

APEX ENERGY NL

**Illawarra Coal Seam Gas
Exploration Drilling and Gas
Monitoring Program
Proposed Additional Borehole
Site AI19**



**Environmental Assessment to Support a Request to
Modify Project Approval
Under Part 3A Environmental Planning & Assessment Act**

January 2011

Prepared by Olsen Environmental Consulting Pty Limited

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Information Statement

David Olsen, Director of Olsen Environmental Consulting Pty Limited prepared this Environmental Assessment. David holds a Bachelors Degree in Agricultural Science with Honours.

This Environmental Assessment is based on information provided by Apex Energy NL and various reports prepared by specialist consultants. Olsen Consulting Group Pty Ltd has relied on this information in preparing this Environmental Assessment.

CERTIFICATION

I certify that I have prepared this Environmental Assessment for the proposed additional borehole (Borehole AI19) which will form part of the Apex Energy NL, Illawarra Coal Seam Gas Exploration Drilling and Gas Monitoring Program, and to the best of my knowledge, it is true in all material particulars and does not, by its presentation or omission of information, materially mislead.

David Philip Olsen

Signature.**Name.****Date**

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APPENDICES

APPENDIX I Ecoengineers Pty Ltd. August 2010

Letter to Olsen Environmental Consulting Pty Limited

"Proposed Extra Apex Energy Coal Seam Gas Exploration Borehole AI19 off Darkes Forest Road, Darkes Forest".

APPENDIX II. Niche Environment and Heritage Pty Limited. August 2010.

"Ecological and Cultural Heritage Assessment".

APPENDIX III. