation pipeline six days per week during daylight hours. ▪ BHPBIC will carry out extraction plant implementation activities six days per week during daylight hours.
Working Hours – Operation	

Objective	Commitment
▪ Minimise impacts on the local area from operation of the extraction plant.	▪ The extraction plant(s) will operate 24 hours per day, seven days per week until goaf gas is depleted.
Noise	
▪ Minimise noise impacts from the Appin gas drainage project activities on sensitive receivers.	▪ BHPBIC will endeavour to use the quietest available drilling plant, which is regularly maintained and fitted with appropriate mufflers. ▪ Orient the drill rig and equipment so that the quietest side is faced toward the nearest receivers where it is possible to do so. ▪ Place temporary noise barriers around the drill rig. ▪ Affected neighbours will be contacted and informed of likely duration of work, noise mitigation measures to be installed and contact details of BHPBIC Landholder Advisor will be provided to allow feedback on any noise impacts.
Public Consultation	
▪ Keep local residents informed of BHPBIC operations. ▪ Provide a public opportunity to comment on ongoing operations at Appin Colliery.	▪ BHPBIC will continue to operate the Appin community office during construction of this project to allow for any public comments or enquiries. ▪ BHPBIC will continue to operate the 24-hours telephone line to provide an alternative method for public information. ▪ BHPBIC will continue to support the Appin Area Community Working Group, Douglas Park Advisory Panel and associated liaison activities to ensure the local community have an opportunity to raise any questions regarding the gas drainage project.
Water	
Minimise impacts on: ▪ Quality ▪ Supply ▪ Groundwater	▪ Stormwater runoff, soil and erosion control measures will be managed in accordance with guidelines detailed in the Landcom Publication "Soils and Construction" Volume 1, 4th Edition, dated March 2004. ▪ Water used for drilling operations will be from a Sydney Water Authorised User or licensed extraction from the Nepean River. ▪ All excavated ponds will contain an appropriate impermeable liner to prevent water loss. The walls of the ponds will be of an appropriate height to provide adequate freeboard to prevent inflow or overflow during rainfall. ▪ 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 (approximately 250m underground) this is considerably below any regionally significant aquifers that may be present within the project area.

Objective	Commitment
	▪ The MRD and MSGD boreholes will be cased with welded or threaded steel and grouted in place from the ground surface of the borehole to the end of the radial or build section where the horizontal alignment of the borehole starts, at an approximate depth of 450-500m underground. This is considerably below any regionally significant aquifers that may be present within the project area. ▪ The water used in the extraction plant cooling process and borehole drilling will be removed and reused at Appin, West Cliff Collieries or another licensed facility.
Flora and Fauna	
BHPBIC will minimise impacts on native vegetation and animals by managing: ▪ Weeds ▪ Cumberland Plain Woodland (CPW)	▪ Machinery and heavy vehicles will be washed down prior to accessing private properties to avoid the transmission of weeds or disease into intact areas of native vegetation. ▪ Rehabilitation of the land that was at the contingency goaf gas extraction location with local native species characteristic of CPW after the cessation of the goaf gas drainage.
Rehabilitation	
▪ To reduce long term affects from the proposed developments on the environment. ▪ To ensure public and/or private safety following completion of the borehole use.	▪ Any disturbed land will be rehabilitated to ensure the environment is returned back to the pre-development condition or to meet landowner specific requirements. ▪ Decommissioning of the boreholes will be undertaken in accordance with EDG01 Borehole Sealing Requirements on Land (Summerhayes, 1997). All boreholes will be sealed in accordance with these guidelines upon completion of operations.
Waste	

BHPBIC will minimise impacts on the environment associated with waste generation and disposal.	▪ BHPBIC will minimise waste where possible through careful planning of the extraction locations prior to implementation.
	▪ Drilling waste will be reused where possible:
	  ▪ At the West Cliff Coal Waste Emplacement for site capping or rehabilitation.
	  ▪ Onsite for construction and rehabilitation purposes.
	  ▪ Onsite for construction of noise barriers.
	▪ Appropriate capture and transfer of waste to suitable reuse, recycling or disposal location.
	▪

Objective	Commitment
Air Quality	
Reduce impacts from dust on surrounding properties.	▪ Construction activities will be managed in order to minimise dust generation.
Heritage	
BHPBIC will minimise impacts on Aboriginal and cultural heritage.	▪ Aboriginal cultural sites will be avoided and temporarily fenced during construction where possible. ▪ Aboriginal cultural sites that may be impacted during construction will be managed in accordance with the Aboriginal Cultural Heritage Management Plan and in consultation with registered Aboriginal Stakeholders.
Traffic	
Reduce the potential for traffic associated with the project to crate congestion	▪ During the construction phase, warning signs will be erected at critical access points, including along Menangle Road and Moreton Park Road. ▪ A Journey Management Plan will be developed by the contractor and approved by the BHPBIC Project Manager prior to the commencement of any drilling works. This plan will guide appropriate controls for movement of project equipment including drilling rigs. ▪ If necessary, a Traffic Management Plan will be prepared by the Contractor and approved by the BHPBIC Project Manager prior to the commencement of any construction works. This plan will control movements of employee's vehicles and associated implementation traffic. ▪ BHPBIC has consulted with and obtained written agreements from all landholders. In addition, residents will be advised prior to the commencement of works and advised of any related disruptions to local traffic.
Construction Management	
▪ Minimise impact on the environment from construction work. ▪ Ensure employee safety during construction.	▪ The successful contractor/s will prepare a safe work method statement for approval by BHPBIC prior to work commencing. ▪ The Contractor will maintain equipment to a safe standard and ensure secure storage. ▪ The Contractor will prepare an Environmental Management Plan for BHPBIC approval prior to the commencement of works. ▪ All works will be conducted in accordance with relevant construction legislation and best practice.

8 CONSTRUCTION MANAGEMENT

The project will be constructed by a number of different contractors, however BHPBIC will maintain responsibility for the environmental management of the proposed project. BHPBIC's Environmental Management System is certified to the ISO14001 standard.

The contractor(s) appointed to undertake construction works will prepare or update Health, Safety and Environmental documentation as per the Approved Project including the BHPBIC *Appin Mine Safety Gas Drainage – Environmental Management Strategy*.

It will be a requirement of the project that all contractor environmental documents and management plans are approved by BHPBIC prior to the commencement of any works by the contractor.

9 CONCLUSIONS

This Environmental Assessment forms part of an application for a Section 75(W) modification to the existing Project Approval (MP 08_0256) for the Appin Gas Drainage Project as granted by the Minister for Planning under Section 75(J) of the *Environmental Planning and Assessment Act 1979*. The set of approved conditions issued by the Minister for Planning for the project, were previously modified in December 2010.

The proposed modification works include the drilling, operation and rehabilitation of MSGD wells, MRD boreholes and vertical boreholes with associated assess tracks and infrastructure to facilitate gas drainage within CCL 767. Some drained gas will be piped into the existing surface pipeline reticulation system at Longwalls 704 and 705, while gas drained from the MSGD wells will be flared onsite. It is proposed that construction hours on Saturday be extended to 6pm.

In general the designated work sites are highly modified environments due to historical native vegetation clearing for pastoral or agricultural purposes. The Ecology Assessment (Niche, 2011) indicated that there would be no impact to native vegetation or threatened species. Niche also prepared the Heritage assessment which found that the proposed works would not cause harm to Aboriginal objects, and that there are no archaeological and Non-Aboriginal heritage constraints at the subject sites.

Due to the hilly topography, some cutting is required to provide level drilling pad compounds, while some minor filling is required to construct the temporary access tracks. These works are unlikely to significantly impact on surface waters, soils and the topography. The Groundwater Assessment (Geoterra, 2011) indicated that an observable adverse reduction in groundwater quality or aquifer depressurisation is not anticipated, with adverse impacts to the groundwater regime or surrounding beneficial users unlikely. Based on current regulations and existing approvals, an 'aquifer interference approval' or 'water access licence' would not be required.

The Noise Assessment (Wilkinson Murray, 2011) indicated that operational noise from the proposed modification works would meet the relevant noise criteria. Temporary construction noise generated from the drilling of vertical boreholes is predicted to be acceptable, following the application of temporary 3.5m high noise barriers to mitigate noise impacts from the drilling of MRD wells. The use of temporary 5m and 4m high noise barriers is required to mitigate noise impacts from the drilling of MSGD Site #1 and Site #2 respectively. These will also act as a visual screening measure.

Visual impacts of the proposed modification are considered to be low given the temporary nature of the works, the small extent of ground disturbance relative to the existing predominantly cleared hilly terrain, and the size of equipment to be used.

Air quality impacts as assessed by PAE Holmes (2011) are predicted to be minor, and to be limited primarily to dust generation during construction. PAE Holmes estimated that capturing and using the goaf gas for electricity generation would offset approximately 82kt CO_2-e / annum and flaring gas from the MSGD wells would offset approximately 221kt CO_2-e / annum.

Existing arterial roads (Picton Road, Moreton Park Road and Menangle Road), would primarily be used to convey traffic to the sites. Primary impacts to local traffic are expected to occur during mobilisation and demobilisation of drilling equipment to the sites. Light vehicle movements would be required for operation and maintenance of the sites within approved construction hours.

BHPBIC have consulted with and obtained written agreements from all landowners where the proposed works would occur. The results of these landowner negotiations have had a direct impact on the design and location of the above ground infrastructure. Illawarra Coal has undertaken community consultations prior to this application being made, and will continue to consult with the community throughout this project.

In summary, the potential environmental impacts and proposed mitigation measures are consistent with the Approved Project. The impacts are considered to be minor in scale resulting in minimal environmental impacts due to the temporary nature of the works, proposed management and mitigation measures, and long-term agricultural land use of the project area.

10 REFERENCES

Australian Standard *AS/NZS 4360:2004 Risk Management*

BHPBIC (2008) *Bulli Seam Operations Project Description Report and Preliminary Assessment*. Prepared by BHP Billiton Illawarra Coal Pty Ltd.

Cardno (2008) *Preliminary Environmental Assessment Appin Colliery Area 7 – Goaf Gas Drainage Project*. Prepared by Cardno Forbes Rigby for BHP Billiton Illawarra Coal Pty Ltd., December 2008.

Commonwealth Government (1999) *Environment Protection & Biodiversity Conservation Act 1999*.

Department of Housing (2004) *Managing Urban Stormwater: Soils and Construction* (4th Edition). NSW Government.

DoP (2009) *Appin Coal Mine, Douglas Park*. Source: http://majorprojects.planning.nsw.gov.au/index.pl?action=view_job&job_id=2827>, Accessed: 7 April 2009.

Hazelton, P.A., and Tille, P.J. (1990) *Soil Landscapes of the Wollongong-Port Hacking 1:100,000 Sheet*. Soil Conservation Service NSW, Sydney.

NSW Government. NSW Department of Planning (2009) *Major Project Assessment: Appin Gas Drainage Project (08_0256)*.

NSW Department of Planning (2005) *State Environmental Planning Policy – Major Projects*.

NSW Government. NSW Department of Planning (2007) *State Environmental Planning Policy – Mining, Petroleum Production and Extractive Industries*.

NSW State Government (1979) *Environmental Planning & Assessment Act 1979*.

NSW State Government (1979) *Environmental Planning & Assessment Regulation 2000.*

NSW State Government (1974) *National Parks & Wildlife Act 1974*.

NSW State Government (1992) *Mining Act 1992*.

NSW State Government (1995) *Threatened Species Conservation Act 1995*.

NSW State Government (1997) *Protection of the Environment Operations Act 1997*.

NSW State Government (1997) *Sydney Regional Environmental Plan No. 20 Hawkesbury – Nepean River*.

Summerhayes, G. (1997) EDF01 *Borehole Sealing Requirements on Land: Coal Exploration*. Prepared by Mineral Resources New South Wales Environmental Management Guidelines for Industry. NSW Department of Mineral Resources, 1 December 1997.

Wollondilly Shire Council (2011) *Wollondilly Local Environmental Plan 2011*.

Appendix A

Ecology Assessment

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Environment and Heritage

APPIN MINE GAS DRAINAGE AND MINE SAFETY GAS DRAINAGE (MSGD) PROJECT

SECTION 75W MODIFICATION APPLICATION (MOD#2):

ECOLOGY ASSESSMENT

FOR BHP BILLITON ILLAWARRA COAL

NOVEMBER 2011

DOCUMENT CONTROL

Business Unit	**Niche Environment and Heritage, Illawarra/Southern NSW**		
Project No.	1111		
Document Description	An ecological assessment to support a Section 75w Modification for the drainage of gas from Longwalls 704 and 705, and MSGD 2 and MSGD 3.		
	Name	**Signed**	**Date**
Supervising Manager	Matthew Richardson		26 October 2011
Author(s) of This Document	Luke Baker/Matthew Richardson		
External Review			
Document Status	Final Report		
Date	7 November 2011		

Prepared for:

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

Cover Photo: View towards rail line from MSGD 3 location.

LIST OF CONTENTS

1 SCOPE OF WORKS

1.1 Background

Niche Environment and Heritage Pty Ltd (Niche) has been commissioned by BHP Billiton Illawarra Coal Holdings Pty Ltd (BHPBIC) to undertake an assessment of the ecological constraints and potential impacts associated with the Section 75w Modification for the drainage of gas from Longwalls 704 and 705, and Area 9 Mine Safety Gas Drainage wells (MSGD).

The ecological assessment involved the assessment of:

- Two Mine Safety Gas Drainage (MSGD) wells within Appin Area 9 (Site 1);
- Three vertical wells within Appin Area 9 (Site 2);
- Seven vertical goaf gas extraction well sites above Longwall 704;
- Five vertical goaf gas extraction well sites, and six Medium Radius Drilling (MRD) sites above Longwall 705;
- The proposed route of a connecting pipeline (trenched);
- Trimming and/or slashing of a narrow patch of vegetation along Menangle Road that may be required to provide safe site access to Site 1; and
- The access tracks to the sites across farm paddocks.

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.

1.2 Definitions

The following definitions are taken from the Office of Environment and Heritage (OEH) *Threatened Species Assessment Guidelines: The Assessment of Significance* (DECC 2007) and have been adopted for this assessment.

Subject Site: the area to be directly affected by the proposal.

Study Area: the subject site and any additional areas which may potentially be affected by the proposal.

Direct Impacts: those that directly affect the habitat and/or individual plants and animals and cannot be avoided or mitigated.

Indirect Impacts: those that affect species, populations or ecological communities in a manner other than through direct loss or disturbance. These can usually be avoided or mitigated.

Local Population: the population of a particular species that occurs in the study area.

Locality: the area within 10 km of the study area.

Local Occurrence: refers to the distribution of an ecological community within the study area.

1.3 The Proposal and Study Area

The layout of the proposal within the study area is illustrated in Figure 2 and 3. For a detailed description and justification of the project refer to Section 1 of the *Environmental Assessment* (Cardno – Forbes Rigby 2011). Generally these sites will require the following construction and on site activities:

- Development of a 50 x 50m drilling compound which will allow for the temporary installation of drilling equipment, gas drainage pipes and, gas extraction units.
- Temporary Installation of site facilities including toilet/washroom facilities at each site.
- Movement on site of various vehicles.
- A larger (e.g. 100x100m) compound will be required for the six proposed MRD and two MSGD wells.

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

Table 1: Gas Well and Extraction Flaring Unit Locations

Site	Easting (MGA)	Northing (MGA)
Area 9		
Site 1	285831	6215353
Site 2	285258	6215387
Longwall 704		
V3	290866	6216345
V4	290709	6216269
V5	290448	6216153
V6	290366	6216113
V7	290284	6216071
V8	290202	6216031
V9	290123	6215981
Longwall 705		
MRD-A	291088	6216944
MRD-B	291095	6216930
MRD-C	290177	6216487
MRD-D	290188	6216466
MRD-E	291088	6216944.
MRD-F	291095	6216930
V-1	291130	6216886
V-2	290948	6216797

Site	Easting (MGA)	Northing (MGA)
V-3	290305	6216482
V-4	290122	6216392
V-5	289755	6216212

1.4 Site Assessment

A site assessment of the proposal was undertaken on the 31st of August 2011. Staff from BHP Billiton Illawarra Coal, along with Cardno Forbes Rigby were present at the site assessment to discuss the extent of works required.

Locations for the gas wells and associated infrastructure, along with access tacks and pipeline routes, 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 well and infrastructure sites was located within highly disturbed pasture land and as such, 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 routes were all within farm paddocks or on existing roads/access tracks. Only access to Site 1 may require the removal of one juvenile *Eucalyptus moluccana*, and the trimming of weed species within a narrow patch (approximately 60 meters by 3 meters) of vegetation along the road corridor of Menangle Road near the property fence. The removal of weeds within this patch of vegetation would improve visibility for vehicles exiting the property. No vegetation removal would be required for any other part of the Proposal.

No threatened plant or animal species were recorded from the area of possible disturbance. No hollow bearing trees were recorded within the area of possible disturbance. Species lists have not been prepared for this report as the location of the Study Area was located in highly modified pastures and contained minimal native vegetation or fauna habitat values.

1.5 Existing Environment

Site 1 and 2 are located to the west of Douglas Park, and Longwalls 704 and 705 are located between Douglas Park and Menangle, within the Wollondilly Local Government Area. The proposed location for the gas wells, connecting pipeline, associated infrastructure and the proposed access tracks to the sites are located within a modified and disturbed environment. The proposed locations, with the exception to access along Menangle Road for Site 1, 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 minimised.

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 4**):

- 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 and Conservation Act* 1995 (TSC Act) and Commonwealth *Environmental Protection and Biodiversity Conservation Act* 1999 (EPBC Act).
- Alluvial Woodland and Riparian Forest which are both 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;
- Moist Shale Woodland which is equivalent to Moist Shale Woodland in the Sydney Basin Bioregion listed on the TSC Act;
- Western Sydney Dry Rainforest which is equivalent to the TSC Act listed Western Sydney Dry Rainforest in the Sydney Bioregion; and,
- Shale Plains Woodland and Shale Hills Woodland, equivalent to the Cumberland Plain Woodland which is listed under both the TSC and EPBC Acts;

The field survey confirmed that the Study Area predominantly occurred within cleared paddocks.

The only section of the Study Area that may require very minimal vegetation impacts is the proposed access point off Menangle Road for Site 1. The access point may require the removal of one young *Eucalyptus moluccana* along the Menangle Road edge. To improve road visibility for vehicles exiting the property, the trimming and slashing of exotic shrubs and grasses along a 60 meter portion of the Menangle road corridor edge may be required. Weed species include *Chloris gayana, Paspalum dilatatum, Eragrostis curvula, Ehrharta erecta* and *Olea europaea*. Scattered native trees and shrubs including *Eucalyptus moluccana* and *Acacia decurrens* occur sporadically along this road corridor. These species will not be removed or slashed.

The rest of the Study Area is devoid of native vegetation. Dominant species recorded in cleared paddocks include pasture grasses including *Paspalum dilatatum, Pennisetum clandestinum* and *Setaria gracilis*. Weed species recorded within the paddock areas included *Chloris gayana, Verbena bonariensis, Sida rhombifolia, Senecio madagascariensis* and *Cynodon dactylon*. Further, the extensive disturbance of the area and the absence of native species confirm a complete lack of ecosystem resilience. Therefore, no EEC occurs, or is likely to regenerate in the Study Area.

The proposal will not impact any EEC listed on the TSC or EPBC Acts.

2.2 Threatened Species

A total of 24 threatened flora and 60 threatened fauna have previously been recorded within a 10 km radius of the study area (Figure 5 and Figure 6). Records have been derived from both the Atlas of NSW Wildlife, and the EPBC Act Protected Matters Search tool. Tables identifying the habitat requirements for each of the species listed, has been provided in Appendix (Table 2 & Table 3).

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 Study Area, and the length of time it has been disturbed this is considered highly unlikely.

No core or potential habitat defined under the State Environmental Planning Policy 44 – Koala Habitat Protection (SEPP 44) will be impacted by the proposal.

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. No SEPP 44 Koala Habitat will be impacted, nor any important habitat features. Potential impacts from the proposal are confined to areas within a modified and disturbed environment, and as such, no potential habitat exists for any threatened flora or fauna.

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.
- All sites to be rehabilitated after works have been completed.
- Trimming and slashing that may be required along the Menangle Road corridor, should only target weed species. Clearing of native vegetation should be minimised to allow for a safe entry to Site 1. Only one juvenile *Eucalyptus moluccana* and Acacia are within the proposed access point, and may require removal.
- Any soils disturbance or vegetation clearing, other than that described in this assessment, will require further assessment.

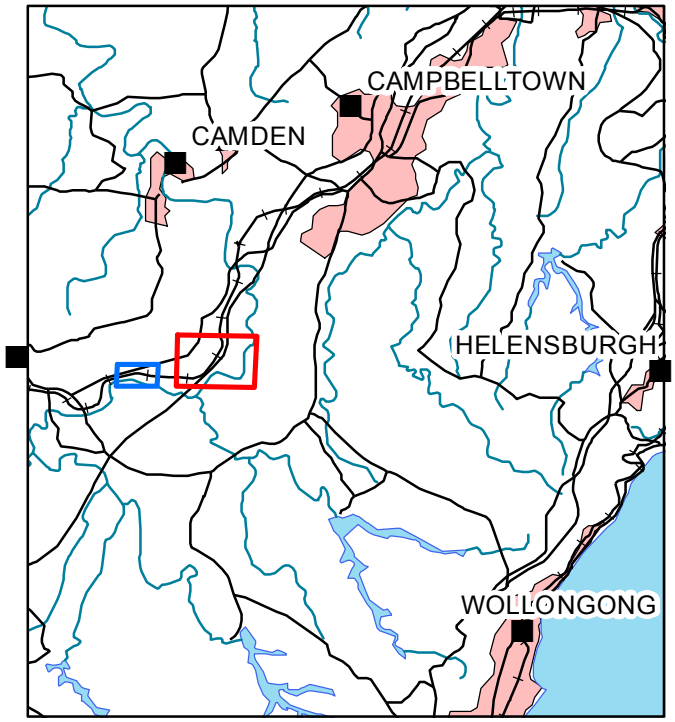
4 REFERENCES

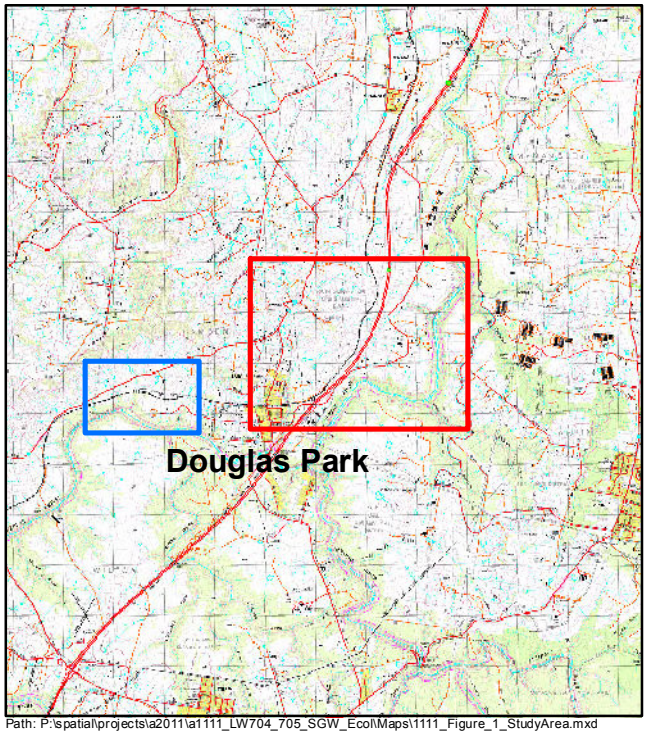
Biosis Research (2011) Appin Area 9 Surface to Inseam (MSGD) Boreholes – Terrestrial Flora and Fauna and Cultural Heritage Assessment.

Cardno (2011) Appin Gas Drainage Project – Section 75W Modification Application (Mod#2):Additional Gas Drainage – Environmental Assessment, Report Prepared for BHP Billiton 2011.

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

APPENDIX





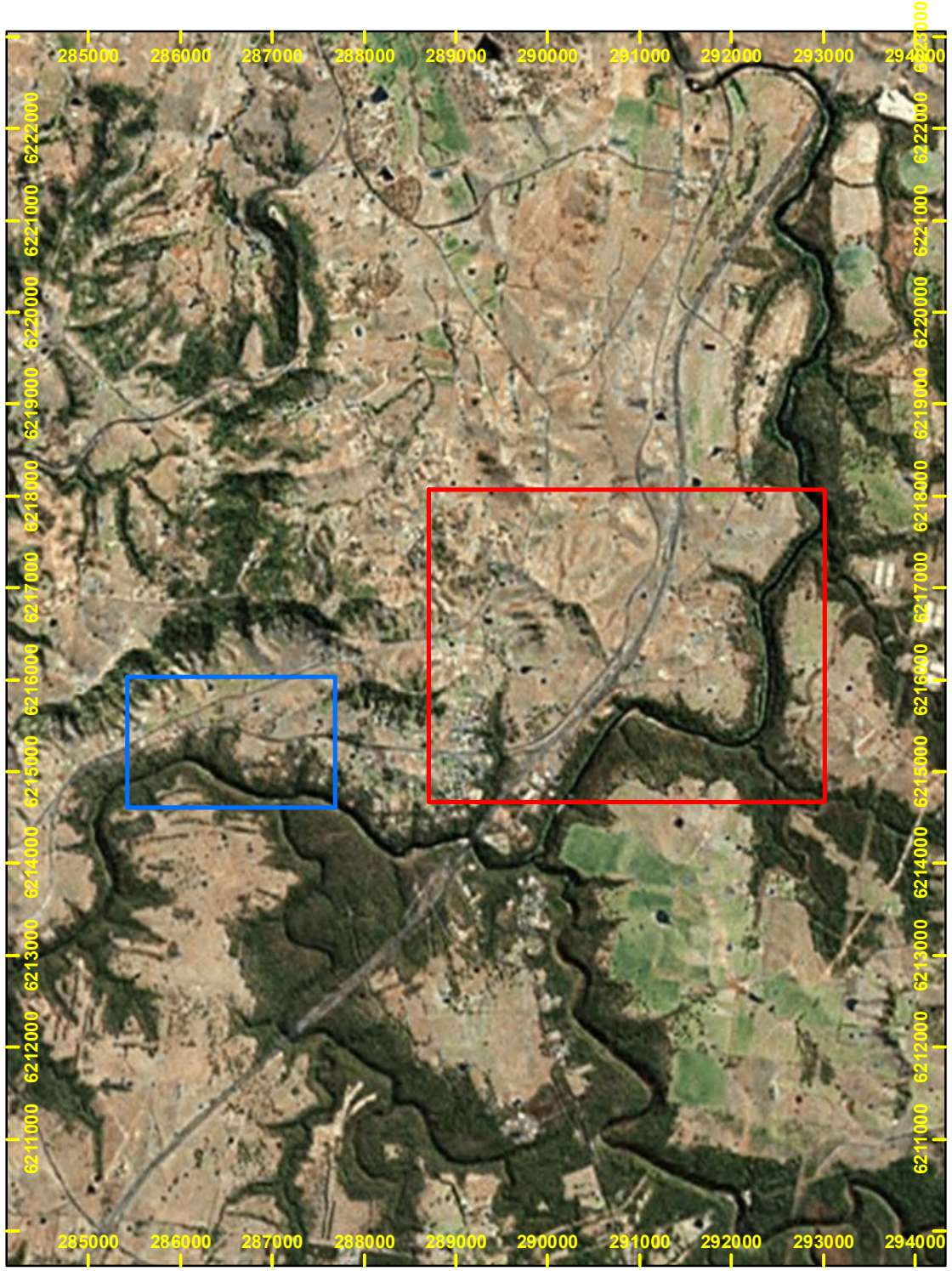


Figure 1: Location Map

1111 LW 704 - 705 Surface Gas Wells

Drawn by: RJ

Project Mgr: MR

Date: 09/09/2011

Study Area

MSGD Wells

Vertical Wells

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Metres

0 250500 1,000 1,500 2,000 2,500

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Horizontal Datum
MGA Zone 56

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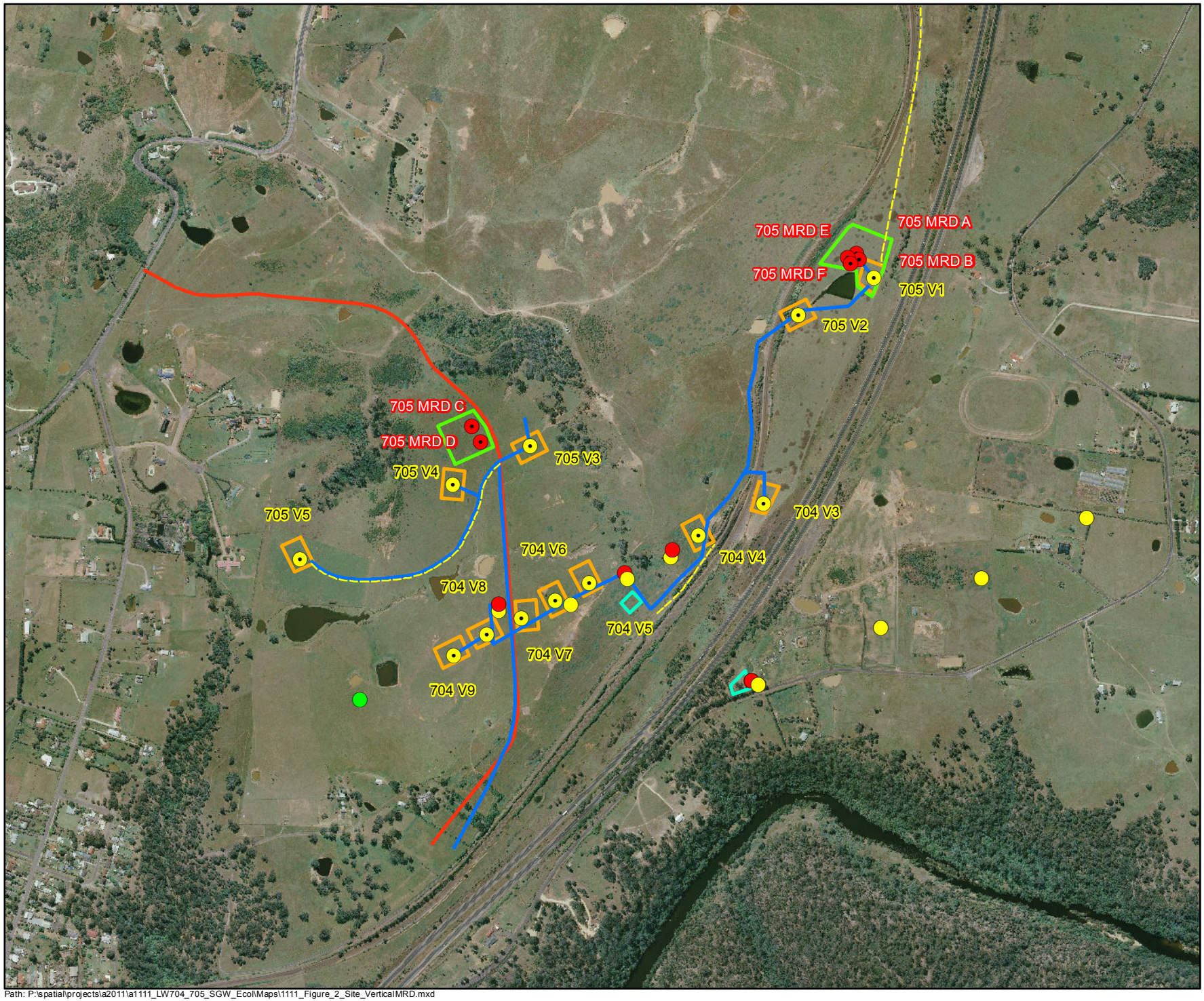

Figure 2: Vertical and MRD Well Sites

1111 LW 704 - 705 Surface Gas Wells

Drawn by: RJ

Project Mgr: MR

Date: 07/11/2011

Approved Boreholes
- MRD Borehole (Approved)
- Vertical Borehole (Approved)
- Downhole (Approved)

Proposed MRD Borehole

Proposed Vertical Borehole

- AccessTrack
- Drainage Pipelines
- Approved Access Road
- MRD Well Sites
- Extraction Plant Locations
- Vertical Well Sites

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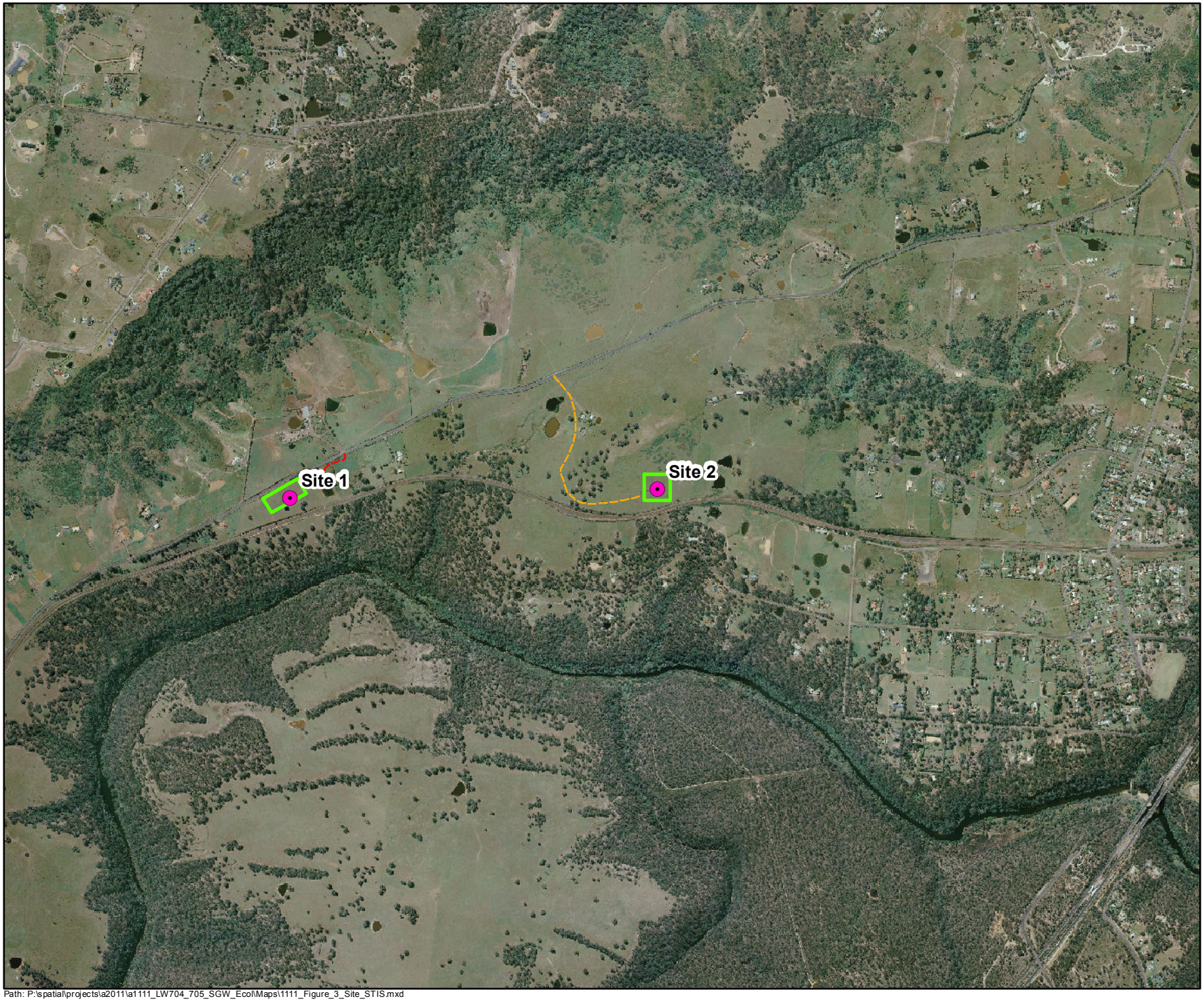

Figure 3: Mine Safety Gas Drainage Site Plan

1111 LW 704 - 705 Surface Gas Wells

Drawn by: RJ

Project Mgr: MR

Date: 07/11/2011

Proposed Well Locations

Indicative Access Road

Indicative Contingency Access

Proposed Drilling Pad

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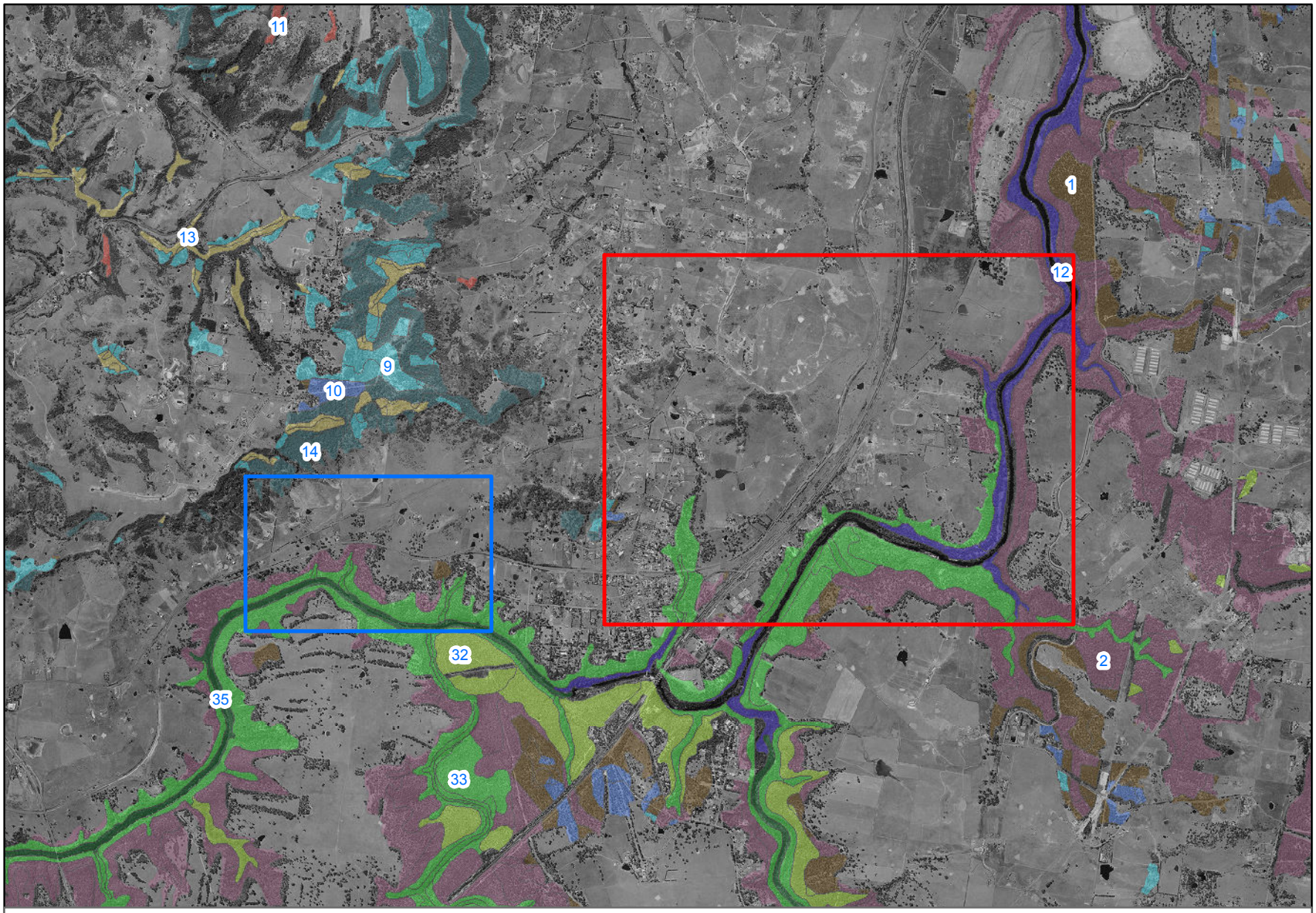

Study Area
MSGD Wells
Vertical Wells

Cumberland Plain Vegetation

1 - Shale Sandstone Transition Forest (Low Sandstone Influence)
10 - Shale Plains Woodland
11 - Alluvial Woodland
12 - Riparian Forest
13 - Western Sydney Dry Rainforest
14 - Moist Shale Woodland
2 - Shale Sandstone Transition Forest (High Sandstone Influence)
31 - Sandstone Ridgetop Woodland
32 - Upper Georges River Sandstone Woodland
33 - Western Sandstone Gully Forest
35 - Riparian Scrub
9 - Shale Hills Woodland

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Figure 4: Vegetation

1111 LW 704 - 705 Surface Gas Wells

Drawn by: RJ
Project Mgr: MR

Date: 09/09/2011

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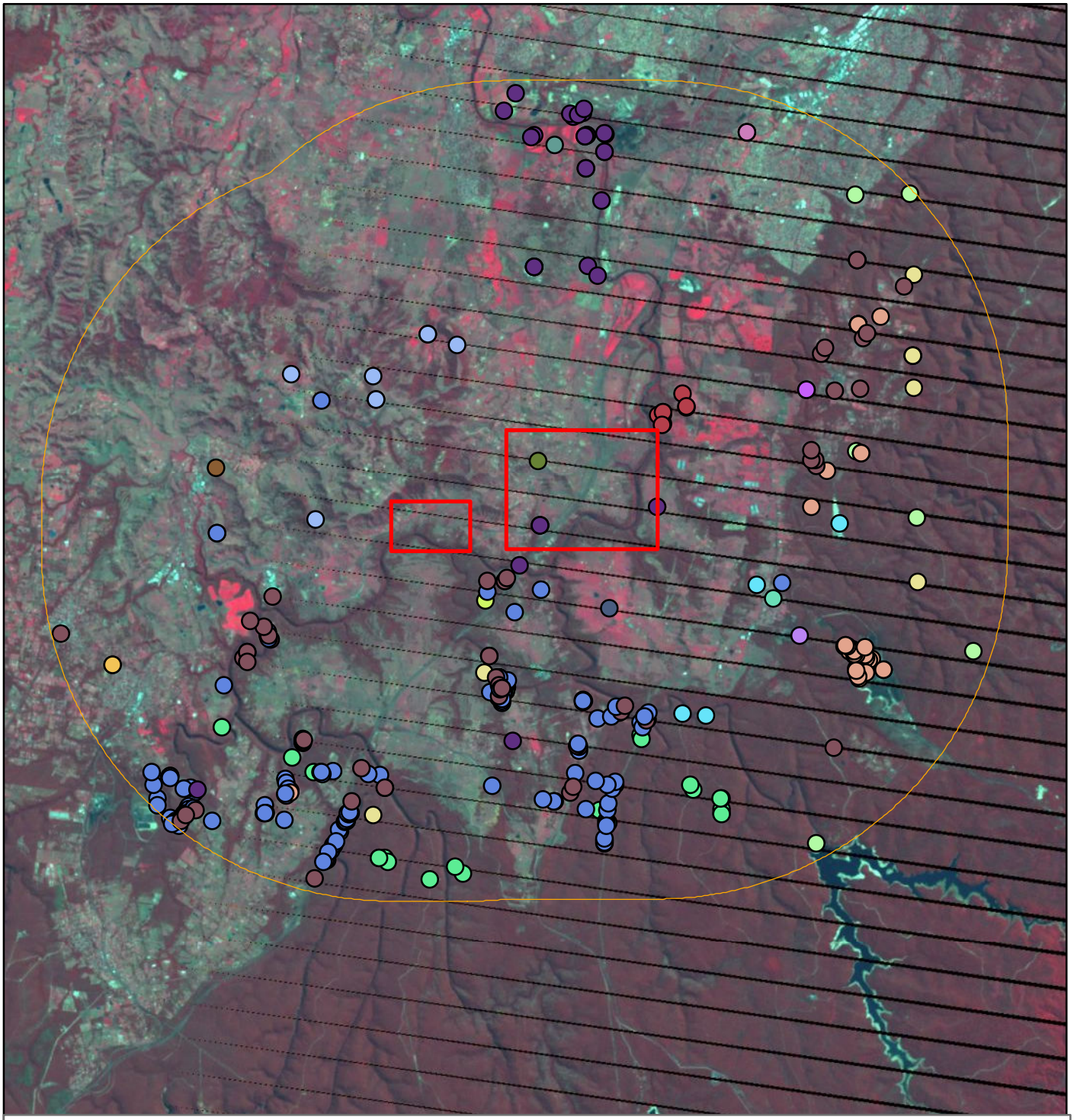

Figure 5: Threatened Flora previously found within 10km of the Study Area
1111 LW 704 - 705 Surface Gas Wells

Drawn by: RJ

Project Mgr: MR

Date: 09/09/2011

Atlas of NSW Wildlife: 14 June 2011

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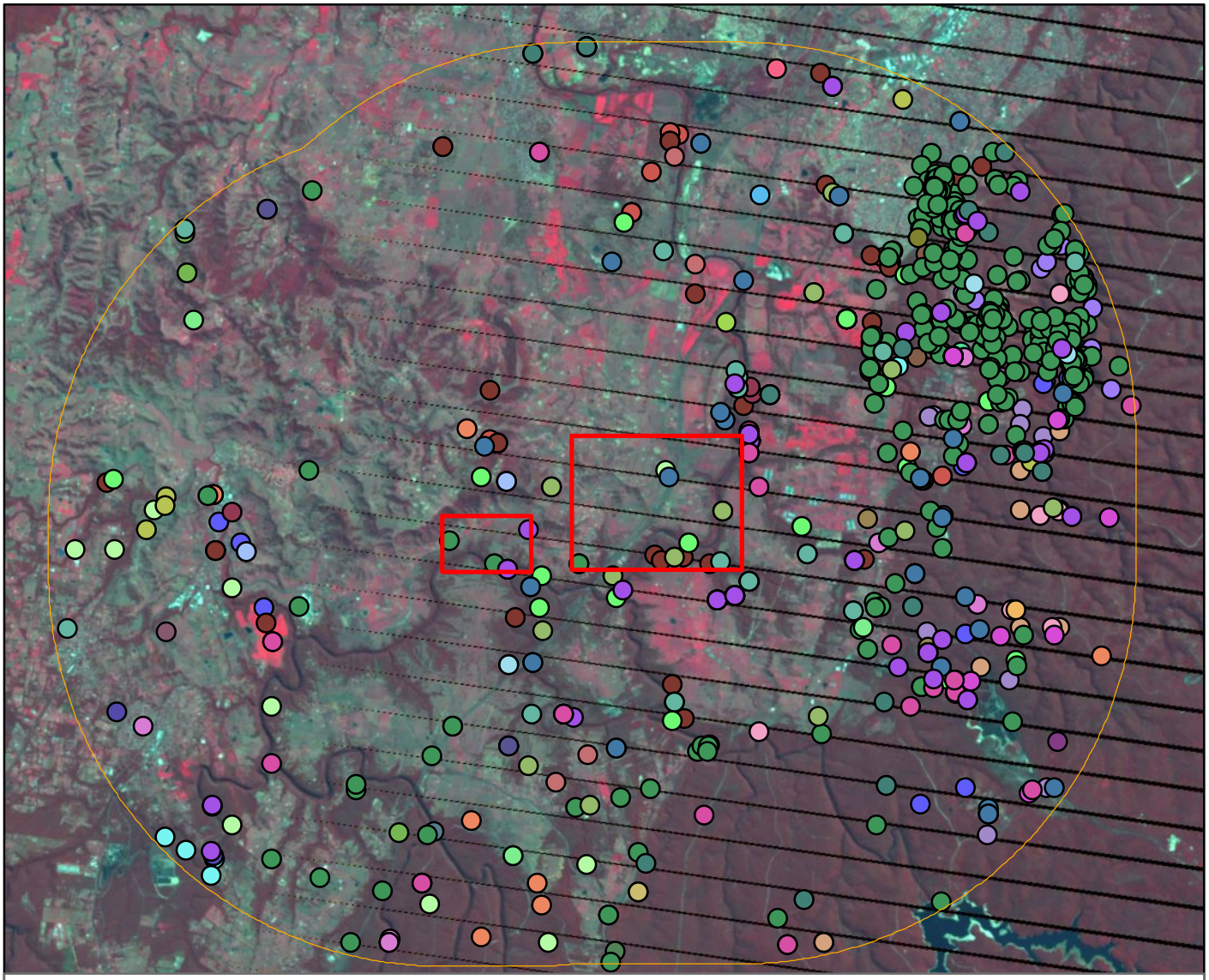

Study Area
10km Search

Threatened Fauna

- Barking Owl
- Black-chinned Honeyeater (eastern subspecies)
- Black-necked Stork
- Broad-headed Snake
- Brown Treecreeper
- Brown Treecreeper (eastern subspecies)
- Bush Stone-curlew
- Cumberland Plain Land Snail
- Diamond Firetail
- Eastern Bentwing-bat
- Eastern False Pipistrelle
- Eastern Freetail-bat
- Eastern Ground Parrot
- Eastern Pygmy-possum
- Flame Robin
- Freckled Duck
- Gang-gang Cockatoo
- Giant Burrowing Frog
- Glossy Black-Cockatoo
- Greater Broad-nosed Bat
- Grey-headed Flying-fox
- Hooded Robin
- Koala
- Large-eared Pied Bat
- Little Eagle
- Little Lorikeet
- Littlejohn's Tree Frog
- Macquarie Perch
- Powerful Owl
- Red-crowned Toadlet
- Regent Honeyeater
- Rosenberg's Goanna
- Scarlet Robin
- Southern Myotis
- Speckled Warbler
- Spotted Harrier
- Spotted-tailed Quoll
- Square-tailed Kite
- Squirrel Glider
- Swift Parrot
- Turquoise Parrot
- Varied Sittella
- Yellow-bellied Glider
- Yellow-bellied Sheathtail-bat

Figure 6: Threatened Flora previously found within 10km of the Study Area
1111 LW 704 - 705 Surface Gas Wells

Drawn by: RJ

Project Mgr: MR

Date: 09/09/2011

Atlas of NSW Wildlife: 14 June 2011

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Table 2: Threatened Flora Likelihood Occurrence

Threatened Flora	Habitat Requirements[1]	Conservation Status
Acacia bynoeana	*A. bynoeana* occurs mainly in heath and dry sclerophyll forest (Morrison & Davies 1991). The substrate is typically sand and sandy clay, often with ironstone gravels and is usually very infertile and well-drained. The species seems to prefer open, sometimes slightly disturbed sites such as trail margins, edges of roadside spoil mounds.	**NSW:** Vulnerable **Commonwealth:** Vulnerable
Caladenia tessellata Tessellated Spider Orchid	The Tessellated Spider Orchid is found in grassy sclerophyll woodland on clay loam or sandy soils, though the population near Braidwood is in low woodland with stony soil. Known from the Sydney area (old records), Wyong, Ulladulla and Braidwood in NSW. Populations in Kiama and Queanbeyan are presumed extinct. ROTAP: 3V	**NSW:** Endangered **Commonwealth:** Vulnerable
Callistemon linearifolius	Grows in dry sclerophyll forest on the coast and adjacent ranges. Recorded from the Georges River to Hawkesbury River in the Sydney area, and north to the Nelson Bay area of NSW. Recorded in 2000 at Coalcliff in the northern Illawarra. For the Sydney area, recent records are limited to the Hornsby Plateau area near the Hawkesbury River. The species was more widespread in the past, and there are currently only 5-6 populations remaining from the 22 populations historically recorded in the Sydney area. Three of the remaining populations are reserved in Ku-ring-gai Chase National Park, Lion Island Nature Reserve and Spectacle Island Nature Reserve. The species has also been recorded from Yengo National Park.	**NSW:** Vulnerable **Commonwealth:** Not listed
Cryptostylis hunteriana Leafless Tongue Orchid	The Leafless Tongue Orchid has been recorded from as far north as Gibraltar Range National Park south into Victoria around the coast as far as Orbost. Does not appear to have well defined habitat preferences and is known from a range of communities, including swamp-heath and woodland. The larger populations typically occur in woodland dominated by Scribbly Gum (*Eucalyptus sclerophylla*), Silvertop Ash (*E. sieberi*), Red Bloodwood (*Corymbia gummifera*) and Black Sheoak (*Allocasuarina littoralis*); appears to prefer open areas in the understorey of this community and is often found in association with the Large Tongue Orchid (*C. subulata*) and the Tartan Tongue Orchid (*C. erecta*).	**NSW:** Vulnerable **Commonwealth:** Vulnerable
Cynanchum elegans	*C. elegans* occurs mainly at the ecotone between dry subtropical rainforest and sclerophyll forest/woodland communities. *C. elegans* is restricted to eastern NSW where it is recorded from 86 locations. The known geographic range of the species extends from Yabbra State Forest (north-east of Tenterfield) in the north to Gerroa in the south and west to Merriwa in the Upper Hunter.	**NSW:** Endangered **Commonwealth:** Endangered
Epacris purpurascens	Found in a range of habitat types, most of which have a strong shale	**NSW:**

[1] Unless otherwise stated information for the threatened species habitat requirements have been taken from the NSW Office of Environment and Heritage – threatened species website: http://www.threatenedspecies.environment.nsw.gov.au/tsprofile/index.aspx

Threatened Flora	Habitat Requirements[1]	Conservation Status
var. purpurascens	soil influence. Recorded from Gosford in the north, to Narrabeen in the east, Silverdale in the west and Avon Dam vicinity in the South.	Vulnerable **Commonwealth:** Not listed
Eucalyptus benthamii	Requires a combination of deep alluvial sands and a flooding regime that permits seedling establishment. Occurs in open forest. Occurs on the alluvial flats of the Nepean River and its tributaries. There are two major subpopulations: in the Kedumba Valley of the Blue Mountains National Park and at Bents Basin State Recreation Area. Several trees are scattered along the Nepean River around Camden and Cobbitty. At least five trees occur on the Nattai River in Nattai National Park.	**NSW:** Vulnerable **Commonwealth:** Vulnerable
Grevillea parviflora	Grows in sandy or light clay soils usually over thin shales. Occurs in a range of vegetation types from heath and shrubby woodland to open forest. Often occurs in open, slightly disturbed sites such as along tracks. Sporadically distributed throughout the Sydney Basin with the main occurrence centred around Picton, Appin and Bargo (and possibly further south to the Moss Vale area).	**NSW:** Vulnerable **Commonwealth:** Vulnerable
Gyrostemon thesioides	Grows on hillsides and riverbanks and may be restricted to fine sandy soils. Within NSW, has only ever been recorded at three sites, to the west of Sydney, near the Colo, Georges and Nepean Rivers. The most recent sighting was of a single male plant near the Colo River within Wollemi National Park. The species has not been recorded from the Nepean and Georges Rivers for 90 and 30 years respectively, despite searches	**NSW:** Endangered **Commonwealth:** Not listed
Leucopogon exolasius	The plant occurs in woodland on sandstone. Found along the upper Georges River area and in Heathcote National Park.	**NSW:** Vulnerable **Commonwealth:** Vulnerable
Melaleuca deanei	The species grows in heath on sandstone. occurs in two distinct areas, in the Ku-ring-gai / Berowra and Holsworthy / Wedderburn areas respectively	**NSW:** Vulnerable **Commonwealth:** Vulnerable.
Persicaria elatior	This species normally grows in damp places, especially beside streams and lakes. Occasionally in swamp forest or associated with disturbance.	**NSW:** Vulnerable **Commonwealth:** Vulnerable
Persoonia bargoensis	The Bargo Geebung occurs in woodland or dry sclerophyll forest on sandstone and on heavier, well drained, loamy, gravely soils.	**NSW:** Endangered **Commonwealth:** Vulnerable
Persoonia glaucescens	The Mittagong Geebung grows in woodland to dry sclerophyll forest on clayey and gravely laterite. The preferred topography is ridge-tops, plateaux and upper slopes. Aspect does not appear to be a significant factor.	**NSW:** Endangered **Commonwealth:** Vulnerable
Persoonia hirsuta	The Hairy Geebung is found in sandy soils in dry sclerophyll open forest, woodland and heath on sandstone.	**NSW:** Endangered **Commonwealth:** Endangered

Threatened Flora	Habitat Requirements[1]	Conservation Status
Persoonia nutans	Confined to aeolian and alluvial sediments and occurs in a range of sclerophyll forest and woodland vegetation communities, with the majority of individuals occurring within Agnes Banks Woodland or Castlereagh Scribbly Gum Woodland.	**NSW:** Endangered **Commonwealth:** Endangered
Pimelea spicata	In both the Cumberland Plain and Illawarra environments this species is found on well-structured clay soils. On the inland Cumberland Plain sites it is associated with Grey Box and Ironbark.	**NSW:** Endangered **Commonwealth:** Endangered
Pomaderris brunnea	The species is expected to live for 10 - 20 years, while the minimum time to produce seed is estimated to be 4 - 6 years. The species has been found in association with *Eucalyptus amplifolia*, *Angophora floribunda, Acacia parramattensis, Bursaria spinosa* and *Kunzea ambigua*. Brown Pomaderris is found in a very limited area around the Colo, Nepean and Hawkesbury Rivers, including the Bargo area. It also occurs at Walcha on the New England tablelands and in far eastern Gippsland in Victoria.	**NSW:** Vulnerable **Commonwealth:** Vulnerable
Pterostylis saxicola	Most commonly found growing in small pockets of shallow soil in depressions on sandstone rock shelves above cliff lines. The vegetation communities above the shelves where *Pterostylis saxicola* occurs are sclerophyll forest or woodland on shale/sandstone transition soils or shale soils.	**NSW:** Endangered **Commonwealth:** Endangered.
Pultenaea aristata Prickly Bush-pea	Grows in moist, dry sclerophyll woodland to heath on sandstone, specifically the drier areas of Upland Swamps. Restricted to the Woronora Plateau, a small area between Helensburgh, south of Sydney, and Mt Keira above Wollongong. ROTAP: 2V	**NSW:** Vulnerable **Commonwealth:** Vulnerable
Pultenaea pedunculata	*Pultenaea pedunculata* occurs in a range of habitats. NSW populations are generally among woodland vegetation but plants have also been found on road batters and coastal cliffs. It is largely confined to loamy soils in dry gullies in populations in the Windellama area.	**NSW:** Endangered **Commonwealth:** Not listed
Syzygium paniculatum Magneta Lilly-pilly	The Magenta Lilly Pilly is found only in NSW, in a narrow, linear coastal strip from Bulahdelah to Conjola State Forest. On the south coast the Magenta Lilly Pilly occurs on grey soils over sandstone, restricted mainly to remnant stands of littoral (coastal) rainforest. On the central coast Magenta Lilly Pilly occurs on gravels, sands, silts and clays in riverside gallery rainforests and remnant littoral rainforest communities	**NSW:** Endangered **Commonwealth:** Vulnerable
Thelymitra sp. Kangaloon Kangaloon Sun-orchid	Recorded from shallow black peaty soil in coastal heath on sandstone. *Thelymitra* sp. Kangaloon is a terrestrial orchid endemic to New South Wales, and is known from three locations near Robertson in the Southern Highlands.	**NSW:** Not Listed **Commonwealth:** Critically Endangered
Thesium australe	Occurs in grassland or grassy woodland. Often found in damp sites in association with Kangaroo Grass (*Themeda australis*). Austral Toad-flax is found in very small populations scattered across eastern NSW, along the coast, and from the Northern to Southern Tablelands. It is also found in Tasmania and Queensland and in eastern Asia.	**NSW:** Vulnerable **Commonwealth:** Vulnerable

Table 3: Threatened Fauna Likelihood Occurrence

Threatened Fauna	Description[2]	Conservation Status
Birds		
Apus pacificus (Fork tailed swift)	The Fork-tailed Swift is almost exclusively aerial, flying from less then 1 m to at least 300 m above ground and probably much higher.	**NSW:** Not listed **Commonwealth:** Migratory
Ardea alba (Great egret)	Terrestrial wetlands, estuarine and littoral habitats and moist grasslands. Inland, prefer permanent waterbodies on floodplains; shallows of deep permanent lakes (either open or vegetated), semi-permanent swamps with tall emergent vegetation and herb dominated seasonal swamps with abundant aquatic flora. Also regularly use saline habitats including mangrove forests, estuarine mudflats, saltmarshes, bare saltpans, shallows of salt lakes, salt fields and offshore reefs. Breeding requires wetlands with fringing trees in which to build nests including mangrove forest, freshwater lakes or swamps and rivers (Marchant, 1990).	**NSW:** Not listed **Commonwealth:** Migratory
Ardea ibis (Cattle egret)	Occurs in tropical and temperate grasslands, wooded lands and terrestrial wetlands (Marchant, 1990).	**NSW:** Not listed **Commonwealth:** Migratory
Botaurus poiciloptilus (Australasian bittern)	Favours permanent freshwater wetlands with tall, dense vegetation, particularly bullrushes (*Typha* spp.) and spikerushes (*Eleoacharis* spp.).	**NSW:** Vulnerable **Commonwealth:** Not listed
Burhinus grallarius (Bush Stone-curlew)	The Bush Stone-curlew is found throughout Australia except for the central southern coast and inland, the far south-east corner, and Tasmania. Only in northern Australia is it still common however and in the south-east it is either rare or extinct throughout its former range	**NSW**: Vulnerable **Commonwealth:** Not listed
Callocephalon fimbriatum (Gang-gang Cockatoo)	In summer, generally found in tall mountain forests and woodlands, particularly in heavily timbered and mature wet sclerophyll forests. In winter, may occur at lower altitudes in drier more open eucalypt forests and woodlands, and often found in urban areas.	**NSW:** Vulnerable Commonwealth: Not listed

2 Unless otherwise stated information for the threatened species habitat requirements have been taken from the NSW Office of Environment and Heritage- threatened species website: http://www.threatenedspecies.environment.nsw.gov.au/tsprofile/index.aspx

Threatened Fauna	Description[2]	Conservation Status
Calyptorhynchus lathami (Glossy Black Cockatoo)	Inhabits open forest and woodlands of the coast and the Great Dividing Range up to 1000 m in which stands of she-oak species, particularly Black She-oak (*Allocasuarina littoralis*), Forest She-oak (*A. torulosa*) or Drooping She-oak (*A. verticillata*) occur.	**NSW:** Vulnerable **Commonwealth:** Endangered only in South Australia Population
Circus assimilis (Spotted Harrier)	Occurs in grassy open woodland including acacia and mallee remnants, inland riparian woodland, grassland and shrub steppe. It is found most commonly in native grassland, but also occurs in agricultural land, foraging over open habitats including edges of inland wetlands.	**NSW:** Vulnerable **Commonwealth:** Not listed
Climacteris picumnus victoriae (Brown Treecreeper)	Found in eucalypt woodlands (including Box-Gum Woodland) and dry open forest of the inland slopes and plains inland of the Great Dividing Range; mainly inhabits woodlands dominated by stringybarks or other rough-barked eucalypts, usually with an open grassy understorey, sometimes with one or more shrub species; also found in mallee and River Red Gum (*Eucalyptus camaldulensis*) Forest bordering wetlands with an open understorey of acacias, saltbush, lignum, cumbungi and grasses; usually not found in woodlands with a dense shrub layer; fallen timber is an important habitat component for foraging; also recorded, though less commonly, in similar woodland habitats on the coastal ranges and plains.	**NSW:** Vulnerable **Commonwealth:** Not listed
Daphoenositta chrysoptera (Varied Sittella)	The Varied Sittella is sedentary and inhabits most of mainland Australia except the treeless deserts and open grasslands, with a nearly continuous distribution in NSW from the coast to the far west. It inhabits eucalypt forests and woodlands, especially rough-barked species and mature smooth-barked gums with dead branches, mallee and *Acacia* woodland. The Varied Sittella feeds on arthropods gleaned from crevices in rough or decorticating bark, dead branches, standing dead trees, and from small branches and twigs in the tree canopy. It builds a cup-shaped nest of plant fibres and cobweb in an upright tree fork high in the living tree canopy, and often re-uses the same fork or tree in successive years (ref: http://www.environment.nsw.gov.au/determinations/variedsittellapd.htm	**NSW:** Vulnerable **Commonwealth:** Vulnerable
Ephippiorhynchus asiaticus (Black-necked Stork)	Black-necked Storks are mainly found on shallow, permanent, freshwater terrestrial wetlands, and surrounding marginal vegetation, including swamps, floodplains, watercourses and billabongs, freshwater meadows, wet heathland, farm dams and shallow floodwaters, as well as extending into adjacent grasslands, paddocks and open savannah woodlands. They also forage within or around estuaries and along intertidal shorelines, such as saltmarshes, mudflats and sandflats, and mangrove vegetation.	**NSW:** Vulnerable **Commonwealth:** Not listed

Threatened Fauna	Description[2]	Conservation Status
Gallinago hardwickii (Lathams snipe)	Typically found on wet soft ground or shallow water with good cover of tussocks. Often found in wet paddocks, seepage areas below dams (Pizzey 1997).	**NSW:** Vulnerable **Commonwealth:** Migratory
Glossopsitta pusilla (Little Lorikeet)	Forages primarily in the canopy of open Eucalyptus forest and woodland, yet also finds food in Angophoras, Melaleucas and other tree species. Riparian habitats are particularly used, due to higher soil fertility and hence greater productivity. Isolated flowering trees in open country, e.g. paddocks, roadside remnants and urban trees also help sustain viable populations of the species.	**NSW:** Vulnerable **Commonwealth:** Not listed
Haliaeetus leucogaster (White bellied sea eagle)	A migratory species that is resident to Australia. Found in terrestrial and coastal wetlands; favouring deep freshwater swamps, lakes and reservoirs; shallow coastal lagoons and salt marshes (English, 2001).	**NSW:** Not listed **Commonwealth:** Migratory
Hieraaetus morphnoides (Little Eagle)	Occupies open eucalypt forest, woodland or open woodland. Sheoak or acacia woodlands and riparian woodlands of interior NSW are also used. Nests in tall living trees within a remnant patch, where pairs build a large stick nest in winter.	**NSW:** Vulnerable **Commonwealth:** Not listed
Hirundapus caudacutus (White throated needle tail)	An aerial species found in feeding concentrations over cities, hilltops and timbered ranges (Pizzey, 1997).	**NSW:** Not listed **Commonwealth:** Migratory
Lathamus discolor (Swift Parrot)	On the mainland they occur in areas where eucalypts are flowering profusely or where there are abundant lerp (from sap-sucking bugs) infestations. Favoured feed trees include winter flowering species such as Swamp Mahogany *Eucalyptus robusta*, Spotted Gum *Corymbia maculata*, Red Bloodwood *C. gummifera*, Mugga Ironbark *E. sideroxylon*, and White Box *E. albens*.	**NSW:** Endangered **Commonwealth:** Endangered
Melanodryas cucullata cucullata (Hooded Robin)	Prefers lightly wooded country, usually open eucalypt woodland, acacia scrub and mallee, often in or near clearings or open areas. Requires structurally diverse habitats featuring mature eucalypts, saplings, some small shrubs and a ground layer of moderately tall native grasses. Often perches on low dead stumps and fallen timber or on low-hanging branches, using a perch-and-pounce method of hunting insect prey.	**NSW:** Vulnerable **Commonwealth:** Not listed
Melithreptus gularis gularis (Black-chinned Honeyeater)	Occupies mostly upper levels of drier open forests or woodlands dominated by box and ironbark eucalypts, especially Mugga Ironbark (*Eucalyptus sideroxylon*), White Box (*E. albens*), Inland Grey Box (*E. microcarpa*), Yellow Box (*E. melliodora*) and Forest Red Gum (*E. tereticornis*). Also inhabits open forests of smooth-barked gums, stringybarks, ironbarks and tea-trees.	**NSW:** Vulnerable **Commonwealth:** Not listed

Threatened Fauna	Description[2]	Conservation Status
Merops ornatus (Rainbow bee eater)	Usually occurs in open or lightly timbered areas, often near water (Higgins, 1999).	**NSW:** Not listed **Commonwealth:** Migratory
Monarcha melanopsis (Black faced monarch)	A migratory species found during the breeding season in damp gullies in temperate rainforests. Disperses after breeding into more open woodland (Pizzey, 1997).	**NSW:** Not listed **Commonwealth:** Migratory
Myiagra cyanoleuca (Satin flycatcher)	Migratory species that occurs in coastal forests, woodlands and scrubs during migration. Breeds in heavily vegetated gullies (Pizzey, 1997).	**NSW:** Not listed **Commonwealth:** Migratory
Neophema pulchella (Turquoise Parrot)	Lives on the edges of eucalypt woodland adjoining clearings, timbered ridges and creeks in farmland.	**NSW:** Vulnerable **Commonwealth:** Not listed
Ninox connivens (Barking Owl)	Inhabits woodland and open forest, including fragmented remnants and partly cleared farmland. Is flexible in its habitat use and hunting can extend in to closed forest and more open areas. Sometimes able to successfully breed along timbered watercourses in heavily cleared habitats (e.g. western NSW) due to the higher density of prey on these fertile soils. Roost in shaded portions of tree canopies, including tall midstorey trees with dense foliage such as Acacia and Casuarina species. During nesting season, the male perches in a nearby tree overlooking the hollow entrance.	**NSW:** Vulnerable **Commonwealth:** Not listed
Ninox strenua (Powerful Owl)	The Powerful Owl inhabits a range of vegetation types, from woodland and open sclerophyll forest to tall open wet forest and rainforest. The Powerful Owl requires large tracts of forest or woodland habitat but can occur in fragmented landscapes as well. The species breeds and hunts in open or closed sclerophyll forest or woodlands and occasionally hunts in open habitats. It roosts by day in dense vegetation comprising species such as Turpentine *Syncarpia glomulifera*, Black She-oak *Allocasuarina littoralis*, Blackwood *Acacia melanoxylon*, Rough-barked Apple *Angophora floribunda*, Cherry Balart *Exocarpus cupressiformis* and a number of eucalypt species.	**NSW:** Vulnerable **Commonwealth:** Not listed

Threatened Fauna	Description[2]	Conservation Status
Petroica boodang (Scarlet Robin)	The Scarlet Robin is primarily a resident in forests and woodlands, but some adults and young birds disperse to more open habitats after breeding. The Scarlet Robin lives in dry eucalypt forests and woodlands. The understorey is usually open and grassy with few scattered shrubs. This species lives in both mature and regrowth vegetation. It occasionally occurs in mallee or wet forest communities, or in wetlands and tea-tree swamps. Scarlet Robin habitat usually contains abundant logs and fallen timber: these are important components of its habitat. The Scarlet Robin breeds on ridges, hills and foothills of the western slopes, the Great Dividing Range and eastern coastal regions; this species is occasionally found up to 1000 metres in altitude. In autumn and winter many Scarlet Robins live in open grassy woodlands, and grasslands or grazed paddocks with scattered trees.	**NSW:** Vulnerable **Commonwealth:** Not listed
Petroica phoenicea (Flame Robin)	Breeds in upland tall moist eucalypt forests and woodlands, often on ridges and slopes. Prefers clearings or areas with open understoreys. The groundlayer of the breeding habitat is dominated by native grasses and the shrub layer may be either sparse or dense. Occasionally occurs in temperate rainforest, and also in herbfields, heathlands, shrublands and sedgelands at high altitudes. In winter, birds migrate to drier more open habitats in the lowlands (i.e. valleys below the ranges, and to the western slopes and plains). Often occurs in recently burnt areas; however, habitat becomes unsuitable as vegetation closes up following regeneration. In winter lives in dry forests, open woodlands and in pastures and native grasslands, with or without scattered trees. In winter, occasionally seen in heathland or other shrublands in coastal areas.	**NSW:** Vulnerable **Commonwealth:** Not listed
Pezoporus wallicus wallicus (Eastern Ground Parrot)	The Ground Parrot occurs in high rainfall coastal and near coastal low heathlands and sedgelands, generally below one metre in height and very dense. The coastal and subcoastal heathland and sedgeland habitats of the Ground Parrot are particularly fire-prone (DECCW 2005).	**NSW:** Vulnerable **Commonwealth:** Not listed
Pyrrholaemus saggitatu (Speckled Warbler)	The Speckled Warbler lives in a wide range of Eucalyptus dominated communities that have a grassy understorey, often on rocky ridges or in gullies. Typical habitat would include scattered native tussock grasses, a sparse shrub layer, some eucalypt regrowth and an open canopy. Large, relatively undisturbed remnants are required for the species to persist in an area.	**NSW:** Vulnerable **Commonwealth:** Not listed
Rhipidura rufifrons (Rufous fantail)	Migratory species that prefers dense, moist undergrowth of tropical rainforests and scrubs. During migration it can stray into gardens and more open areas (Pizzey, 1997).	**NSW:** Not listed **Commonwealth:** Migratory

Threatened Fauna	Description[2]	Conservation Status
Rostratula australis (Australian Painted Snipe)	Generally inhabits shallow terrestrial freshwater (occasionally brackish) wetlands, including temporary and permanent lakes, swamps and claypans. They also use inundated or waterlogged grassland or saltmarsh, dams, rice crops, sewage farms and bore drains (DEWHA).	**NSW:** Vulnerable **Commonwealth:** Endangered
Stagonopleura guttata (Diamond Firetail)	Feeds exclusively on the ground, on ripe and partly-ripe grass and herb seeds and green leaves, and on insects (especially in the breeding season). Found in grassy eucalypt woodlands, including Box-Gum Woodlands and Snow Gum *Eucalyptus pauciflora* Woodlands. Also occurs in open forest, mallee, Natural Temperate Grassland, and in secondary grassland derived from other communities. Often found in riparian areas (rivers and creeks), and sometimes in lightly wooded farmland.	**NSW:** Vulnerable **Commonwealth:** Not listed
Stictonetta naevosa (Freckled Duck)	Prefer permanent freshwater swamps and creeks with heavy growth of Cumbungi, Lignum or Tea-tree. During drier times they move from ephemeral breeding swamps to more permanent waters such as lakes, reservoirs, farm dams and sewage ponds.	**NSW:** Vulnerable **Commonwealth:** Not listed
Xanthomyza Phrygia (Regent Honeyeater)	The Regent Honeyeater is a flagship threatened woodland bird whose conservation will benefit a large suite of other threatened and declining woodland fauna. The species inhabits dry open forest and woodland, particularly Box-Ironbark woodland, and riparian forests of River Sheoak. Regent Honeyeaters inhabit woodlands that support a significantly high abundance and species richness of bird species. These woodlands have significantly large numbers of mature trees, high canopy cover and abundance of mistletoes.	**NSW:** Endangered **Commonwealth:** Endangered
Amphibians		
Heleioporus australiacus (Giant Burrowing Frog)	Breeding habitat of this species is generally soaks or pools within first or second order streams. They are also commonly recorded from 'hanging swamp' seepage lines and where small pools form from the collected water.	**NSW:** Vulnerable **Commonwealth:** Vulnerable
Litoria aurea (Green and Golden Bell Frog)	Inhabits marshes, dams and stream-sides, particularly those containing bullrushes (*Typha* spp.) or spikerushes (*Eleocharis* spp.). Optimum habitat includes water-bodies that are un-shaded, free of predatory fish such as Plague Minnow (*Gambusia holbrooki*), have a grassy area nearby and diurnal sheltering sites available.	**NSW:** Endangered **Commonwealth:** Vulnerable

Threatened Fauna	Description[2]	Conservation Status
Litoria littlejohni (Little John's Tree Frog)	Occurs in wet and dry sclerophyll forests associated with sandstone outcrops between 280 and 1000 m on the eastern slopes of the Great Dividing Range (Barker, 1995). Prefers rock flowing streams, but individuals have also been collected from semi-permanent dams with some emergent vegetation (Barker, 1995). Forages both in the tree canopy and on the ground, and has been observed sheltering under rocks on high exposed ridges during summer. It is not known from coastal habitats.	**NSW:** Vulnerable **Commonwealth:** Vulnerable
Litoria raniformis (Growling Grass Frog)	Usually found in or around permanent or ephemeral Black Box/Lignum/Nitre Goosefoot swamps, Lignum/Typha swamps and River Red Gum swamps or billabongs along floodplains and river valleys. They are also found in irrigated rice crops, particularly where there is no available natural habitat.	**NSW:** Endangered **Commonwealth:** Vulnerable
Mixophyes balbus (Stuttering frog)	This species is usually associated with mountain streams, wet mountain forests and rainforests (Barker, 1995). It rarely wanders very far from the banks of permanent forest streams, although it will forage on nearby forest floors. Eggs are deposited in leaf litter on the banks of streams and are washed into the water during heavy rains (Barker, 1995).	**NSW:** Endangered **Commonwealth:** Vulnerable
Pseudophryne australis (Red-crowned Toadlet)	Red-crowned Toadlets are quite a localised species that appear to be largely restricted to the immediate vicinity of suitable breeding habitat. Red-crowned Toadlets are usually found as small colonies scattered along ridges coinciding with the positions of suitable refuges near breeding sites. Due to this tendency for discrete populations to concentrate at particular sites, a relatively small localised disturbance may have a significant impact on a local population if it occurs on a favoured breeding or refuge site. Occurs in open forests, mostly on Hawkesbury and Narrabeen Sandstones.	**NSW:** Vulnerable **Commonwealth:** Not listed
Reptiles		
Hoplocephalus bungaroides (Broad-headed Snake)	Shelters in rock crevices and under flat sandstone rocks on exposed cliff edges during autumn, winter and spring. Moves from the sandstone rocks to shelters in hollows in large trees within 200 m of escarpments in summer.	**NSW:** Endangered **Commonwealth:** Vulnerable
Varanus rosenbergi (Rosenberg's Goanna)	Found in heath, open forest and woodland. Associated with termites, the mounds of which this species nests in; termite mounds are a critical habitat component.	**NSW:** Vulnerable **Commonwealth:** Not listed
Mammals		

Threatened Fauna	Description[2]	Conservation Status
Cercartetus nanus (Eastern Pygmy-possum)	Inhabits rainforest through to sclerophyll forest and tree heath. Banksias and myrtaceous shrubs and trees are a favoured food source. Will often nest in tree hollows, but can also construct its own nest (Turner, 1995). Because of its small size it is able to utilise a range of hollow sizes including very small hollows (Gibbons, 1997). Individuals will use a number of different hollows and an individual has been recorded using up to 9 nest sites within a 0.5ha area over a 5 month period (Ward, 1990).	**NSW:** Vulnerable **Commonwealth:** Not listed
Chalinolobus dwyer (Large-eared Pied Bat)	Roosts in caves (near their entrances), crevices in cliffs, old mine workings and in the disused, bottle-shaped mud nests of the Fairy Martin (*Hirundo ariel*), frequenting low to mid-elevation dry open forest and woodland close to these features. Females have been recorded raising young in maternity roosts (c. 20-40 females) from November through to January in roof domes in sandstone caves. They remain loyal to the same cave over many years.	**NSW:** Vulnerable **Commonwealth:** Vulnerable
Dasyurus maculatus (Spotted-tailed Quoll)	Recorded across a range of habitat types, including rainforest, open forest, woodland, coastal heath and inland riparian forest, from the sub-alpine zone to the coastline.	**NSW:** Vulnerable **Commonwealth:** Endangered
Falsistrellus tasmaniensis (Eastern False Pipistrelle)	Generally roosts in eucalypt hollows, but has also been found under loose bark on trees or in buildings.	**NSW:** Vulnerable **Commonwealth:** Not listed
Miniopterus schreibersii oceanensis (Eastern Bentiwing-bat)	Caves are the primary roosting habitat, but also use derelict mines, storm-water tunnels, buildings and other man-made structures.	**NSW:** Vulnerable **Commonwealth:** Not listed
Mormopterus norfolkensis (Eastern Freetail-bat)	Occur in dry sclerophyll forest, woodland, swamp forests and mangrove forests east of the Great Dividing Range. Roosts mainly in tree hollows but will also roost under bark or in man-made structures.	**NSW:** Vulnerable **Commonwealth:** Not listed
Myotis macropus (Large-foorted Myotis)	Generally roost in groups of 10 - 15 close to water in caves, mine shafts, hollow-bearing trees, storm water channels, buildings, under bridges and in dense foliage.	**NSW:** Vulnerable **Commonwealth:** Not listed
Petaurus norfolcensis (Squirrel Glider)	Inhabits mature or old growth Box, Box-Ironbark woodlands and River Red Gum forest west of the Great Dividing Range and Blackbutt-Bloodwood forest with heath understorey in coastal areas.	**NSW:** Vulnerable **Commonwealth:** Not listed
Petaurus australis (Yellow-bellied Glider)	Occur in tall mature eucalypt forest generally in areas with high rainfall and nutrient rich soils. Forest type preferences vary with latitude and elevation; mixed coastal forests to dry escarpment forests in the north; moist coastal gullies and creek flats to tall montane forests in the south. Found along the eastern coast to the western slopes of the Great Dividing Range, from southern Queensland to Victoria.	**NSW:** Vulnerable **Commonwealth:** Not listed

Threatened Fauna	Description[2]	Conservation Status
Isoodon obesulus (Southern brown bandicoot)	Prefers sandy soils with scrubby vegetation and/or areas with low ground cover that are burn from time to time (Braithwaite, 1995 344 /id). A mosaic of post fire vegetation is important for this species (Maxwell, 1996).	**NSW:** Endangered **Commonwealth:** Endangered
Petrogale penicillata (Brush-tailed Rock-wallaby)	Occupy rocky escarpments, outcrops and cliffs with a preference for complex structures with fissures, caves and ledges facing north.	**NSW:** Endangered **Commonwealth:** Vulnerable
Phascolarctos cinereus (Koala)	Inhabit eucalypt woodlands and forests.	**NSW:** Vulnerable **Commonwealth:** Not listed
Pseudomys novaehollandiae (New Holland Mouse)	Coastal heath and dry sclerophyll forest and woodland.	**NSW:** Not listed **Commonwealth:** Vulnerable
Pteropus poliocephalus (Grey-headed Flying-Fox)	Occur in subtropical and temperate rainforests, tall sclerophyll forests and woodlands, heaths and swamps as well as urban gardens and cultivated fruit crops. Roosting camps are generally located within 20 km of a regular food source and are commonly found in gullies, close to water, in vegetation with a dense canopy.	**NSW:** Vulnerable **Commonwealth:** Vulnerable
Saccolaimus flaviventris (Yellow-bellied Sheathtail-bat)	Roosts singly or in groups of up to six, in tree hollows and buildings; in treeless areas they are known to utilise mammal burrows.	**NSW:** Vulnerable **Commonwealth:** Not listed
Scoteanax rueppellii (Greater Broad-nosed Bat)	Utilises a variety of habitats from woodland through to moist and dry eucalypt forest and rainforest, though it is most commonly found in tall wet forest. Although this species usually roosts in tree hollows, it has also been found in buildings.	**NSW:** Vulnerable **Commonwealth:** Not listed
Invertebrates		
Meridolum corneovirens (Cumberland Plain Snail)	Primarily inhabits Cumberland Plain Woodland (an endangered ecological community). This community is a grassy, open woodland with occasional dense patches of shrubs. Lives under litter of bark, leaves and logs, or shelters in loose soil around grass clumps. Occasionally shelters under rubbish.	**NSW:** Endangered **Commonwealth:** Not listed

Threatened Fauna	Description[2]	Conservation Status
Fish		
Macquaria australasica (Macquarie Perch)	Macquarie perch are found in both river and lake habitats, especially the upper reaches of rivers and their tributaries[3].	**NSW:** Vulnerable **Commonwealth:** Endangered

[3] Prime Fact 9: Threatened Species in NSW – Macquarie Perch – *Macquaria australasica*. NSW Department of Primary Industries (2005). http://www.dpi.nsw.gov.au/__data/assets/pdf_file/0008/5102/Primefact_Macquarie_perch.pdf

PLATES – SITE PHOTOGRAPHS

Appin Area 9

Plate 1: Site 1 location

Plate 2: Site 1 access point along Menangle Road. One *Eucalyptus moluccana* and *Acacia* may require removal.

Plate 3: Exotic grasses along Menangle road edge to be slashed to improve access visibility. Only one Eucalypt and acacia may require removal (shown in Plate 2).

Plate 4: Site 2 location

Longwall 704

Plate 5: Gas well V-3 location

Plate 6: Gas well V-4 location located at bottom of hill near access track

Plate 7: Gas well V-5-9 within cleared paddock

Longwall 705

Plate 8: MRD A, B, E & F Gas well location

Plate 9: MRD A, B, E & F Gas well location

Plate 10: V-1 Gas well location

Plate 11: V-2 Gas well location

Plate 12: V-3 Gas well location

Plate 13: V-4 Gas well location

Plate 14: V-5 Gas well location

Appendix B

Cultural Heritage Assessment

HERITAGE ASSESSMENT

Appin Mine Surface Gas Drainage Project

November 2011

Local Government Area:	Wollondilly
Consultant Name:	Niche Environment and Heritage Pty Ltd
Authors:	Renée Regal
Proponent:	BHP Billiton Illawarra Coal

Document Controls

Project No.	1110		
Document Description	Heritage Assessment Appin Mine Surface Gas Drainage Project BHP Billiton Illawarra Coal		
	Name	**Signed**	**Date**
Niche Project Manager(s)	Matthew Richardson		26 October 2011
Document Manager	Jamie Reeves		
Authors	Renée Regal		
Internal Review	Jamie Reeves and Matthew Richardson		
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	Environmental Approvals Manager Sustainable Development BHP Billiton Illawarra Coal PO Box 514 Unanderra NSW 2526		
Document Status	FINAL		
Date	14 November 2011		
Prepared for:	Dr Bruce Blunden Environmental Approvals Manager Sustainable Development BHP Billiton Illawarra Coal PO Box 514 Unanderra NSW 2526		

Cover Photo:

Western View of proposed vertical well locations 704 V5 to 704 V7 ©Niche Environment and Heritage.

Sydney Office

PO Box 231, Concord, NSW 2137
Mobile: 0488 224 888
Fax: 02 4017 0071

jreeves@niche-eh.com

Central Coast/Hunter Office

PO Box 3104, Umina Beach, NSW 2257
Mobile: 0488 224 999
Fax: 02 4017 0071

rharrington@niche-eh.com

Illawarra/Southern NSW Office

PO Box 12, Macarthur Square, NSW 2560
Mobile: 0488 224 777
Fax: 02 4017 0071

mrichardson@niche-eh.com

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Summary

This report presents a Heritage Assessment for the proposed modification to the Appin Mine Surface Gas Drainage Project and the proposed Mine Safety Gas Drainage (MSGD) well sites , near Douglas Park, Wollondilly Local Government Area, in New South Wales.

The assessment concluded that the modification to the Appin Surface Gas Drainage Project and the two MSGD sites was not going to cause harm to Aboriginal objects, historical relics or have an adverse effect on heritage items.

The proposed works are located approximately 100 meters from the two known Aboriginal archaeological sites Mounbatten-1 and Mountbatten OCS-1, and management measures are required to ensure no harm to Aboriginal objects at these sites. The proposed works were assessed as not having an adverse effect on the locally significant heritage items: Morton Park: Mountbatten Group (290085); Mountbatten garden building: Mountbatten group (2690088); Mountbatten House (2690086); Mountbatten Stone Chapel: Mountbatten Group (2690087), because the items are not in close proximity to the works.

1. The existing Aboriginal Cultural Heritage Management Plan for the Appin Mine Surface Gas Drainage Project should be amended and reissued to include the recommendations above, and provision for assessing and notifying the discovery of historical relics.
2. The location of the Aboriginal sites Mountbatten-1 and Mountbatten OCS-1 must be marked on all relevant site plans and work instructions.
3. The sites Mountbatten-1 and Mountbatten OCS-1 must be separated by a physical barrier from the proposed construction activities. The avoidance areas should consist of an appropriate secure barrier that blocks all potential access to the location of the artefacts, and should be of a size to ensure no harm comes to the immediate context that surrounds the artefacts.
4. Construction vehicles should be confined to designated access tracks.

Introduction

This report presents a Heritage Assessment for the proposed modification to the Appin Mine Surface Gas Drainage Project and the two proposed MSGD well sites, near Douglas Park, Wollondilly Local Government Area, in New South Wales.

Niche Environment and Heritage Pty Ltd was commissioned by BHP Billiton Illawarra Coal to conduct and prepare this heritage assessment. This heritage assessment was prepared by Renée Regal and Jamie Reeves of Niche Environment and Heritage. It has been prepared in support of a s.75W modification to the Major Project Approval 08_0256 Appin Mine Surface Gas Drainage Project.

BHP Billiton Illawarra Coal operates the Appin Colliery in the Southern Coalfields of New South Wales. Appin Colliery extracts coal from the Bulli Seam using longwall mining methods. The continued operation of the Appin Colliery is part of the Bulli Seam Operations. The proposed surface gas drainage project is necessary to provide safe conditions for both the development of and future mining of the Appin Mine.

The heritage assessment considered the potential for the gas drainage project to harm Aboriginal and non-Aboriginal heritage. The assessment is for a s.75W modification to an existing approval under Part 3A of the *Environmental Planning and Assessment Act* 1979 (NSW) and as such should be considered in conjunction with the assessment titled *Archaeological and Cultural Heritage Impact Assessment of Proposed Appin Area 7 Goaf Gas Drainage Project* prepared by Biosis Research, May 2009 and the subsequent Aboriginal Cultural Heritage Management Plan titled *Appin Area 7 Longwalls 703 to 704 Goaf Gas Drainage Project: Aboriginal Cultural Heritage Management Plan and Monitoring Methodology* prepared by Biosis Research, May 2009.

Location

The proposed BHPBIC works are located adjacent to the township of Douglas Park, NSW (Figure 1).

The project area is bordered in the east by the Hume Highway and in the south west by Harris Creek. The area is typically open grazed pasture with native vegetation surrounding Harris Creek. Native vegetation also surrounds the two MSGD sites (Figure 3) that are located approximately 3.5 km to the west of Douglas Park.

The project area for this heritage 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 as well as access and pipeline routes, as described in the Proposed Works section of this assessment.

Proposed Works

The proposal involves the construction of up to 12 goaf gas drainage vertical wells, 2 MSGD wells and up to six medium radius drilling (MRD) wells. Generally these sites will require the following construction and on site activities:

- Development of a 100 m x 100 m drilling compound which will allow for the temporary installation of drilling equipment, gas drainage pipes and, water tanks, pumps and flaring units for the MSGD wells.
- Temporary Installation of site facilities including toilet/washroom facilities at each site.
- Movement on site of various vehicles including construction of temporary site access.
- 50 m x 50 m drilling pads would be required for vertical bores, while a larger (eg. 100 m x100 m) medium radius drilling (MRD) compound will be required for the six proposed MRD wells (Figure 2).

Aims

This heritage assessment aims to provide an assessment that is adequate to support a modification to the existing approval of Major Project application 08_256. Biosis Research conducted a heritage assessment (Biosis Research 2009a) and prepared an Aboriginal Cultural Heritage Management Plan (Biosis Research 2009b) for the Appin Mine Surface Gas Drainage Project. The Director General's Assessment report (NSW Government Department of Planning 2009) for the application approval concluded the following with regard to the heritage matters assessed by the Biosis Research (2009a) report:

> *The Department has recommended conditions that would require Illawarra Coal to prepare an ACHMP*
>
> *The Department is satisfied that impact to Aboriginal heritage sites would be minimal and is confident that the ACHMP would ensure that all impacts to Aboriginal heritage sites are minimised and managed accordingly.*

The Director General's Requirements (DGRs) for the original approval being modified by this Section 75W Application were issued on 2 February 2009 for the Appin Gas Drainage Project (Project Application Number 08_0256). The DGRs identified Aboriginal and non-Aboriginal heritage as key issues and required:

> *A detailed assessment of the key issues specified below [Aboriginal and non-Aboriginal heritage], and any other significant issues identified in the general overview of environmental impacts of the project, which includes:*
>
> - *A description of the existing environment, using baselines data;*
> - *An assessment of the potential impacts of all stages of the project, taking into consideration any relevant policies, guidelines, and statutory provisions (see below); and*
> - *A description of the measures that would be implemented to avoid, minimise, mitigate, rehabiliutate/remediate, monitor and/or offset the potential impacts of the project, including detailed contingency plans for managing any significant risks to the environment;…*
>
> *Policies, Guidelines and Plans:*
>
> - *Draft Guidelines for Aboriginal Cultural Heritage Impact Assessment and Community Consultation (DECC)*
> - *Aboriginal Cultural Heritage Standards and Guidelines Kit (NSW EPA)*
> - *NSW Heritage Manual (NSW Heritage Office and DUAP)*

Hence, this heritage assessment aims to provide an assessment consistent with the specified requirements and approval conditions of Application 08_0256, and the existing assessment report (Biosis Research 2009a) and Aboriginal Cultural Heritage Management Plan (Biosis Research 2009b).

The methods employed to do this are described in the following section.

Methods

The broad methodology for this project is outlined below:

- Undertake a background review of relevant literature and conduct searches of relevant heritage databases, including the Office of Environment and Heritage Aboriginal Heritage Information Management System (AHIMS), the National Heritage Register, the State Heritage Register and the State Heritage Inventory
- Review the Heritage Schedules of the Wollondilly LEP 2011;
- Consult with the Aboriginal community;
- Undertake an archaeological survey of the project area;
- Record any cultural heritage and/or archaeological sites that occur in the project area;
- Assess the cultural heritage significance of the individual sites and the project area in accordance with the *Burra Charter* (Australia ICOMOS 1999), the NSW Heritage Manual (NSW Heritage Office and DUAP 2001)(as updated), OEH *Draft Guidelines for the Aboriginal Cultural Heritage Impact Assessment and Community Consultation 2005* (DECC 2005) and *Standards and Guidelines Kit* (NPWS 1997);
- Determine the potential impacts from the proposal to the cultural heritage value of individual sites, the cultural landscape as a whole, and contemporary cultural values;
- Provide recommendations to avoid impacts and conserve values, or to mitigate impacts where avoidance is not possible.

The site inspection involved walking over each of the proposed vertical well, access track, pipeline, two MSGD sites and MRD hole locations, as well as inspecting areas of exposure for the presence of Aboriginal objects or historical relics on the ground surface. Where present, native vegetation was inspected for Aboriginal scarring.

A differential GPS was used to record the area that was walked over, and the location of features and finds. A 12 megapixel digital camera was used to photograph finds and features, and the general landscape setting.

Field notes were recorded in a notebook, and as annotations on aerial photos.

Consultation with the Aboriginal Community

Consultation with the Aboriginal community has followed on from the consultation for the Appin Area 7 Goaf Gas Drainage Project conducted in 2009, by BHP Billiton Illawarra Coal and Biosis Research (Biosis Research 2009: 6). Consultation has been conducted with the Tharawal Local Aboriginal Land Council and Cubbitch Barta Native Title Claimants. Representatives of both these organisations were invited to participate in the field survey and site inspections.

Kirsty-Lee Chalker of Cubbitch Barta Native Title Claimants was present for the site inspections of all vertical well, MSGD sites and MRD locations as well as their access tracks on the 31st of August 2011. A copy of this report has been forwarded to her for comment, which will be included when it is received.

Tharawal Local Aboriginal Land Council (TLALC) was unfortunately not able to have a site officer to attend the site inspections due to other work commitments (See appendix for correspondence) a copy of the draft report however has been submitted to the Land Council for comment. Any comments will be included when received.

Landscape Context

The assessment area for the goaf gas drainage MRD and vertical wells is situated approximately 2km east of the township of Douglas Park. The two MSGD well sites are located approximately 3.5km south west of the township.

The landscape of the goaf gas drainage MRD and vertical wells project area consists of undulating plains with ridgelines running perpendicular to the Hume Highway. The main drainage feature is Harris Creek which runs along the south western boarder of the goaf gas drainage project area. The project area of the two proposed MSGD well sites are also made up of undulating plains and ridgelines, however in this case the ridgelines run parallel to Menangle Road.

Soils and topography

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 south east of the assessment area. The soil landscape of the project 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 *in situ* 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.

Ecology and cultural heritage

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 Harris Creek is a shallow sandstone drainage line that runs south to the Nepean River. South 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 Nepean River contains rock-shelters which were used for art and occupation (Biosis Research 2006, Sefton 1998).

Disturbance and Modification

The Douglas Park district was one of the earliest areas settled by Europeans after the establishment of the penal colony at Sydney in 1788. At the beginning of the nineteenth century Francis Barrallier (1975), one of the first Europeans to visit the area, reported damage to waterways near Douglas Park from feral cows which had escaped the Sydney colony sometime earlier. The first land grants in the district were issued between 1810 and 1820 and in the following decades the district established an agricultural and pastoral industry, including wheat and maize crops, and dairying (Whitaker 2005). The district has maintained its rural roots through to the present day, and mining has become an important regional industry. More recently the establishment of the southern suburbs of the Sydney urban area has begun to encroach further into the area, as former farmland is transformed into residential housing.

The result of this history has been the almost complete removal of native vegetation—Cumberland Plain Woodland—from the landscape and the establishment of pasture or agricultural land on all areas of suitable topography. Native vegetation only remains in and on the flanks of the steep sandstone creeks and rivers, which were unsuitable for agricultural or pastoral development. Hence, virtually all areas of land have been cleared, tilled and variously modified and landscaped for agriculture through the establishment of water storage dams, fences, vehicle tracks and occasionally contour banking. Gully erosion is present in the northern part of the assessment area, otherwise the area is generally stable.

The assessment area itself has been subject to significant rural development, as it contains one of the oldest residences in the district Morton Park (also called Mountbatten)(Williams 2009). The assessment area is also in very close proximity to the transport corridor which contains the Hume Highway and the Main Southern Railway. The following landscape modifications, which are fairly typical of rural properties, are present within the assessment area:

- Native vegetation cleared or partially cleared,
- Historical air photos show all cleared areas have been tilled,
- three large dams, with several others on the property,
- roads and tracks,
- various residential and rural buildings,
- tree and hedge rows,
- a former horse training track,
- directly buried telecommunications cable,
- feeder drains and banks for dams, and
- refuse dumping.

Despite the relatively high level of modification to the landscape there are some large eucalypt trees, probably over 100 years old or more, in the vicinity of the Morton Park buildings, and a patch of resilient and regrown woodland next to Harris Creek, in the south-west of the assessment area. Intensive land clearing and agricultural disturbance will impact the surface soils of an area. While such events will impact any Aboriginal objects situated at or near the surface of the ground (stone artefacts, or scarred trees) they will not remove the potential for there to be buried Aboriginal objects, or for Aboriginal objects to be visible in areas exposed by erosion or other disturbance.

Local History

The Douglas Park 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 Douglas Park 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.

The original Morton Park land grant of 2,000 acres was granted by Governor Macquarie to Spanish free settler Jean Baptiste Lehimas De Arrieta by an order dated 17 August 1821 (Williams 2009: 7). The grant encompassed lands bounded by the Douglas Park (or "Hoare Town") grant to the west and the Nepean River to the south, and the extensive South Camden land holdings of John Macarthur to the north.

De Arrieta was captured by the British during the Napoleonic wars and was sent to England as Prisoner of War. He later served with the British in the Peninsular War of 1808 – 1814, and through connections within the English society claimed recompense from the British for his service. By way of reckoning, rather than money, the British gave De Arrieta the understanding that he would receive a land grant if he were to travel to New South Wales (Williams 2009: 7). De Arrieta arrived in Sydney on the *Duchess of York* on 3 April 1821, again carrying introductions and representations from social benefactors in England.

Soon after his arrival, De Arrieta wrote to Governor Macquarie explaining his claim and a desire to cultivate vines and olives and rear sheep. Macquarie wrote back with the offer of 2,000 acres in the Cow Pastures, plus an offer of support from the government stores for De Arrieta himself and six convict servants for a period of six months, and 10 cows that would not need to paid for until the expiration of three years (Williams 2009: 8).

In early 1822 De Arrieta took up residence at Morton Park, and quickly began clearing and cropping the land. The original Morton Park stone cottage and the stone chapel were constructed during this time. Within two years the population of Morton Park numbered 42, consisting of De Arrieta, an overseer and 40 convicts. Morton Park was producing wheat, oats, barley, maize and orchard fruits, and included 48 cattle and 62 pigs (Williams 2009: 8). However, the cash flow required to support such a large contingent of servants eluded De Arrieta, and he had been forced to mortgage the property by 1823, and again in 1824. De Arrieta struggled on, with a reduced labour force (having completed the land clearing) and a focus on growing vines and tobacco rather than grain crops, and 86 cattle by 1828. De Arrieta married Sophia Spearing from the Illawarra in early 1828, in the Morton Park stone chapel.

Morton Park was eventually sold to Samuel Terry, a convict and stone mason whose sentence had expired in 1807, in March 1831. De Arrieta continued to live and work on Morton Park. The property was sold again in 1837 to Lachlan Macalistar, a former Scottish soldier and part time explorer of Gippsland in Victoria (Williams 2009: 35). Both De Arrieta and Terry died in 1838. De Arrieta's funeral service was held in his chapel at Morton Park, and as there is no record of his burial Williams (2009: 11) speculates

that he may be buried on Morton Park. De Arrieta had been a somewhat well known resident of the area, and appears in many contemporary memoirs and journals. Spaniards Hill to the north of Douglas Park is named after him.

Macalistar mortgaged Morton Park back to the Terry family in 1844, and the property eventually passed to Ellen Hughes (the stepdaughter of Samuel Terry's nephew, John Terry Hughes) in 1858. Ellen and Samuel Terry Hughes arrived at Morton park in 1858, and Samuel built the built the homestead that same year (Williams 2009: 16). Ellen Hughes later married Franklin McMullen, and as Ellen McMullen remained owner of Morton Park until her death in 1914. Subsequent to this the property began to be subdivided by the trustees of Ellen's estate, and was sold as smaller lots.

The recent history of the property has seen the homestead renovated in the 1940s and the chapel appropriated for use as a stable and farm building. It was subsequently sold to Neville Hemsworth, who made several alterations including a swimming pool and dancehall, renaming the homestead "Mountbatten" (after Lord Louis Mountbatten) and leasing it as a guesthouse. It was later used as a stud farm and horse riding school, and was again refurbished by Audrey de Graf in the mid 1990s. Part of the property reverted to the name Morton Park during the 1980s. In 2010 the Mountbatten and Morton Park properties were purchased by BHP Billtion Illawarra Coal Holdings Pty Ltd.

Register Searches

An extensive AHIMS search was conducted on 29 August 2011 (AHIMS search ID # 50076). The search covered an area that encompassed the Appin Mine Surface Gas Drainage Project area. There are 25 previous recordings of Aboriginal archaeological sites in the area surrounding the Project Area. The AHIMS search results are presented in Table 1 and shown in Figure 2. A separate AHIMS search was carried out for the two MSGD sites, due to their distance from the MRD and vertical well locations (AHIMS search ID # 50890). There were no Aboriginal places or sites located within an area of 4km^2 of the proposed MSGD well locations.

One of the existing records is 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 Goaf gas drainage works is Mountbatten 1 (Site ID 52-2-3674). This site comprises of an open camp site and is situated approximately 120 metres east of proposed goaf gas vertical well 704-V6. Activities associated with the placement and use of well site 704-V6 will have no impact on this stone artefact scatter.

Table 1. AHIMS search results within close proximity to the proposed Goaf Gas Drainage and proposed MSGD 1 and MSGD 2 sites

Site ID	SiteName	Context	SiteFeatures
52-2-2052	Nepean River 2;Douglas Park; same as 52-2-1922	Closed site	Art (Pigment or Engraved) : -
52-2-1214	Unit D ground axe Paddock;Didicoolum;	Open site	Artefact : -
52-2-3845	Morton Park Rd 5	Open site	Artefact : 20

Site ID	SiteName	Context	SiteFeatures
52-2-3671	Moreton Park Road IA-1	Open site	Artefact : -
52-2-3673	Moreton Park OCS-1	Open site	Artefact : -
52-2-3578	WA01, West Appin	Open site	Artefact : 1
52-2-3571	Prices Road, Douglas Park PAD	Open site	Potential Archaeological Deposit (PAD) : -
52-2-1213	Unit e rubbish Dummp;Didicoolum;	Open site	Grinding Groove : -
52-2-1921	Brooks Point 8	Closed site	Art (Pigment or Engraved) : -
52-2-3844	Morton Park Rd 4	Open site	Artefact : 1
52-2-1922	Nepean River 2 (Douglas Park); same as 52-2-2052	Closed site	Art (Pigment or Engraved) : -
52-2-3843	Morton Park Rd 3	Open site	Artefact : 22
52-2-2097	Nepean river 4	Closed site	Earth Mound : -, Shell : -, Artefact : -
52-2-3672	Moreton Park Road IA-2	Open site	Artefact : -
52-2-3846	Mountbatten 2	Open site	Artefact : 1
52-2-2095	Nepean River 6	Closed site	Artefact : -
52-2-2096	Nepean River 7	Open site	Modified Tree (Carved or Scarred) : -
52-2-3674	Mountbatten 1	Open site	Artefact : 1
52-2-0014	Douglas Park;	Closed site	Art (Pigment or Engraved) : -
52-2-3840	Brooks Point Rd 1	Open site	Artefact : 5
52-2-2094	Nepean River 5	Closed site	Artefact : -
52-2-2098	Nepean River 3	Closed site	Artefact : -
52-2-2099	Brooks Point 9	Closed site	Art (Pigment or Engraved) : -, Artefact
52-2-3841	Morton Park Rd 1	Open site	Artefact : 8
52-2-3842	Morton Park Rd 2	Open site	Artefact : 3

Further Heritage Searches

Searches of the New South Wales heritage branch database and of the Wollondilly Local Environment Plan (LEP) 2011 were completed 7 September 2011. The following items were found to be registered within the project area:

Table 2. Heritage items within close proximity to the goaf gas drainage works and two MSGD sites

State Heritage Inventory Number	Heritage item
2690085	Morton Park: Mountbatten Group
2690088	Mountbatten garden Building: Mountbatten Group
2690086	Mountbatten House: Mountbatten Group
2690087	Mountbatten Stone Chapel: Mountbatten Group

These items have been assessed to have local heritage significance, comprising historical, associative and aesthetic significance. A number of heritage assessments have been completed in regards to these heritage items these include Biosis Research (2006b), Michael Pearson (2009) and Niche (2010).

Previous Archaeological Work

The last decade has seen increasing levels of archaeological investigation in the Douglas Park area. Much of this work has been conducted either in or in very close proximity to the proposed longwalls 704 to 705 goaf gas drainage area, revealing a characterization of the type of material traces of past Aboriginal land use that are present here. The previous investigations with relevance to the current assessment area are reviewed below.

Overview of previous Aboriginal object investigations

Sefton 1998

Archaeological Investigation of Longwalls 16 and 17 and Future Mining Extensions, Tower Colliery

Caryll Sefton conducted a major survey of the Nepean River and some of its tributaries in the Douglas Park area as part of this project. The survey was limited to the immediate area of cliffs and sandstone overhangs of the Nepean River and its tributaries. The survey recorded four sites, all sandstone shelters with art, and identified many other shelters which had the potential to contain archaeological deposit.

Sefton 1999

Archaeological Investigation of Longwalls 18-24 Tower Colliery

Caryll Sefton followed up the 1998 surveys with additional surveys the year later. This survey focused more on the tributaries of the Nepean River, in an area approximately 3 km north-east of the proposed vent shaft site. Sefton recorded six new sites: five sandstone shelter sites and a single scarred tree.

Biosis Research 2006a

Douglas Area 7 Project Environmental Impact Statement Appendix H: Impacts on Indigenous and Historical Archaeology – Revised Report

This assessment was undertaken to characterise the cultural heritage resources in the predicted subsidence area of Appin Colliery Longwalls 701 to 704. This project assessed a large area of land immediately to the north and east of the current assessment area, including a large portion of overlap with the current assessment area with the proposed access road corridor and Picton Soil Landscape environment. Biosis Research's survey took in sandstone environments that flanked the Nepean River and some of its westerly tributaries, but crucially this survey also investigated the cleared landscapes of the Cumberland Lowlands in the Douglas Park area. It was one of the first surveys to do so, and discovered 8 previously unknown stone artefact sites in the area, including artefacts on the Mountbatten property, as described in more detail the next section.

Biosis Research noted that stone artefact sites in the local area were generally under-represented in AHIMS records due to a lack of previous survey effort to find them (with most previous survey focusing on finding sandstone shelters). The report concluded that: the landform with the most archaeological sensitivity in the region were tributaries and gullies, as these contained sandstone shelter sites with rock art and archaeological deposit; in addition stone artefacts were likely to occur in all parts of the undulating hills of the lowlands (the discontinuous "background scatter" of stone artefacts) as has been documented elsewhere on the Cumberland Plain (Biosis Research 2006a: 54-55).

Biosis Research 2006b

Douglas North 66/11kV Substation and Transmission Line Upgrade: Aboriginal and Historical Cultural Heritage Assessment

In 2006 Biosis Research conducted a cultural heritage assessment for the construction of the Douglas North Substation (the substation will be further upgraded during the ventilation shaft No. 6 project). The survey focused on the existing electricity easement and substation footprint. It relocated two open stone artefact sites that had been recorded earlier in the year for the Douglas Area 7 project, but no other finds. Biosis Research recommended sub-surface testing through excavation of test pits for the sub-station site. The test excavation program did not find significant archaeological deposits. Sub-surface artefacts were found to be in a similar low density to those identified on the ground surface during the survey. The results supported those models of Aboriginal land use that had been previously presented, showing that occupation of the lowland plains and hills, especially in the areas fringing drainage lines, resulted in low density stone artefact sites.

Biosis Research 2009a

Bulli Seam Operations Aboriginal Cultural Heritage Assessment

The Bulli Seam Operations Project application sought an approval to allow future mining in a large area straddling from Darkes Forest on the Woronora Plateau to the Maldon area on the Cumberland Lowlands. The assessment area for the Bulli Seam Operations Project encompassed the vent shaft assessment area of the current project. Biosis Research focused their survey efforts on relocating sites of relatively higher significance, and the majority of survey effort was directed at the landscapes of the Woronora Plateau and rock art sites. Nevertheless, a comparatively small amount of survey was undertaken on the Cumberland Lowlands, recording several stone artefact sites in open contexts. The results were consistent with previous studies and models of Aboriginal occupation of the area.

An extensive program of Aboriginal community consultation was also undertaken as part of the Bulli Seam Operations project. A total of 15 Aboriginal community groups were consulted for the project. Two consistent themes were identified by the Aboriginal communities: 1) All archaeological and cultural heritage sites have high value to the Aboriginal community, and 2)

Sites should be preserved for future generations (Biosis Research 2009: 11). Biosis Research concluded that the Bulli Seam Operations assessment area was a cultural landscape of high significance, with the Cumberland Lowlands area contributing value as it preserved "an important history of occupation of the plains prior to their current development" (Biosis Research 2009a: 82).

Biosis Research 2009b

Archaeological and Cultural Heritage Impact Assessment of the Proposed Appin Area 7 Goaf Gas Drainage Project

Biosis Research conducted an archaeological and cultural heritage assessment for this project, which involved a small gas plant and gas pipeline. The gas pipeline traversed country just to the east of the current proposed goaf gas drainage assessment area, before crossing the Southern Railway / Hume Highway corridor and continuing on the east side of the highway. The survey discovered 3 stone artefact sites to the east of the Hume Highway. Two of these sites contained single artefacts, whilst the other contained 2 artefacts. In all cases there was very good archaeological exposure, and no areas of further potential at the sites were identified.

Niche Environment and Heritage 2010

Aboriginal Cultural Heritage Assessment: Appin Colliery Area 9, Ventilation Shaft No.6

This assessment considered the potential impacts of a proposed Ventilation Shaft and access track on the Morton Park property near Douglas Park, NSW. The current project is situated on the same property that was assessed by Niche Environment and Heritage in 2010. The study noted that there were four known Aboriginal archaeological sites in the vicinity of the proposed vent shaft site and access track, however it concluded that based on the results of the current assessment, previous assessments and the landforms present that the study area (which includes the same landforms as the current goaf gas drainage proposal) was of low archaeological potential. In consideration of the Aboriginal cultural landscape Niche Environment and Heritage concluded that although there would be a minor impact to the cultural landscape, especially considering the already fragmented nature of the landscape.

Summary

The area in the vicinity of the proposed goaf gas drainage and MSGD sites have been subject to intensive archaeological study over the last decade. Most of the archaeological work has been initiated by impact assessments for various mining related activities. Initially the work has focused on the sandstone environments of the Nepean River and its tributaries, biasing site records toward sandstone shelter sites. However recent investigations on the plains and hills have shown that these areas contain many stone artefact sites, as is the case with virtually the entire Cumberland Plain (White and McDonald 2010). Generally, the stone artefact sites in the vicinity of the assessment area comprise small sites with only a few artefacts or a single artefact. This partly reflects the lack of investigation until recently and is possibly a result of generally limited archaeological exposure in the landscape. It may be due to the way Aboriginal people used the transitional zone between the plains and the sandstone gorges and plateau areas. To date, the main issues that have been dealt with by these studies have necessarily been to do with questions of presence or absence of sites, and broad characterisation of where the sites occur in the landscape.

Predictive Model

The review of previous archaeological investigations presented above showed that the material traces of past Aboriginal and use in the Douglas Park area comprise:

- Stone artefact sites, generally with low artefact numbers, in open contexts;
- Sandstone shelter sites with art and deposit within close proximity to the Nepean River and Harris Creek and;
- Scarred trees.

Generally, the stone artefact sites are small in area and the number and density of artefacts they contain. Overall in the Douglas Park area previous investigators have focused their assessments around the gorges and ridgelines of the Nepean River looking for the presences of sandstone shelter sites with deposit and or art art. Only recently has there been assessment of the open cleared areas of the area due to the mine exploration assessments of the area.

On the Cumberland Plain at Rouse Hill, west of Sydney, White and McDonald (2010) have analysed the distribution of stone artefacts across the Rouse Hill development Area, which measures around 5 km x 5 km. This is the first such peer reviewed and published analysis and predictive model. White and McDonald analysed several landscape variables against the results of sub-surface investigations (a database containing 4429 stone artefacts) and concluded that the stream order (the size of a drainage line) and landform were the most important factors in determining artefact density and distribution. In summary they conclude:

> *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 51-100 m from 4th order streams, and within 50 m of 2nd order streams.* (White and McDonald 2010: 36)

White and McDonald's observation about the importance of stream order and landform on artefact distribution and density is noteworthy and describes the known distribution of stone artefact sites in the Douglas Park area, such that it is. Harris Creek can be defined as a 2nd order stream as it is perennial and connects to the Nepean River which is classified as a first order stream.. This suggests artefacts will be present within the landscape, but they will be more dispersed, and have concentrations containing relatively few (less than 50, for example) artefacts. The most frequent and highest density concentrations are likely to be within 50 m of Harris Creek (White and McDonald 2010; 34).

Considering the characteristics of the Cumberland Plain in general, and the specific results of previous investigations in the Douglas Park area the following predictive statements can be made:

- Open stone artefact sites may occur anywhere in the landscape, but are most likely to occur on flats, lower slopes and hill crests.
- Relatively higher density stone artefact sites will occur on lower slopes or flats in close (50 m – 100 m) proximity to Harris Creek.

- ❒ Relatively moderate density stone artefact sites will occur on ridges and crests in proximity to Harris Creek.
- ❒ Scarred trees may (and do) occur wherever there is remnant woodland vegetation of sufficient age.

The predictive statements are limited to the open stone artefact and scarred tree site types, as these are the only site types with a predictable likelihood to occur in the assessment area.

Archaeological Survey - Results

The site inspections were conducted on 31 August 2011 by Renée Regal (Niche Environment and Heritage) and Kirsty-Lee Chalker (Cubbitch Barta Native Title Claimants). The inspections involved visiting each of the proposed development sites and the proposed access tracks/pipelines. The survey results are presented in Table 3.

Table 3. Survey Results

Site Name	Archaeological assessment notes	Recommendations
705 V1	• Area previously cleared for agriculture. Cattle currently grazing in the paddock. • No remnant vegetation. • 10% visibility due to long length of grass. • 10% exposure due to cattle track and small areas of over grazing by cattle. • Gently sloping location- simple slope.	No further archaeological assessment required.
705 V2	• Area previously cleared for agriculture. Cattle currently grazing in the paddock. • No remnant vegetation. • 10% visibility due to long length of grass. • 10% exposure due to cattle track and small areas of over grazing by cattle. • Gently sloping location- simple slope.	No further archaeological assessment required.
704 V3	• Area previously cleared for cattle grazing. Now covered in blackberry. • No remnant vegetation. • 20% visibility due to long length of grass. • 20% exposure due to cattle track and small areas of over grazing by cattle. • Gently sloping location- lower slope.	No further archaeological assessment required.

704 V4	• Area previously cleared for cattle grazing. Now covered in blackberry. • No remnant vegetation. • 0% visibility due to long length of grass and blackberry. • 0% exposure due to long length of grass and blackberry coverage of entire location. • Gently sloping location- simple slope.	No further archaeological assessment required.
704 V5	• Area previously cleared for agriculture. Horses still grazing at the location. • No remnant vegetation. • 5% visibility due to long length of grass. • 5% exposure due to small areas of over grazing by cattle and erosion. • Gently sloping location- lower slope.	No further archaeological assessment required. However it is recommended that all personnel be made aware at site 705 V5 that there is one registered Aboriginal site- Open Camp Site (52-2-3674) approximately 150m south east of the vertical well location.
704 V6	• Area previously cleared for agriculture. Horses still grazing at the location. • No remnant vegetation. • 5% visibility due to long length of grass. • 5% exposure due to small areas of over grazing by cattle and erosion. • Gently sloping location- lower slope..	No further archaeological assessment required. However it is recommended that all personnel be made aware at site 705 V6 that there is one registered Aboriginal site- Open Camp Site (52-2-3674) approximately 120m south east of the vertical well location.
704 V7	• Area previously cleared for agriculture. Horses still grazing at the location. • No remnant vegetation. • 5% visibility due to long length of grass. • 5% exposure due to small areas of over grazing by cattle and erosion. • Gently sloping location- simple slope.	No further archaeological assessment required. However it is recommended that all personnel be made aware at site 705 V7 that there is one registered Aboriginal site- Open Camp Site (52-2-3674) approximately 200m east of the vertical well location.

704 V8	• Area previously cleared for agriculture. Horses still grazing at the location. • No remnant vegetation. • 0% visibility due to long length of grass. • 0% exposure . • Gently sloping location- simple slope.	No further archaeological assessment required.
704 V9	• Area previously cleared for agriculture. Horses still grazing at the location. • No remnant vegetation. • 0% visibility due to long length of grass. • 0% exposure . • Gently sloping location- simple slope.	No further archaeological assessment required.
705 V3	• Area previously cleared for agriculture. Horses still grazing at the location. • No remnant vegetation. • 5% visibility due to long length of grass. • 5% exposure due to small areas of over grazing by cattle and erosion. • Gently sloping location- lower slope.	No further archaeological assessment required.
705 V4	• Area previously cleared for agriculture. Horses still grazing at the location. • No remnant vegetation. • 0% visibility due to long length of grass. • 0% exposure. • Gently sloping location- mid slope.	No further archaeological assessment required.
705 V5	• Area previously cleared for agriculture. Horses still grazing at the location. • No remnant vegetation. • 0% visibility due to long length of grass. • 0% exposure • Gently sloping location- mid slope.	No further archaeological assessment required.

705 MRD A	• Area previously cleared for agriculture. Cattle still grazing at the location. • No remnant vegetation. • 5% visibility due to long length of grass. • 5% exposure due to cattle over grazing. • Gently sloping location- simple slope.	No further archaeological assessment required.
705 MRD B	• Area previously cleared for agriculture. Cattle still grazing at the location. • No remnant vegetation. • 5% visibility due to long length of grass. • 5% exposure due to cattle over grazing. • Gently sloping location- simple slope.	No further archaeological assessment required.
705 MRD C	• Area previously cleared for agriculture. Cattle still grazing at the location. • No remnant vegetation. • 0% visibility due to long length of grass. • 0% exposure . • Gently sloping location- mid slope.	No further archaeological assessment required.
705 MRD D	• Area previously cleared for agriculture. Cattle still grazing at the location. • No remnant vegetation. • 0% visibility due to long length of grass. • 0% exposure . • Gently sloping location- mid slope.	No further archaeological assessment required.

705 MRD E	• Area previously cleared for agriculture. Cattle still grazing at the location. • No remnant vegetation. • 5% visibility due to long length of grass. • 5% exposure due to cattle over grazing. • Gently sloping location- simple slope.	No further archaeological assessment required.
705 MRD F	• Area previously cleared for agriculture. Cattle still grazing at the location. • No remnant vegetation. • 5% visibility due to long length of grass. • 5% exposure due to cattle over grazing. • Gently sloping location- simple slope.	No further archaeological assessment required.
MSGD 1	• Area previously cleared for agriculture. Horses still grazing in the paddock. • Limited native vegetation remaining. • 5% visibility due to long length of grass. • 10% exposure due to cattle over grazing also checked around the dam which is within close proximity to the proposed MSGD well location. • Gently sloping location- simple slope. •	No further archaeological work required.
MSGD 2	• Area previously cleared for agriculture. Cattle still grazing in the paddock. • Limited native vegetation remaining. • 0% visibility due to long length of grass. • 0% exposure • Gently sloping location- simple slope.	No further archaeological work required
Access track to 705V5 and 705 V4	• Area previously cleared for agriculture. Cattle still grazing in the paddock. • 0% visibility due to long length of grass. • 0% exposure • Gently sloping location- simple slope.	No further archaeological work required

Site Description: Aboriginal Archaeological Site – Mountbatten OCS-1 (52-2-3674)

During the assessment of the existing access track one previously unregistered Aboriginal Open Camp Site (OCS) was identified. Mountbatten OCS-1 (52-2-3875) consisted of a single silcrete flake (Plate 1 and 2). Due to the location of this ridge in the Blacktown soil landscape and the close proximity of this artefact to the previously registered Mountbatten 1 (52-2-3674), and it being located on the same ridge line (prior to the cutting of this ridge line in half for the implementation of the Hume Highway) as sites Moreton Park Road IA-2 (52-2-3672), Moreton Park Road OCS-1 (52-2-3673) and Moreton Park Road IA-1 (52-2-3671)this site has been registered as an Open Camp Site, as it is highly likely that there is further archaeological material present within the surrounds of this area of exposure. This site will not be adversely affected by the proposed goaf gas drainage works.

Plate 1: Silcrete flake identified as Mountbatten OCS-1 (52-2-3875)

Plate 2: North western view of ridgeline where Mountbatten OCS-1 (52-2-3875) is located.

Non-Aboriginal cultural heritage values

The proposed works, whilst located on the same property as the heritage items listed in the Heritage Schedules of the Wollondilly LEP 2011, are located no closer than 350 m to the nearest heritage item.

There were no historical relics identified during the site inspections, and none are considered likely to occur in the area of the proposed works. This sis because the area has not been subject to development (which is focused around the Morton Park/Mountbatten Homestead area) but has only been subject to rural use.

Analysis and Discussion

The archaeological survey of Appin Mine Surface Gas Project and MSGD well sites assessment area achieved a reasonable level of effectiveness, although there were limitations due to landscape disturbance from previous farming activities and infrastructure implementation and sometimes poor archaeological visibility and exposure.

The predictive model suggested that the most likely Aboriginal site types to be encountered would be stone artefacts sites of small size and density, and scarred trees. The results of the survey have

confirmed the predictive model, which was simply a statement of the relevant parts of the predictive models forwarded by previous researchers, in particular White and McDonald (2010).). The undeveloped areas of the Mountbatten property (Lot 1 DP 576136 and Lot A DP 421246) have archaeological potential in that they are may have sub-surface Aboriginal objects present. These objects will likely be typical of what has been reported for other sections of the Cumberland Plain in the vicinity of low order streams. In summary past Aboriginal occupation appears to be focused on the junction of lower order streams, and ridge tops, hill crests and low order creek flats appear to also be a focus for activity and artefact discard. This may be a pattern of past Aboriginal land use specific to this part of the Cumberland Plain, giving it some comparative value in regards to the rest of the Plain.

In conclusion the general Douglas Park landscape has the potential to yield some information about past Aboriginal life in the area. Dependent on the further understanding of the sub-surface occurrence of artefacts in areas of remnant soil, however, the area probably has little to contribute other than to be noted as an area with a characteristic occurrence of stone artefacts, and some remnant vegetation.

Cultural Heritage Significance

The Burra Charter (Australia ICOMOS 1999) defines the basic principles and procedures to be observed in the conservation of important places. It provides the primary framework within which decisions about the management of heritage sites in Australia should be made. The Burra Charter defines cultural significance as being derived from the following values:

Aesthetic value

Aesthetic value includes aspects of sensory perception for which criteria can and should be stated. Such criteria may include consideration of the form, scale, colour, texture and material of the fabric; the smells and sounds associated with the place and its use.

Historic value

Historic value encompasses the history of aesthetics, science and society, and therefore to a large extent underlies all of the terms set out in this section.

A place may have historic value because it has influenced, or has been influenced by, an historic figure, event, phase or activity. It may also have historic value as the site of an important event. For any given place the significance will be greater where evidence of the association or event survives in situ, or where the settings are substantially intact, than where it has been changed or evidence does not survive. However, some events or associations may be so important that the place retains significance regardless of subsequent treatment.

Scientific value

The scientific or research value of a place will depend upon the importance of the data involved, on its rarity, quality or representativeness, and on the degree to which the place may contribute further substantial information.

Social value

Social value embraces the qualities for which a place has become a focus of spiritual, political, national or other cultural sentiment to a majority or minority group.

Other approaches

The categorisation into aesthetic, historic, scientific and social values is one approach to understanding the concept of cultural significance. However, more precise categories may be developed as understanding of a particular place increases.

The NSW OEH DECCW guidelines for the significance assessment of Aboriginal archaeological sites are contained within the *Aboriginal Cultural Heritage Standards and Guidelines Kit (NPWS 1997)*. The Kit identifies with two main streams in the overall significance assessment process: the assessment of cultural/social significance to Aboriginal people and the assessment of scientific significance to archaeologists.

This approach encapsulates those aspects of the Burra Charter that are relevant to Aboriginal archaeological sites. The guidelines specify the following criteria for archaeological significance, as paraphrased below:

Research Potential

It is the potential to elucidate past behaviour which gives significance under this criterion rather than the potential to yield collections of artefacts. Matters considered under this criterion include – the intactness of a site, the potential for the site to build a chronology and the connectedness of the site to other sites in the archaeological landscape.

Representativeness

As a criterion, representativeness is only meaningful in relation to a conservation objective. Presumably all sites are representative of those in their class or they would not be in that class. What is at issue is the extent to which a class of sites is conserved and whether the particular site being assessed should be conserved in order to ensure that we retain a representative sample of the archaeological record as a whole. The conservation objective which underwrites the 'representativeness' criteria is that such a sample should be conserved.

Rarity

This criteria cannot easily be separated from that of representativeness. If a site is 'distinctive' then it will, by definition, be part of the variability which a representative sample would represent. The criteria might best be approached as one which exists within the criteria of representativeness, giving a particular weighting to certain classes of site. The main requirement for being able to assess rarity will be to know what is common and what is unusual in the site record but also the way that archaeology confers prestige on certain sites because of their ability to provide certain information.

The criterion of rarity may be assessed at a range of levels: local, regional, state, national, global.

Educational Potential

Heritage sites and areas should be conserved and managed in relation to their value to people. It is assumed that archaeologists have the ability to speak of the value of sites to members of their own profession. Where archaeologists or others carrying out assessments are speaking for the educational value of sites to the public the onus is on them to go to the public for an assessment of this value, or to reputable studies which have canvassed public demand for education. The danger, otherwise, is that archaeologists will be projecting their values onto a public which is itself given no voice on the matter.

Aesthetics

Archaeologists are not expected to include an assessment of aesthetic significance along with their assessment of scientific significance. In relation to heritage places, aesthetic significance is generally taken to mean the visual beauty of the place. Aesthetic value is not inherent in a place but arises in the sensory response people have to it.

Although the guidelines provide no expectation for archaeologists to consider *aesthetic values* it is often the case that a site's or a landscape's aesthetic is a significant contributory value to significance. Examples of archaeological sites that may have high aesthetic values would be rock art sites, or sites located in environments that evoke strong sensory responses – a local example would be the visually striking Illawarra Escarpment. For this reason we consider it appropriate to include aesthetic values as part of the significance assessment below.

The OEH standards and Guidelines Kit (NPWS 1997) also provides advice on the assessment of Aboriginal cultural significance, based on the critical starting point that Aboriginal people are the primary determinants of the significance of their cultural heritage. DECCW's Draft Guidelines for Aboriginal Cultural Heritage Impact Assessment and Community Consultation (DEC 2005b) provides advice on the heads of consideration for project assessments under Part 3A of the EP&A Act The Draft Guidelines focus on highlighting the multilayered and dynamic nature of Aboriginal cultural heritage and require that such considerations be included in heritage assessments. The Draft Guidelines also provide advice with regard to cultural landscapes:

…the significance of individual features is derived from their inter-relatedness within the cultural landscape. This means that features cannot be assessed in isolation, and that assessments need to consider the feature and its associations in a holistic manner. This may require a range of assessment methods with the close involvement and participation of Aboriginal people. Assessment will include lands, waterways, landscape features and native plants and animals that are culturally significant to Aboriginal people (DEC 2005b: 2).

The Heritage Branch, Planning NSW has produced the guideline *Assessing Heritage Significance* (Heritage Office 2001), which is part of the *Heritage Manual*. The guideline sets out the methods, and criteria for assessing heritage significance in accordance with the NSW Heritage Branch requirements. The relevant parts of the requirements are reproduced below:

An item will be considered to be of State (or local) heritage significance if, in the opinion of the Heritage Council of NSW, it meets one or more of the following criteria:

Criterion (a)	An item is important in the course, or pattern, of NSW's cultural or natural history (or the cultural or natural history of the local area);
Criterion (b)	An item has strong or special association with the life or works of a person, or group of persons, of importance in NSW's cultural or natural history (or the cultural or natural history of the local area);

Criterion (c)	An item is important in demonstrating aesthetic characteristics and/or a high degree of creative or technical achievement in NSW (or the local area);
Criterion (d)	An item has strong or special association with a particular community or cultural group in NSW (or the local area) for social, cultural or spiritual reasons;
Criterion (e)	An item has potential to yield information that will contribute to an understanding of NSW's cultural or natural history (or the cultural or natural history of the local area);
Criterion (f)	An item possesses uncommon, rare or endangered aspects of NSW's cultural or natural history (or the cultural or natural history of the local area);
Criterion (g)	An item is important in demonstrating the principal characteristics of a class of NSW's • cultural or natural places; or • cultural or natural environments. (or a class of the local area's • cultural or natural places; or • cultural or natural environments.)

An item is not to be excluded from the Register on the ground that items with similar characteristics have already been listed on the Register. While all criteria should be referred to during the assessment, only particularly complex items or places will be significant under all criteria. In many cases, items of environmental heritage will be significant under only one or two criteria.

In using these criteria it is important to assess the values first, then the context in which they are significant. Decide the appropriate context by considering similar items of local and State significance in each of these contexts.

Different components of a place may make a different relative contribution to its heritage value. Loss of integrity or condition may diminish significance. In some cases it may be useful to specify the relative contribution of an item or its components. While it is useful to refer to the following table when assessing this aspect of significance it may need to be modified to suit its application to each specific item.

Grading	Justification	Status
EXCEPTIONAL	Rare or outstanding element directly contributing to an item's local and State significance.	Fulfils criteria for local or State listing
HIGH	High degree of original fabric. Demonstrates a key element of the item's significance. Alterations do not detract from significance.	Fulfils criteria for local or State listing
MODERATE	Altered or modified elements. Elements with little heritage value, but which contribute to the overall significance of the item.	Fulfils criteria for local or State listing
LITTLE	Alterations detract from significance. Difficult to interpret.	Does not fulfil criteria for local or State listing
INTRUSIVE	Damaging to the item's heritage significance.	Does not fulfil criteria for local or State listing

Assessment of Archaeological Significance – Aboriginal Archaeological Sites

An assessment of archaeological significance for the sites recorded within the assessment area is presented below. A statement of significance for the cultural landscape is also presented. This final statement of significance draws together both archaeological (or scientific) and cultural values.

Mountbatten OCS-1
Archaeological Significance: LOW
Considerations against values criteria:
Research Potential
The site has low value against this criterion, as it exists in a disturbed and modified context. It has no potential beyond its recording in the landscape, which contributes to the overall patterning of archaeological sites, and understanding of Aboriginal occupation of the landscape in conjunction with other locally and regionally recorded sites.
Representativeness
Mountbatten OCS-1 is an example of the most common class of site in the locality and the region, and it is likely that many further similar sites exist, but have not yet been documented.
Rarity
Sites containing stone artefacts are not rare. The site contains a single artefact that is typical of the area. Locally and regionally the site is of low value against this criteria as it is an example of the most common class of sites.
Aesthetic
The site is located in a heavily disturbed and modified environment. It has no value under this criterion.

Assessment of Significance – the Aboriginal Cultural Landscape

An assessment of the significance of the cultural landscape considers the landscape as a contiguous geographic area (DEC 2005c: 174), within which the relationships between locations and features in the landscape provide a holistic and dynamic historical record (Moylan *et al*. 2009, Guilfoyle 2006).

The landscape of the assessment area today is that of cleared farmland. The area has been cleared of most of its native vegetation, with a number of dams being developed and the implementation of infrastructure such as power and optical fibre cables. The areas where remnant vegetation still exist will not be adversely effected by the proposed vertical, MRD or MSGD well and associated infrastructure. Archaeological work on the Cumberland Plain over the last few decades has demonstrated that it holds a rich record of the material traces of past Aboriginal land use and history (Attenbrow 2010, White and McDonald 2010). This archaeological richness is well known to the Aboriginal community, and is a key cultural value. The representative from the Cubbitch Barta advised whilst on site that the Aboriginal object present at Mountbatten OCS-1 is culturally significant as they are evidence of Aboriginal occupation of the Douglas Park area prior to European arrival.

In summary, the assessment area has low cultural landscape significance. The significance derives from values associated with the archaeological record of stone artefact sites and areas of archaeological potential: these provide a connectedness to the past within the now farming landscape. These past traces of Aboriginal land use provide a tangible link with the past for the contemporary Aboriginal custodians. The cultural landscape significance is adversely affected by the high levels of landscape modification that have taken place to create the farms that proposed vertical, MRD and MSGD wells will be located on.

Overall the Douglas Park area makes relatively little contribution to the regional cultural heritage landscape values, as it is an area that has seen significant farming development. To the south of the Douglas Park area, within the Nepean River catchment area there still exist significantly less fragmented landscapes, with higher potential cultural landscape value.

Significance Assessment – non-Aboriginal Heritage

The Wollondilly LEP 2011 lists the Mountbatten Group (house, chapel and garden building) as an item of local heritage significance.

The State Heritage Inventory records the listings as:

- Morton Park: Mountbatten Group (SHI database number 2690085)
- Mountbatten Garden Building: Mountbatten Group (SHI database number 2690088)
- Mountbatten House: Mountbatten Group (SHI database number 2690086)
- Mountbatten Stone Chapel: Mountbatten Group (SHI database number 2690087)

The heritage significance of the Mountbatten Group has previously been assessed by:

- JRC Planning Services (1993) for the Wollondilly Heritage Study.
- Biosis Research (2006) for Appin Colliery Longwalls 701 to 704 Environmental Impact Statement.
- Michael Pearson (2009) for the Bulli Seam Operations Project Environmental Assessment.
- Niche Environment and Heritage (2010b) for Appin Mine No 6 Vent Shaft

No additional heritage significance assessment was considered necessary for the current project, as it is not in close proximity to and hence will not have a physical impact on the listed items.

Impact Assessment

Potential Impacts

The proposal involves the construction of up to 12 goaf gas drainage vertical wells, two MSGD well sites and up to six medium radius drilling (MRD) wells. Generally these sites will require the following construction and on site activities:

- Development of a 100 m x 100 m drilling compound which will allow for the temporary installation of drilling equipment, gas drainage pipes and, water tanks, pumps and flaring units for the MSGD wells.
- Temporary Installation of site facilities including toilet/washroom facilities at each site.
- Movement on site of various vehicles including construction of temporary site access.
- 50 m x 50 m drilling pads would be required for vertical bores, while a larger (eg. 100 m x100 m) medium radius drilling (MRD) compound will be required for the six proposed MRD wells (Figure 2).

Sites and Areas of Archaeological Potential

The proposed gas drainage works will cause no direct harm to the Aboriginal or European objects and areas of archaeological sensitivity that have been recorded within the project area. The potential significance of the archaeological heritage values of the project area have previously been reduced due to the continued use of the area for farming purposes.

Impact Assessment – non-Aboriginal Heritage

With regard to the Vent Shaft development, which is larger and closer to the heritage items than the goaf gas proposal currently being assessed Niche Environment and Heritage (2010b: 21) concluded " the proposed works will have some minor heritage impact to the Morton Park: Mountbatten Group. This impact is confined to an affect to the contributory value that the existing rural environment makes to the aesthetic significance of the site. If the intrusive elements associated with the development are removed upon decommissioning of the Vent Shaft No.6, this will remedy the impact".

The impact assessment for the proposed goaf gas drainage works is similar to the above, however the goaf gas drainage works are less intrusive and will have a relatively short life span prior to decommissioning. Overall the impact from the proposed goaf gas drainage works is concluded to be very minor, and temporary.

Previous land-use and the local context suggest relics are not present within the development area.

Conclusion

The proposed Appin Mine surface gas drainage works for longwalls 704 to 705 and proposed MSGD 1 and MSGD 2 well sites are assessed to have no or minor and temporary impact to the Aboriginal and non-Aboriginal cultural heritage values of the project area. Given the long period of time that the project area has been used for agricultural purposes, and the commitment to decommission and rehabilitate the project are, these minor impacts are considered to be acceptable if the proposed mitigation measures recommended below are implemented.

While it is unlikely that the proposed works will disturb historical relics, provision must be made in a management plan to note that s.146 of the Heritage Act 1977 (NSW) requires all relics to be reported to the Heritage Council. Therefore a management plan detailing the steps of assessment (to determine if unexpected material are 'relics' as determined by s.4 of the Heritage Act 1977 (NSW)) and notification should be developed, or included in the existing Aboriginal Cultural Heritage Management Plan for the Appin Mine Surface Gas Drainage Project, which may be easily modified to include historical relics.

With the exception of the recommendations made in this report, the existing Aboriginal Cultural Heritage Management Plan for the Appin Mine Surface Gas Drainage Project contains all necessary safe guards and response procedures that would be applicable to proposed project.

Recommendations

The archaeological assessment concluded that the Appin Mine Surface Gas Drainage Project and proposed MSGD 1 and MSGD 2 well sites will not cause harm to Aboriginal objects because of extensive disturbance associated with previous farming and grazing on the site. The proposed works are not in close proximity to the heritage items listed in Schedule 5 of the Wollondilly LEP 2011, and will not impact these items. The works are not located in an area that is likely to contain historical relics. There were no further archaeological constraints for the project area. However to ensure that no harm was to occur to Aboriginal objects:

1. The existing Aboriginal Cultural Heritage Management Plan for the Appin Mine Surface Gas Drainage Project should be amended and reissued to include the recommendations above, and provision for assessing and notifying the discovery of historical relics.
2. The location of the Aboriginal sites Mountbatten-1 and Mountbatten OCS-1must be marked on all relevant site plans and work instructions.
3. The sites Mountbatten-1 and Mountbatten OCS-1 must be separated by a physical barrier from the proposed construction activities. The avoidance areas should consist of an appropriate secure barrier that blocks all potential access to the location of the artefacts, and should be of a size to ensure no harm comes to the immediate context that surrounds the artefacts. Construction vehicles should be confined to designated access tracks. existing Aboriginal Cultural Heritage Management Plan for the Appin Mine Surface Gas Drainage Project should be amended and reissued to include the outcomes of this assessment, and provision for assessing and notifying the discovery of historical relics.

References

Attenbrow, V. 2010. *Sydney's Aboriginal Past: Investigating the archaeological and historical records.* University of New South Wales Press, Sydney.

Bannerman, S. M. and P. A. Hazelton 1990. *Soil Landscapes of the Penrith 1:100 000 Sheet*. Soil Conservation Service of NSW, Sydney.

Barrallier, F. 1975. *Journal of the Expedition into the Interior of New South Wales 1802*. Marsh Walsh Publishing, Melbourne.

Biosis Research 2004 *An Archaeological Reconnaissance Survey of Appin Area 7: Neapean River, New South Wales*. An unpublished report for BHP Billiton Illawarra Coal.

Biosis Research 2006 *Douglas Area 7 longwalls 701 to 704: Impacts on Indigenous and Historical Archaeological Sites*. An unpublished report for BHP Billiton Illawarra Coal

Biosis Research 2006b. *Douglas Area 7 Project Environmental Impact Statement Appendix H: Impacts on Indigenous and Historical Archaeology - Revised Report*. An Unpublished report prepared for BHP Billiton Illawarra Coal.

Biosis Research 2009a *Appin Area 7 Longwalls 703 to 704 Goaf Gas Drainage Project: Aboriginal Cultural Heritage Management Plan and monitoring Methodology*. An unpublished report for BHP Billiton Illawarra Coal.

Biosis Research 2009b *Archaeological and Cultural Heritage Impact Assessment of the Proposed Appin Area 7 Goaf Gas Drainage Project*. An unpublished report for BHP Billiton Illawarra Coal.

Department Environment, Climate Change and Water NSW, 2010a *Aboriginal Cultural Heritage Consultation Requirements for Proponents 2010: Part 6 of the National Parks and Wildlife Act 1974.* Department of Environment, Climate Change and Water NSW.

Department Environment, Climate Change and Water NSW, 2010b *Due Diligence Code of Practice for the Protection of Aboriginal Objects in New South Wales*. Department of Environment, Climate, Change and Water NSW.

DECCW 2010c. Sydney basin sub-regions. Available at: http://www.environment.nsw.gov.au/bioregions/SydneyBasin-Subregions.htm. Accessed 6 May 20101.

Hazelton and Tille, 1990 *Soil Landscapes of the Wollongong-Port Hacking 1:100,000 Sheet soil conservation service NSW*, Sydney.

Niche Environment and Heritage 2010 *Heritage Impact Statement: Appin Colliery Ventillation Shaft No. 6 Douglas Park NSW*. An unpublished report for BHP Billiton Illawarra Coal

Niche Environment and Heritage 2011 *Aboriginal Objects Due Diligence Assessment West Cliff Goaf Gas Drainage Project Longwall 35*. An unpublished report for BHP Billiton Illawarra Coal.

Niche Environment and Heritage 2011 *Aboriginal Objects Due Diligence Assessment West Cliff Goaf Gas Drainage Project Longwalls 36 and 37*. An unpublished report for BHP Billiton Illawarra Coal.

NSW Minerals Council, 2010. NSW *Minerals Industry Due Diligence Code of Practice for the Protection of Aboriginal Objects,* Sydney, 13 September 2010.

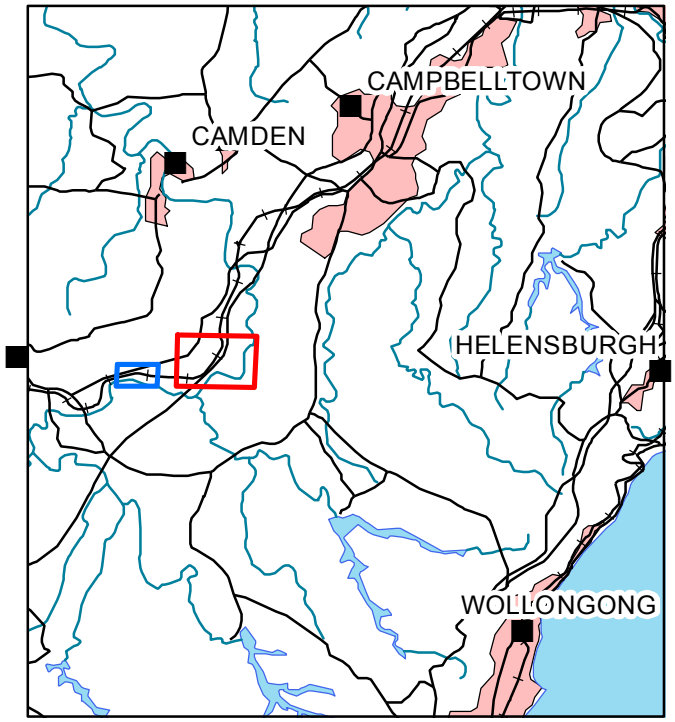
Organ, M. 1990. *Illawarra and South Coast Aborigines 1770-1850*. Aboriginal Education Unit, University of Wollongong, Wollongong.

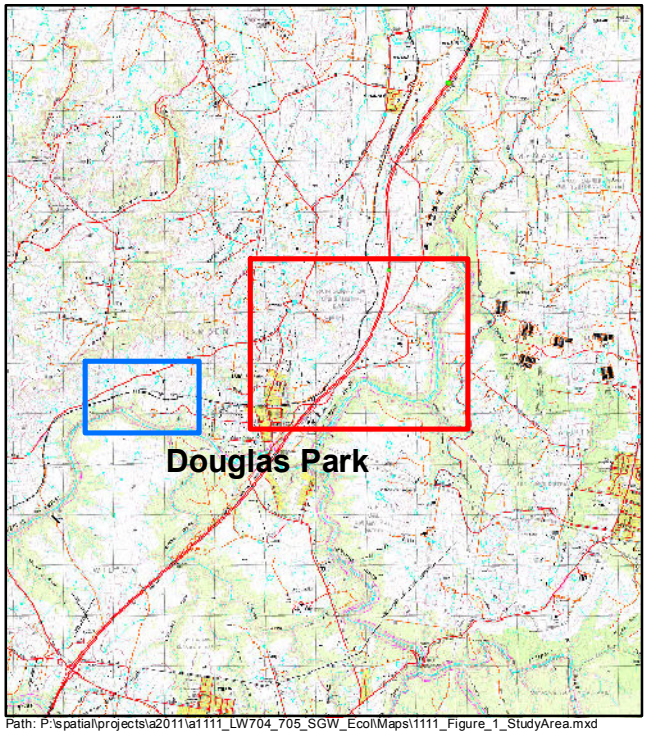
Pearson, M. 2009. *Bulli Seam Operations Non-Aboriginal Heritage Assessment (Statement of Heritage Impact). An* unpublished report prepared for Illawarra Coal Holdings Pty Ltd.

SA Museum 2010. Tribal Boundaries in Aboriginal Australia, Norman S Tindale. Available at http://www.samuseum.sa.gov.au/page/default.asp?site=2&page=TIN_Tribal. Accessed 28 August 2010.

White, B and J. McDonald 2010. Lithic Artefact Distribution in the Rouse Hill Development Area, Cumberland Plain, New South Wales. *Australian Archaeology,* Number 70, pp:29-38.

Figures





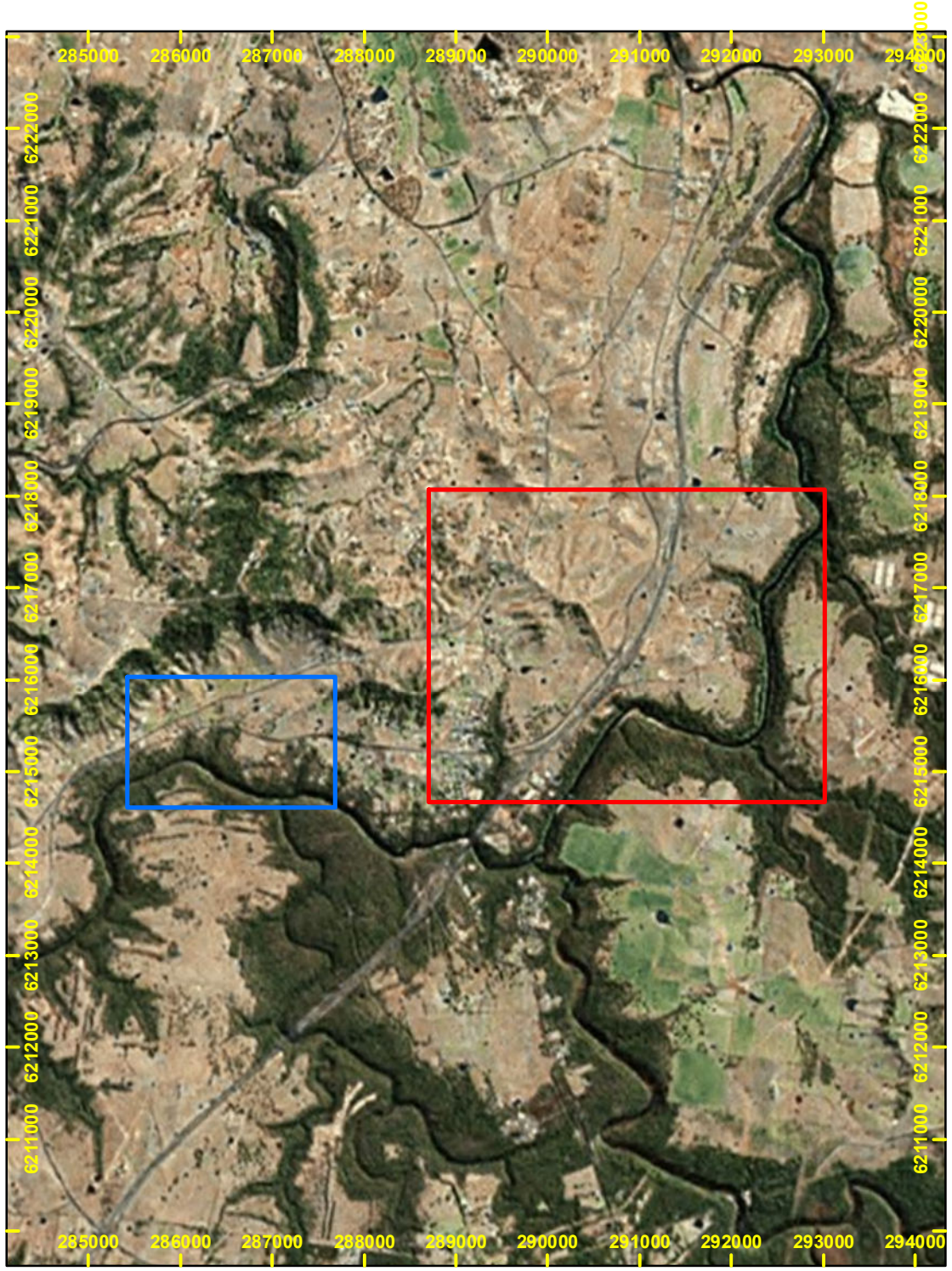


Figure 1: Location Map

1111 LW 704 - 705 Surface Gas Wells

Drawn by: RJ

Project Mgr: MR

Date: 09/09/2011

Study Area

MSGD Wells

Vertical Wells

N

W E

S

Metres

0 250500 1,000 1,500 2,000 2,500

niche
Environment and Heritage

Horizontal Datum
MGA Zone 56

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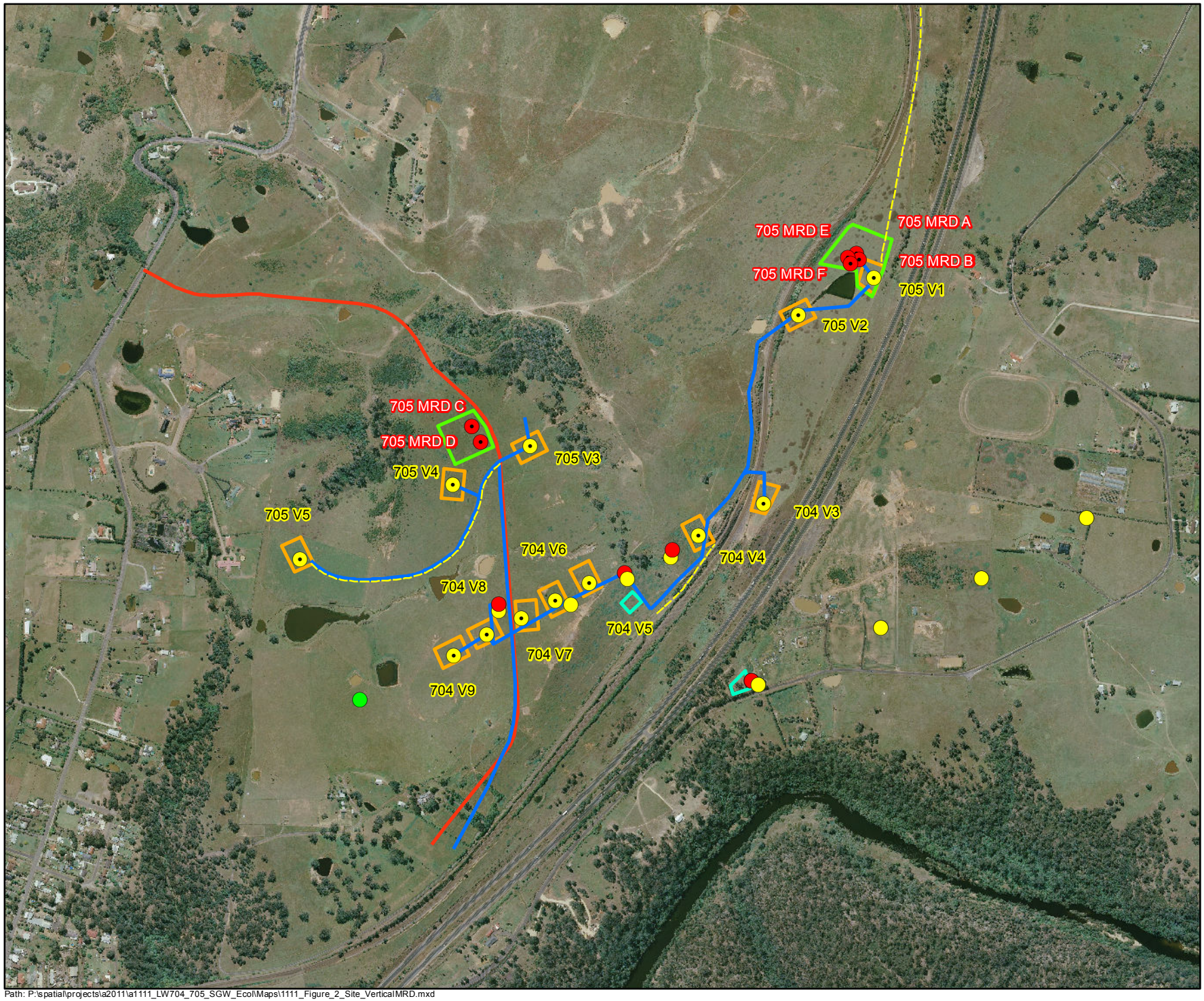

Figure 2: Vertical and MRD Well Sites

1111 LW 704 - 705 Surface Gas Wells

Drawn by: RJ

Project Mgr: MR

Date: 07/11/2011

Approved Boreholes
- MRD Borehole (Approved)
- Vertical Borehole (Approved)
- Downhole (Approved)

Proposed MRD Borehole

Proposed Vertical Borehole

- AccessTrack
- Drainage Pipelines
- Approved Access Road
- MRD Well Sites
- Extraction Plant Locations
- Vertical Well Sites

N
W E
S

Metres
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niche
Environment and Heritage

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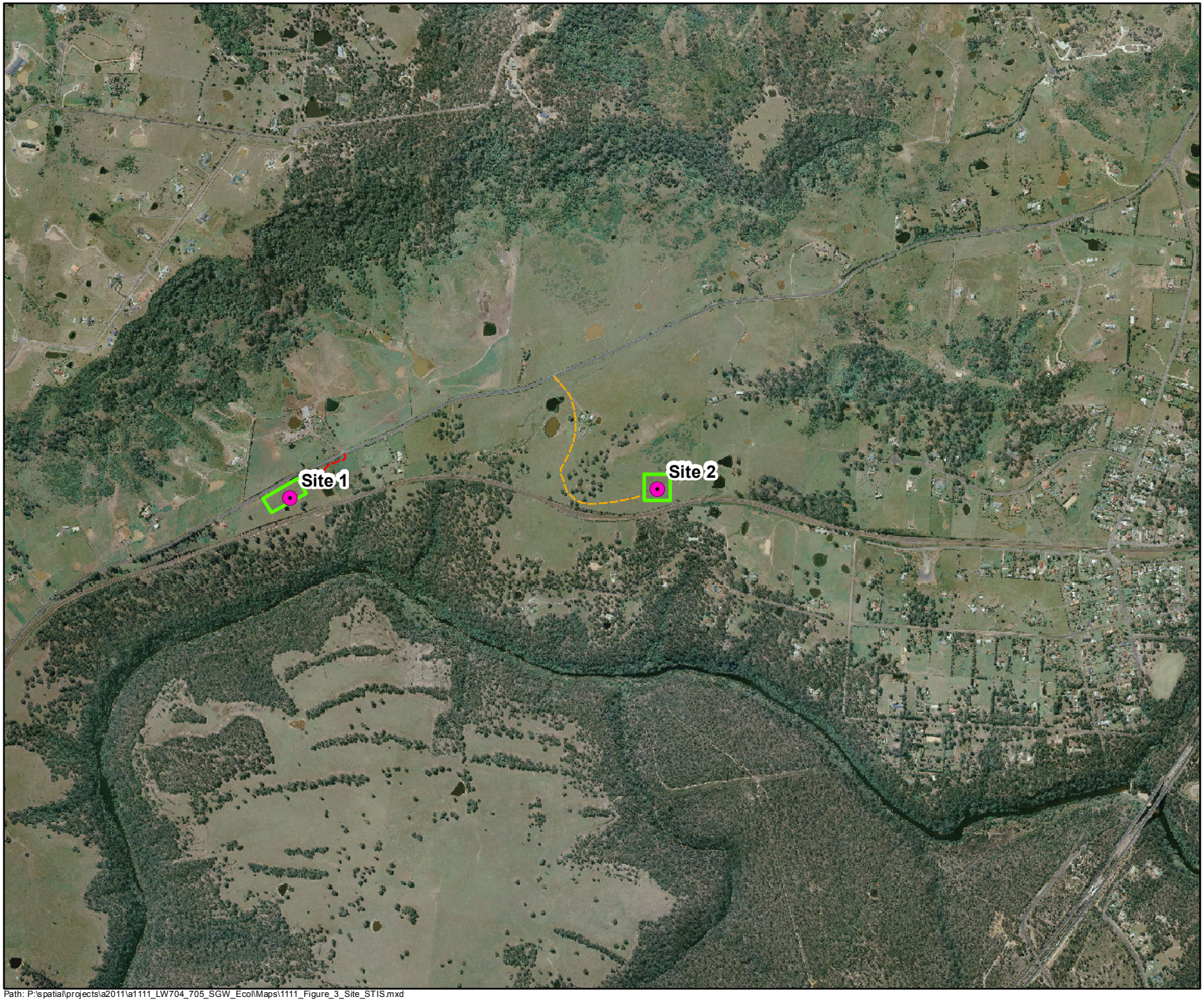

Figure 3: Mine Safety Gas Drainage Site Plan

1111 LW 704 - 705 MSGD Gas Wells

Drawn by: RJ

Project Mgr: MR

Date: 07/11/2011

- Proposed Well Locations
- Indicative Access Road
- Indicative Contingency Access
- Proposed Drilling Pad

N

W E

S

Metres

0 125 250 500 750

niche Environment and Heritage

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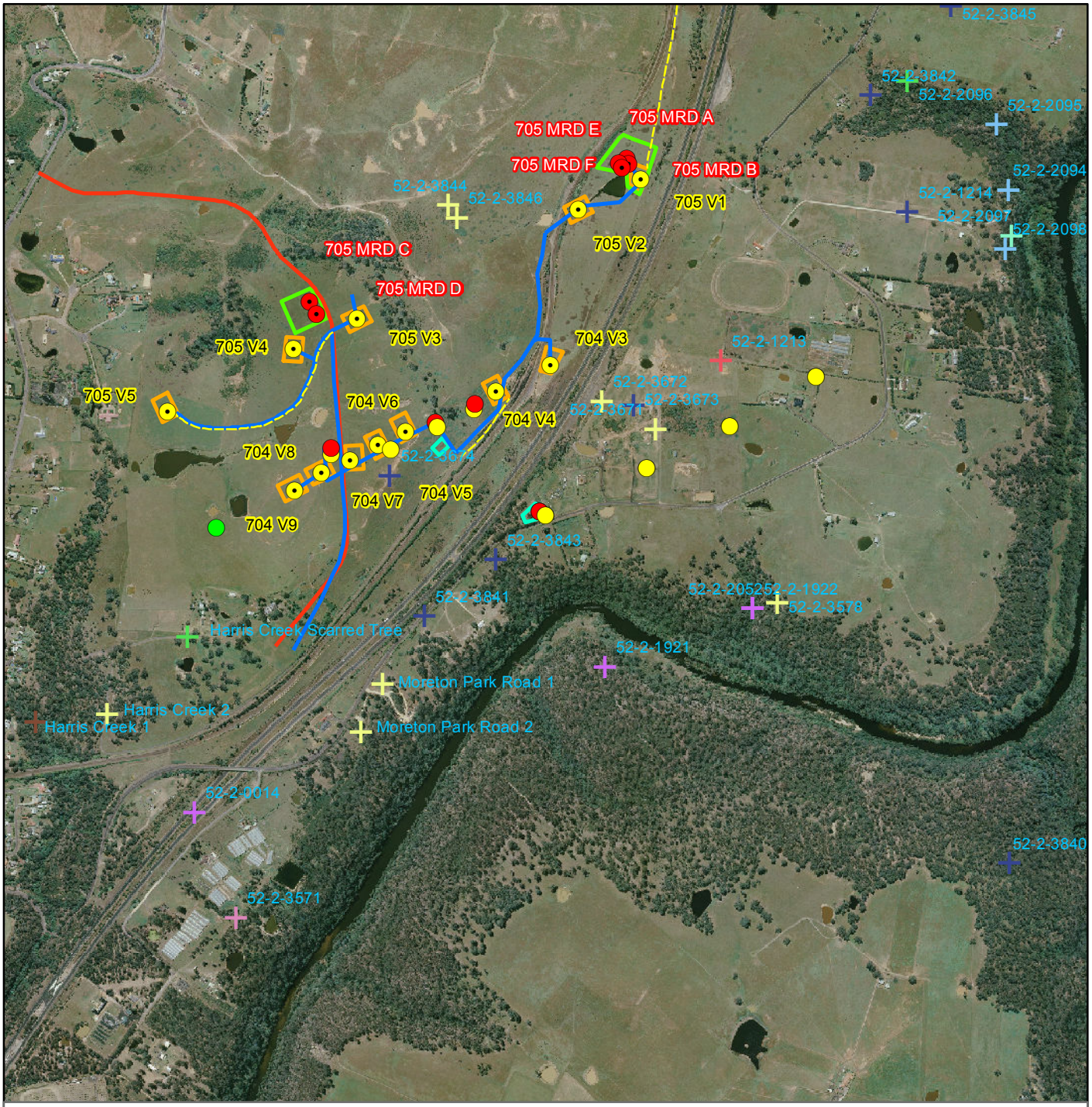

Approved Boreholes
- MRD Borehole (Approved)
- Vertical Borehole (Approved)
- Downhole (Approved)

Proposed MRD Borehole

Proposed Vertical Borehole

- AccessTrack
- Drainage Pipelines
- Approved Access Road
- MRD Well Sites
- Extraction Plant Locations
- Vertical Well Sites

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

Figure 4: Cultural Heritage features previously recorded in the Study Area
1110 LW 704 - 705 Surface Gas Wells

Drawn by: RJ

Project Mgr: MR

Date: 07/11/2011

NB: no Cultural Heritage features were located in the vicinity of the **MSGD** holes

N W E S

Meters
0 50100 200 300 400

niche Environment and Heritage

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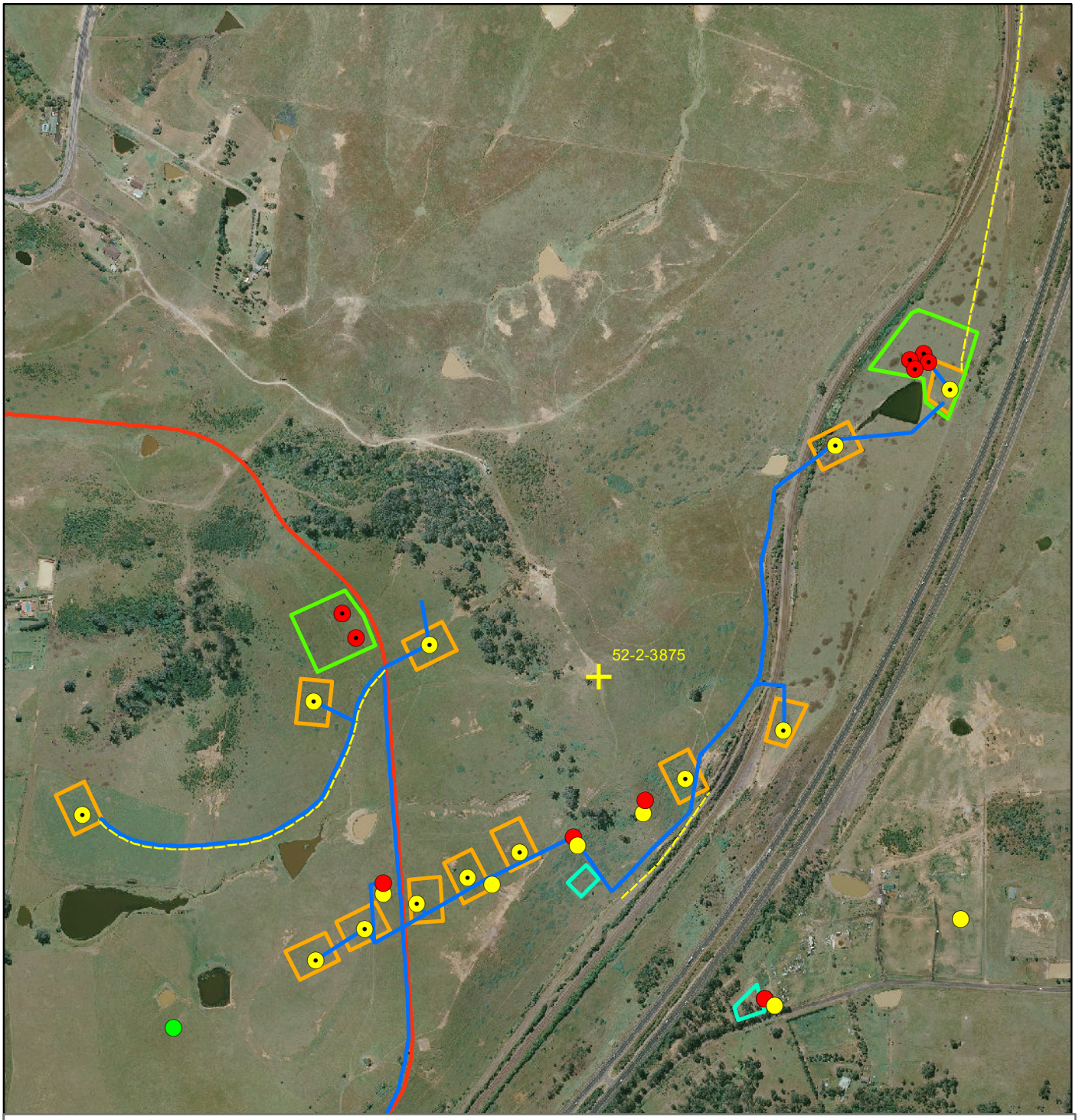

Figure 5: Cultural Heritage features identified in the Study Area during assessment

1110 LW 704 - 705 Surface Gas Wells

Drawn by: RJ

Project Mgr: MR

Date: 07/11/2011

N
W E
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Meters

0 50 100 200

niche Environment and Heritage

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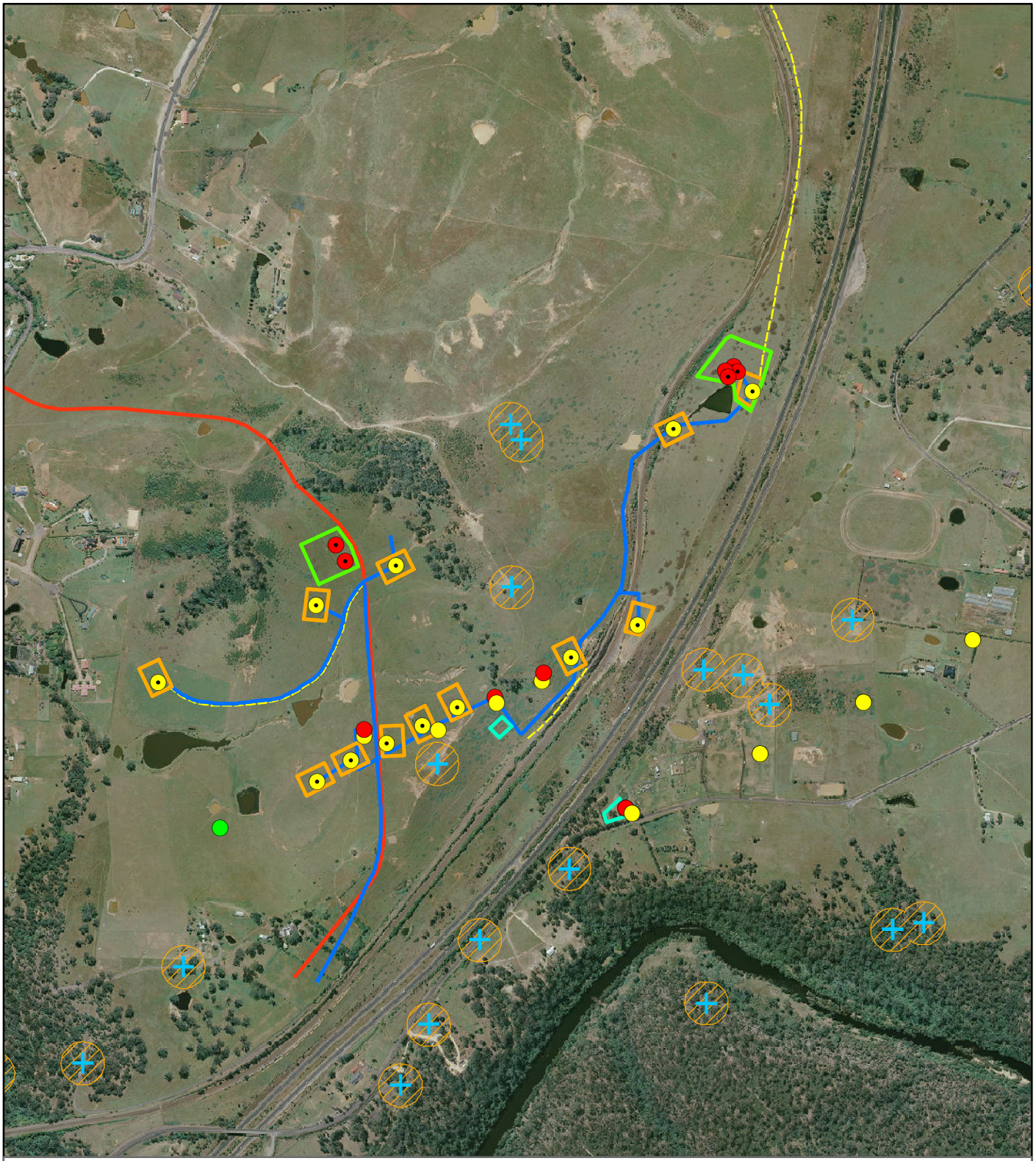

Figure 6: Cultural Heritage Sensitivity Analysis of the Study Area
1110 LW 704 - 705 Surface Gas Wells

Drawn by: RJ

Project Mgr: MR

Date: 07/11/2011

N
W E
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Meters
0 50 100 200 300

niche
Environment and Heritage

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Appendices

Correspondence with the Tharawal Local Aboriginal Land Council and Cubbitch Barta Native Title Claimants

From: reception
To: Renee Regal
Subject: FW: Tharawal Local Aboriginal Land Council request 31.08.2011
Date: Wednesday, 31 August 2011 9:29:30 AM

From: Dulcine Blair
Sent: Wednesday, 31 August 2011 9:16 AM
To: reception
Subject: RE: Tharawal Local Aboriginal Land Council request 31.08.2011

Hi Renee,

Just had a discussion with Alfred and unfortunately he will be away on the 7th September and he will be unavailable for 4 to six weeks. Donna will also be unavailable as she is on a job until the 16th.

Sorry for any inconvenience.

Regards

Dulcine Blair
Tharawal Local Aboriginal Land Council
Ph: 02 4681 0059
Fax: 02 4683 1375

From: reception
Sent: Wednesday, 24 August 2011 12:20 PM
To: Dulcine Blair
Subject: FW: Tharawal Local Aboriginal Land Council request 31.08.2011

From: Renee Regal [mailto:rregal@niche-eh.com]
Sent: Wednesday, 24 August 2011 9:46 AM
To: reception
Cc: Matthew Richardson
Subject: Tharawal Local Aboriginal Land Council request 31.08.2011

Good morning Dulcine,

Please find attached a request for a representative of TLALC to attend a day of field assessment for BHPBIC on the 31st of August 2011. Apologies for the late request.

Kind regards,

Renée

Renée Regal BA (Hons)
Archaeologist

PO Box 12 Macarthur Square NSW 2560
rregal@niche-eh.com www.niche-eh.com
Mob: 0488 224 758 **Fax:** 02 4017 0071

Appendix C

Noise Assessment

ACOUSTICS AND AIR

APPIN MINE SURFACE GAS DRAINAGE

NOISE ASSESSMENT

REPORT NO. 11203
VERSION D

WILKINSON MURRAY

APPIN MINE SURFACE GAS DRAINAGE

NOISE ASSESSMENT

REPORT NO. 11203
VERSION D

NOVEMBER 2011

PREPARED FOR

BHP BILLITON ILLAWARRA COAL
PO BOX 514 UNANDERRA
NEW SOUTH WALES 2526 AUSTRALIA

Wilkinson Murray Pty Limited · ABN 39 139 833 060
Level 2, 123 Willoughby Road, Crows Nest NSW 2065, Australia • Offices in Orange, Qld & Hong Kong
t +61 2 9437 4611 • f +61 2 9437 4393 • e acoustics@wilkinsonmurray.com.au • w www.wilkinsonmurray.com.au

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.

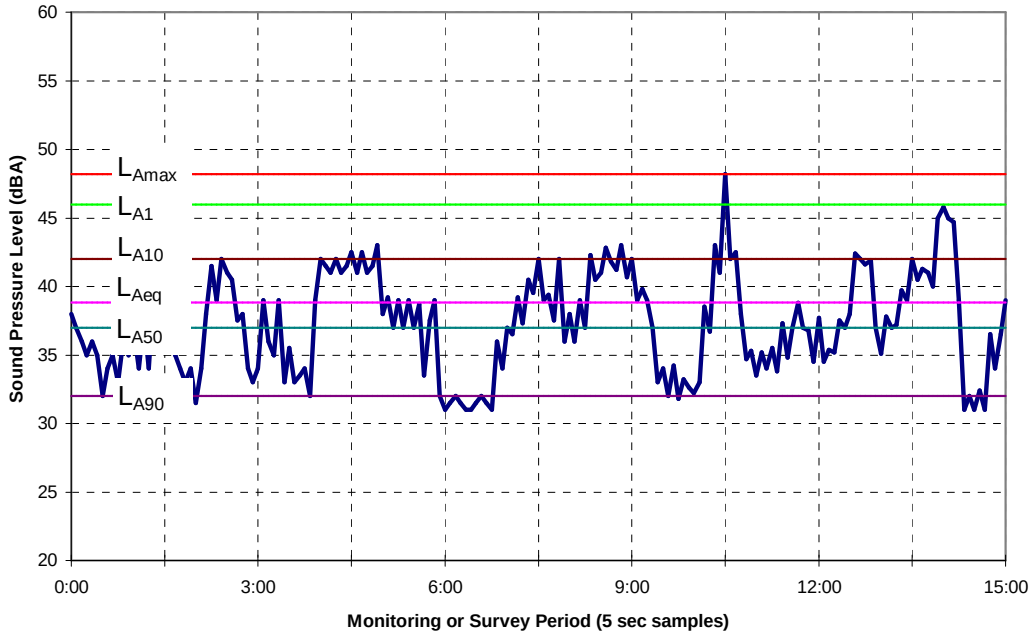
L_{A90} – The L_{A90} level is the noise level which is exceeded for 90% of the sample period. During the sample period, the noise level is below the L_{A90} level for 10% of the time. This measure is commonly referred to as the background noise level.

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.

dB, dBA, dBC – Linear, A-weighted and C-weighted decibels respectively. The decibel (dB) is a logarithmic unit that indicates the ratio of a physical quantity relative to a specified or implied reference level. Unless stated otherwise all sound pressure levels are re 2×10^{-5} Pa.

Typical Graph of Sound Pressure Level vs Time



1 INTRODUCTION

BHP Billiton Illawarra Coal (BHPBIC) operates the Appin coal mine. Part of the operation of this mine involves the removal of gas before and during mining. High concentrations of methane gas are present in the coal seam and adjacent strata. If this gas is not removed it presents a safety hazard to workers in the adjoining mine workings. To remove this gas, wells are drilled from the surface and the gas is extracted.

BHPBIC are preparing an application for the extraction of goaf gas from Longwalls 704 and 705. Numerous wells and extraction plants are already approved (see Project Approval 08_0256).

Illawarra Coal has also identified Appin Area 9 as a future mining area. It is expected that mining of Area 9 may commence in 2015. Area 9 has relatively high coal seam methane concentrations. In order to facilitate safe operations in the mine, it is preferable to undertake gas drainage of the coal seam prior to mining activities. The effectiveness of in seam gas drainage is a function of the pre-mining lead time where the gas can be removed from the coal seam. As such, the Area 9 Mine Safety Gas Drainage (MSGD) will commence as soon as possible following approval.

This report presents an assessment of noise impacts associated with goaf gas drainage and mine safety gas drainage in the above areas which do not have current project approval.

2 SITE DESCRIPTION

2.1 Goaf Gas Drainage Sites

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

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

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

2.1.1 Proposal Description

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

- Up to 12 vertical gas wells; and
- Up to six Medium-Radius Drilling (MRD) directional wells exceeding 1km in length.

These numbers include contingency wells which may be drilled and operated depending on the gas extraction requirements observed during mining and well construction/completion methods.

Each of the vertical wells will take approximately 30 days drilling time. In addition to this the site will need to be established and decommissioned.

Due to the length of MRD wells, drilling of these wells requires 24 hour operation to minimise seizing of drills within the well and to maintain well integrity. Each MRD well is likely to take approximately 90 days drilling time to complete. In addition to this the site will need to be established and decommissioned.

Vertical wells will be drilled using a comparatively smaller rig than that used for the MRD wells.

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 1-2 weeks would be expected for each well.

2.1.2 Hours

The bulk of construction will be limited to the Office of Environment and Heritage (OEH) recommended standard construction hours, namely:

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

(* extended construction hours are requested for the civil works associated with access road and drill pad construction as well as the construction of surface gas management infrastructure within the drilling compounds provided that the work is generally inaudible at nearby residents)

Drilling of MRD wells will require 24 hour drilling, seven days.

Establishing access tracks and drill pads may require work on Monday to Saturday from 7am to 6pm in order to make efficient use of construction teams and limit project duration. This includes the periods of 7am to 8am and 1pm to 6pm Saturday, which are outside the standard construction hours. Construction of surface gas management infrastructure within the drilling compounds, provided that the work is generally inaudible, at nearby residents may also be required to establish the site infrastructure in an efficient manner.

Table 2-1 Surrounding Residential Receivers – Goaf Drainage Sites

Receiver #	Noise Catchment Area (NCA)	Distance to Nearest MRD Site (m)	Distance to Nearest Vertical Well Drilling Site (m)
1	4	750	500
2		680	470
3		580	320
4		900	510
5		750	410
6		580	210
7		920	470
8		660	160
9		860	360
10		870	370
11		1050	550
12		930	410
13		940	430
14		1150	650
15		1050	530
16		1050	570
17		1200	720
18		1200	730
19		1250	780
20		1150	670
21		1100	620
22		1050	590
23		1250	750
24		1250	770
25	5	870	420
26		840	350
27	4	710	790
28		620	670
29	5	1050	550
30		820	300
31		840	440
32	6	850	720
33	5	1000	600
34	6	770	720
35	5	440	390
36		280	250
37	6	700	660
38		650	630
39		830	490
40		950	910
41		1020	970
42		1120	1070

Figure 2-1 Aerial Image of the Goaf Drainage Site

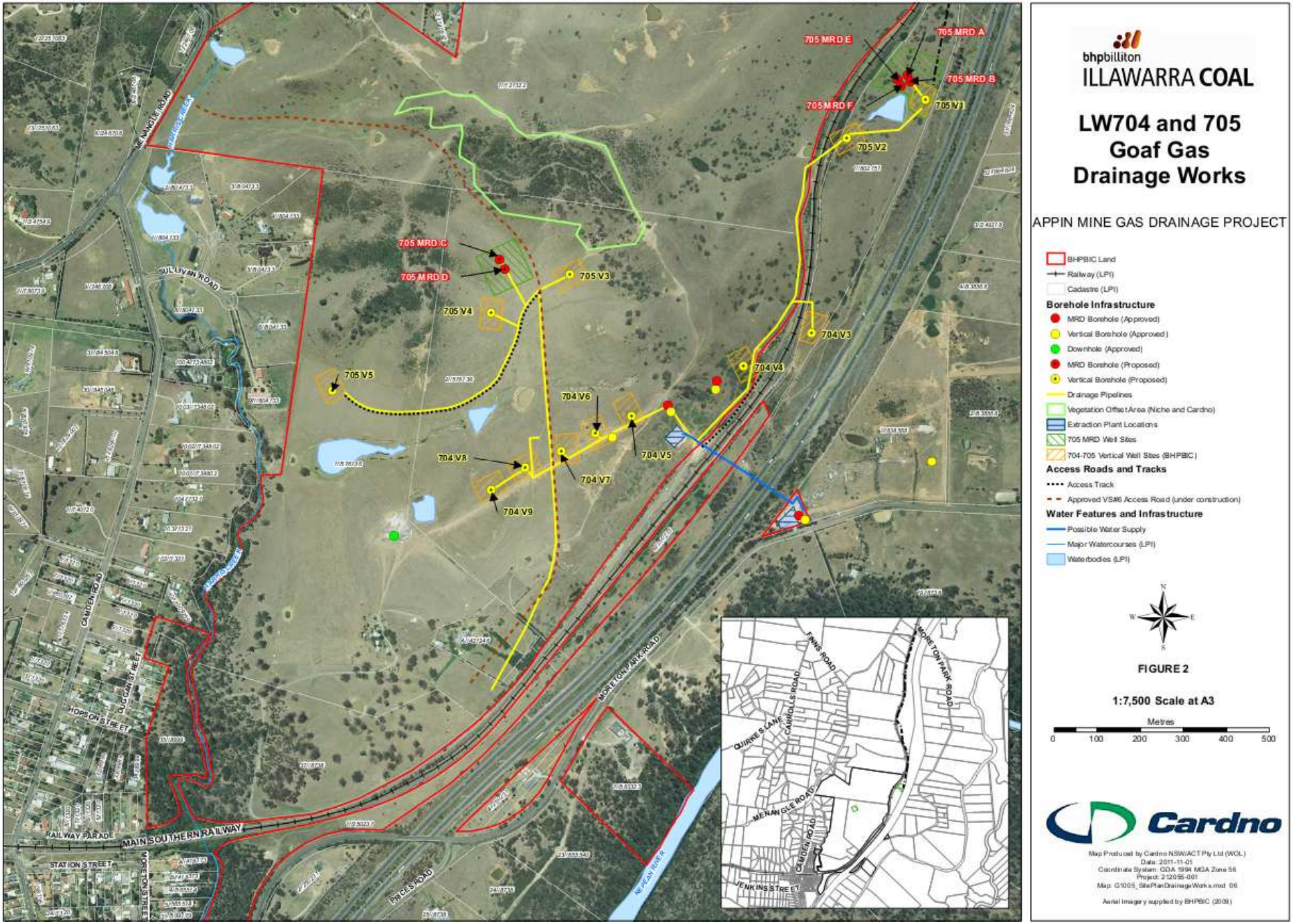
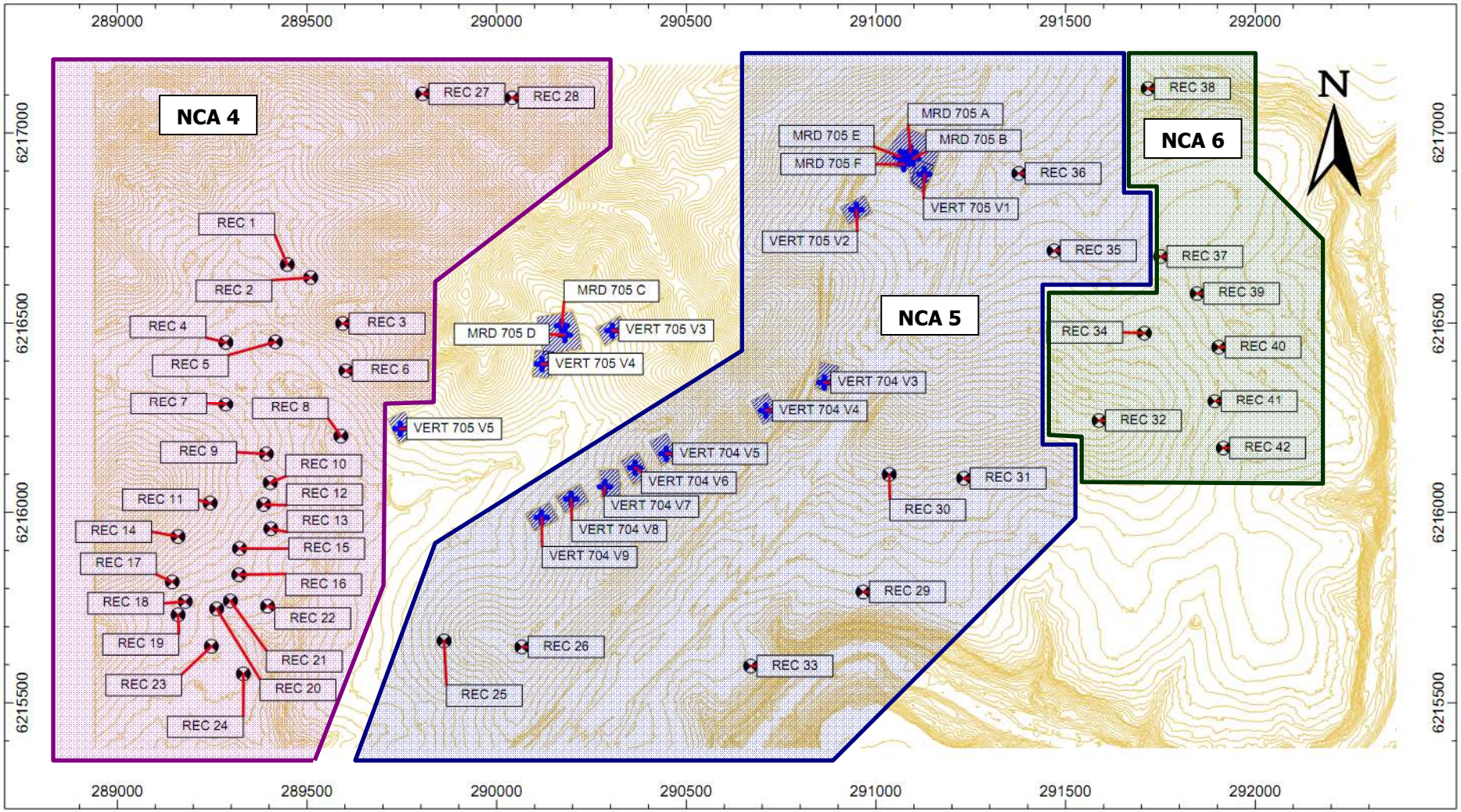


Figure 2-2 Goaf Drainage Site Plan Showing Wells, Receivers and Ground Height Contours



2.2 Mine Safety Gas Drainage Sites

An aerial photograph showing the indicative location of the MSGD wells is shown in Figure 2-3. The nearest sensitive receivers are also shown in Figure 2-4 and Figure 2-5.

The construction program involves site establishment and drill rig assembly at the MSGD Site 1 and 2, drilling of steered horizontal and vertical wells, and construction of operational infrastructure and ancillaries. Vertical wells would be constructed in daylight hours with the small rig described for the goaf drainage component of this project. The vertical wells are estimated to take 5 weeks durations each and operate during daytime hours. A week of rig mobilisation/demobilisation would be required at the start and completion of each TRD drilling phase.

The operational noise sources will be limited to a silenced gas fuelled generator, pumps and flaring units. The scope of this assessment is limited to construction noise and so operational noise has not been quantitatively assessed, however Wilkinson Murray has observed similar units at West Cliff Area 5 and considers them unlikely to exceed criteria at surrounding receivers. If necessary this can be reviewed at a later stage.

For engineering reasons the construction of the steered horizontal wells at MSGD Site 1 requires 24 hour operation to minimise seizing of drills within the well and to maintain well integrity. Each steered horizontal well is anticipated to require 90 days to drill. In addition to this the site will need to be established and decommissioned.

The bulk of construction will be limited to the Office of Environment and Heritage (OEH) recommended standard construction hours, namely:

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

(* extended construction hours (8am – 6pm) are requested on Saturdays for the civil works associated with access road and drill pad construction as well as the construction of surface gas management infrastructure within the drilling compounds provided that the work is inaudible at nearby residents)

Establishing drill pads may require work on Monday to Saturday from 7am to 6pm in order to make efficient use of construction teams and limit project duration. This includes the periods of 7am to 8am and 1pm to 6pm Saturday, which are outside the standard construction hours. Construction of surface gas management infrastructure within the drilling compounds, provided that the work is generally inaudible at nearby residents, may also be required to establish the site infrastructure in an efficient manner.

This work is expected to last approximately one month for site establishment and two months for construction of site infrastructure. Decommissioning and demobilisation will last approximately one month. A further one month will be required to plug the wells at the completion of the project and to complete final site rehabilitation.

Table 2-2 Surrounding Residential Receivers - MSDG

MSGD Site 1		MSGD Site 2	
Receiver #	**Distance Drill Site (m)**	**Receiver #**	**Distance Drill Site (m)**
44	280	1	370
45	260	2	530
46	300	3	370
48	460	4	230
69	940	5	450
70	940	6	550
75	1030	7	570
76	570	8	510
77	850	48	1010
		49	420

Figure 2-3 Aerial Photograph

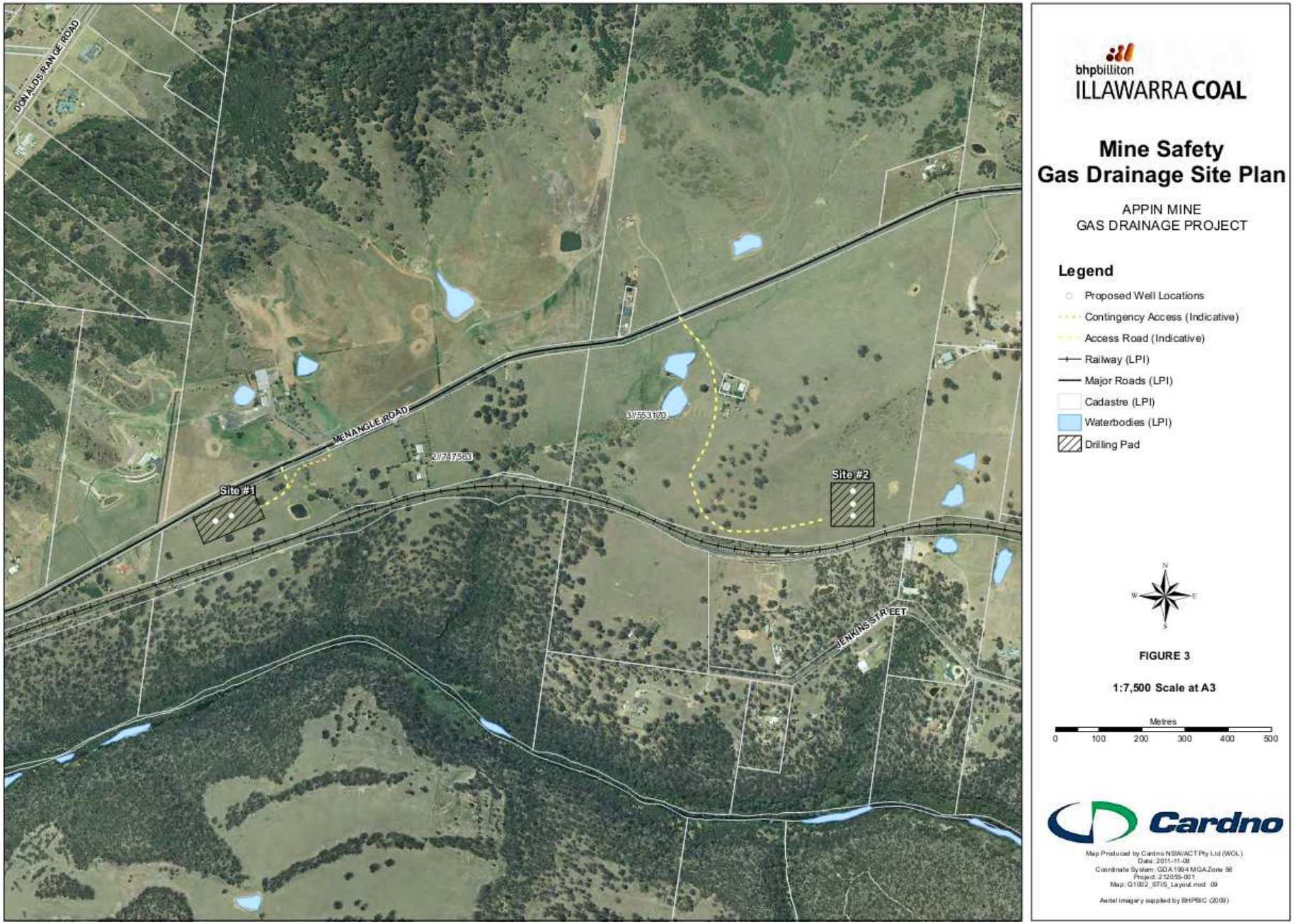


Figure 2-4 MSGD Site 1 and Receivers

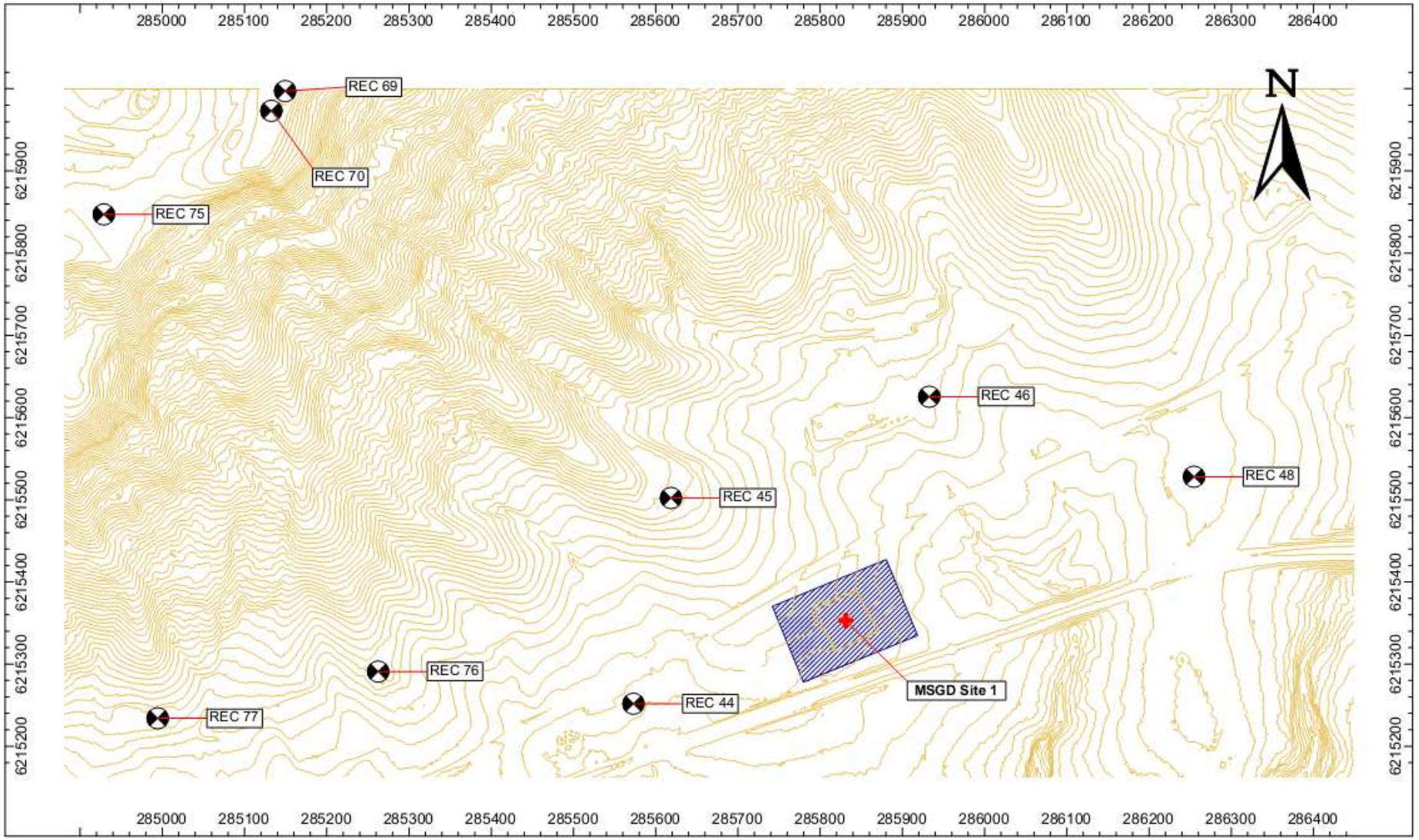
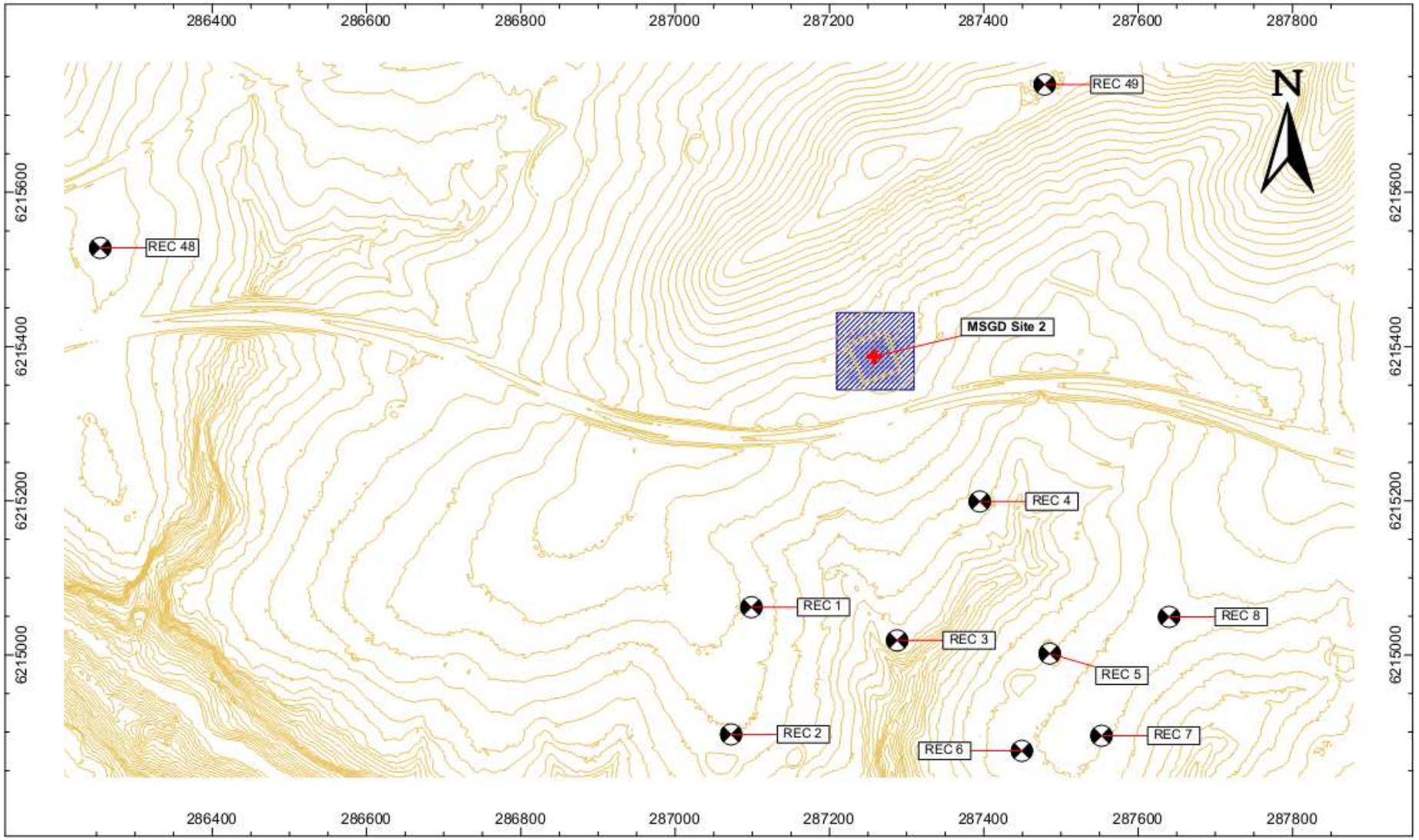


Figure 2-5 MSGD Site 2 Site and Receivers



3 CONSTRUCTION NOISE CRITERIA

The NSW OEH *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 3-1.

Table 3-1 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.
Outside recommended standard hours	Noise affected RBL + 5 dB	• A strong justification would typically be required for works outside the recommended standard hours. • The proponent should apply all feasible and reasonable work practices to meet the noise affected level. • Where all feasible and reasonable practices have been applied and noise is more than 5 dB(A) above the noise affected level, the proponent should negotiate with the community.

Drilling the MRD and steered horizontal wells for MSGD requires 24 hour operation and thus will occur outside standard construction hours. As this is an engineering requirement, justification for these works is considered to be present and so the management levels in Table 3-1 are applicable, i.e. RBL + 5 dB. Extended operational hours on Saturday (during the day) are also requested for civil works associated with access and drill pad construction as well as the construction of site infrastructure.

All other work will occur during standard construction hours and so a management level of RBL + 10 dB is applicable.

To facilitate derivation of criteria the receivers have been divided into Noise Catchment Areas (NCA). The three NCAs were selected on the basis of receivers' exposure to the Hume Highway, which was identified as the dominant background noise source in the area. NCA 4 (West) captures the eastern extents of Douglas Park and contains the most concentrated receivers. The noise environment of NCA 4 is characterised by some local traffic and domestic sources, though the Hume Highway generally dominates the background noise levels. NCA 5 is adjacent to the Hume Highway and as such the noise environment is generally dominated by the highway. NCA 6 (East) is more distant from the highway than NCA 5, though the background noise environment is generally dominated by the highway. Noise catchments corresponding to each of the MSGD sites have also been defined (NCAs 1 & 2).

Note that these NCAs have only been used for derivation of criteria and that noise level predictions have been undertaken to discrete receivers. Table 3-2 presents a summary of the background noise levels for each catchment.

Specific background noise monitoring has not been undertaken for this project. Instead data from previous nearby assessments has been used. The Hume Highway has been identified as the dominant background noise source in the area. Previous monitoring has been conducted in and around Douglas Park, which is adjacent to the highway. NCAs 3, 4 and 5 have similar exposures to the highway as the previous monitoring locations and so would have a similar background noise environment. Therefore no adjustment of levels has been made at these locations. In the case of NCA 2, which is further from the highway, the background noise level has been adjusted for the increased distance to this source.

Table 3-2 Rating Background Level (RBL) – dBA

NCA		Day	Evening	Night	Source
MSGD	Site 1	36	36	31	WM Report 10112 + adjustment for distance to main background noise source
	Site 2	40	40	34	WM Report 10112
Goaf	4 (West)	40	40	35	WM Report 10112
	5 (Adjacent to Hwy)	45	45	38	WM Report 08396
	6 (East)	40	40	36	WM Report 08396

Table 3-3 presents a summary of the construction noise goals for each NCA for standard hours and out of hours work. These are based on the RBL values in Table 3-2.

Table 3-3 Construction Noise Criteria – dBA

NCA		Standard Construction Hours $L_{Aeq(15mins)}$	Outside Standard Construction Hours $L_{Aeq(15mins)}$		
			Day	Evening	Night
MSGD	Site 1	46	41	41	36
	Site 2	50	45	45	39
Goaf	4	50	45	45	40
	5	55	50	50	43
	6	50	45	45	41

At night there is a requirement to consider sleep disturbance criteria outlined in the *ICNG* for short term noise events. The *ICNG* requires quantitative assessment of the potential for sleep disturbance if works will occur for more than two consecutive nights. The *ICNG* refers to the *Environmental Criteria for Road Traffic Noise* (*ECRTN*) for guidance on applicable sleep disturbance criteria. A commonly used screening criterion for assessment of sleep disturbance, which is specified in the OEH's Application Notes to the INP, is that the $L_{A1,1min}$ should not exceed the background noise level by more than 15 dBA. This applies to the level of construction noise external to any residence or other noise-sensitive receiver for the night period (10pm-7am).

Table 3-4 presents a summary of sleep disturbance screening noise levels for each NCA.

Table 3-4 Sleep Disturbance Construction Noise Goals – dBA

NCA		Night time Background Noise Level RBL	Acceptable $L_{A1,1min}$ Noise Level Night
MSGD	Site 1	31	46
	Site 2	34	49
Goaf	4	35	50
	5	38	53
	6	36	51

There is evidence in the appendices to the *ECRTN* to suggest that external noise levels less than 50-55 dBA are insufficient to cause awakening reactions. Therefore these criteria are considered conservative.

If operations must occur outside the standard construction hours then Wilkinson Murray recommends that consultation with affected landholder be undertaken.

Wherever written negotiated noise agreements with surrounding landholders are established, then the noise goals outlined in this section need not be achieved to permit works outside standard construction hours.

4 CONSTRUCTION NOISE ASSESSMENT

4.1 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 and associated auxiliary equipment at each location is unknown at this stage, the highest measured sound power level has been applied to all directions. Some noise level reductions could be achieved by orienting equipment such that the greatest noise emissions are directed away from receivers, though ultimately the rig itself is not significantly directional and any measured difference in emissions across various directions is generally due to shielding provided by auxiliary equipment. In the case where barriers are present, minimal benefits (beyond those provided by the barriers) would be expected from the drill rig orientation and as such the assumed noise source levels are appropriate. 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.

The rig that will be used to construct the MSGD steered horizontal wells is currently used in the Camden area. The worst-direction equivalent sound power level for this rig is 108 dBA L_{Aeq}, and thus this sound power level has been conservatively assumed for the MSGD drill rig. This assessment has assumed that the rig will be used for the most noise-sensitive site in this assessment, being MSGD Site 1. The vertical wells at MSGD Site 2 well be drilled using the same rig as detailed above.

4.2 MRD Well 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 *ICNG* does not explicitly require the consideration of meteorological effects on noise propagation, however, due to the extended duration of construction at night and the distances to receivers Wilkinson Murray consider that it is appropriate to do so in this instance. Wilkinson Murray has adopted a 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 an approach using a single set of meteorological

data as it accounts for the directional distribution of prevailing winds for each residence surrounding the site.

This 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 10th percentile calculated noise level as a measure of noise impacts on residences has been accepted by NSW regulatory authorities has been considered acceptable by the OEH for previous similar assessments.

4.2.1 The ENM Computer Noise Model

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

The ENM model has been endorsed by the OEH 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.

4.2.2 Meteorological Data

Meteorological data used in the assessment was generated by PAEHolmes for a nearby BHPBIC project site, 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.

4.2.3 Noise Calculations

The noise model utilised 2m ground contours provided by BHPBIC.

Predictions were made to discrete receiver points. In some cases these points could refer to a group of localised receivers.

Predicted 10th percentile exceedance noise levels for the MRD wells are presented in Appendix A. Due to their close proximities, MRD 705-A, -B, -E & -F, which represent wells that may be drilled at different times, were modelled by a single location labelled MRD 705-B (in the location of MRD 705-B). Similarly MRD 705-C & -D were modelled by a single location labelled MRD 705-D.

The 10th percentile exceedance noise levels resulting from MRD 705-B (Table A-1) are predicted to exceed the night time noise criteria at several receivers (32 and 34-39). In addition to this several exceedances of day and evening noise criteria are predicted. Therefore it is necessary to consider noise mitigation.

A 3.5m noise barrier was modelled at a setback of 10m from the noise source. The barrier is shown in Appendix D. In the past BHPBIC have constructed temporary noise barriers using a 3.5m precast barrier system, erected on top of earth mounds as required (up to approximately 1.5m high) as required to achieve the necessary height. With this mitigation the 10th percentile noise levels from MRD 705-B (Table A-2) are predicted to be within the relevant criteria. The highest predicted 10th percentile noise level with the barrier is 43 dBA at Receiver 36, which complies with the night time noise criteria of 43 dBA.

The 10th percentile exceedance noise levels resulting from MRD 705-D (Table A-3) are predicted to exceed the night time noise criteria at two receivers (25 & 26). Therefore it is necessary to consider noise mitigation.

A 3.5m noise barrier was modelled at a setback of 10m from the noise source. The barrier is shown in Appendix D. With this mitigation the 10th percentile noise levels from MRD 705-D (Table A-4) are predicted to be within the relevant criteria. The greatest predicted 10th percentile noise level with the barriers is 42 dBA at Receiver 26, which complies with the night time noise criteria of 43 dBA.

Note that the noise barriers modelled are contingent on the setback and positions relative to the noise source. Therefore these barriers may need to be relocated for each MRD well location (within the pad) or greater height and lengths will be required to sufficiently shield all MRD wells on a single pad.

Short-term noises that would produce $L_{A1,1min}$ noise levels are not expected to exceed the drill rig noise level (which dominates the $L_{Aeq,15min}$ noise level from the site) by more than 10 dB. As the $L_{A1,1min}$ screening criteria are 10 dB greater than $L_{Aeq,15min}$ criteria, we consider that managing L_{Aeq} noise emissions from the site to be within relevant criteria will also ensure that $L_{A1,1min}$ noise levels are within sleep disturbance screening criteria. Therefore, with the implementation of the noise mitigation discussed above, we consider that the works will not typically exceed sleep disturbance screening criteria and thus are acceptable in this regard.

Therefore, with the proposed mitigation the noise emissions from the MRD drilling are predicted to be acceptable. If the newly developed drill rig is utilised for the MRD drilling, noise levels would be expected to reduce and this represents an additional community benefit, though we note that the mitigation measures detailed are expected to achieve satisfactory noise emissions regardless.

4.3 Vertical Well Noise Level Calculation

Noise levels for this operation were calculated using the same procedures described above for MRD drilling; however as the drilling will only occur during daytime periods, meteorological effects were not considered.

Vertical wells will be drilled at the sites identified in Figure 2-1 and Figure 2-2 MSGD Site 2 (Figure 2-3 and Figure 2-5).

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

Noise levels from this drilling are predicted to satisfy the relevant criteria at all but three receivers. The predicted exceedance at each of these three receivers is 1 dB under neutral meteorological conditions, which is imperceptible and is thus considered negligible. Therefore noise levels from vertical well drilling during standard construction hours are predicted to be acceptable and no specific mitigation (e.g. noise barriers) is considered necessary.

Illawarra Coal have employed temporary concrete noise walls to mitigate against noise and visual amenity impacts. If these walls are utilised, then no exceedance at any receiver will occur.

Drilling of the vertical wells at MSGD Site 2 is predicted to exceed criteria at two receivers (1 and 4). A 4m high barrier, setback 10m from the dominant noise sources was modelled and predictions show that with the inclusion of this barrier no exceedances of criteria are predicted (Table B-2).

4.4 MSGD Steered Horizontal Well Noise Level Calculation

Noise levels for this operation were calculated using the same procedures described in Section 4.2.

The noise model utilised 2m ground contours provided by BHPBIC.

Predictions were made to discrete receiver points. In some cases these points could refer to a group of localised receivers.

Predicted 10^{th} percentile exceedance noise levels for the MSGD steered horizontal wells are presented in Appendix C.

The 10^{th} percentile exceedance noise levels resulting from drilling steered horizontal wells at MSGD Site 1 (Table C-1) are predicted to exceed the night time noise criteria at several receivers (44-46, 48, 70 and 76-77). 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 MSGD Site 1 are predicted to comply with criteria at all but one receiver (45). The highest predicted 10^{th} percentile night time noise level with the barrier is 37 dBA at Receivers 45, which represents a 1 dB exceedance and is considered negligible.

Short-term noises that would produce $L_{A1,1min}$ noise levels are not expected to exceed the drill rig noise level (which dominates the $L_{Aeq,15min}$ noise level from the site) by more than 10 dB. As the $L_{A1,1min}$ screening criteria are 10 dB greater than $L_{Aeq,15min}$ criteria, we consider that managing L_{Aeq} noise emissions from the site will also ensure that $L_{A1,1min}$ noise levels are within acceptable limits. Therefore, with the implementation of the noise mitigation discussed above, we consider that the works will not typically exceed sleep disturbance screening criteria and thus are acceptable in this regard.

During the operation of the MSGD wells, it is planned to replace the Pressure Cavity Pumps (PCP) and to undertake maintenance of the well to ensure optimal gas flow This operation will require a work over rig to extract the PCP and to replace it with a new pump, and to undertake removal of any solids built up in the well. It is expected that this work will take place during

day time operational hours for a duration of about two weeks. The work over rig is smaller and quieter than the proposed drilling rigs, and the same mitigation measures would be in place during pump change out. It is expected that noise from this operation would comply with day time construction noise limits. The maintenance operations will be determined on the operational performance of the wells, but it is likely that at least two maintenance operations will be required for each MSGD horizontal well.

4.5 Construction of Drill Pads

For construction of drill pads, 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 power levels.

- Excavator 109 dBA
- Truck 108 dBA
- Small Dozer 110 dBA

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.

These plant items are likely to comply with noise management levels at most drill sites (i.e. most vertical wells and MRDs). Some exceedances of the noise management levels are anticipated at sites with nearby receivers (i.e. Vert 704 V9, Vert 705 V5, MSGD Sites 1 and 2).

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

- The bulk of the work should be limited to the standard construction hours, namely:
    - 7.00am to 6.00pm Monday to Friday;
    - 8.00am to 1.00pm Saturday. Work may be permitted during the periods of 7.00am-8.00am and 1.00pm-6.00pm on Saturday for civil construction of the access roads and drill pads as well as construction of site infrastructure or other works that are generally inaudible at residential receivers (see below); and
    - mo work on Sundays or public holidays.

  (Note: Travel restrictions for some heavy or wide loads apply on Menangle Road. If heavy / wide loads are required to be transported to the sites then these may be delivered outside of the nominated construction hours. Delivery of such equipment would take place with appropriate traffic control and be generally inaudible at residential receivers. Few (if any) restricted loads are proposed.

- Potentially affected residences (i.e. within 300m of the works) should be contacted and notified of the works and their anticipated duration.

With regard to site establishment works outside standard construction hours (i.e. Saturday

daytime), we consider that consideration should given to the limited duration of site establishment, which would involve works outside standard construction hours on only 2-6 Saturdays, the relatively low sensitivity of the time period in question, and the mild to moderate range of noise levels expected. In this context we consider that it could be acceptable for access road, drill pad and site infrastructure construction to occur outside standard construction hours during the Saturday daytime periods. The potential for complaints from these activities would be greatly reduced if the general noise management measures detailed in the Section 5 are implemented.

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

4.6 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 power levels.

- Excavator 109 dBA
- Truck 108 dBA

These plant items will be audible at receivers surrounding the works, and will likely exceed noise management levels at times. 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 OEH's standard construction hours, namely
    - 7.00am to 6.00pm Monday to Friday
    - 8.00am to 1.00pm Saturday. Work may be permitted during the periods of 7.00am-8.00am and 1.00pm-6.00pm on Saturday for civil construction of the gas pipelines where noise emissions are generally inaudible at residential receivers; and
    - 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.

4.7 Construction Vehicles on Access Roads

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.
- 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.

5 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 during drilling. 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 so the noisiest side faces 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;
- using spotters, closed circuit television monitors, "smart" reversing alarms, or "quacker" type reversing alarms in place of traditional reversing alarms.
- selecting plant and equipment based on noise emission levels, including drill rigs;
- using alternative construction methods to minimise noise levels; and
- providing alternative arrangements with affected residents such as temporary relocation;

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 5-1. Other measures

that also provide significant benefits are listed in Table 5-2. It is recommended that these be considered in preparation of a construction noise management plan prior to commencing works on site.

Table 5-1 Measures to Reduce Construction Noise Levels

Management Measure	Potential Noise Reduction, dBA
Administrative Controls	
Turning off machinery when not in use (assuming other similar equipment is operational)	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 5-2 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

6 CONCLUSION

Wilkinson Murray has conducted an assessment of construction noise associated with the extraction of goaf gas and MSGD drilling sites for surface gas drainage at BHPBIC's Appin Mine.

Assessment has been conducted in general accordance with the OEH's *Interim Construction Noise Guideline*.

Drilling of MRD wells is predicted to exceed relevant criteria, especially during the night time period. 3.5m 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 well sites are predicted to be acceptable at all receivers during standard construction hours. The greatest predicted noise levels from vertical wells associated with the goaf gas drainage, under neutral meteorological conditions, exceed relevant criteria by only 1 dB, which is considered negligible.

Drilling of vertical wells at MSGD Site 2 is predicted to exceed criteria at two receivers. A 4m high, temporary noise barrier has been investigated at this site and with its inclusion no exceedances are predicted.

Noise levels from drilling the MSGD Site 1 wells are predicted to exceed the relevant criteria without mitigation. Temporary noise barriers have been modelled on sides of the rig that are exposed to nearby receivers and this is predicted to reduce noise levels significantly. With the barriers, residual exceedances of up to 1 dBA are predicted, which is negligible and thus noise impacts are considered acceptable.

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 5 be considered and, wherever possible, implemented.

Note

All materials specified by Wilkinson Murray (Sydney) Pty Limited have been selected solely on the basis of acoustic performance. Any other properties of these materials, such as fire rating, chemical properties etc. should be checked with the suppliers or other specialised bodies for fitness for a given purpose. The information contained in this document produced by Wilkinson Murray is solely for the use of the client identified on front page of this report. Our client becomes the owner of this document upon full payment of our **Tax Invoice** for its provision. This document must not be used for any purposes other than those of the document's owner. Wilkinson Murray undertakes no duty to or accepts any responsibility to any third party who may rely upon this document.

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	Draft	12 September 2011	Adam Bioletti	Neil Gross
B	Draft	15 September 2011	Adam Bioletti	
C	Final	19 September 2011	Adam Bioletti	
D	Final	10 November 2011	Adam Bioletti	

APPENDIX A

MRD WELL NOISE PREDICTIONS

Table A-1 Summary of MRD 705-B 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
30	26	26	24	27	26	26	27	26	26	27	26	24	50	50	43
31	30	29	27	29	29	28	29	29	29	31	29	26			
32	**47**	**47**	**45**	**47**	**47**	**47**	**47**	**47**	**47**	**48**	**48**	**45**	45	45	41
34	**46**	45	**42**	**47**	45	**45**	45	45	**45**	**49**	**48**	**43**			
35	46	46	**45**	47	46	**46**	46	46	**46**	48	48	**45**	50	50	43
36	47	47	**47**	47	47	**47**	47	47	**47**	48	49	**47**			
37	**47**	**47**	**46**	**47**	**47**	**47**	**47**	**47**	**47**	**51**	**51**	**46**	45	45	41
38	45	45	**46**	44	44	**45**	44	44	**44**	**47**	**48**	**47**			
39	**46**	**46**	**45**	**46**	**46**	**46**	**46**	**46**	**46**	**49**	**49**	**45**			
40	40	40	39	40	40	40	40	40	40	42	42	39			
41	39	39	37	39	39	39	39	39	39	40	40	37			
42	32	32	31	32	32	32	32	32	32	34	33	31			

Note: Shaded cells represent exceedances of relevant criteria.

Table A-2 Summary of MRD 705-B Predicted Receiver Levels with Mitigation Measures (3.5m Barrier)

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
30	26	26	24	27	26	26	27	26	26	27	26	24	50	50	43
31	30	29	27	29	29	28	29	29	29	31	29	26			
32	38	37	35	38	37	37	37	37	37	39	38	36	45	45	41
34	38	37	36	38	37	37	37	37	37	39	39	36			
35	40	40	39	40	40	40	40	40	40	41	41	39	50	50	43
36	43	43	43	43	43	43	42	42	43	43	43	43			
37	37	37	36	37	37	37	37	37	37	39	39	37	45	45	41
38	39	39	40	38	38	39	38	38	38	40	40	40			
39	37	37	36	37	36	37	36	36	37	39	39	36			
40	34	34	33	34	34	34	34	34	34	36	36	33			
41	34	34	32	34	34	34	34	34	34	35	35	32			
42	31	31	29	31	31	31	31	31	31	32	32	30			

Table A-3 Summary of MRD 705-D 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	24	25	24	25	25	23	25	24	24	23	24	23	45	45	40
2	25	25	25	25	25	24	26	25	25	24	25	24			
3	26	27	26	27	27	26	27	27	27	26	26	25			
5	24	25	24	25	25	24	25	25	24	23	24	23			
6	26	26	26	26	26	26	27	26	26	25	26	25			
8	26	27	26	27	27	26	28	27	27	26	26	25			
25	46	46	**45**	47	46	**46**	47	46	**46**	47	46	43	50	50	43
26	46	46	**45**	47	46	**46**	47	46	**46**	47	46	**44**			
27	32	32	33	31	32	32	32	31	32	30	32	32	45	45	40
28	25	26	27	25	26	26	25	25	25	25	26	26			
29	25	25	23	26	25	25	25	25	25	27	27	24	50	50	43
30	23	23	22	23	23	23	23	23	23	25	25	22			
33	27	26	24	27	26	26	26	26	26	29	27	24	45	45	41

Note: Shaded cells represent exceedances of relevant criteria.

Table A-4 Summary of MRD 705-D Predicted Receiver Levels with Mitigation Measures (3.5m Barrier)

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	24	25	24	25	25	23	25	24	24	23	24	23	45	45	40
2	25	25	25	25	25	24	26	25	25	24	25	24			
3	26	27	26	27	27	26	27	27	27	26	26	25			
5	24	25	24	25	25	24	25	25	24	23	24	23			
6	26	26	26	26	26	26	27	26	26	25	26	25			
8	26	27	26	27	27	26	28	27	27	26	26	25			
25	41	40	39	41	40	40	42	40	40	41	40	38	50	50	43
26	42	41	40	42	41	41	42	41	41	42	41	39			
27	32	32	33	31	32	32	32	31	32	30	32	32	45	45	40
28	25	26	27	25	26	26	25	25	25	25	26	26			
29	25	25	23	26	25	25	25	25	25	27	27	24	50	50	43
30	24	25	24	25	25	23	25	24	24	23	24	23			
33	25	25	25	25	25	24	26	25	25	24	25	24	45	45	41

APPENDIX B

VERTICAL WELL NOISE PREDICTIONS

Table B-1 Summary of Vertical Well Predicted Receiver Levels without Mitigation

No.	Criteria (dBA)	Noise Level (dBA)											
		VERT 704 V3	VERT 704 V4	VERT 704 V5	VERT 704 V6	VERT 704 V7	VERT 704 V8	VERT 704 V9	VERT 705 V1	VERT 705 V2	VERT 705 V3	VERT 705 V4	VERT 705 V5
1		11	15	22	23	23	23	24	10	12	18	19	33
2		13	16	23	24	24	24	25	11	12	19	20	31
3		14	18	25	25	26	26	28	11	13	21	23	45
4		12	16	28	30	32	36	36	10	11	18	20	46
5		13	17	24	25	29	33	35	10	11	19	21	47
6		13	17	25	26	28	31	35	11	13	21	23	**51**
7		13	18	33	35	38	39	40	11	13	21	21	46
8		14	19	35	34	37	39	40	11	13	22	24	**51**
9		14	19	34	36	40	37	42	12	14	23	23	49
10		15	20	34	36	40	38	42	12	14	24	24	48
11	50	14	19	33	37	38	38	40	12	15	24	24	45
12		15	19	34	36	40	38	42	12	12	25	25	47
13		15	20	34	36	39	37	39	11	12	27	26	47
14		14	19	33	36	37	38	39	11	12	25	24	43
15		15	19	33	35	38	39	41	11	11	28	25	45
16		15	19	33	35	37	37	38	10	11	29	25	44
17		15	15	16	27	15	15	7	-	26	3	4	8
18		23	19	19	14	18	32	36	36	38	38	10	10
19		41	19	17	15	19	18	**51**	14	14	13	42	36
20		17	16	16	15	40	16	39	36	28	19	20	16
21		31	16	16	32	4	18	24	13	21	10	12	24

No.	Criteria (dBA)	Noise Level (dBA)											
		VERT 704 V3	VERT 704 V4	VERT 704 V5	VERT 704 V6	VERT 704 V7	VERT 704 V8	VERT 704 V9	VERT 705 V1	VERT 705 V2	VERT 705 V3	VERT 705 V4	VERT 705 V5
22	50	14	18	32	34	36	37	38	10	10	28	24	40
23		17	22	21	27	19	18	16	29	27	31	36	38
24		23	21	26	23	22	22	27	36	36	35	33	19
25	55	23	5	15	14	8	15	6	12	24	26	23	14
26		36	36	37	38	10	10	29	24	41	21	21	17
27	50	31	18	16	16	31	26	31	38	27	22	19	19
28		25	25	20	29	34	29	25	21	19	26	26	12
29	55	19	32	34	36	36	37	10	10	30	25	42	12
30		20	32	35	37	36	37	10	10	30	26	43	12
31		20	33	35	37	37	38	10	11	32	28	44	11
32	50	19	32	34	36	35	37	10	10	30	27	41	11
33	55	20	32	34	36	35	35	10	10	32	29	41	13
34	50	26	35	37	37	39	40	12	12	36	38	44	16
35	55	31	41	41	41	47	48	14	14	40	41	43	27
36		18	28	28	27	25	23	26	22	24	26	24	27
37	50	17	19	18	18	18	17	24	23	20	20	18	20
38		39	33	26	23	21	21	18	22	20	21	18	24
39		43	34	26	25	24	22	22	23	18	21	19	26
40		39	31	24	23	22	20	23	25	16	18	17	43
41		33	29	20	21	20	18	37	35	14	14	16	24
42		37	36	26	24	23	23	22	18	21	20	19	41

Note: Shaded cells represent exceedances of relevant criteria.

Table B-2 Summary of MSGD Site 2 Vertical Well Predicted Receiver Levels

Receiver No.	Criteria (dBA)	Noise Level (dBA)	
		Without Mitigation	With 4m Barrier
1	45	**46**	36
2		42	33
3		44	35
4		**48**	39
5		44	34
6		43	32
7		44	31
8		43	32
48		26	26
49		42	42

Note: Shaded cells represent exceedances of relevant criteria.

APPENDIX C

MSGD STEERED HORIZONTAL WELL NOISE PREDICTIONS

Table C-1 Summary of MSGD Site 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
44	**45**	**46**	**45**	**46**	**46**	**45**	**46**	**45**	**46**	**45**	**45**	**44**	41	41	36
45	**53**	**53**	**53**	**53**	**53**	**53**	**53**	**53**	**53**	**52**	**53**	**53**			
46	**52**	**52**	**53**	**51**	**52**	**52**	**52**	**51**	**51**	**52**	**53**	**53**			
48	**48**	**48**	**48**	**47**	**47**	**48**	**47**	**47**	**47**	**48**	**49**	**49**			
70	32	32	33	32	32	31	33	32	32	31	32	32			
75	26	27	27	27	27	25	27	26	26	24	26	25			
76	40	41	**40**	41	41	**40**	42	41	**41**	40	40	**40**			
77	36	37	36	37	**37**	35	38	37	**37**	35	36	34			

Note: Shaded cells represent exceedances of relevant criteria.

Table C-2 Summary of MSGD Site 1 Predicted Receiver Levels with Mitigation Measures (5.0m Barrier)

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
44	34	35	34	34	34	34	35	34	34	34	34	33	41	41	36
45	36	37	**37**	37	37	36	37	37	**37**	36	37	36			
46	35	35	36	35	35	35	35	35	35	35	36	36			
48	30	30	31	30	30	30	29	29	30	31	31	31			
70	26	26	27	26	26	26	27	26	26	25	26	26			
75	23	23	23	23	23	22	23	23	23	22	23	22			
76	28	29	28	29	29	28	29	28	28	27	28	27			
77	24	25	24	25	25	24	26	25	25	24	24	23			

Note: Shaded cells represent exceedances of relevant criteria.

APPENDIX D

NOISE BARRIER PLANS

Figure D-1 MRD 705-B Barrier Plan

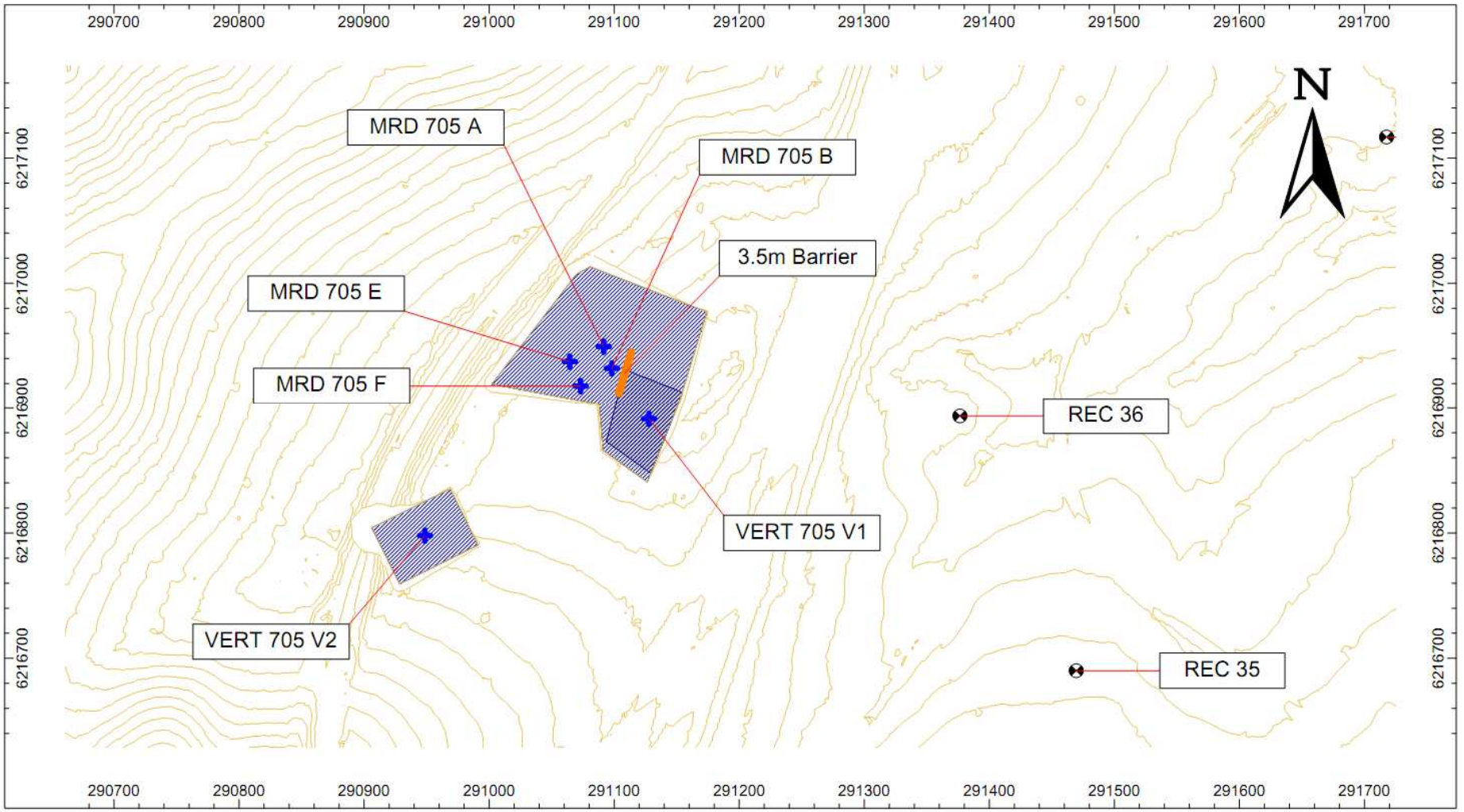


Figure D-2 MRD 705-D Barrier Plan

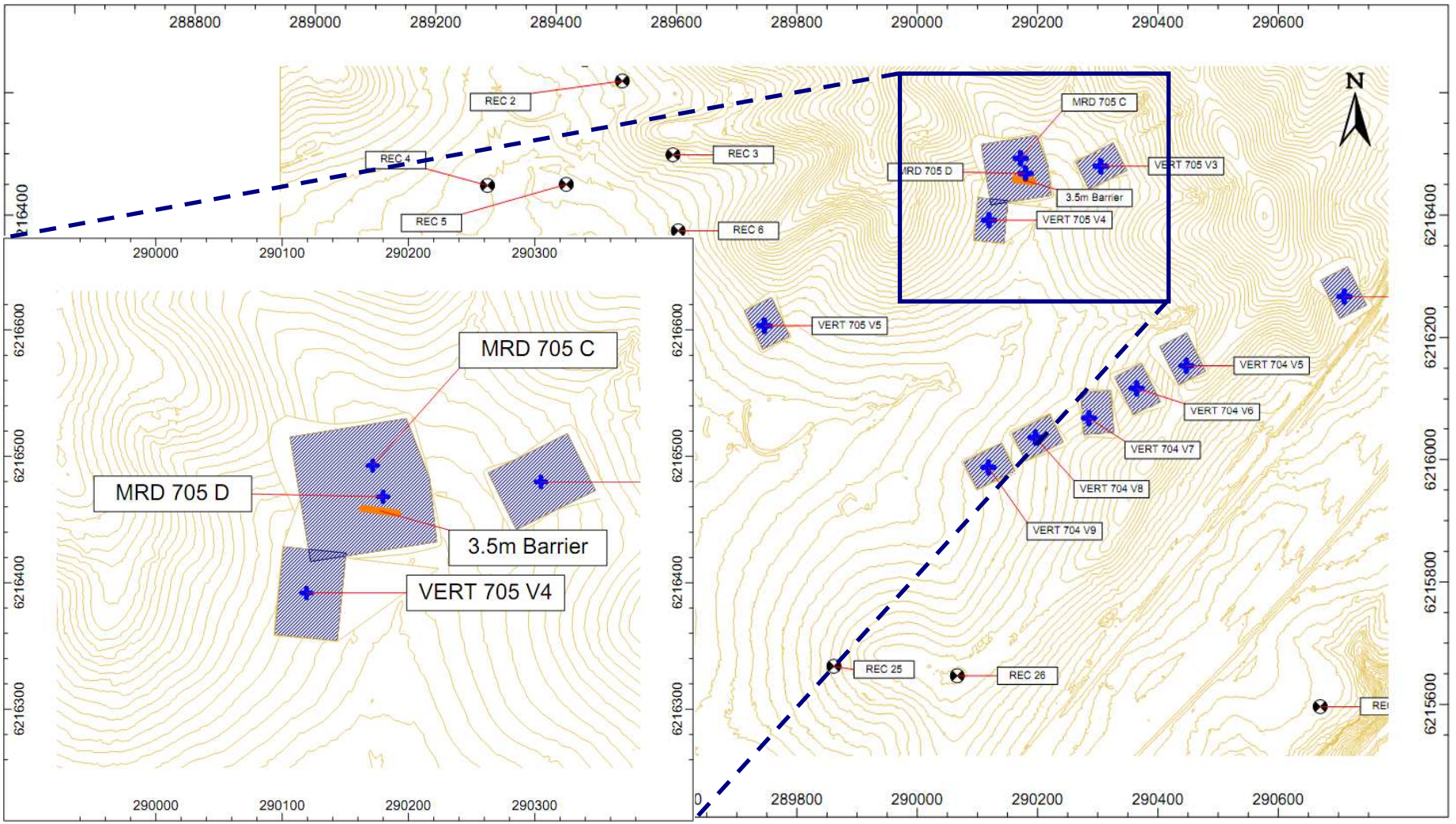


Figure D-3 MSDG Site 1 Barrier Plan

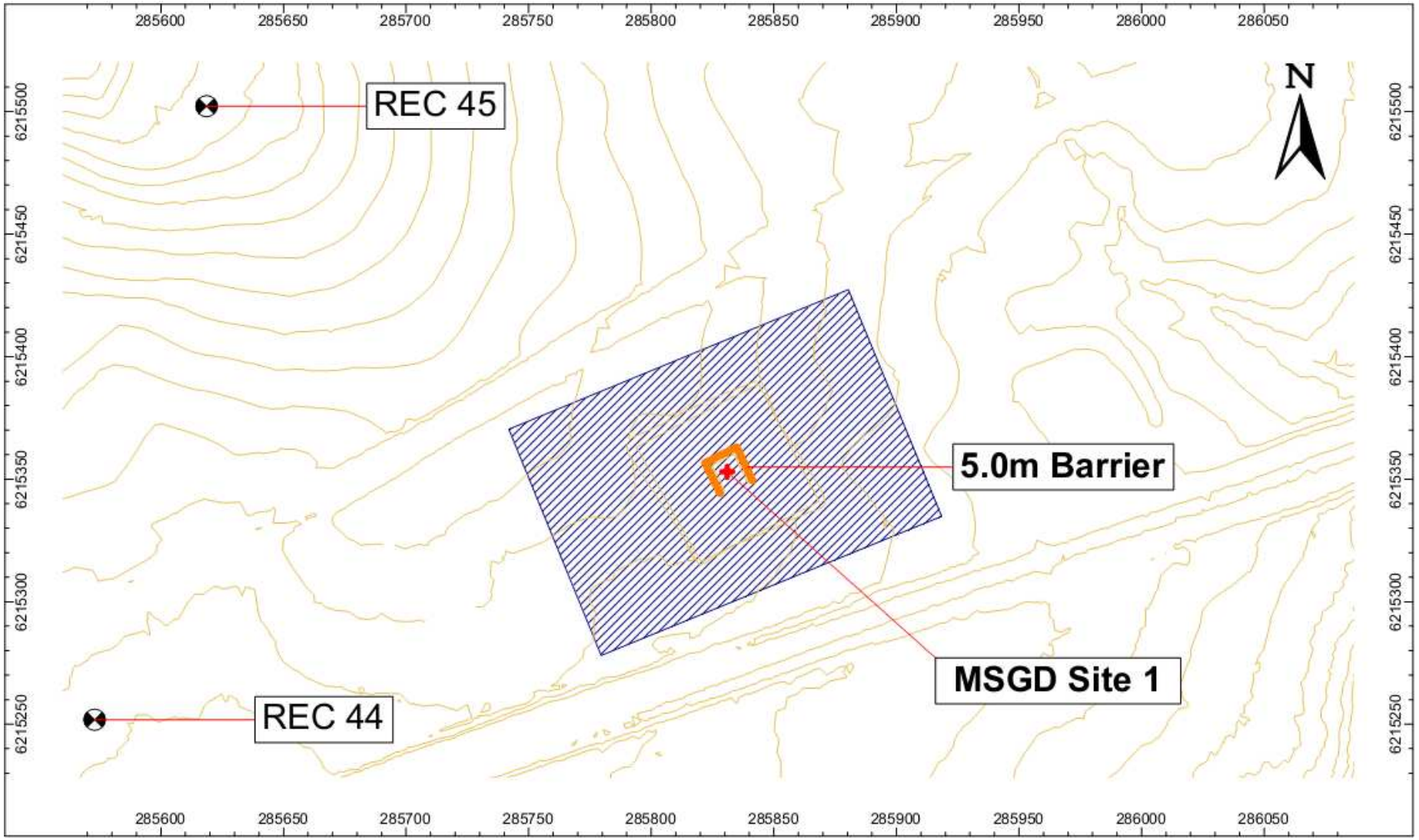
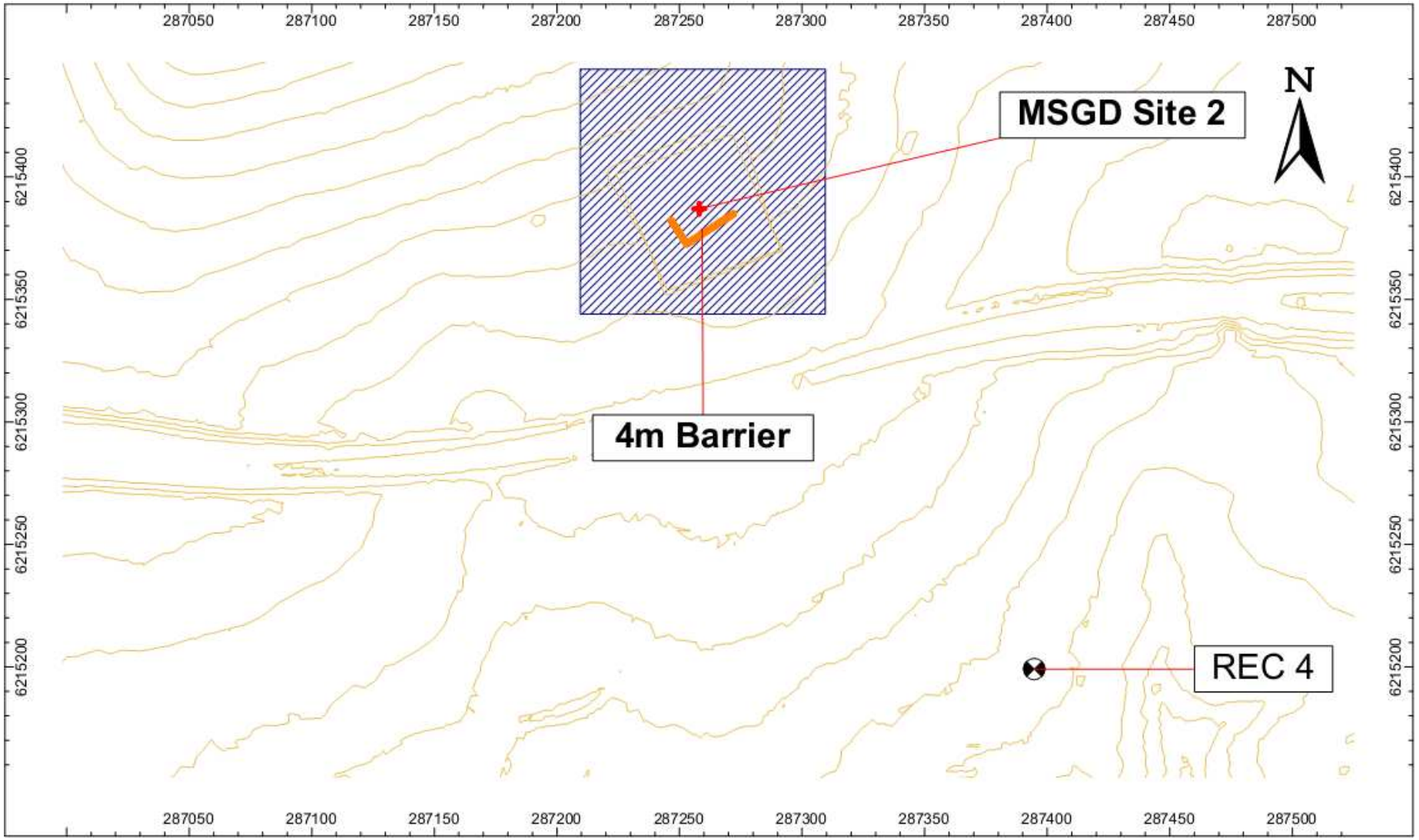


Figure D-4 MSGD Site 2 Barrier Plan



Appendix D

Air Quality Impact Assessment

REPORT - FINAL

AIR QUALITY IMPACT ASSESSMENT – BHP BILLITON ILLAWARRA COAL – APPIN GAS DRAINAGE

BHP Billiton Illawarra Coal

Job No: **6211**

14 November 2011

PROJECT TITLE:	**AIR QUALITY IMPACT ASSESSMENT – BHP BILLITON ILLAWARRA COAL – APPIN GAS DRAINAGE**
JOB NUMBER:	**6211**
PREPARED FOR:	Bruce Blunden **BHP BILLITON ILLAWARRA COAL**
PREPARED BY:	R. Kellaghan
APPROVED FOR RELEASE BY:	D. Roddis
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Queensland Environment Pty Ltd trading as
PAEHolmes ABN 86 127 101 642

SYDNEY:
Suite 203, Level 2, Building D, 240 Beecroft Road
Epping NSW 2121
Ph: +61 2 9870 0900
Fax: +61 2 9870 0999

PERTH:
Level 18, Central Park Building,
152-158 St Georges Terrace, Perth WA 6000
Ph: +61 8 9288 4522
Fax: +61 8 9288 4400

BRISBANE:
Level 1, La Melba, 59 Melbourne Street, South Brisbane QLD 4101
PO Box 3306, South Brisbane QLD 4101
Ph: +61 7 3004 6400
Fax: +61 7 3844 5858

MELBOURNE:
Suite 62, 63 Turner Street, Port Melbourne VIC 3207
PO Box 23293, Docklands VIC 8012
Ph: +61 3 9681 8551
Fax: +61 3 9681 3408

ADELAIDE:
72 North Terrace, Littlehampton SA 5250
PO Box 1230, Littlehampton SA 5250
Ph: +61 8 8391 4032
Fax: +61 7 3844 5858

GLADSTONE:
Suite 2, 36 Herbert Street, Gladstone QLD 4680
Ph: +61 7 4972 7313
Fax: +61 7 3844 5858

Email: info@paeholmes.com
Website: www.paeholmes.com

ES1 EXECUTIVE SUMMARY

BHP Billiton Illawarra Coal (BHPBIC) are proposing an s75W modification to the Appin Gas Drainage Project for future goaf drainage activities at Appin Area 7 (Longwall 704 and 705) and Mine Safety Gas Drainage (MSGD) at two locations.

Several options for goaf drainage at Longwall 704 and 705 are considered, however all have similar elements and include medium radius drilled (MRD) wells, vertical contingency wells, pipelines and access roads. Gas will be extracted from each well and reticulated back via an existing gas management system to the power plants at Appin West and Appin No 2 shaft for electricity generation.

Construction impacts associated with the goaf drainage activities at Longwall 704 and 705 have been assessed. Although fugitive dust emissions can be expected, construction of each pad and well would be staged and therefore impacts would be relatively short lived and easily controlled. Extracted goaf gas would be reticulated back via an existing gas management system to power plants at Appin West and Appin No 2 shaft for electricity generation. There would be no change to existing approvals at these power plants.

Mine Safety Gas Drainage is proposed at two locations, referred to as MSGD Site 1 and 2. During operation, the MSGD sites will result in emissions to air from the operation of enclosed flares at each location. Extraction plant would be powered by mains electricity.

Dispersion modelling for the operation of the flares at the two sites has been conducted and predicts that ground level concentrations for all pollutants assessed would be well below the relevant impact assessment criteria. A level 1 cumulative assessment indicates that cumulative impacts would be well below the relevant impact assessment criteria for all pollutants and averaging periods.

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1 INTRODUCTION

BHP Billiton Illawarra Coal Pty. Ltd. (BHPBIC) operates the Appin Mine, an underground longwall mining operation in the Bulli Seam of the Illawarra Coal Measures in the Southern Coalfield area of NSW, approximately 25km north-west of Wollongong. BHPBIC are proposing an s75W modification to the Appin Gas Drainage Project for:

- future goaf drainage activities at Appin Area 7 (Longwall 704 and 705); and
- Mine Safety Gas Drainage activities associated with Area 9.

PAEHolmes have been engaged to prepare an Air Quality Impact Assessment (AQIA) for the proposal.

1.1 Objectives of the Study

The primary objective of the study is to assess the potential air quality impacts from the construction and operational phases of the project. This will be achieved by the following scope of work:

- Conduct an Air Quality Impact Assessment in accordance with the NSW Office of Environment and Heritage (OEH)[1] "*Approved Methods for the Modelling and Assessment of Air Pollutants in NSW*" (**NSW DEC, 2005**);
- Identify and quantify emissions to air for all relevant phases;
- Provide a description of the ambient receiving environment, including background pollution concentrations, prevailing meteorological conditions and nearby sensitive receptors; and
- Provide a cumulative impact assessment based on regulatory dispersion model predictions and representative background pollution concentrations.

[1] The NSW EPA exists as a legal entity operated within the Office of Environment and Heritage (OEH) which came into existence in April 2011. The 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.

2 PROJECT DESCRIPTION

There are two distinct aspects to the Appin Gas Drainage Project, as follows:

- Future goaf drainage activities at Appin Area 7 (Longwall 704 and 705); and
- Pre-mine drainage activities associated with the first workings development of Area 9.

2.1 Longwall 705 goaf drainage

Several options for goaf drainage at Longwall (LW) 705 and 704 are considered, however all have similar elements and include Medium Radius Drilled (MRD) wells, vertical contingency wells, pipelines and access roads. Gas will be extracted from each well and reticulated back via an existing gas management system to the power plants at Appin West and Appin No 2 shaft for electricity generation.

There is no change to existing approvals for the Appin West and Appin No 2 power generation and impacts from an air quality perspective are expected to be limited to construction of the wells and pads and associated infrastructure. The gas extraction units will be mains powered.

An overview of the proposed LW704 and LW705 goaf drainage is show in **Figure 2.1**. Each MRD well will take approximately 70 days to drill on a 24/7 basis. Each vertical well will take approximately 30 days to drill on a 5.5 day/week basis and during daylight hours. Civil works (pads, roads etc) will be constructed 5.5 days/week basis during daylight hours (standard construction hours).

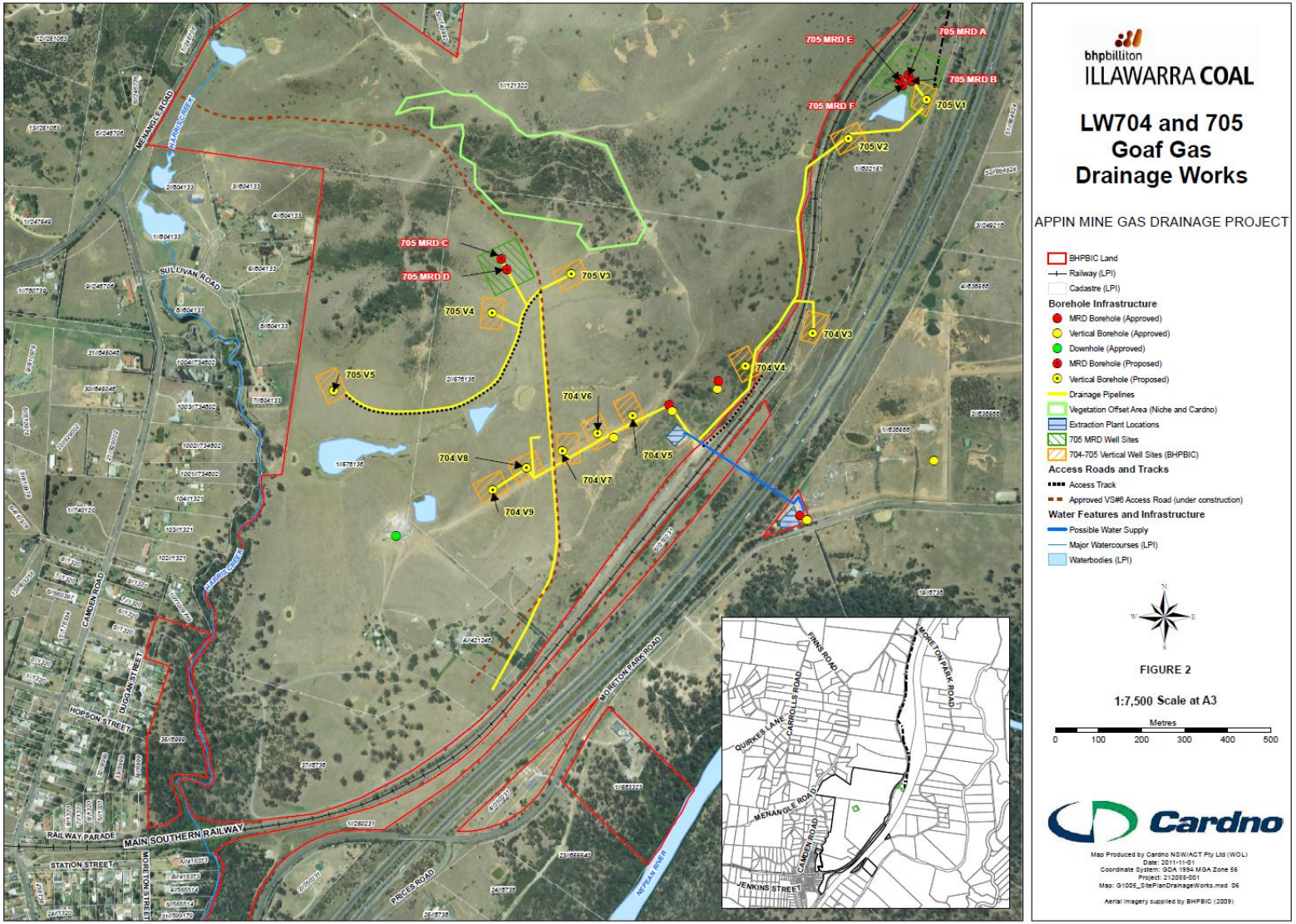


Figure 2.1: Longwall 704 and 705 Goaf Drainage

2.2 Mine Safety Gas Drainage

Mine Safety Gas Drainage (MSGD) is proposed at two locations, referred to as MSGD Sites 1 and 2, shown in **Figure 2.2**. The key infrastructure at the MSGD sites, in terms of air quality impact, will be the operation of enclosed flares at both sites which will be able to burn approximately 500L/s of gas at each flare. The gas extraction infrastructure will be electrically powered.

An overview of the MSGD options is provided below.

- MSGD Site 1 - includes drilling of two steered MSGD gas extraction wells, construction of an access road and construction of a drill pad, construction and operation of an infrastructure compound with electric water pump, water collection tanks, and an enclosed flare to burn the gas. Water will be temporarily stored in tanks and trucked daily back to Appin West or West Cliff pit top for reuse.
- MSGD Site 2 – includes access road, site preparation for a 100 x 100 m drill pad, three vertical wells, one enclosed flare (up to 500 L/s), as well as water collection tanks.

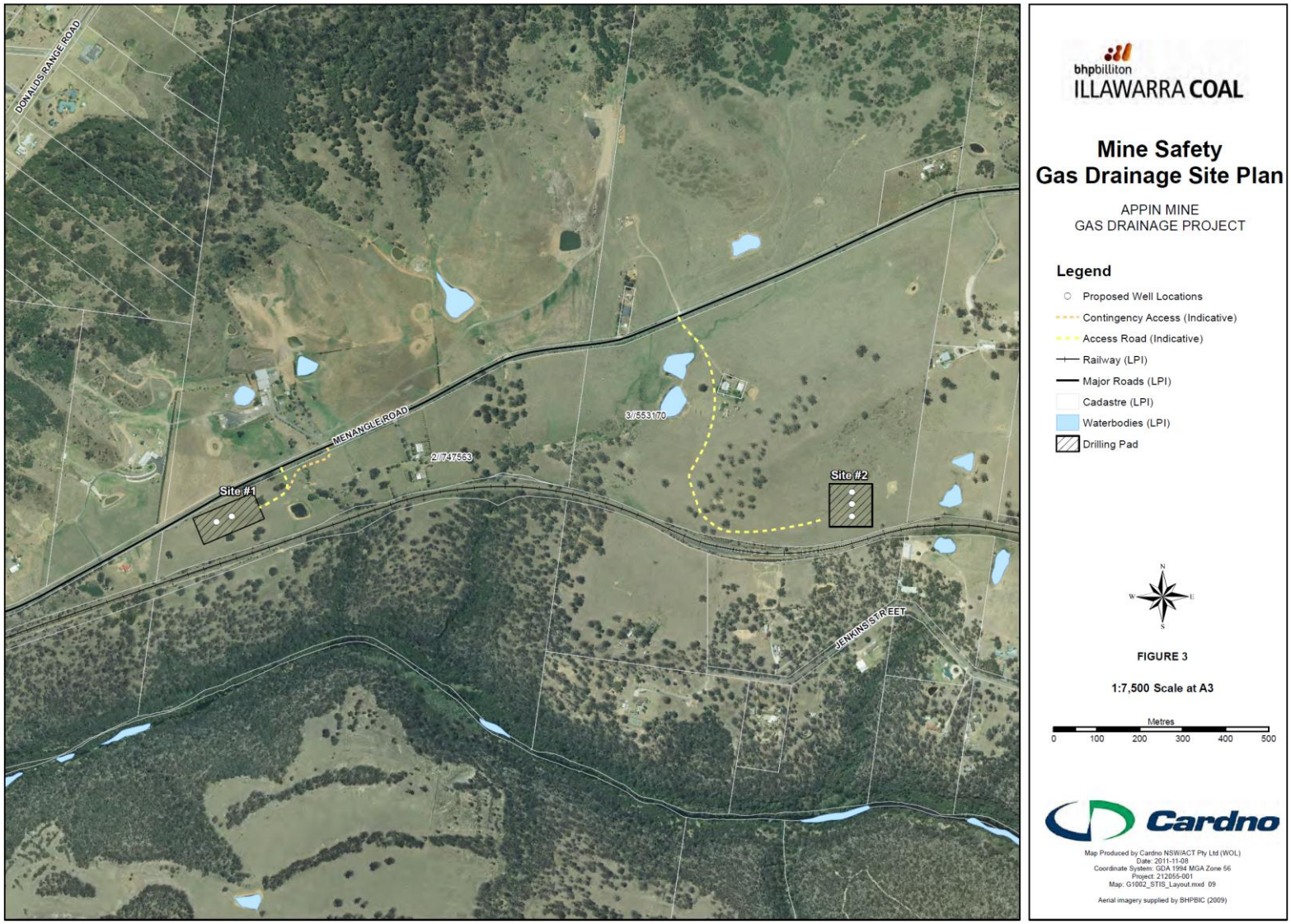


Figure 2.2: MSGD Locations

3 LOCAL SETTING

The proposed location of MSGD sites and associated infrastructure is shown in **Figure 2.2**. BHPBIC have access agreements in place with both properties. The existing landscape can be described as previously cleared, open land with undulating to hilly topography. The MSGD sites are adjacent to the main southern railway to the north and Nepean River to the south. For the purposes of assessing impacts from the Project, the receptor locations shown in Figure 3.1 have been selected (refer **Table 3.1**). The township of Douglas Park is located to the east.

A three-dimensional representation of the local topography is shown in **Figure 3.2**.

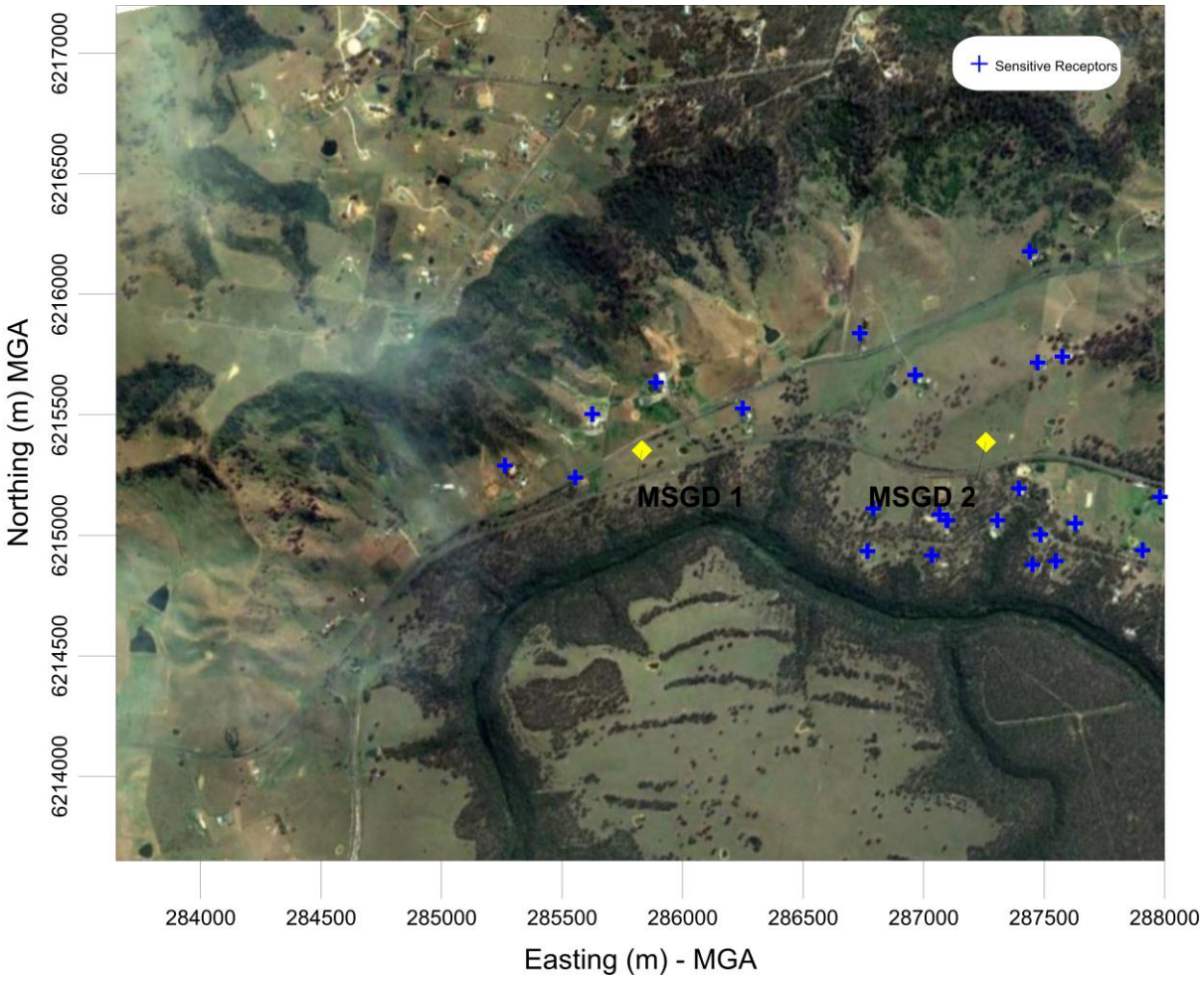


Figure 3.1: Local Setting and Receptor Locations

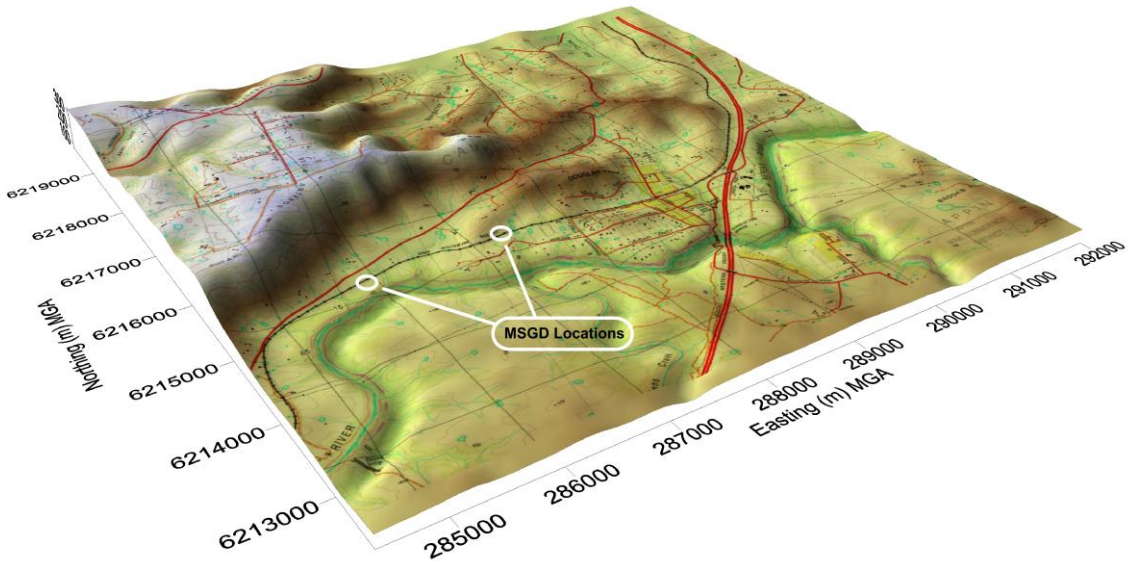


Figure 3.2: Pseudo 3-Dimensional Representation of Regional Topography

Table 3.1: Closest Receptor Locations

Location/ Name	Easting (m)	Northing (m)	Elevation (m)
1	285889	6215634	132
2	285625	6215503	139
3	285263	6215290	150
4	285554	6215239	128
5	286249	6215526	120
6	286735	6215839	129
7	286965	6215665	126
8	287473	6215717	151
9	287576	6215742	162
10	287440	6216178	155
11	287980	6215160	131
12	287908	6214938	127
13	287630	6215050	128
14	287548	6214894	128
15	287451	6214879	127
16	287485	6215003	127
17	287306	6215063	124
18	287098	6215062	134
19	287395	6215195	126
20	287066	6215086	134
21	287095	6215062	133
22	287034	6214916	132
23	286767	6214935	126
24	286791	6215111	133

4 AIR QUALITY ISSUES AND EFFECTS

From an air quality perspective, it is important to consider the potential emissions that would occur during the construction and operation of the project. During construction, fugitive dust emissions can be expected although construction of the wells would be staged and therefore relatively short lived. Construction activities will include access route construction, clearing/striping/excavation, drilling of MRD and vertical wells, and laying pipework.

During operation, the MSGD sites will result in emissions of oxides of nitrogen (NO_x), carbon monoxide and volatile organic compounds (VOCs) from the operation of enclosed flares at each location. Extraction plant would be powered by mains electricity.

There would also be emissions from diesel-powered construction equipment and truck movements; however these are 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 ($PM_{2.5}$). Goals for TSP were developed before more recent health studies suggested stronger relationships between health impacts and exposure to smaller size fractions of particulate matter, including PM_{10} and $PM_{2.5}$.

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. Generally the finer the particle, the greater the health effect, based on the particles ability to penetrate deep into the lungs. Particles larger than PM_{10} tend to be trapped in the nose, mouth, throat or major bronchi and are typically expelled relatively quickly from the body.

Impact assessment criteria for particulate matter provide benchmarks, which if met, are intended to protect the community against the adverse effects of air pollutants. These criteria reflect current Australian community standards for the protection of health and protection against nuisance effects. To assist in interpreting the significance of predicted concentration some background discussion on the potential harmful effects is provided below.

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. In practice, particles larger than 30 to 50 μm settle out of the atmosphere too quickly to be regarded as air pollutants but are considered for their impacts on amenity.

The health-based assessment criteria used by NSW OEH have, to a large extent, been developed by reference to epidemiological studies undertaken in urban areas with large populations where the primary pollutants are the products of combustion. This means that, in contrast to dust of crustal[b] origin, the particulate matter from combustion would be composed of smaller particles and would generally contain acidic and carcinogenic substances.

[b] The term crustal dust is used to refer to dust generated from materials that constitute the earth's crust.

Particulate matter generated during construction activities would be predominantly in the larger size fraction range.

4.2 Oxides of Nitrogen

Oxides of nitrogen are produced when fossil fuels are combusted. Nitrogen oxides (NO_x) emitted by fossil fuel combustion are comprised mainly of nitric oxide (NO) and nitrogen dioxide (NO_2). NO is much less harmful to humans than NO_2 and is not generally considered a pollutant at the concentrations normally found in urban environments.

NO_2 is the regulated oxide of nitrogen in NSW and effects of exposure to NO_2 include irritation of the lungs and lower resistance to respiratory infections such as influenza. The effects of short-term exposure are still unclear, but continued or frequent exposure to concentrations that are typically much higher than those normally found in the ambient air may cause increased incidence of acute respiratory illness in children. Concern with NO is related to its transformation to NO_2 and its role in the formation of photochemical smog.

Typically, close to the combustion sources, NO_2 makes up 5 to 20 per cent by weight of the total oxides of nitrogen. At the point of emission, NO_x would consist of approximately 90-95% of NO and 5-10% of NO_2, the regulated oxide. The dominant short term conversion is NO to NO_2 through oxidation with atmospheric ozone (O_3) as the plume travels from source.

$$NO + O_3 \equiv NO_2 + O_2$$

Therefore, to predict the ground level concentration of NO_2 it is necessary to account for the transformation of NO_x to NO_2.

4.2.1 Volatile Organic Compounds (VOCs)

Organic hydrocarbons are comprised of a collection of various volatile organic compounds (VOCs), and several of these compounds may be toxic, including benzene, ethylbenzene, 1,3-butadiene, toluene and xylenes. Methane itself is a common VOC but is often distinguished from other VOCs using the term non-methane VOCs or NMVOCs.

Air toxics 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. Organic hydrocarbons also include reactive organic compounds, which play a role in the formation of photochemical smog. There are no impact assessment criteria specified for total VOCs, however modelling predictions can be compared to the impact assessment criteria for individual organic pollutants that may be present in the extracted gas.

4.2.1 Carbon Monoxide

Emissions of Carbon Monoxide (CO) can be expected from the flaring of extracted gas. Carbon monoxide is a colourless, odourless gas, formed from the incomplete or inefficient combustion of fuels containing carbon and may be emitted from the flaring of goaf gas.

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.

4.3 Summary of Air Quality Goals

The NSW OEH 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: NSW OEH Impact Assessment Criteria

Pollutant	Assessment Criteria	Averaging Period
Total suspended particulate matter (TSP)	90 μg/m3	Annual mean
PM_{10}	30 μg/m3	Annual mean
	50 μg/m3	24-hour average
Nitrogen Dioxide	246 μg/m3	1-Hour
	62 μg/m3	Annual
Carbon Monoxide	30 mg/m3	1-Hour
	10 mg/m3	8-Hour
VOCs	N/A[1]	N/A

Note: [1] Compound Specific

5 EXISTING AMBIENT AIR QUALITY

Air quality standards and goals are used to assess the total pollutant level in the environment, including the contributions from new projects and 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 OEH 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 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 regional 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

Note: Based on 2010 data

Further data from these monitoring sites have been obtained for 2009 (year chosen for modelling) and presented in **Section 5.1** and **Section 5.2**.

5.1 Nitrogen Dioxide

NO_2 is monitored at Bargo, Macarthur and Oakdale. **Figure 5.1** shows the 24-hour average NO_2 concentration for 2009 at each of the monitoring stations. The measured NO_2 concentrations at all three stations were well below the annual average NO_2 criterion of 62 µg/m^3. The annual average NO_2 concentrations recorded at Bargo, Macarthur and Oakdale were 9.3 µg/m^3, 16.8 µg/m^3 and 4.2 µg/m^3 respectively.

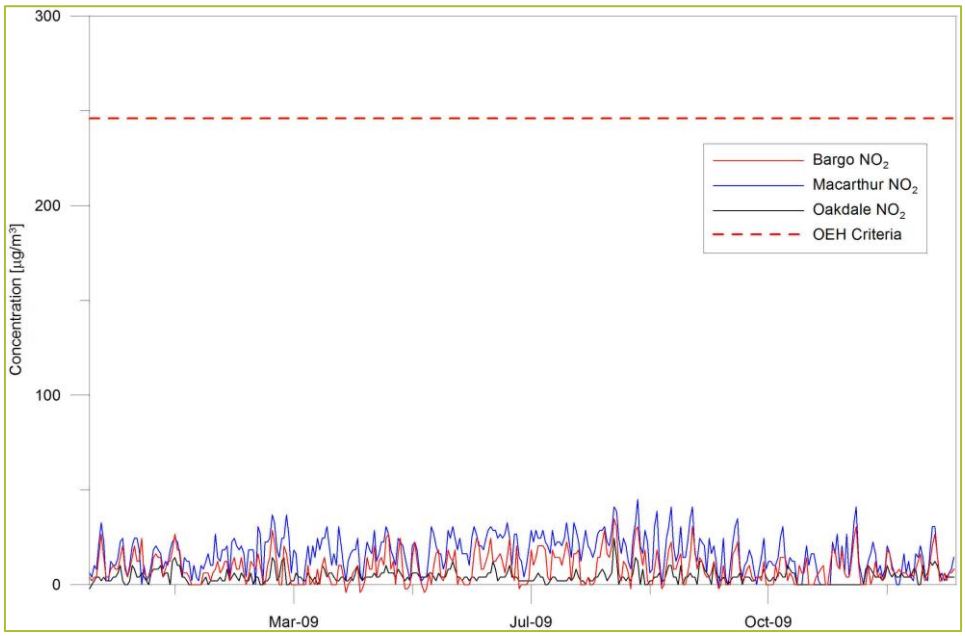


Figure 5.1: OEH Monitoring NO_2 - 2009

5.2 Carbon Monoxide

CO is monitored at Macarthur and **Figure 5.1** shows the 24-hour average CO concentration for 2009. The measured CO concentrations at all three stations were well below the 8-hr average CO criterion of 30 mg/m^3.

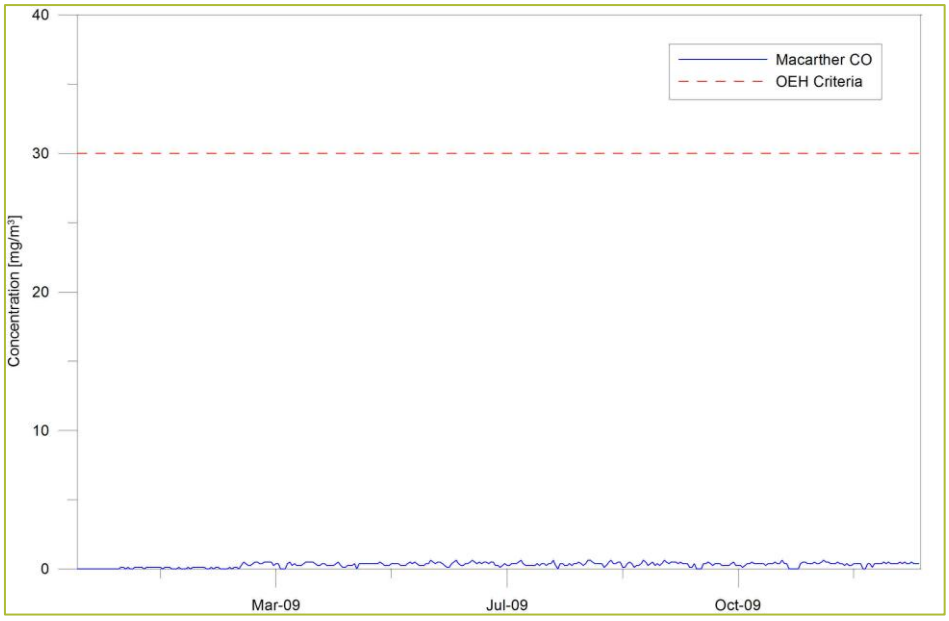


Figure 5.2: OEH Monitoring NO_2 – 2009

6 PREVAILING METEOROLOGY

6.1 Prevailing Winds

Local meteorological data are collected at the EDL Appin Power Station, located approximately 8 km southeast of the MSGD sites. Data from 2008 to 2010 have been analysed and data from 2009 chosen for assessment purposes. 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**).

Annual and seasonal wind roses are presented in **Figure 6.1**. On an annual basis, the most common winds are from the southeast, south-southeast and south. This pattern is reflected in most seasons except during winter when strong winds from the west also dominate. The average wind speed recorded at Appin is 3.5 m/s and calm conditions (<= 0.5 m/s) are infrequent at approximately 1.2% of the time.

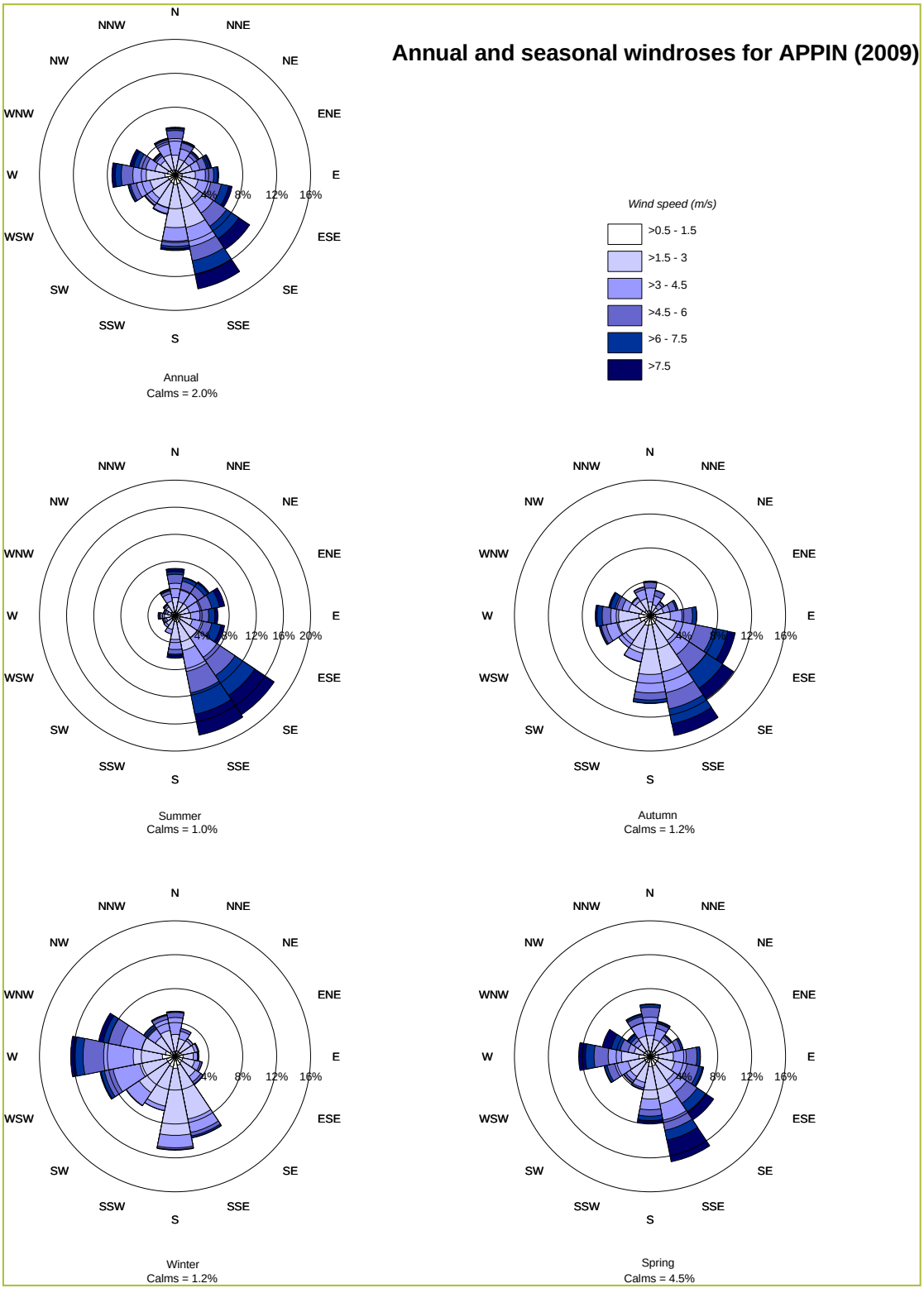


Figure 6.1: Wind Roses for Appin- 2009

6.2 Dispersion Meteorology

The CALMET/CALPUFF modelling system was chosen for this study. This is based on the fact that simple Gaussian dispersion models such as AUSPLUME assume that the meteorological conditions are uniform spatially over the entire modelling domain for any given hour. While this may be valid for some applications, in complex flow situations, such as hilly terrain, the meteorological conditions may be more accurately simulated using a wind field model such as CALPUFF.

CALMET is the meteorological pre-processor for CALPUFF 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.

CALMET was initially run for a coarse outer grid domain of 100 km x 100 km, centred close to Douglas Park, 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) Automatic Weather Station (AWS) 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 BoM sites located at Camden Airport AWS, Campbelltown Airport AWS and Bellambi AWS were used as input for CALMET. Cloud cover and cloud heights were sourced from observations at Camden Airport and Bellambi. Upper air data were also extracted from TAPM[c] 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 5 km x 5 km with a 0.1 km resolution. The inner grid modelling was used to create a fine resolution three-dimensional meteorological field for the area around the area around the MSGD sites.

Annual and seasonal wind roses for the approximate location of the MSGD sites are presented in **Figure 6.2**. The CALMET annual wind rose displays moderate to strong wind speeds predominantly from the west and west-southwest which is aligned with the dominant terrain of the area.

[c] The Air Pollution Model, or TAPM, is a three dimensional meteorological and air pollution model developed by the CSIRO Division of Atmospheric Research. Detailed description of the TAPM model and its performance can be found in Hurley (2008) and Hurley, Edwards et al. (2009). TAPM was set up with 4 domains, with a resolution of 30 km, 10 km, 3 km and 1 km respectively. To improve model accuracy, observed wind conditions from Appin Power Station , Camden Airport AWS, Campbelltown Airport AWS and Bellambi AWS were used to improve the TAPM solution.

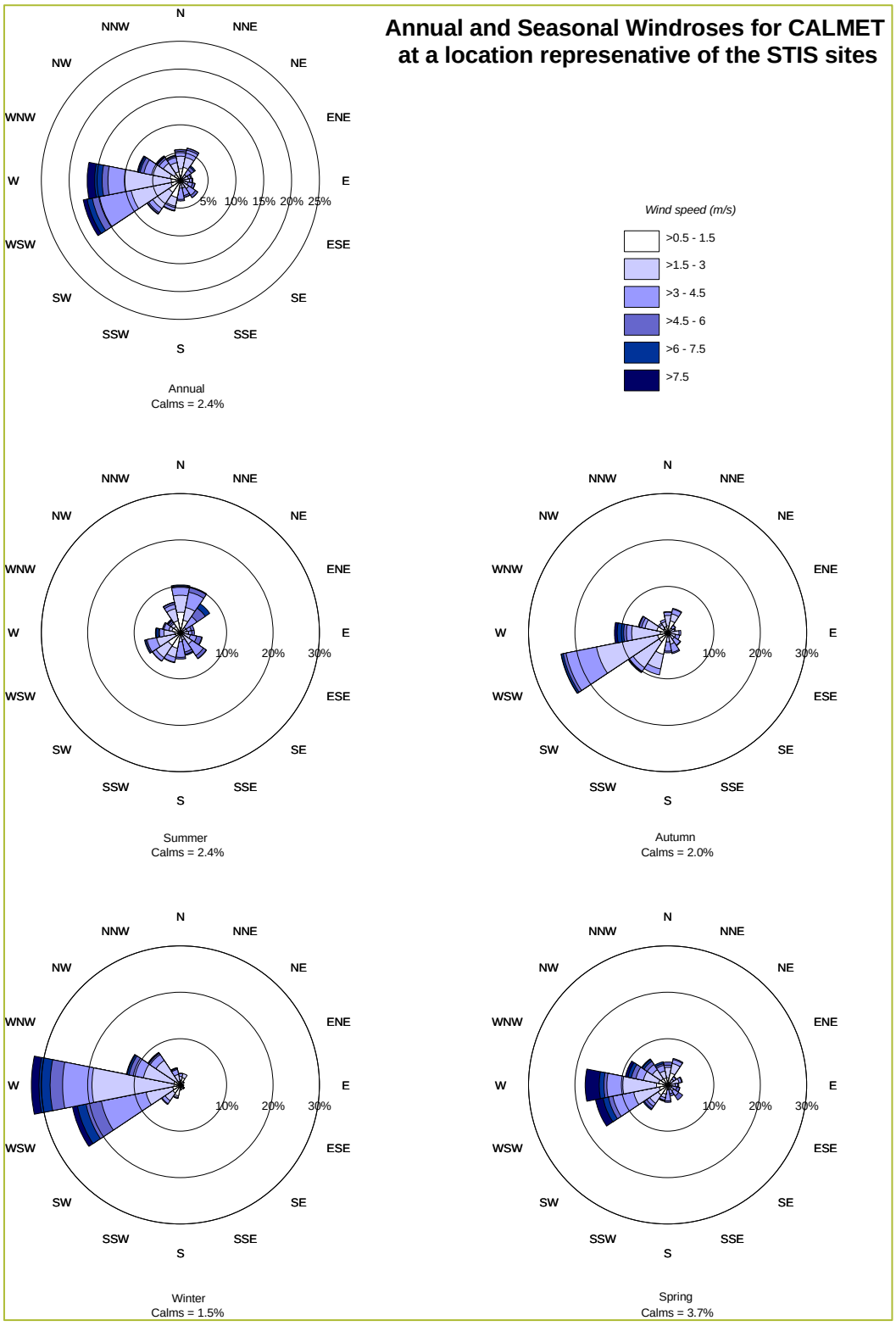


Figure 6.2: Wind Roses generated for MSGD Sites – Calmet 2009

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 PG stability class for the site and the frequency distribution of estimated PG stability classes is presented in **Figure 6.3**. The data show a high proportion of stable conditions (class F). It is noted that a turbulence based scheme within CALPUFF was used in the modelling and the Pasquill-Gifford stability class frequency is shown for information only. The use of turbulence based dispersion coefficients is recommended (**TRC, 2010**) for the same reasons that the United States Environmental Protection Agency (US EPA) has replaced PG-based dispersion with a turbulence-based approach in their regulatory model (AERMOD) and is in accordance with best science practice and model evaluation studies.

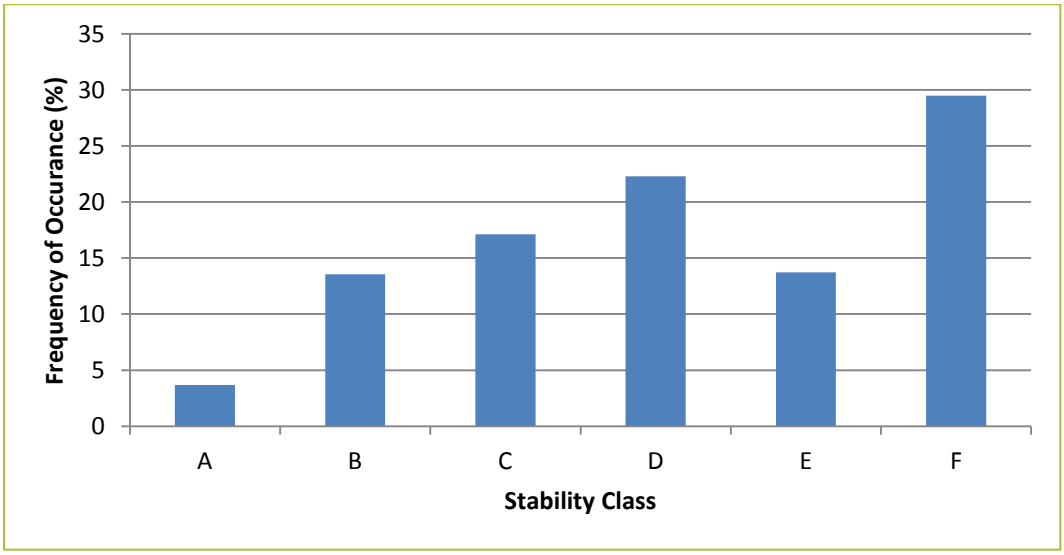


Figure 6.3: Stability Class Frequency (2009)

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 an important parameter within air pollution meteorology as vertical diffusion or mixing of a plume is generally considered to be limited by the mixing height, as the air above this layer tends to be stable, with restricted vertical motion.

Mixing height 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.

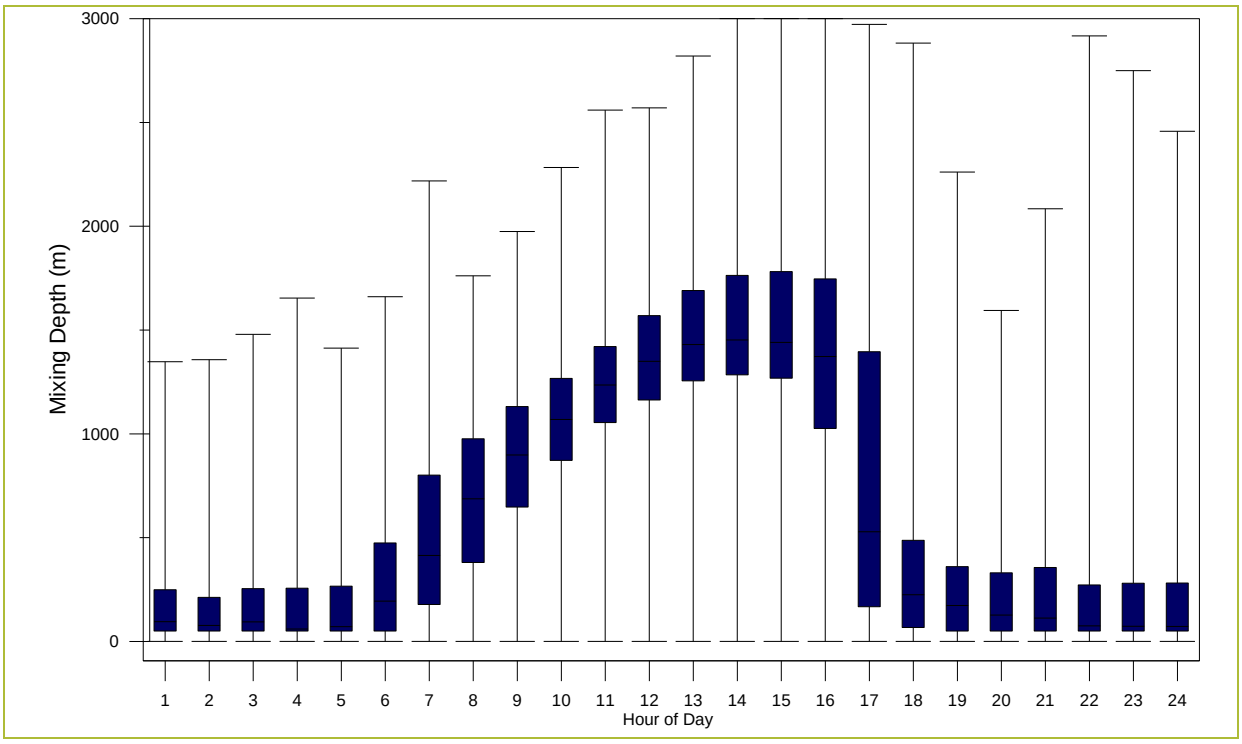


Figure 6.4: Average Daily Diurnal Variation in Mixing Layer Depth

7 EMISSIONS TO AIR

Dust emissions generated during construction phases have not been quantified but are addressed qualitatively in **Section 8.1**. The primary emissions of concern during the operation phase will be emissions from the flaring of MSGD sites.

Emissions from two MSGD sites have been derived based on Chapter 13.5 (Industrial Flares) of the US EPA AP-42 emission factors (**US EPA, 1995**), based on enclosed flares operating at each site and a gas flow rate of 450 L/s per flare.

It is conservatively assumed that the flares would operate at each site with a total gas flow of 450 L/s or 0.45 m^3/s. The modelled parameters for each MSGD site are presented in **Table 7.1**.

Table 7.1: Modelling Emission Rates

Parameter	MSGD Site 1	MSGD Site 2
Gas Flow Rate (m^3/s)	0.45	0.45
Exit Velocity (m/s)	20.0	20.0
Release Height (m)	7.0	7.0
Stack Diameter (m)	1.0	1.0
Temperature (K)	1273	1273
X coordinate (m)	286182	287115
Y coordinate (m)	6215079	6215126
Elevation (m)	116.39	130.89
	Emission Factor (lb/MMBtu [1])	**Emissions Rates (g/s)**
NO_x	0.068	0.5
CO	0.37	2.7
VOC	0.14	1.0

Note: [1] MMBtu = Million British Thermal Units. 1 MMBtu = 28.32 m^3 methane

Modelling flare emissions differs from conventional plumes in that the buoyancy flux is affected by the radiative heat loses during plume rise. The flare emission source has been modelled by replacing Briggs plume rise with numerical plume rise to allow for radiative heat loss, vertical wind shear and ambient temperature stratification, with the "no stack tip downwash" option chosen (**Robe, 2009**). Adjustments are typically required to determine the effective release height and effective stack diameter of the flame. 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.

It is acknowledged that the above stack parameters were selected for modelling purposes. Subsequent to the modelling being conducted, it is understood that BHPBIC propose to use an Horizontal Enclosed Flaring System (HEFS). The HEFS uses an open hearth refractory arrangement to provide flame retention under a wide range of gas flows, and an elevated temperature that can handle reduced-quality gas.

Despite some changes to the exit parameters associated with the adoption of such a system, pollutant mass emission rates remain comparable. As such, no significant changes to the study outcomes are anticipated associated with the adoption of a HEFS configuration.

7.1 Oxides of Nitrogen

Some analysis of the percentage of NO_x which has been converted to NO_2 is particularly useful for this study as estimates of NO_2 concentrations are commonly derived from NO_x predictions.

As discussed in **Section 4.1**, generally at the point of emission NO will comprise the greatest proportion of emission and typically constitute 95% by volume of the NO_x and NO_2 will comprise 5%.

Ultimately however all NO emitted into the atmosphere will be oxidised to NO_2 and to other higher oxides of nitrogen. The rate at which this oxidisation takes place depends on prevailing atmospheric conditions including temperature, humidity and the presence of other substances in the atmosphere such as ozone. It can vary from a few minutes to many hours. The rate of conversion is quite important because from the point of emission to the point of maximum ground-level concentration there will be an interval of time during which some oxidation will take place. If the dispersion is sufficient to have diluted the plume to the point where the concentration is very low it is unimportant that the oxidation has taken place. However, if the oxidation is rapid then high concentrations of NO_2 can occur.

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. For the assessment in this study it has been assumed that the ratio of NO_2 to NO_x is 20% by the time that the plume has reached the point where the maximum ground-level concentrations are predicted.

7.2 Standards of Concentration for Flares

The NSW Government's *Protection of the Environment Operations (Clean Air) Regulation 2010* ("the Clean Air Regulation") details appropriate stack emission limits for both scheduled and unscheduled activities, including the use of flares.

The Clean Air Regulation specifies that no visible emission other than for a total period of no more than 5 minutes in any 2 hours should occur from new flare sources.

8 IMPACT ASSESSMENT

8.1 Construction phase impacts

The principal emissions during the construction phase will be dust and particulate matter, occurring from the activities including:

- Vegetation clearing / earthmoving during site preparation and access road construction.
- Drilling of wells and handling of spoil material.
- Movement of heavy plant and machinery within the site on unsealed areas.
- Graders / scrapers working access road construction.
- Wind erosion from exposed surfaces.

Emissions of particulate, carbon monoxide (CO), nitrogen dioxide (NO_2), and sulphur dioxide (SO_2) will occur from diesel-powered plant and equipment and vehicle movements to site. However these emissions are typically minor for projects of this scale and too widely dispersed to give rise to significant off-site concentrations.

Construction of the access tracks, vertical wells and MRD wells will be staged across the proposed locations and potential dust impacts at each location will therefore be relatively short lived. Notwithstanding this, procedures for controlling dust impacts during construction will include, but not necessarily be limited to the following measures.

8.1.1 Clearing / Excavation

Emissions can be effectively controlled by increasing the moisture content of the soil / surface. Other controls that will be considered are:

- Modification of working practices by limiting excavation during periods of high winds.
- Limiting the extent of clearing of vegetation and topsoil to the designated footprint required for construction and appropriate staging of any clearing.

8.1.2 Access Route Construction

Dust emissions should be controlled through the use of water sprays during road construction. Where conditions are excessively dusty and windy, and fugitive dust can be seen leaving the site, work practices should be modified by limiting scraper / grader activity. Given the temporary nature of the access route construction and implementation of standard dust control measures, dust impacts are expected to be minor.

8.1.3 Haulage and Heavy Plant and Equipment

Vehicles travelling over paved or unpaved surfaces tend to produce wheel generated dust and can result in dirt track-out on paved surfaces surrounding the work areas.

- All vehicles on-site should be confined to a designated route with a speed limits enforced;
- Trips and trip distances should be controlled and reduced where possible, for example by coordinating delivery and removal of materials to avoid unnecessary trips;
- Material that has been tracked onto sealed roads should be cleaned as soon as practicable; and

- When conditions are excessively dusty and windy, and dust can be seen leaving the works site the use of a water truck (for water spraying of travel routes) should be used;

8.1.4 Wind Erosion

Wind erosion from exposed ground should be limited by avoiding unnecessary vegetation clearing and ensure rehabilitation occurs as quickly as possible. Wind erosion from temporary spoil stockpiles can be limited by minimising the number of stockpiles on-site and minimising the number of work faces on stockpiles.

8.2 Operational Phase

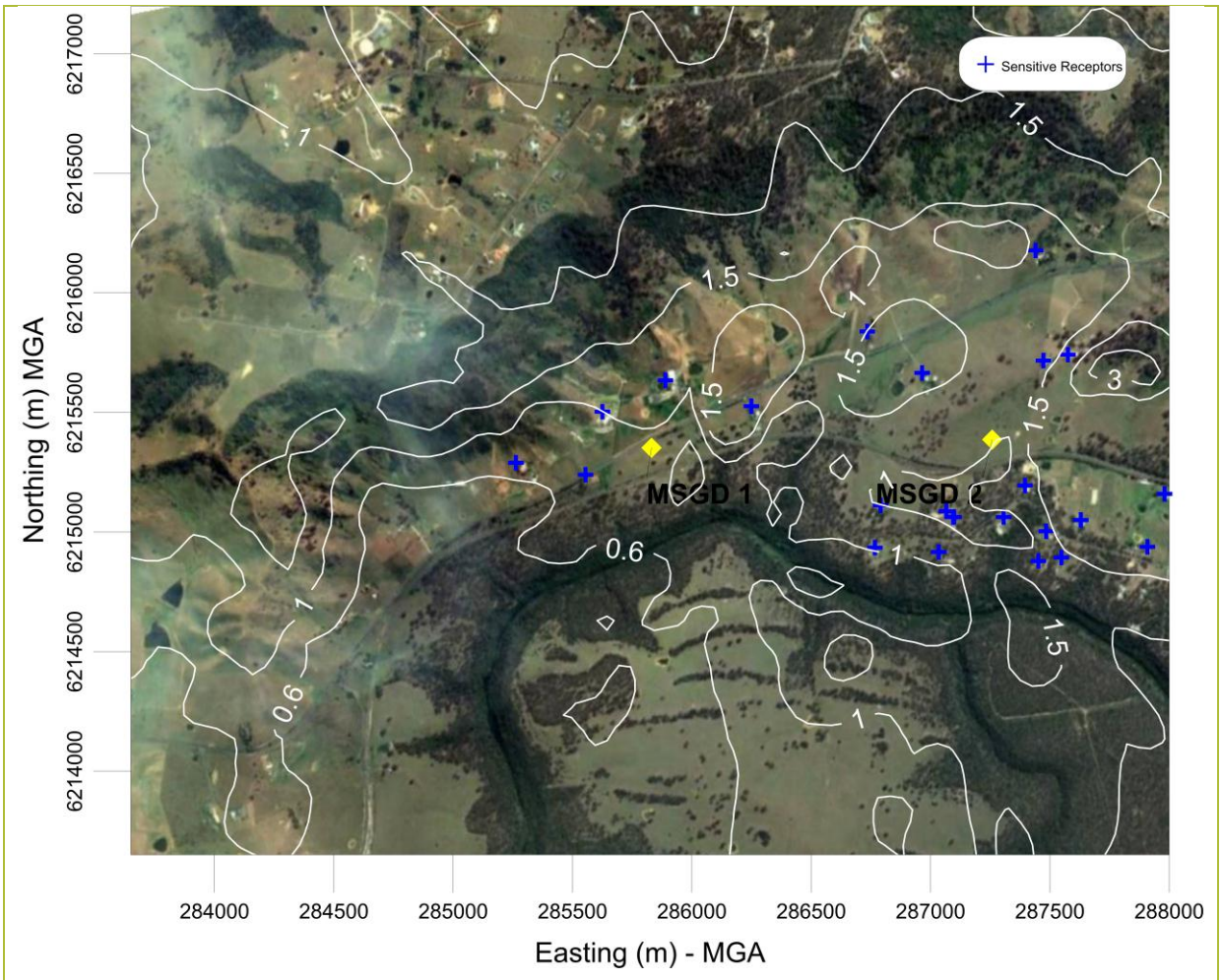
Dispersion modelling for the operation of the flares at the two MSGD sites has been conducted using CALPUFF. CALPUFF is a multi-layer, multi-species non-steady state puff dispersion model that can simulate the effects of time and space varying meteorological conditions on pollutant transport, transformation 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.

A CALPUFF computation grid of 5 km x 6 km was nested within the CALMET meteorological grid and on the MSGD sites. A Cartesian receptor sampling grid of 100 m was used.

8.2.1 Nitrogen Dioxide

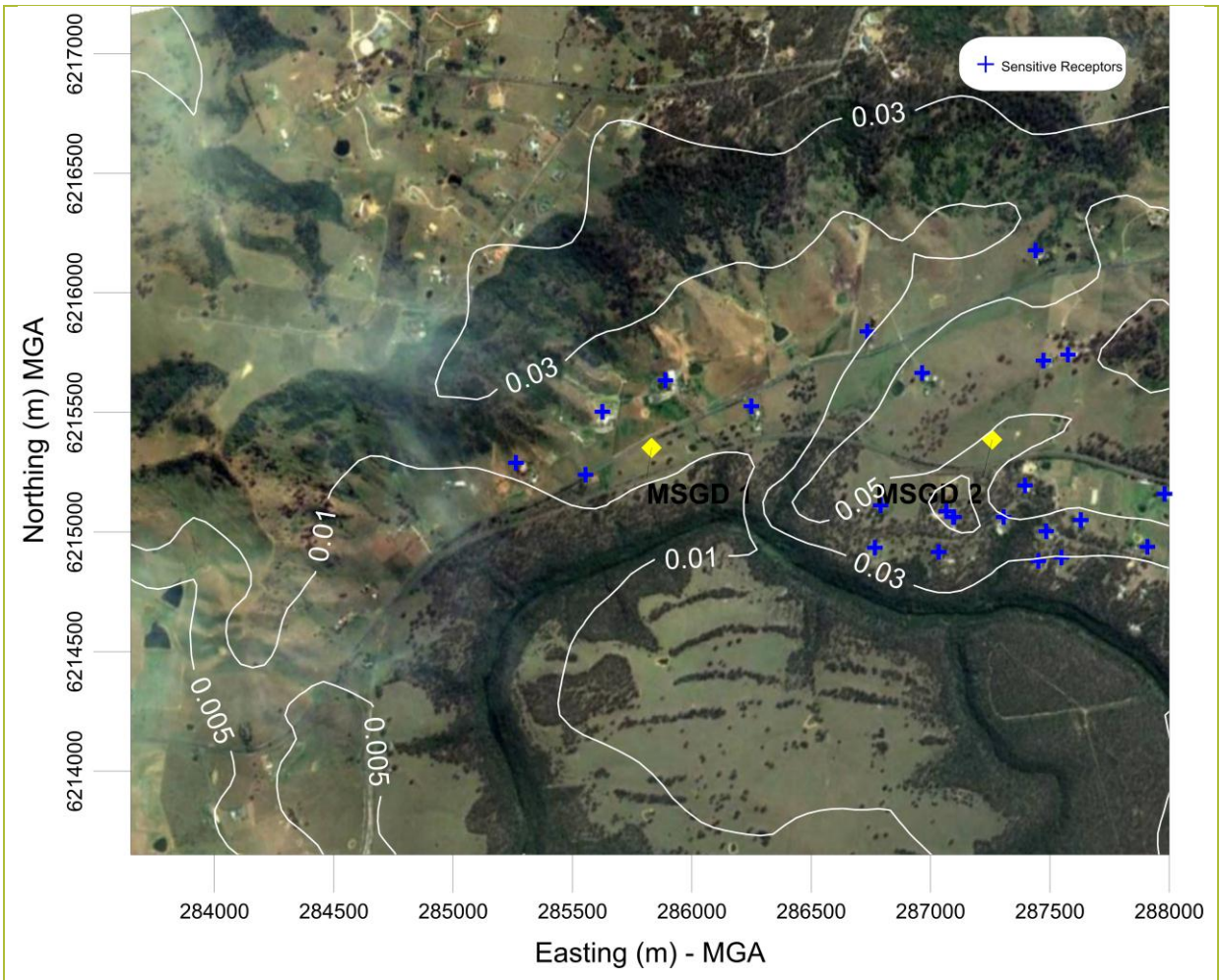
The results of the 1-hour and annual average NO_2 modelling predictions for the Project are presented in **Figure 8.1** and **Figure 8.2**. The contours show the predicted 1-hour and annual average NO_2 concentrations are well below the OEH criteria.

The predicted NO_2 concentrations at each of the sensitive receptors in **Table 3.1** are presented in **Table 8.1**. The predicted 1-hour and annual average NO_2 concentrations are well below the NO_2 criteria at all selected receptor locations.



Species:	Location:	Scenario:	Percentile:	Averaging Time:
NO_2	Appin	Maximum	100th	1 hour
Model Used:	**Units:**	**Guideline:**	**Met Data:**	**Plot:**
CALPUFF v6.262	µg/m³	246 µg/m³	CALMET Generated(2009)	R. Kan

Figure 8.1: Predicted Maximum NO_2 Concentration – 1 hour Average



Species:	Location:	Scenario:	Percentile:	Averaging Time:
NO_2	Appin	Maximum	100th	Annual
Model Used:	**Units:**	**Guideline:**	**Met Data:**	**Plot:**
CALPUFF v6.262	$\mu g/m^3$	62 $\mu g/m^3$	CALMET Generated(2009)	R. Kan

Figure 8.2: Predicted Maximum NO_2 Concentration – Annual Average

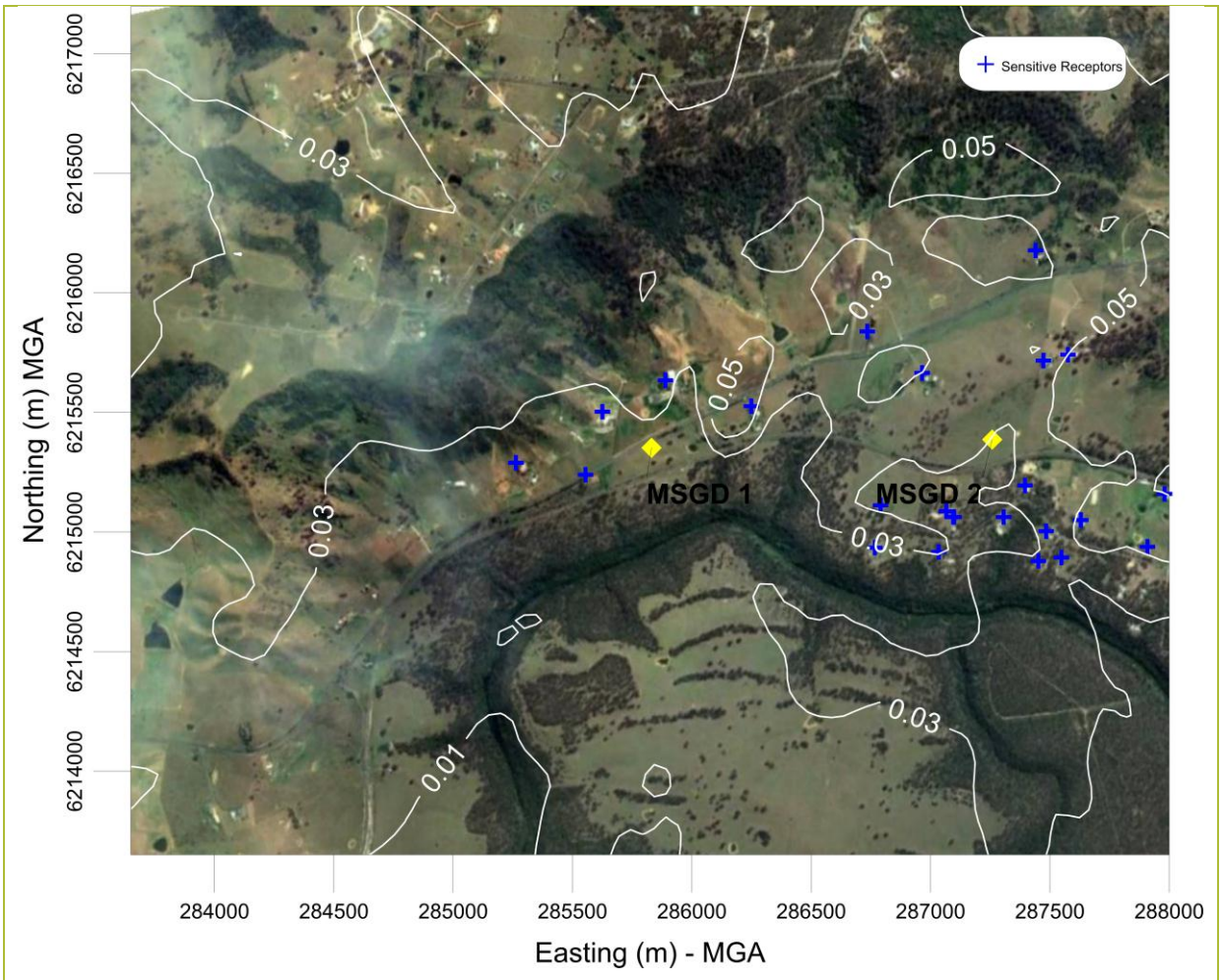
Table 8.1: Predicted NO_2 Concentrations at Sensitive Receptors

Receptor ID	Predicted NO_2 Concentration – 1 hr Average ($\mu g/m^3$)	1-hr Impact Assessment Criteria ($\mu g/m^3$)	Predicted NO_2 Concentration – Annual Average ($\mu g/m^3$)	Annual Impact Assessment Criteria ($\mu g/m^3$)
1	1.2	246	0.02	62
2	1.0	246	0.02	62
3	0.7	246	0.01	62
4	0.7	246	0.01	62
5	2.1	246	0.02	62
6	1.5	246	0.03	62
7	1.8	246	0.06	62
8	1.2	246	0.06	62
9	1.8	246	0.07	62
10	1.1	246	0.04	62
11	1.6	246	0.06	62
12	2.1	246	0.04	62
13	2.0	246	0.05	62
14	1.1	246	0.03	62
15	1.1	246	0.03	62
16	1.1	246	0.04	62
17	0.8	246	0.05	62
18	1.0	246	0.02	62
19	1.2	246	0.07	62
20	1.0	246	0.02	62
21	1.0	246	0.02	62
22	1.5	246	0.05	62
23	0.8	246	0.04	62
24	1.1	246	0.05	62

8.2.2 Carbon Monoxide

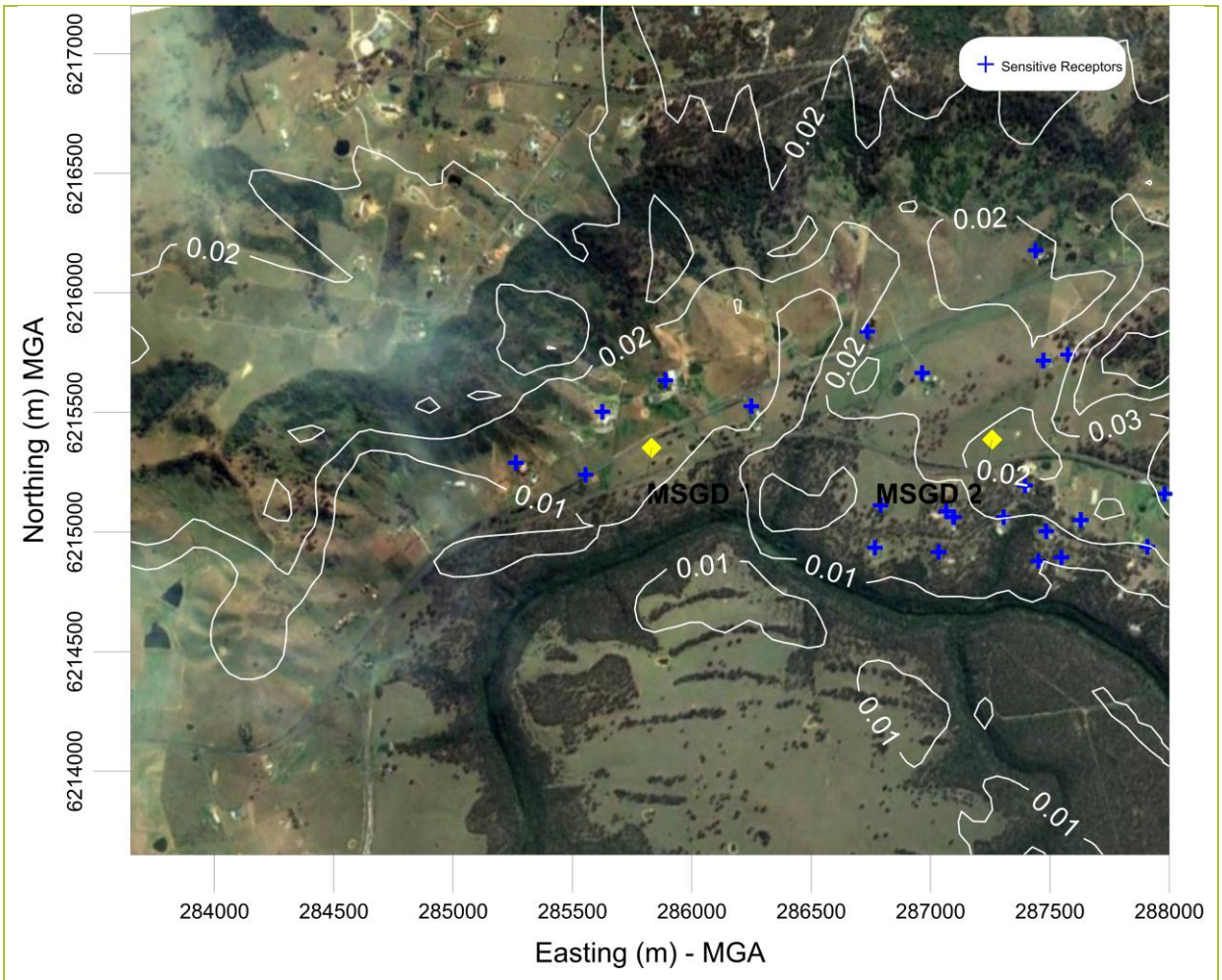
The results of the CO modelling predictions for the site are presented in **Figure 8.3** for 1-hour average and **Figure 8.4** for 8-hr average. The plots demonstrate the predicted CO concentrations are well below the CO Impact Assessment Criteria.

The predicted 1-hr and 8-Hr CO concentrations at each of the sensitive receptors in **Table 3.1** are presented in **Table 8.2**. The results indicate that the predicted 1-hour and 8-hour concentrations are minor.



Species:	Location:	Scenario:	Percentile:	Averaging Time:
CO	Appin	Maximum	100th	1 hour
Model Used:	**Units:**	**Guideline:**	**Met Data:**	**Plot:**
CALPUFF v6.262	mg/m^3	30 mg/m^3	CALMET Generated(2009)	R. Kan

Figure 8.3: Predicted Maximum CO Concentration – 1 hour Average



Species:	Location:	Scenario:	Percentile:	Averaging Time:
CO	Appin	Maximum	100th	8 hour
Model Used:	**Units:**	**Guideline:**	**Met Data:**	**Plot:**
CALPUFF v6.262	mg/m^3	10 mg/m^3	CALMET Generated(2009)	R. Kan

Figure 8.4: Predicted Maximum CO Concentration – 8 hour Average

Table 8.2: Predicted CO Concentrations at Sensitive Receptors

Receptor ID	Predicted CO Concentration – 1 hr Average (mg/m^3)	1-hr Impact Assessment Criteria (mg/m^3)	Predicted CO Concentration – 8-hr (mg/m^3)	8-Hr Impact Assessment Criteria (mg/m^3)
1	0.03	30	0.02	10
2	0.03	30	0.01	10
3	0.02	30	0.01	10
4	0.02	30	0.01	10
5	0.06	30	0.01	10
6	0.04	30	0.02	10
7	0.05	30	0.03	10
8	0.03	30	0.02	10
9	0.05	30	0.03	10
10	0.03	30	0.02	10
11	0.04	30	0.03	10
12	0.06	30	0.02	10
13	0.05	30	0.03	10
14	0.03	30	0.01	10
15	0.03	30	0.01	10
16	0.03	30	0.02	10
17	0.02	30	0.02	10
18	0.03	30	0.01	10
19	0.03	30	0.02	10
20	0.03	30	0.01	10
21	0.03	30	0.01	10
22	0.04	30	0.02	10
23	0.02	30	0.01	10
24	0.03	30	0.02	10

8.2.3 Volatile Organic Compounds

The predicted 1-hr VOC concentrations at each of the sensitive receptors in **Table 3.1** are presented in **Table 8.3**. There are no impact assessment criteria specified for total VOCs, however results for total VOCs can be compared to the 1-hour impact assessment criteria for individual hydrocarbons that may be present in the extracted gas (refer **Appendix A**).

For example, comparing the total VOC concentration to impact assessment criteria of 30 mg/m^3 for n-pentane, which is detected in the goaf gas, indicates that compliance is easily achieved. Even when the total VOC concentration is compared to impact assessment criteria for principal toxic air pollutants such as benzene (0.029 mg/m^3) compliance is also achieved. It is noted that benzene is unlikely to be present and if it was would make up a very small percentage of the total VOCs.

Table 8.3: Predicted VOC Concentrations at Sensitive Receptors – 1hr Average

Receptor ID	Predicted VOC Concentration – (mg/m^3)
1	0.012
2	0.010
3	0.007
4	0.007
5	0.022
6	0.016
7	0.019
8	0.012
9	0.019
10	0.011
11	0.017
12	0.022
13	0.020
14	0.011
15	0.011
16	0.011
17	0.009
18	0.010
19	0.012
20	0.010
21	0.010
22	0.015
23	0.008
24	0.011

[1] Impact assessment criteria for benzene

8.2.4 Cumulative Impacts

To assess impacts against 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. A cumulative assessment for NO_x and CO uses the maximum of background data obtained at Bargo, Macarthur and Oakdale, as representative of the area (described in **Section 5**). The purpose of the cumulative assessment is to demonstrate that no additional exceedances of the Impact Assessment Criteria will occur as a result of the operation of the MSGD sites when considered with background concentrations.

A Level 1 cumulative assessment uses the maximum measured background concentration added to the 100^{th} percentile dispersion modelling prediction to obtain a worst case total potential impact.

Even using this worst case approach, cumulative impacts would still be well below the relevant impact assessment criteria for all pollutants and averaging periods.

9 GREENHOUSE GAS EMISSIONS

9.1 Area 7 Goaf Gas Extraction

Goaf Gas is extracted from the 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. The goaf gas would be reticulated back via an existing gas management system to power plants at Appin West and Appin No 2 shaft for electricity generation. A maximum flow rate of 400 L/s is assumed to occur for 10% of the time and a more typical flow rate of 200 L/s is assumed to occur for 90% of the time, on an annual basis. The estimated GHG emissions (tonnes (t) CO_2-e / annum) are presented in **Table 9.2**.

Using the assumptions applied above, capturing and using the goaf gas for electricity generation is estimated to offset approximately 82 kt CO_2-e / annum. There would also be minor emissions associated extraction plant (electrically powered) and small GHG emissions associated with construction, however these have not been quantified.

Table 9.1: Estimated GHG emissions from Goaf Gas Drainage

Scenario	t CO_2-e / annum Goaf Gas Venting	t CO_2-e / annum - Power Generation
Without Goaf Gas Extraction	93,879	N/A
Goaf Gas Extraction and Power Generation	N/A	12,083
GHG Reduction	**81,795**	

9.2 Mine Safety Gas Drainage

An estimate has been made of the GHG emissions associated with the operation of the MSGD (i.e. using enclosed flares at each site) and compared with the estimated GHG emissions if this gas is vented direct to atmosphere (either through direct gas venting or later during mining via mine ventilation air (MVA)).

The MSGD flow is up to 450 L/s per flare and it is assumed that flares may operate at both MSGD sites for a total gas flow of 600 L/s. Similar to goaf gas, gas content is assumed to be approximately 90% methane and 2% CO_2.

The estimated GHG emissions (t CO_2-e / annum) are presented in **Table 9.2**. With two flares operating, the flaring of MSGD is estimated to offset approximately 221 kt CO_2-e / annum. There would also be minor emissions associated extraction plant, gas powered generators and small GHG emissions associated with construction, however these have not been quantified.

Table 9.2: Estimated GHG emissions from Pre-Drainage

Scenario	t CO_2-e / annum - MVA	t CO_2-e / annum - Flaring
Without Pre-Drainage [1]	256,033	N/A
With Pre-Drainage	N/A	34,238
GHG Offset	**221,795**	

Note: [1] Assuming emissions occur during mining via MVA

10 CONCLUSIONS

There are two distinct aspects to the Appin Gas Drainage Project including Mine Safety Gas Drainage and future goaf drainage activities at Appin Area 7 (Longwall 704 and 705).

Construction impacts associated with the goaf drainage activities at LW704 and 705 have been assessed qualitatively. Although fugitive dust emissions can be expected, construction of wells would be staged and therefore impacts would be relatively short lived and easily controlled using standard dust management techniques. Extracted goaf gas would be reticulated back via an existing gas management system to power plants at Appin West and Appin No 2 shaft for electricity generation. There would be no change to existing approvals at these power plants.

Mine Safety Gas Drainage would result in emissions from the flaring of the gas. Dispersion modelling for the operation of the flares at the two sites has been conducted and predicts ground level concentrations for all pollutants assessed well below the relevant impact assessment criteria. A level 1 cumulative assessment indicates that cumulative impacts would be well below the relevant impact assessment criteria for all pollutants and averaging periods.

11 REFERENCES

HAS (2006) "Air Quality Impact Assessment – Endeavour Project – West Cliff Colliery, Appin NSW" Holmes Air Sciences, September 2006.

HAS (2008) "Air Quality Impact Assessment: Metropolitan Coal Project", Holmes Air Sciences, June 2008.

Hurley, P. (2008). TAPM V4. Part 1: Technical Description, CSIRO Marine and Atmospheric Research Paper.

Hurley, P., M. Edwards, et al. (2009). "Evaluation of TAPM V4 for Several Meteorological and Air Pollution Datasets." Air Quality and Climate Change 43(3): 19.

NSW DEC (2005) "Approved Methods for the Modelling and Assessment of Air Pollutants in NSW", August 2005.

PAEHolmes (2009) "Air Quality Impact Assessment: Bulli Seam Operations", 15 May 2009.

PAEHolmes (2009a) "Air Quality Impact Assessment Appin Mine Area 7 Goaf Gas Drainage Project", May 2009

POEO (2010) "Protection of the Environment Operations (Clean Air) Regulations", 2010.

Robe, F (2009). Flare Modelling CASANZ 2009 Conference Joint Odour and Modelling Workshop – Perth September 6, 2009. TRC Atmospheric Study Group.

Scire, J.S., D.G. Strimaitis and R.J. Yamartino (2000). A User's Guide for the CALPUFF Dispersion Model (Version 5), Earth Tech, Inc., Concord, MA

TRC (2010) "Generic Guidance and Optimum Model Settings for the CALPUFF Modelling System for Inclusion into the "Approved Methods for Modelling and Assessment of Air Pollutants in NSW, Australia", prepared for NSW DECCW, Sydney Australia.

US EPA (1995) Compilation of Air Pollutant Emission Factors – Volume 1: Stationary Point and Area Sources, AP-42 Fifth Edition, Office of Air Quality Planning and Standards, Office of Air and Radiation, U.S. Environmental Protection Agency, Research Triangle Park, NC 27711, January 1995.

Appendix A: Gas Content Report

Cordeaux Gas Laboratory

Gas Analysis Report: 1108165 **Issue No.:** 1

Attention: Clive Pickering, Mick Loney

Sample Details: Goaf Plant LW34 11A

bhpbilliton

Illawarra Coal Holdings
Cordeaux Mine Site
Picton Road Mt Keira West NSW 2500
PO Box 514 Unanderra NSW 2526
Ph: +61 2 4224 6296 Fax: +61 2 4224 6256

Sampled By: Scott Grindle

Sampling Date: 18/08/2011 **Analysis Date:** 18/08/2011

Sampling Time: 8:30 **Analysis Time:** 10:56

Analyte	As Received Basis	Air Free Basis
oxygen	2.73 %v/v	- -
argon	0.257 %v/v	- -
nitrogen	10.7 %v/v	- -
methane	77.4 %v/v	89.7 %v/v
hydrogen	0.428 %v/v	0.496 %v/v
carbon monoxide	Not Detected	Not Detected
carbon dioxide	0.464 %v/v	0.533 %v/v
ethane	5.35 %v/v	6.2 %v/v
ethylene	Not Detected	Not Detected
propane	1.62 %v/v	1.87 %v/v
propylene	Not Detected	Not Detected
i-butane	0.33 %v/v	0.39 %v/v
n-butane	0.44 %v/v	0.51 %v/v
i-pentane	0.14 %v/v	0.17 %v/v
n-pentane	0.11 %v/v	0.12 %v/v
	Air Contamination:	13.01 %v/v

Comments:
All results analysed as received, dry basis. Results normalised to 100%. Argon determined by difference.
Air-free results calculated free of O_2, Ar and N_2.

Signed: ..... Murray Bull Date: 19/08/2011

Illawarra Coal Holdings Pty Ltd
ABN 69 093 857 296

A member of the BHP Billiton Group which is headquartered in Australia
Registered Office: 600 Bourke Street Melbourne Victoria 3000 Australia
ABN 49 004 028 077
Registered in Australia

Appendix E

Groundwater Impact Assessment

GeoTerra

BHP BILLITON ILLAWARRA COAL PTY LTD

APPIN MINE
SURFACE GAS EXTRACTION
GROUNDWATER ASSESSMENT

Douglas Park, NSW

BHP5-RGC

28 OCTOBER, 2011

GeoTerra PTY LTD **ABN 82 117 674 941**

77 Abergeldie Street Dulwich Hill NSW 2203

Phone: 02 9560 6583 Fax: 02 9560 6584 Mobile 0417 003 502 Email: geoterra@iinet.net.au

BHP5-RGC (28 OCTOBER, 2011)

GeoTerra

BHP Billiton Illawarra Coal Holdings Pty Ltd
PO Box 514
UNANDERRA NSW 2526

Attention: Bruce Blunden

Bruce,

RE: BHP Appin Mine
Surface Gas Extraction Groundwater Assessment

Please find enclosed a copy of the above mentioned report.

Yours faithfully

GeoTerra Pty Ltd

Andrew Dawkins (AuSIMM CP-Env)

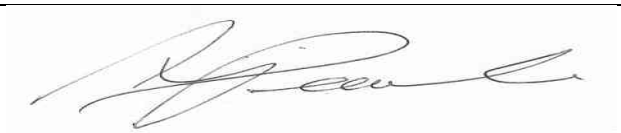
Managing Geoscientist

Distribution: Original GeoTerra Pty Ltd
1 electronic copy BHPB Illawarra Coal Pty Ltd

GeoTerra PTY LTD **ABN 82 117 674 941**

77 Abergeldie Street Dulwich Hill NSW 2203

Phone: 02 9560 6583 Fax: 02 9560 6584 Mobile 0417 003 502 Email: geoterra@iinet.net.au

Authorised on behalf of Geoterra Pty Ltd:	
Name:	Andrew Dawkins
Signature:	
Position:	Managing Geoscientist

Date	Rev	Comments
09.09.2011		Initial Draft
13.09.2011	A	Incorporate reviewers comments
19.09.2011	B	Incorporate reviewers comments
28.10.2011	C	Incorporate reviewers comments

GeoTerra PTY LTD **ABN 82 117 674 941**

77 Abergeldie Street Dulwich Hill NSW 2203

Phone: 02 9560 6583 Fax: 02 9560 6584 Mobile 0417 003 502 Email: geoterra@iinet.net.au

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1. INTRODUCTION

BHP Billiton Illawarra Coal (BHPBIC) propose to install surface gas drainage boreholes within the Appin Project Area over Longwalls 704 and 705 in the Area 7 longwall mining domain, as well as in the southern portion of the proposed Area 9 longwall mining area.

The proposed Medium Radius Drilling (MRD) and vertical surface gas drainage bores are proposed to be used to drain formation gas from the Bulgo Sandstone and goafed areas within the proposed longwall mine subsidence areas.

The Mine Safety Gas Drainage (MSGD) bores are proposed to be used to drain gas from the Bulli Seam.

2. GROUNDWATER RELATED LEGISLATION, POLICIES AND GUIDELINES

The following section outlines New South Wales State Government legislation, policy and guidelines with respect to groundwater that must be addressed when assessing the proposal.

2.1 Water Act 1912

The *Water Management Act 2000* commenced on the 1ST July 2011 in the Hawkesbury Nepean Region, and therefore the *Water Act 1912* no longer applies at the Project Site as the *Water Sharing Plan for the Greater Metropolitan Region Groundwater Sources* was gazetted on 1 July 2011.

As a result, all existing Water Act 1912 licences are being converted to water access licences and approvals under the *Water Management Act 2000*.

2.2 Water Management Act 2000

The *Water Management Act 2000* governs the issue of new water licences and the trade of water access licences and allocations for those water sources (rivers, lakes and groundwater) in NSW where water sharing plans have commenced.

Water access licences under the *Water Management Act 2000*:

- provide a defined share of the available water in a particular water source that can be sustainably extracted;
- provide a defined entitlement that is separate from land ownership;
- separate the entitlement to access water from the approvals associated with supply works and the use of water;
- in the case of continuing water access licences (licences granted in perpetuity), allow for the licence and water allocation available under that licence to be bought and sold fully or in parts and for the licences to be subdivided, consolidated and changed (e.g. for category, zone,water source), and;
- are listed on a public Water Access Licence Register

The *Water Management Act 2000* provides the framework for assessing areas that are seen to be suitable for water management, as well as implementing the water management process and determining applications to use groundwater. Provisions in the Act relating to approvals and controls only apply to areas with an approved water

management plan or water sharing plan.

2.2.1 Interim Aquifer Interference Regulation

An interim aquifer interference regulation came into force on 30 June 2011 which requires new mining and petroleum exploration activities that take more than 3ML/year from groundwater sources to hold a water access licence.

Stage 1 of the Aquifer Interference Regulation amended the blanket exemption from volumetric water licensing requirements that previously applied to persons engaged in prospecting or fossicking for minerals or petroleum.

This regulation allows an exemption from water licensing requirements for activities that take up to 3ML/year of water for that purpose in any year commencing 1 July 2011.

The new regulation includes transitional provisions, which, until 1 February 2012, retain certain entitlements under the Water Act 1912 to take water for the purpose of prospecting or fossicking for minerals or petroleum.

Under this legislation, a licence is usually required to be held by anyone taking water from an aquifer or river system and a separate approval is required for aquifer interference activities.

2.2.2 Aquifer Interference Policy Development

The NSW Office of Water is currently developing an Aquifer Interference Policy that will ultimately be implemented using a revision to the Stage 1 Aquifer Interference Regulation to ensure the policy forms part of the regulatory framework under the *Water Management Act 2000*.

The draft Aquifer Interference Policy, which has not been publicly released yet, defines exemptions from approval requirements based on the level of risk.

Exempt activities may be those that pose a low risk to water sources, their dependent ecosystems and other water users. Conditional exemptions from requiring a water licence may apply where risks can be avoided or minimised by following appropriate policies, guidelines or standards.

There are some exceptions to requiring a licence, such as where a basic landholder right to take water is held under section 52 of the Act.

The Aquifer Interference Policy, when it is released, is anticipated to clarify the information and studies required to be provided to the NSW Office of Water and the assessment considerations applied when deciding applications for water access licences and aquifer interference approvals.

The policy will ultimately define aquifer interference activities and describe how they will be managed under the licensing and approvals regime under the *Water Management Act 2000*.

The policy will focus on high risk activities that have the potential to contaminate groundwater or result in unacceptable loss of storage or other structural damage to an aquifer.

The draft Aquifer Interference Policy, which is being developed by the NSW Office of Water as a component of the *NSW Government's Strategic Regional Land Use Policy,* will clarify how the volume of water taken from a water source as part of an aquifer interference activity will be licensed and accounted for.

In June 2011 the draft policy was provided to a stakeholder reference group working with the NSW government in order to progress the Aquifer Intereference Policy under the Strategic Regional Land Use Policy.

The *Strategic Regional Land Use Policy* aims to strike a balance between agricultural, mining and energy sectors, while ensuring the protection of high value conservation lands.

In response to written submissions currently received from the reference group, many changes were incorporated into the draft, which is being developed for subsequent broader community consultation.

The draft Aquifer Interference Policy, as it stands, requires that all activities or works that intersect an aquifer and are not for the primary purpose of extracting groundwater must have an aquifer interference approval (unless approved under Part 3A of the Environmental Planning and Assessment Act 1979) and, if the work causes a decline in groundwater quantity, a water access licence is also required.

Release of the draft Aquifer Interference policy is anticipated, at the earliest, around October 2011 (Gill et al, 2011) and will be placed on public exhibition by the NSW government to allow feedback from interested parties.

Following consultation with the community, the policy will be finalised and new regulations enacted.

2.2.3 Aquifer Interference Approvals

Even if there is no dedicated “take” of water, aquifer interference activities can still have impacts on the aquifer and connected water sources, their water users and dependent ecosystems.

Impacts can include aquifer compaction and permanent loss of storage, creation or enhancement of hydraulic connections within and between water sources and subsequent loss of flow or pressure, cross-contamination or change to ambient water quality and irreversible damage to river beds and banks.

Anyone undertaking an aquifer interference activity is currently required to hold an aquifer interference approval unless they are specifically exempt from this requirement.

2.3 Environmental Planning and Assessment Act 1979 and the Environmental Planning and Assessment Regulation 2000

Authorisations such as an Aquifer Interference Approval under section 91 of the Water Management Act 2000 are not required where a project is approved in accordance with Part 3A of the Environmental Planning and Assessment Act 1979 (see section 75U of the EP&A Act).

This application seeks to modify the existing Project Approval (08_0256) granted in accordance with Part 3A of the Environmental Planning and Assessment Act 1979, hence it is assessed that no Aquifer Interference Approval will be required under section 91 of the Water Management Act 2000 for the proposed works.

2.4 Aquifer Risk

The NSW Government "Aquifer Risk Assessment Report" classifies the Southern Highlands Fractured Rock and Sydney Basin Sandstone, which covers the Project Area, as a "medium risk aquifer". However, no specific mention or additional description of the specific Project Area is contained within the report.

2.5 Groundwater Embargoes

There are currently no embargos on further applications for sub-surface water licences in the project area.

3. KEY GROUNDWATER CHARACTERISTICS

The proposed surface gas wells are targeted to extract gas from the Bulli Seam (lying at approximately 550m below surface) and the overlying strata that form the goaf during and after longwall mining

3.1 Hydrogeology

Three main aquifer systems are present in the project area, namely:

- thin, unconsolidated, perched, ephemeral, alluvial aquifers associated with stream valleys. Due to the steep topography and limited alluvium, there is no notable groundwater bearing stream based alluvium in the study area;
- perched ephemeral aquifers within the dual matrix porosity, tortuous and unpredictable flow paths within limited joint / fracture / bedding plane or dyke related groundwater flow systems of the shallow Hawkesbury Sandstone, and;
- dual matrix porosity, tortuous and unpredictable flow paths within limited joint / fracture / bedding plane or dyke related groundwater flow systems within the deeper basement Hawkesbury Sandstone and underlying lithologies in a variable sequence of aquicludes and aquitards comprising mainly mudstones and shales and low yielding aquifers in sandstones and coal seams.

The Illawarra Coal Measures are overlain by a thick, non-uniform, interbedded sandstone, siltstone and shale with a wide range of permeabilities in a sequence of aquifers and aquitards.

The strata overlying the Illawarra Coal Measures are generally low yielding and can contain fractured bedrock aquifers with permeabilities up to two orders of magnitude greater than the adjoining strata due to interconnected bedding, joint and fracture patterns.

The Hawkesbury Sandstone and Bulgo Sandstone are the most significant aquifers within the overburden.

Groundwater under the plateau flows under a hydraulic gradient to the Nepean River, with the water movement being predominantly horizontal and determined by confined flow along discrete layers underlain by fine grained or relatively impermeable strata.

Aquitards are formed by the shales within the Wianamatta Group, Bald Hill Claystone and by claystones located between the Bulgo Sandstone and the Illawarra Coal Measures.

The strata in the vicinity of the Project Area dips at a low angle to the north west, with groundwater flow being essentially horizontal.

Groundwater recharge is generally through lateral migration within the strata, with limited vertical migration.

Groundwater quality in the Project Area ranges from brackish to saline, with salinity generally increasing with depth and infiltration through the saline Ashfield Shale contributing to the brackish water quality observed in the Hawkesbury Sandstone.

3.1.1 Upland Swamps

No upland swamps are located within the Project Area.

3.1.2 Perched / Alluvial Aquifers

Outside of the Nepean River gorge, thin unconsolidated silts, sands and minor gravels of mixed colluvial and alluvial origin occur in valleys, creeks and gullies within the Project Area.

The alluvial deposits are thin and laterally discontinuous, with no significant groundwater storage capacity.

Due to the shallow and permeable nature of the alluvial deposits, any limited groundwater they contain is highly responsive to rainfall and stream flow.

Recharge is predominantly through rainfall infiltration and any water present is likely to drain rapidly into the creeks and gullies.

As a result, the alluvial deposits are not considered a significant aquifer or water resource in the Project Area.

3.1.3 Wianamatta Group, Mittagong Formation and Ashfield Shale

Where colluvial and alluvial deposits are absent, the Hawkesbury Sandstone, and to a lesser degree in the immediate area of the proposed gas extraction bores, the Wiannamatta Group, are exposed at the surface.

The Wianamatta Group is characterised by shales of low permeability, low storage and high groundwater salinity due to its marine depositional environment in the mid Triassic period. These characteristics generally render groundwater within the shales unsuitable for beneficial use (DMR, 1980).

Underlying the Wianamatta Group is the Mittagong Formation, which comprises interbedded shale laminate, medium grained quartz sandstone and black siltstone (SCA, 2007). The Mittagong Formation is a relatively thin layer within the strata and forms a transitional zone between the Ashfield Shale and the Hawkesbury Sandstone.

3.1.4 Hawkesbury Sandstone

The Hawkesbury Sandstone is generally a medium to coarse grained quartz rich sandstone with claystone, siltstone, minor shale and shale lenses which can contain a significant groundwater resource and is the major aquifer in the study area from a yield and water quality perspective.

The Hawkesbury Sandstone generally provides low yielding aquifers with low hydraulic conductivities.

Extraction of groundwater from the Hawkesbury Sandstone generally targets naturally fractured zones where the secondary porosity provides greater yield.

The Hawkesbury Sandstone is a sandstone sequence with varying permeabilities that contains localised barriers, such as siderite and clay or shale lenses.

The proposed surface gas wells lie within Groundwater Flow System 6 (GFS6) - Hawkesbury Sandstone Confined (Grey and Ross, 2003).

Within GFS6, the Hawkesbury Sandstone forms a layered aquifer system with groundwater occurring at vertically discrete horizons. There is limited and variable downward groundwater movement between the horizons. Flow occurs as both primary intergranular and secondary fracture flow in an unconfined to confined system.

Salinities range from 500 - 2000mg/L, with higher salinities in the Wianamatta Group capped areas, along with variable concentrations of dissolved iron.

The Nepean River and its tributaries dominates the topography in the Study Area in a 'gaining' system, where groundwater flows from the plateau under a regional hydraulic gradient to the river, with groundwater flow being dominantly horizontal within confined flow along discrete layers underlain by fine grained or relatively impermeable strata.

The plateau streams which drain to the Nepean River would be within a "losing" system, where the streams recharge the underlying regional groundwater system.

The Hawkesbury Sandstone sequence exposed in the Nepean River gorge is characteristic of sedimentary deposition and erosion in a braided stream with individual facies representing local sedimentary processes that generally do not persist across the area.

3.1.5 Narrabeen Group

The Narrabeen Group, which lies between the Hawkesbury Sandstone and Illawarra Coal Measures, is dominated by the fine to coarse grained quartz lithic Bulgo Sandstone, which has a similar matrix to the Hawkesbury Sandstone.

It is generally more cemented, less quartzose, less porous and has lower yields than the Hawkesbury Sandstone.

3.1.6 Illawarra Coal Measures

Although the Illawarra Coal Measures are essentially impermeable, some coal seams can form minor aquifers where their permeability is enhanced through fracturing, cleating and jointing.

Groundwater flow within the seams is almost exclusively horizontal as they are bound by fine-grained sediments which act as aquitards.

Groundwater within the coal seams is generally more saline compared to the near-surface sandstone aquifers.

3.1.7 Bore Census

There are two open standpipe BHPBIC monitoring piezometers (NGW3 and 4) located in the vicinity of the proposed gas extraction bores over Longwalls 704 and 705, with groundwater level and water quality monitoring being conducted in these piezometers since June 2004 as outlined in **Table 1**.

The "NGW series" piezometers were installed by BHPBIC within the Hawkesbury Sandstone to 10m below the base of the Nepean River Gorge. NSW Office of Water (NOW) Test Monitoring Bore Licences for the NGW series bores were submitted on 20 December 2007 and approved on 3 April 2009.

Two NOW registered private bores are also located within the general vicinity of the proposed gas extraction bores (GW101437 and GW104154) as summarised in **Table 1**.

Three private bores are located in the vicinity of the proposed Mine Safety Gas Drainage bores as summarised in **Table 2**.

Private bores not listed in **Tables 1** and **2**, although shown in **Drawing 1**, are used to demonstrate the distribution of private bores in the region. These regional private bores are not discussed further in this report as they are outside the specific gas extraction area.

All NOW registered private bores in the region are located on the western plateau of the Nepean River gorge. They were drilled between 70m to 250m below surface, with water obtained primarily from sandstone aquifers, however some thin, perched horizons encountered water intersections in the Wianamatta Shale (GW103161 at 17-18m and GW104602 at 30m.

Reported yields range from 0.2L/sec and 1.63L/sec from inflow zones ranging from 9 - 219m below surface. NOW bore data within the study area indicates that the regionally significant groundwater sources are generally intersected beneath 100m below surface within sandstone aquifers.

According to available records, private bore groundwater intersections as shallow as 9m may be present in shallow, perched aquifers with limited extent, as well as in limited, perched horizons within the Wianamatta Shale. The actual intersected aquifer horizon is generally deeper than the measured piezometric surface of a bore because when a confined aquifer is drilled into, formation water rises up the bore due to a combination of lithostatic and hydrostatic pressures. Based on this principle, and on assessment of the NOW data, the majority of aquifer intersections in the study area lie at or below the relative height of the Nepean River, even though the bore water levels may rise under pressure to higher elevations in a bore.

Table 1 Longwalls 704 and 705 Private Bores and BHPBIC Piezometers

GW	N	E	SWL (m)	Depth (m)	Drilled	Aquifer	Lithology	YIELD (L/s)	EC (mg/L)	Purpose
Private NOW Registered Bores										
101437	6216406	291651	75	128	1997	119 - 121	sandstone	0.7	2500	Farming
104154	6216080	291240	74	165	2000	116 - 161	shale / sandstone	1.3	2200	Dom / Stock
BHPB NOW Registered Piezometers										
NGW3	6216749.5	275027.4	1.4*	72.1	2004	-	shale / sandstone	-	-	Monit.
NGW4	6216826.2	275789.9	58	78.75	2004	-	sandstone	-	-	Monit.
Private NOW Registered Bores										
102584	6216255	289480	60	186	1999	54 - 179	sandstone	0.9	1300	Dom / Stock
103161	6216499	289511	25	120	2000	17* - 110	sandstone	0.2	1450	Dom / Stock
104602	6216148	288909	42	231	2002	30 - 213	sandstone	0.75	2500	Stock
BHPB NOW Registered Piezometers in the Vicinity of Longwall 701 to 704										
EAW5	6218729	289027	varies	612	2008	n/a	various	n/a	n/a	Monit.
EAW7	6217768	291547	various	611	2008	n/a	various	n/a	n/a	Monit.

Note: * data base information requires field confirmation

Table 2 Area 9 Private Bores and BHPBIC Piezometers

GW	N	E	SWL (m)	Depth (m)	Drilled	Aquifer	Lithology	YIELD (L/s)	TDS (mg/L)	Purpose
35033	6214961	288045	54.80	131	1973	17.6 – 17.7 54.8 – 55.1	sandstone sandstone	0.13 0.23	n/a	Stock
72249	6215538	288091	36.60	97.5	1994	76.2 – 76.3 85.3 – 85.5	sandstone sandstone	0.25 1.14	n/a	Dom / Stk
100673	6216160	286235	49.0	104	1995	71 – 74 84 - 87	sandstone sandstone	0.20 0.40	1200 1400	Stock
BHPB	**PIEZOS**									
EAW9	6216341	287181	various	605	2008	n/a	various	n/a	n/a	Monit.
EAW18	6216904	285466	various	798	2008	n/a	various	n/a	n/a	Monit.
EAW58	6215342	289803	various	525	2010	n/a	various	n/a	n/a	Monit.

Note: n/a not available * swl in mAHD RL as at Oct 2010 TDS total dissolved solids

Groundwater levels are logged hourly using vibrating wire piezometers in the NGW and EAW series piezometers and are downloaded on a weekly basis.

Water levels in the GW104154 bore are automatically measured twice daily and downloaded approximately every 2 months.

3.1.8 Vibrating Wire Piezometers

A fully cemented, sealed vibrating wire piezometer array has been installed by BHPBIC in bores EAW5 and EAW7 near the proposed Longwalls 704 and 705 gas extraction wells, as well as in EAW9, 18 and 58 in the vicinity of the Mine Safety Gas Drainage wells.

Although these wells are not included in additional discussions in this gas extraction focussed report, their water levels are used to enable a regional assessment of pre and post longwall and gas extraction water levels in the region.

3.1.9 Groundwater Licensing

Even though Appin Colliery does not directly extract or use any groundwater as part of its mining operations, BHPBIC has previously applied for a Licence under Part 5 of the Water Act 1912 for incidental extraction of groundwater from the mine in August 2008.

In addition, all open standpipe BHPBIC monitoring bores were licensed under Part 5 of the Water Act 1912 prior to installation.

As outlined in Section 4, the volume of groundwater expected to be produced from the Mine Safety Gas Drainage wells is likely to be less than 3ML/year, with a decline in produced water over time.

Based on an assumed outcome of the Aquifer Interference Policy and Regulation development by the NSW government, it is anticipated that due to the low volume of groundwater extracted and the minor effects on the local groundwater system during bore installation and gas extraction (see discussion in Sections 2 and 4), a water access licence will *not* be required as the proposed extraction volumes will be less than 3ML/year per bore.

4. PREVIOUS LOCAL GAS DRAINAGE EXPERIENCE

Initial flow rates of up to 52.5 kL/day were observed, which dropped down to a background of approximately 1 kL/day as the gas extraction bore matured for a Mine Safety Gas Drainage well that drained gas from the Bulli Seam at West Cliff Colliery in 2002/3.

Extrapolating the approximate three month water production period out to one year indicates the annual groundwater production from the monitored Mine Safety Gas Drainage bore could have been around 0.79 ML/year.

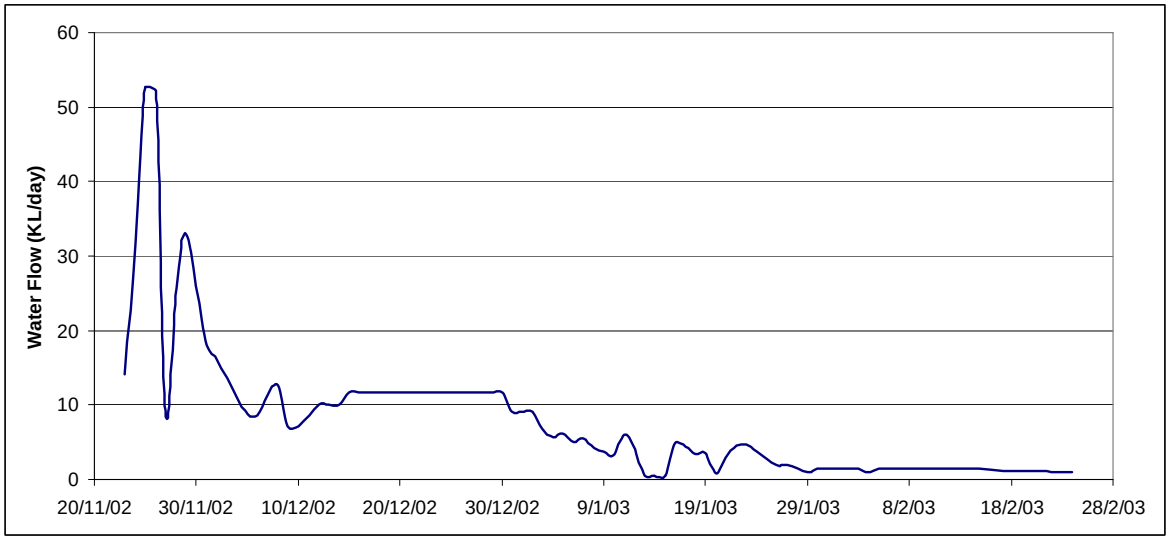


Figure 1 Observed Surface to In Seam (MSGD) Groundwater Flows

Monitoring conducted by AGL Energy Pty Ltd (AGL) during their exploration, development and production operations, which adopt similar bore installation, gas extraction and operational methods as proposed in the Mine Safety Gas Drainage borehole, indicates that a total of 2.4ML / year of groundwater from 80 operational surface gas wells occurred in the Camden exploration and production area (Ross, J, 2011).

AGL observed that some gas wells in their Camden field produced no groundwater inflow after the initial period of dewatering.

AGL also observed that the produced water from the Camden wellfield had a salinity range from 4500 – 9500mg/L.

BHPBIC have observed that no groundwater is produced from the cased and sealed sections in either vertical or MRD surface gas wells that extract gas from the goaf over their longwall mining areas, although incidental water is extracted from the gas drainage zones as described above.

5. PROPOSED BORE INSTALLATION

The proposed Mine Safety Gas Drainage and MRD drilling involve drilling into the Bulli Seam, or into the overburden, approximately 50m above the Bulli Seam, where the borehole deviates from a central point and continues on a subsurface lateral path along the target horizon.

For the drilling of each Mine Safety Gas Drainage bore, a single pond lined with an impermeable liner will be excavated within each drilling compound to act as a drilling sump.

The approximate dimensions of the sumps are 15m length x 5m width x 3m depth and the approximate volume of water used throughout the drilling process is 20,000L over a drilling period of approximately 6-8 weeks.

For drilling each MRD borehole, which is a much more intensive drilling process, drilling water will be stored in 20,000L tanks.

The approximate volume of water used throughout the MRD drilling process is expected to be 20,000L / bore over a drilling period of approximately 6-8 weeks.

Vertical goaf gas wells that require a single pond lined with an impermeable liner will be excavated within each drilling compound to act as a drilling sump. The approximate dimensions of the sump is 15m length x 5m width x 3m depth and the approximate volume of water used throughout the drilling process is 10,000L over a drilling period of approximately 2 weeks.

Water for the drilling will be supplied from a licenced extraction from the Nepean River or supplied by a Sydney Water Authorised User will be brought onsite, or reused for drilling as per Section 7.

The vertical boreholes will be cased with steel casing and grouted in place from the ground surface to the top of the Bulgo Sandstone, or an approximate depth of 250m below surface, which is well below any regionally significant aquifers present in the project area.

The MRD and Mine Safety Gas Drainage boreholes will be cased with welded or threaded steel casing and grouted in place from the ground surface to the end of the radial or build section where the horizontal alignment of the borehole starts, at an approximate depth of 450m below surface, which is also well below any regionally significant aquifers present in the project area.

The grout used in the MRD, Mine Safety Gas Drainage and vertical boreholes is a cement and water mixture, with a ratio of approximately 1kg of cement to 0.66L of water. The grout mixture will be injected into the voids between the borehole and steel pipeline casing, which will cement the steel casing in place and provide an impermeable barrier between the subsurface strata and the borehole.

The casing and grouting of the boreholes will negate the potential for groundwater inflow to and cross contamination of any aquifers via the boreholes during the operational phase of the proposed project.

The construction requirements of the gas extraction bores are an important component in mitigating any potential adverse impacts associated with bore installation and operation.

The bores are cased with pressure rated steel casing and are grouted into the formation down to the target depth in accordance with DII requirements. The casing provides support for the bores whilst grouting maintains segregation of aquifers within the strata.

6. PROPOSED BORE OPERATION

Water produced during gas extraction will be collected in 22,000L storage tanks.

Stored water will either be re-used for subsequent drilling operations and bore development, or will be disposed to an appropriately licensed offsite facility.

The use of storage tanks minimises the potential for drill water leakage into the underlying soil and shallow aquifers.

The integrity of storage tanks will be monitored regularly to minimise the likelihood of leakage into the underlying soil and shallow aquifers.

Water levels within the storage tanks will also be monitored to ensure overflow does not occur which reduces the likelihood of produced water contributing to surface runoff.

The small amount of water accumulated in the surface pipeline reticulation system due to condensation will be required to be released at periodic intervals. The extremely small volume of water from this source will be evaporated soon after it is released onto nearby pastures.

7. BORE DECOMMISSIONING

When a borehole is no longer required, it will be backfilled with cement to avoid inter-mingling of aquifers, with the casing cut and removed to 1m below ground level.

Cementing the bore casing to the surface means that inundation from surface water is not possible.

8. POTENTIAL EFFECTS ON GROUNDWATER

Activities which are likely to encounter groundwater and potentially affect the hydrogeological regime in the Project Area may comprise:

- installation and operation of the gas extraction wells, and
- subsurface drilling of lateral well paths, gas extraction and associated groundwater from the coal seam.

The potential impacts have been assessed to ensure appropriate management and mitigation measures are outlined to minimise the likelihood of their occurrence. Impacts that may result from the above activities include:

- limited , temporary, depressurisation of the coal measures aquifers, and;
- limited, temporary, reduction in groundwater quality during drilling and limited reduction in groundwater quality in the deeper Ilawarra Coal Measures during well operation.

Water used during drilling the bores may be temporarily exchanged with in situ groundwater if any aquifers are encountered during drilling , thereby leading to a limited, temporary, potential for cross contamination between aquifers during the drilling process, up until the bores are cased and sealed.

However, BHPBIC do not propose to intercept, extract or use groundwater once drilling is completed as all gas extraction boreholes will be fully encased and cemented into the strata to ensure isolation and prevent interconnection between beneficial aquifers, aquicludes and aquitards in the stratigraphy in the Project Area.

Any 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 (approximately 250m below the ground surface), This is well below any regionally significant aquifers that may be present within the project area.

The MRD and Mine Safety Gas Drainage boreholes will be cased with welded or threaded steel and grouted in place from the ground surface of the borehole to the end of the radial or build section where the horizontal alignment of the borehole starts, an approximate depth of 450m underground. This is well below that of any regionally significant aquifers that may be present within the project area.

The casing and sealing of the drilled bores prevents the boreholes from being able to be used for dedicated extraction of groundwater, even where aquifers are intersected.

BHPBIC does not anticipate there will be any specific groundwater extraction activity as part of the proposed goaf gas drainage project once the bores are cased and sealed, apart from the deep, incidental extraction from the target extractions zones during gas extraction.

Any water used for drilling operations will be from a licensed source, or reused from adjacent drilling operations.

All excavated ponds will contain an appropriate impermeable liner to prevent water loss and the pond walls will be of sufficient height to provide adequate freeboard to prevent inflow or overflow during rainfall.

Any water used in the borehole drilling will be removed and reused at Appin and/or West Cliff Collieries or disposed of at an appropriately licensed facility.

It is considered that, no significant actual, or residual, adverse impacts are likely to occur if the management and mitigation measures are implemented and adhered to.

Past experience has shown that the standard procedures used for construction of the gas extraction bores mitigate the potential for negative impacts to occur.

8.1 Aquifer Depressurisation

Existing similar gas extraction bores in the Southern Coalfields have observed limited volumes of groundwater inflow during drilling, which mainly originates from the Hawkesbury Sandstone. All extraction bores will be cased and sealed during installation to prevent inflow of shallow water supply aquifers in the Hawkesbury Sandstone.

The extraction of groundwater in association with the gas from within the Bulli Seam (and coal through development and longwall mining) results in depressurisatioon of groundwater within the Bulli Seam.

The extraction of coal, gas and groundwater, along with subsidence induced secondary flow paths developed in the goaf and overburden over previous longwalls has already depressurised the Bulli Seam on a regional scale. As such, the proposed minor, further, incidental groundwater extraction will have a minimal incremental impact.

Due to the poor water quality, greater depth in the strata and low yields, there are no beneficial users of the coal measures aquifers in the vicinity of the Project Area (Geoterra, 2011A, B) and as such, adverse impacts as a result of dewatering the Bulli Seam are not anticipated. It should also ne noted that the beneficial users listed in **Tables 1 and 2** all

extract from the Hawkesbury Sandstone, which will be cased and sealed off, with no adverse effects due to the proposed gas extraction operations.

The presence of the relatively impermeable Narrabeen Group over the Bulli Seam and the Permian coal measures will also confine the incidental, deep seated, groundwater extraction to the Illawarra Coal Measures.

Adverse impacts to the overlying aquifers are not anticipated as a result of dewatering / degassing the Bulli Seam aquifer due to proven, previously adopted bore installation and operational techniques.

It should be noted that no coal seam fraccing techniques are used in this Project

Subsurface drilling of Mine Safety Gas Drainage lateral bores remain within the coal seam and is therefore not anticipated to result in adverse dewatering of the overlying aquifers.

8.2 Nepean River

No adverse effects are anticipated on the Nepean River stream flow or water quality due to the proposed drilling, casing and bore operation methods.

8.3 Plateau Streams

No adverse effects are anticipated on the plateau stream flow or water quality due to the proposed drilling, casing and bore operation methods.

8.4 Groundwater Levels

Minor, temporary effects on groundwater levels close to each bore annulus may occur during drilling due to localised, temporary increased formation pressures that are caused during the drilling process, where air is injected into the bore the clean out the drill cuttings. As drilling progresses down the bore, the higher elevation air pressure in the bore, above the current drilling depth, decreases and temporary interconnection of aquifers can result until the bore is cased and sealed.

The minor groundwater extraction rates, as discussed in Section 4, along with the proposed drilling, casing and sealing of beneficial aquifers and the proposed well operation methods indicate that no significant adverse effects are anticipated on the local groundwater levels after the bore has been cased and sealed in situ. This is particularly the case since all water extraction will be from below the Bald Hill Claystone in the Bargo sandstone (for the Bargo Sandstone extraction wells) or in the underlying Illawarra Cal Measures for the MRD and Mine Safety Gas Drainage wells.

8.5 Aquifer / Aquitard Interconnection

The proposed bore installation procedures are designed to negate the potential for aquifer connectivity and subsequent drainage of shallow aquifers to deeper levels.

Minor, temporary effects of aquifer / aquitard interconnection may occur during drilling, however no adverse effects are anticipated to occur in regard to any induced aquifer / aquitard interconnection on the local groundwater system due to the proposed drilling, casing and sealing of upper aquifers and the proposed bore operation methods after the

bore has been cased and sealed in situ.

8.6 Private Bore Yields and Water Quality

No adverse effects are anticipated on private bore yields or water quality due to the proposed drilling, casing and bore operation methods.

8.7 Groundwater Seepage in Streams

No adverse effects are anticipated on groundwater seepage to local streams due to the proposed drilling, casing and bore operation methods.

8.8 Groundwater Quality

No adverse effects are anticipated on the regional groundwater quality due to the proposed drilling, casing and bore operation methods.

8.9 Groundwater Dependant Ecosystems

Based on the lack of any high priority GDE's in the Project Area, the low level of connection between the surface and bedrock aquifers in the Sydney Central Basin (NOW, 2010), the depth from which any groundwater would be extracted in the strata, the saline nature of the groundwater to be extracted and the proposed construction of the extraction bores, no adverse impacts impacts to any GDE's are anticipated in the Project Area.

9. GROUNDWATER CONSTRAINTS AND MITIGATION

9.1 Construction Phase

Where possible, all water used for drilling purposes will be stored in tanks. Any excavated ponds will be lined with an appropriate impermeable liner to prevent water loss. The walls of ponds will be of an appropriate height to provide adequate freeboard to prevent inflow or overflow during rainfall.

It is proposed that the water used for drilling will be sourced from a licensed extraction from the Nepean River or Sydney Water Authorised User, or reused from adjacent boreholes.

It is anticipated that the use of high quality water for this purpose will minimise the potential for impacts to groundwater and surface water during the construction phase.

9.2 Bore Installation Phase

If any voids are encountered during the drilling process, drilling will cease and the borehole will be sealed up immediately to prevent groundwater cross contamination from potential fracturing of the strata.

Should any voids be encountered and the potential for groundwater cross contamination arise, the small volume and quality of water proposed for use during the borehole drilling process is unlikely to lead to any significant changes to groundwater quality.

9.3 De-Commissioning Phase

De-commissioning of the boreholes will be undertaken in accordance with EDG01 Borehole Sealing Requirements on Land (Summerhayes, 1997).

All boreholes will be sealed in accordance with the guidelines upon completion of operations.

All water used in the borehole drilling will be removed and reused at Appin or West Cliff Collieries or disposed of at appropriately licensed facilities.

10. CONCLUSIONS

Given the proposed construction method of the Mine Safety Gas Drainage, MRD and vertical bores, the limited volumes of water generated during installation and the strata overlying the target gas extraction zones, an observable adverse reduction in groundwater quality or aquifer depressurisation is not anticipated.

Segregation of the aquifers by casing and sealing reduces the potential for cross contamination between aquifers, with the installation and operational practices used in the drilling and gas extraction meaning that hydraulic connection between the coal measures and overlying aquifers is extremely unlikely.

No adverse impacts to the groundwater regime or surrounding beneficial users of the groundwater resources are considered likely to result as a result of the proposed gas extraction operations.

Adverse impacts to beneficial users in overlying aquifers are not anticipated.

The proposed drilling activities are unlikely to have any measurable effect on the groundwater regime.

No beneficial users of the deep coal measures aquifers are present in the Project Area due to its low yields and poor quality.

Approved borehole construction methods and the containment of produced water in accordance with existing management practises will further minimise the potential of adverse groundwater impacts.

Based on an assumed outcome of the Aquifer Interference Policy and Regulation development by the NSW government, it is anticipated that due to the low volume of extracted groundwater and the anticipated minor effects on the local groundwater system during bore installation and gas extraction (see discussion in Sections 2 and 4), a water access licence will ***not*** be required as the proposed extraction volumes will be less than 3ML/year per bore.

Authorisations such as an Aquifer Interference Approval under section 91 of the Water Management Act 2000 are not required where a project is approved in accordance with Part 3A of the Environmental Planning and Assessment Act 1979 (see section 75U of the EP&A Act). This application seeks to modify the existing Project Approval (08_0256) granted in accordance with Part 3A of the Environmental Planning and Assessment Act 1979, hence no Aquifer Interference Approval will be required under section 91 of the Water Management Act 2000 for the proposed works.

It is considered there will be no groundwater related issues that represent a significant constraint to the proposed development.

11. REFERENCES

DECC, 2009 Draft Guidelines for Groundwater Monitoring

Geoterra, 2011 Appin Area 9 Longwalls 901 to 904 Groundwater Assessment

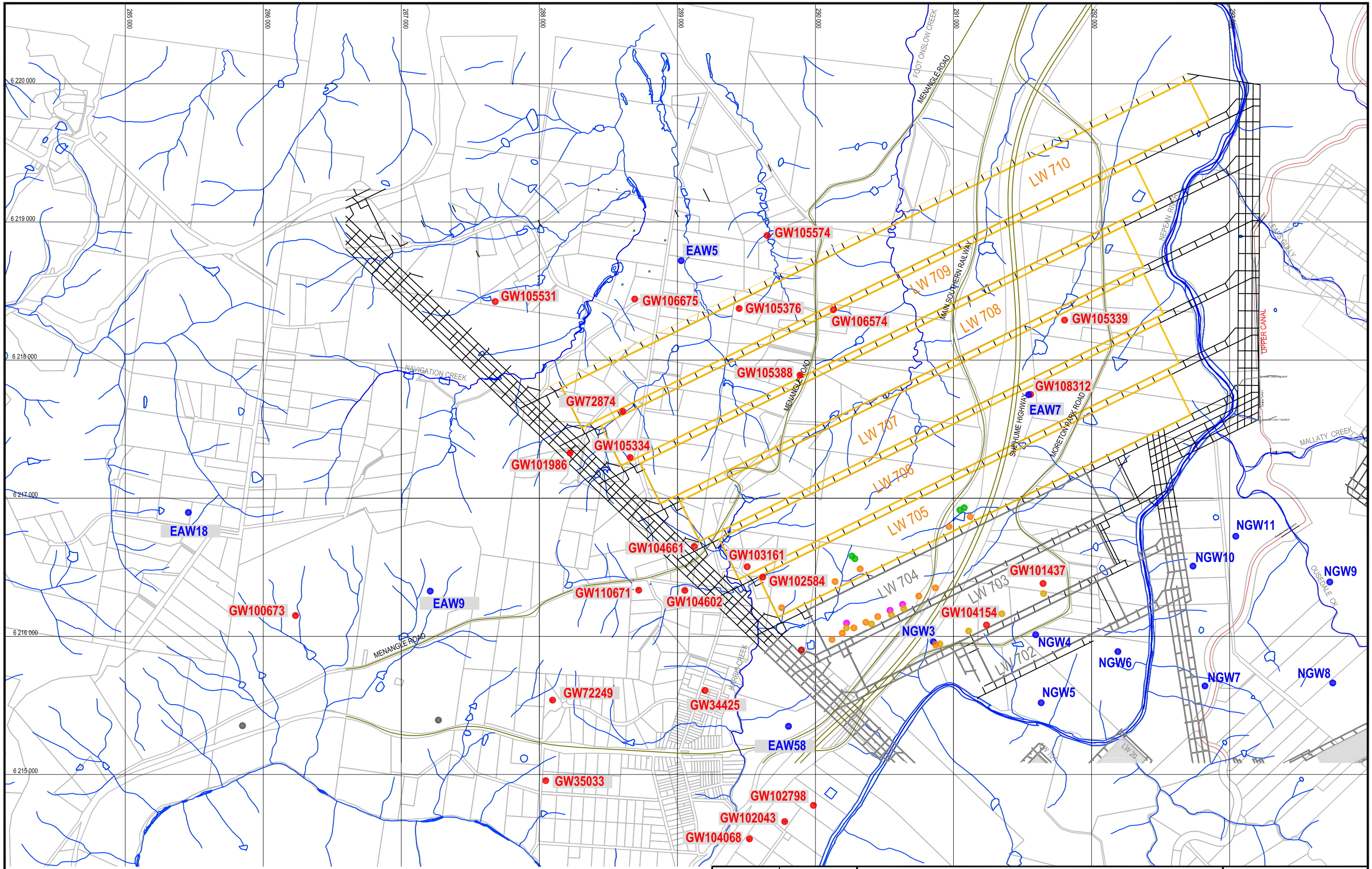
Geoterra, 2011 Appin Area 7 End of Longwall 703 Extraction Groundwater Monitoring Report

Gill, J. Smithson, A. O'Neill, R, 2011 Managing Aquifer Interference Activities in NSW, in Proc. of the International Association of Hydrogeologists, New South Wales Branch, NSW IAH Symposium 2011 Hydrogeology in NSW – the Challenges of Uncertainty, NSW, Aust, 5-6 September, 2011

Heritage Computing, 2010 A Hydrogeological Assessment in Support of the Bulli Seam Operations Environmental Assessment

Ross, J. 2011 AGL's Sustainable Re-Use Strategy for Produced Waters From Coal Seam Gas Operations, in Proc. of the International Association of Hydrogeologists, New South Wales Branch, NSW IAH Symposium 2011 Hydrogeology in NSW – the Challenges of Uncertainty, NSW, Aust, 5-6 September, 2011

DISCLAIMER



NOW REGISTERED BORE
BHPB IC PIEZOMETER
MRD BOREHOLE (PROPOSED)
VERTICAL BOREHOLE (PROPOSED)
MSGD (PROPOSED)
MRD BOREHOLE (APPROVED)
VERTICAL BOREHOLE (APPROVED)
DOWNHOLE (APPROVED)

0 0.25 0.5 0.75 1 1.25
SCALE KILOMETERS

Drawing Base Courtesy MSEC

PROJECT:	BHP5-RGb
DRAWN:	A. DAWKINS
DATE:	28 Oct 2011
SCALE:	1:25 000

BHP BILLITON ILLAWARRA COAL P/L
GAS EXTRACTION BORES
DOUGLAS PARK

Groundwater Piezometer Locations

GeoTerra

DRAWING 1

Appendix F

Photographic Log

Appendix F - Photo Log Appin Gas Drainage Project – s75W Modification

<table>
<tr><td>  </td><td>  </td></tr>
<tr><td>Photo 1 – MSGD Site#1 looking north</td><td>Photo 2 – MSGD Site#1 looking east</td></tr>
<tr><td>  </td><td>  </td></tr>
<tr><td>Photo 3 – MSGD Site#1 Site looking south-east</td><td>Photo 4 – MSGD Site#1 looking south towards Rail Line</td></tr>
</table>

Photo Log Appin Gas Drainage Project – s75W Modification

<table>
<tr><td>  </td><td>  </td></tr>
<tr><td>Photo 5 – MSGD Site#1 looking west</td><td>Photo 6 – MSGD Site#1 Proposed access point from Menangle Road</td></tr>
<tr><td>  </td><td>  </td></tr>
<tr><td>Photo 7 – MSGD Site#1 Proposed location of access track</td><td>Photo 8 – MSGD Site#1 Looking along contingency site access</td></tr>
</table>

Photo Log Appin Gas Drainage Project – s75W Modification

<table>
<tr><td>  </td><td>  </td></tr>
<tr><td>Photo 9 – MSGD Site#2 Site looking north</td><td>Photo 10 – MSGD Site#2 Site looking east</td></tr>
<tr><td>  </td><td>  </td></tr>
<tr><td>Photo 11 – Contingency STIS 3 Site looking south-east</td><td>Photo 12 – Contingency STIS 3 Site looking south towards Rail Line</td></tr>
</table>

Photo Log Appin Gas Drainage Project – s75W Modification

<table>
<tr><td>  </td><td>  </td></tr>
<tr><td>Photo 13 – MSGD Site#2 looking west</td><td>Photo 14 – MSGD Site#2 access track looking east</td></tr>
<tr><td>  </td><td>  </td></tr>
<tr><td>Photo 15 – MSGD Site#2 access track looking west</td><td>Photo 16 – Existing MSGD Site#2 access from Menangle Road</td></tr>
</table>

Photo Log Appin Gas Drainage Project – s75W Modification

<table>
<tr><td> 
</td><td>  </td></tr>
<tr><td>Photo 17 – LW705 MRD A B access of Morton Park Road looking east</td><td>Photo 18 – LW705 MRD A B access of Morton Park Road looking north</td></tr>
<tr><td>  </td><td>  </td></tr>
<tr><td>Photo 19 –705 MRD A/B access requiring filling and drainage works</td><td>Photo 20 – Existing 705 MRD A/B access track off Morton Park Road</td></tr>
</table>

Photo Log Appin Gas Drainage Project – s75W Modification

<table>
<tr><td>  </td><td>  </td></tr>
<tr><td>Photo 21 – LW705 MRD A/B and LW705v1 site looking north</td><td>Photo 22 – LW705 MRD A/B and LW705v1 looking east</td></tr>
<tr><td>  </td><td>  </td></tr>
<tr><td>Photo 23 – LW705 MRD A/B, LW705v1 looking south to LW705v2</td><td>Photo 24 – LW705 MRD A/B and LW705v1 looking west</td></tr>
</table>

Photo Log Appin Gas Drainage Project – s75W Modification

	
Photo 25 – LW704v3 site looking north	**Photo 26 – LW704v3 site looking east**
	
Photo 27 – LW704v3 site looking south	**Photo 28 – LW704v3 site looking west**

Photo Log Appin Gas Drainage Project – s75W Modification

<table>
<tr><td>  </td><td>  </td></tr>
<tr><td>Photo 29 – LW704v4 site looking north-east</td><td>Photo 30 – LW704v4 site looking east</td></tr>
<tr><td>  </td><td>  </td></tr>
<tr><td>Photo 31 – LW704v4 site looking south</td><td>Photo 32 – LW704v4 site looking west</td></tr>
</table>

Photo Log Appin Gas Drainage Project – s75W Modification

Photo 33 – Existing 704 MRD Site

Photo 34 – LW704v5-v9 site looking north

Photo 35 – LW704v5-v9 site looking east

Photo 36 – LW704v5-v9 site looking south

Photo Log Appin Gas Drainage Project – s75W Modification

Photo 37 – LW704v5-v9 site looking west

Photo 38 – LW705MRD C/D and LW705v3 sites looking north

Photo 39 – LW705MRD C/D and LW705v3 sites looking east

Photo 40 – LW705MRD C/D, LW705v3 sites looking south to LW705v4

Photo Log Appin Gas Drainage Project – s75W Modification

<table>
<tr><td>  </td><td>  </td></tr>
<tr><td>Photo 41 – LW705MRD C/D and LW705v3 sites looking west</td><td>Photo 42 – LW705v5 sites looking north-east</td></tr>
<tr><td>  </td><td>  </td></tr>
<tr><td>Photo 43 – South-east of LW705v5</td><td>Photo 44 – View looking west to LW705v5</td></tr>
</table>

Appendix G

Community Consultation Information

02 MEDIUM RADIUS **DRILLING**

SPECIALIST DRILLING EQUIPMENT IS USED TO CONDUCT MEDIUM RADIUS DRILLING (MRD). THE EQUIPMENT DRILLS DOWNWARDS IN A CURVE TO THE COAL SEAM THEN MOVES HORIZONTALLY THROUGH THE COAL SEAM OR IN THE CASE OF GOAF DRAINAGE, ABOVE THE COAL SEAM.

A drilling is used to drill the well which is positioned inside an enclosed compound on the surface. Sound barriers or earth bunds may be used to minimise noise from the site where necessary.

As well as the drill rig required to bore the MRD hole, the compound also contains air compressors, a water tanker, drill mud handling and pumping systems, top soil stockpile, and personnel vehicles and facilities.

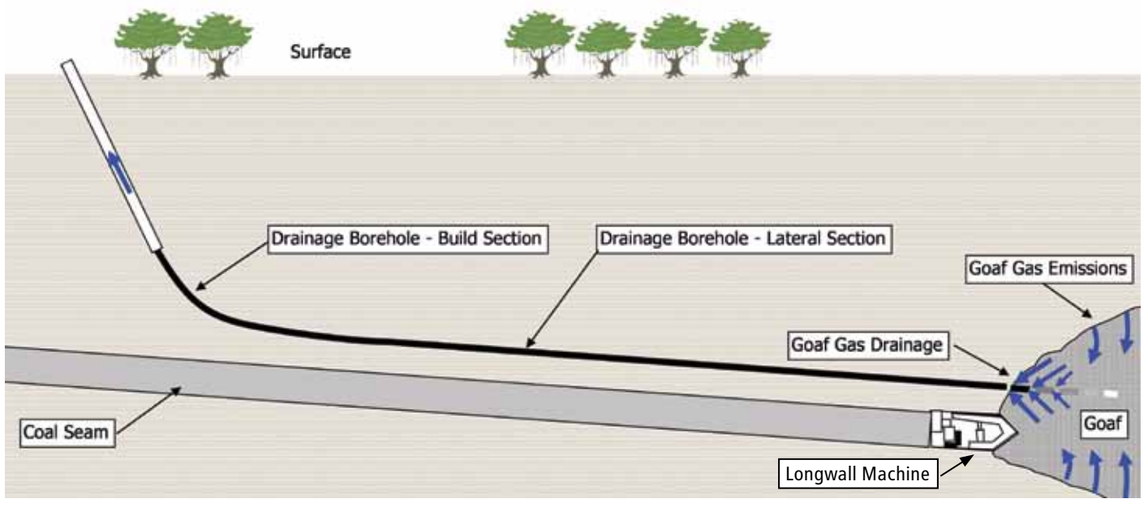
Medium radius drilling works usually occur in four main phases – civil construction, drilling mobilisation, drilling operation and drilling demobilisation. Typically, the four phases of works for surface gas drainage take the following period of time to complete:

- Civil construction – 60 days
- Drilling mobilisation – 10 days
- Drilling operation – 90 days
- Drilling demobilisation – 5 days

NB: These time periods are approximate and may vary.

During medium radius drilling activities, operations take place 24 hours a day, 7 days a week, in order to ensure the integrity of the angled hole.

The medium radius drilling site is prepared using a drill rig that is positioned within a compound surrounded by sound barriers.



VERTICAL **DRILLING** 03

A SECOND GAS DRAINAGE TECHNIQUE USED BY ILLAWARRA COAL IS VERTICAL BOREHOLE DRILLING. THIS TECHNIQUE INVOLVES DRILLING A HOLE STRAIGHT DOWN TO INTERSECT THE COAL SEAM AND DRAW GAS OUT. THE DRILL RIG USED FOR THIS ACTIVITY IS USUALLY SMALLER THAN THE MEDIUM RADIUS DRILLING RIG AND THE OPERATION USUALLY TAKES PLACE IN DAYLIGHT HOURS.

The rig is established within a compound housed by mesh fencing, and concrete noise barriers may also be used where necessary. Also within the compound there may be a water tanker, fuel tanker and light vehicles, and the rods and casings required for drilling the borehole.

MINE SAFETY GAS DRAINAGE **AND THE ENVIRONMENT**

Once the borehole is drilled, it is cased. Casing is a process where the drilled hole is lined with steel and the steel is cemented into the rock formation. This technique allows a complete seal between the rock and the casing, which ensures that aquifers are not compromised, and the water table is not impacted.

GAS MANAGEMENT **AND UTILISATION**

Once the borehole has been drilled, a wellhead (containing valves and control system) is fitted and the well is enclosed in a compound. Gas is drawn to the surface through the wells via a purpose built gas extraction plant.

Wherever possible, Illawarra Coal uses the gas extraction plant to draw gas out of the well and direct it to the Company's methane gas power plants where it is used to generate electricity.

Electricity surplus to Illawarra Coal's requirements is fed back to the state electricity grid, allowing the Company to reduce greenhouse gas emissions by abating close to 2.5 million tonnes of carbon dioxide (CO_2-e) per year, which is the equivalent of preventing emissions from around 625,000 cars.

Alternatively, it may be necessary to flare the methane gas. In flaring, the methane gas is converted to carbon dioxide to minimise greenhouse gas emissions and to avoid odour impacts.

Where possible, Illawarra Coal utilises methane gas to generate electricity, however when this is not possible, the gas is flared in encased flare stacks, minimising greenhouse gas emissions and avoiding odour impacts.

04

LAND **RESTORATION**

GAS DRAINAGE **AND LANDHOLDERS**

WHERE GAS DRAINAGE ACTIVITIES ARE PROPOSED ON PRIVATE PROPERTIES ILLAWARRA COAL WILL CONSULT WITH LANDHOLDERS ABOUT ACCESS TO THEIR PROPERTY AND SEEK AN ACCESS AGREEMENT.

An access agreement is a contract between Illawarra Coal and the landholder that sets out the terms and conditions under which the Company may conduct gas drainage activities on the land and any levels of compensation payments.

Where Illawarra Coal wishes to enter into an access arrangement with a landholder, the Company will make contact with the landholder to notify them of their intention to seek an access agreement. Any approach will outline a plan and description of the area of land to which access is sought and a description of the gas drainage activities intended to be conducted. Illawarra Coal will use its best endeavours to reach a fair and reasonable agreement with the landholder.

ON COMPLETION OF THE DRILLING PHASE, ALL DRILLING EQUIPMENT ON THE SITE IS DEMOBILISED. THE DRILL SITE IS BACKFILLED AND RACK-ROLLED TO AS NEAR AS PRACTICABLE TO THE ORIGINAL CONTOUR OF THE LAND. WHERE THE GAS IS BEING PIPED TO ILLAWARRA COAL'S POWER PLANTS, A STEEL CASING IS INSTALLED AND IS CONNECTED TO A PIPELINE TO DRAIN THE GAS. THIS INFRASTRUCTURE IS ENCLOSED IN A SMALL COMPOUND SIMILAR TO THE COMPOUND DEPICTED IN THE PHOTOGRAPH BELOW.

Upon completion of all gas extraction operations, all infrastructure and associated pipelines including flare stacks are removed and the hole is backfilled with cement. The steel casing is removed below ground level and covered with soil. All disturbed areas are revegetated to their original condition.

Once drilling activities are completed, the site is backfillled to restore original contour of the land and a small compound is constructed around the wellhead.

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Illawarra Coal

FOR FURTHER INFORMATION:

Illawarra Coal Community Call Line
Phone 1800 102 210

PO Box 514, Unanderra NSW 2526

www.bhpbilliton.com

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Production: Mitara Empresa Pty Ltd
www.mitara.com.au

ILLAWARRA**COAL**
MINE SAFETY GAS DRAINAGE

Illawarra Coal conducts mine safety gas drainage works in order to create a safe working environment underground. Once the surface gas drainage activities are complete the site is restored to its pre-work condition.

SURFACE GOAF GAS DRAINAGE – **AN OVERVIEW**

IN THIS FACT SHEET

Illawarra Coal conducts a comprehensive mine safety gas drainage program to remove methane gas from our mines and ensure a safe working environment for employees underground.

This fact sheet details information on mine gas safety drainage techniques used by Illawarra Coal on to drain methane gas from the coal seam to the land's surface.

TO CREATE A SAFE WORKING ENVIRONMENT FOR ITS PEOPLE WORKING UNDERGROUND, ILLAWARRA COAL CONDUCTS A COMPREHENSIVE MINE SAFETY GAS DRAINAGE PROGRAM TO REMOVE METHANE GAS FROM THE COAL SEAM.

Some gas is drained from within the underground workings and some gas is drained from the surface using two borehole drilling techniques– medium radius drilling (MRD) and vertical borehole drilling.

Medium radius drilling is conducted using specialist drilling equipment to create a borehole which curves from the surface downwards towards the coal seam, and then horizontally above or through the coal seam.

Vertical borehole drilling is conducted using drilling equipment which moves vertically from the surface to intersect the coal seam.

Medium radius drilling is used to extract gas from an area of the mine workings known as the goaf. The goaf is a mining term which refers to the area underground that is left behind after mining occurs. The longwall machine cuts the coal going forward and the goaf is the disturbed area behind it. Methane gas is released into the goaf area when coal is extracted by the longwall mining process. In this situation the equipment move horizontally above the coal seam to the goaf. A diagram on page two depicts this.

Vertical borehole drilling can also be used to drain gas from the goaf – where the surface immediately above the goaf is accessible.

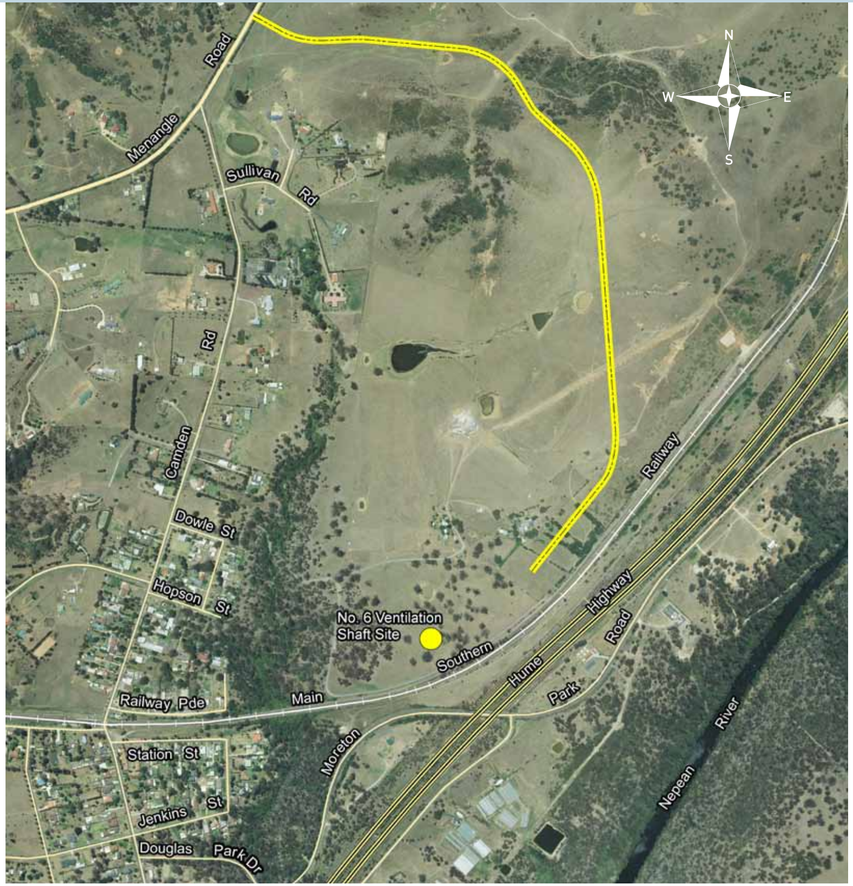
Both techniques can also be used in combination to release gas from an area before any mining occurs.

Where possible, the gas which is drained from the coal seam is piped to the Company's methane gas power plants where it is used to generate electricity, reducing the Company's greenhouse gas emissions. If it is not possible to pipe the gas to the power plants, the gas is flared in an enclosed flare stack.

02

NO 6 VENTILATION SHAFT **UPDATE**

ACTIVITY	COMMENCEMENT	SCHEDULED COMPLETION
Menangle Road intersection	August 2011	November 2011
Access Road	August 2011	January 2012
VS#6 Site Preparation	September 2011	January 2012
VS#6 Shaft Construction	February 2012	December 2014
VS#6 Fan Installation	July 2013	June 2015
Demobilisation, Noise Bund & Revegetation	January 2015	October 2015



03

MINE SAFETY **GAS DRAINAGE**

PROVIDING OUR EMPLOYEES UNDERGROUND WITH FRESH AIR IS A CRITICAL HEALTH AND SAFETY IMPERATIVE FOR US, AND THE NO 6 VENTILATION SHAFT IS AN IMPORTANT ELEMENT IN THE VENTILATION SYSTEM FOR THE EXISTING APPIN MINE (WHICH IS CURRENTLY EXTRACTING COAL BENEATH THE SURFACE APPROXIMATELY ONE KILOMETRE TO THE NORTH-EAST OF DOUGLAS PARK) AND FUTURE WORKINGS IN THE AREA. THE PROCESS OF MINE VENTILATION INVOLVES TAKING AIR IN AT ONE PART OF THE MINING AREA, AND DRAWING IT OUT FROM ANOTHER.

The No 6 Ventilation Shaft will be an 'up-cast' shaft with fans – meaning that the air is drawn through the mine from elsewhere and emitted to the atmosphere via the ventilation shaft. Once site access has been completed, we will start other site preparation works which are expected to take around six months. In mid-2012 shaft construction equipment should begin to arrive on site and the drilling or 'sinking' of the shaft should start soon after that.

The drilling or 'sinking' of the shaft will take around 18 months to complete. Once this has been done, the fans and other infrastructure will be installed. If all these works proceed according to schedule, the ventilation shaft and its associated infrastructure will be completed by mid-2015.

Situated on the southern end of the Mountbatten Stud property and screened by a vegetated earth bund, the shaft structure will not be visible to the township of Douglas Park. Around seven metres high on completion, the top of the shaft structure will be visible from Spaniards Hill and some other surrounding high points.

04

TO CREATE A SAFE WORKING ENVIRONMENT FOR OUR PEOPLE UNDERGROUND, ILLAWARRA COAL CONDUCTS A COMPREHENSIVE MINE SAFETY GAS DRAINAGE PROGRAM TO REMOVE METHANE GAS FROM THE COAL SEAM AHEAD OF MINING.

Illawarra Coal does not 'mine' coal seam gas and we don't use the process known as fraccing. Our primary reason for draining the gas is to improve the safety of our underground operations. Coal seams can contain high levels of methane. When gas builds up in a mine the gas poses a significant safety and operational risk. To minimise the build-up of gas in the mine some of the gas is removed from the coal before mining occurs by drilling a well from the surface.

We are currently developing plans for the next phase of our program to drill mine safety gas drainage holes.

Associated with current and future workings, these holes will be operated on a temporary basis and, when they are no longer required, will be backfilled with cement, all equipment will be removed and the site will be rehabilitated.

This program of works will require drilling on a 24-hour basis, but with strict noise controls in place. Setting up of the site will occur in the day time only and involve standard earthmoving equipment. It will be screened with four-metre high, concrete walls to minimise noise and visual impacts. Noise monitoring will be carried out to ensure we comply with strict noise limits.

Once our gas drainage holes are drilled, they are cased. Casing is a process where the drilled hole is lined with steel which is cemented into the rock formation. This technique allows a complete seal between the rock and the casing, which ensures that aquifers are not compromised, and the water table is not impacted.

Gas from our proposed mine safety gas drainage holes will in some cases be flared in an enclosed flare stack, or where possible, piped to the Company's methane gas power plants where it is used to generate electricity, reducing the Company's greenhouse gas emissions. The flares are quiet and should not be audible at nearby residences. They are very safe and have in-built safety shutoff mechanisms which stop the flow of gas when the flares are not in use.

Where possible, gas from mine safety gas drainage holes is piped to methane gas power plants or in some cases is flared in enclosed flare stacks similar to those pictured above.

LAND **RESTORATION**

UPON COMPLETION OF ALL GAS EXTRACTION OPERATIONS, ALL INFRASTRUCTURE AND ASSOCIATED PIPELINES INCLUDING FLARE STACKS ARE REMOVED AND THE HOLE IS BACKFILLED WITH CEMENT. ALL DISTURBED AREAS ARE REVEGETATED TO THEIR ORIGINAL CONDITION.

05

FOR MORE **INFORMATION**

BHP BILLITON ILLAWARRA COAL **COMMUNITY CALL LINE**

Residents who have any questions, concerns, or complaints about BHP Billiton Illawarra Coal's activities are encouraged to contact us through our community call line on 1800 102 210.

You can also send us feedback, questions or complaints by email using the following address:

ICEnquiries@BHPBilliton.com

Production: Mitara Empresa Pty Ltd
www.mitara.com.au

Contact: Illawarra Coal
PO Box 514, Unanderra NSW 2526
Phone: 02 4286 3000
Fax: 02 4286 3600

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FOR MORE **INFORMATION**

DOUGLAS PARK COMMUNITY **INFORMATION SPOT**

If you would also like to discuss anything in relation to these proposed developments or any other parts of Illawarra Coal's operations with a company representative, you can do so by visiting:

Illawarra Coal's Douglas Park Community Information Spot

Douglas Park Community Centre

Every 1st Thursday of the month (12pm-4pm)
Every 3rd Saturday of the month (10am-2pm)

For additional information please contact:

Deanne Frankel
Landholder Relations Advisor
Illawarra Coal
Phone: 0467 795 623
Email: Deanne.Frankel@BHPBilliton.com

Lee Perry
Landholder Relations Advisor
Illawarra Coal
Phone: 0467 794 412
Email: Lee.Perry@BHPBilliton.com

Illawarra Coal Community Call Line
Phone 1800 102 210

www.bhpbilliton.com

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Illawarra Coal

ILLAWARRA**COAL** COMMUNITY UPDATE

Information regarding Illawarra Coal's activities in the Douglas Park area is contained in this newsletter.

NO 6 VENTILATION SHAFT **UPDATE**

WHO IS ILLAWARRA COAL?

Illawarra Coal is a subsidiary of BHP Billiton and we operate three underground coal mines – Appin and West Cliff in the Wollondilly region, and Dendrobium Mine in the Illawarra region. Using longwall technology, these mines produce premium quality hard coking coal for steelmaking.

We supply more than 70 per cent of the coal used by the Australian steel industry for the manufacture of products such as whitegoods, building materials, cars, railway lines, and many other everyday items.

West Cliff and Appin mines extract coal from the Bulli Seam which is up to 600 metres below the surface. The Appin Mine pit top is situated on Douglas Park Drive, Douglas Park, and has an additional site near the village of Appin. The West Cliff Mine and its associated infrastructure are situated on the Appin Road, east of Appin. These mines and their associated infrastructure are combined to form Illawarra Coal's Bulli Seam Operations.

SEPTEMBER 2011

THE PURPOSE OF THIS INFORMATION SHEET IS TO PROVIDE YOU WITH AN UPDATE ON ILLAWARRA COAL ACTIVITIES IN YOUR AREA.

As you may have noticed, work has commenced on the access road to the No 6 Ventilation Shaft site, which is located on property owned by the Company between Douglas Park township and the Hume Highway. The access road intersects Menangle Road, north of the Camden Road intersection and initial works are associated with constructing the intersection which will include a northbound passing lane and southbound exit lane. Once complete, the road will follow a path to the Shaft location which will be positioned close to the Hume Highway and not visible to most areas of Douglas Park.

The access road will be a seven-metre wide, dual lane, sealed road. The area that is currently disturbed for construction will be grassed to look like the surrounding farm land.

The project received government approval in May 2011 and work on the access road began in August. It is anticipated that the intersection will be complete by November 2011 and the entire access road will be complete by February 2012.

The location of the new access road was determined, in consultation with the Douglas Park Advisory Panel, to avoid interactions between Douglas Park Primary School and construction traffic (the current site access is in Duggan Street, adjacent to the School). All traffic movements will be managed in accordance with government-approved management plans – which address elements such as the timing of traffic movements, speed limits and possible curfews – and the Douglas Park Drivers' Code of Conduct. Under this code, heavy traffic is prohibited within the Douglas Park urban area during drop off and pick up times at Douglas Park School.

A full copy of the approval document, which includes all conditions of consent, is available on the Department of Planning and Infrastructure website: **majorprojects.planning.nsw.gov.au/page/determinations.**

Prior to project approval, we worked closely with the Douglas Park Advisory Panel, particularly on the preparation of the Environment Assessment (EA), and we hope to continue working with the Panel throughout the ventilation shaft construction process. **Your representatives on the Panel are: Naomi Sheil, Patricia Smith, Peter Smith, Amy Parish, Christine Towndrow, Danny Stewart, Jim Samphier, Brian Edwards.**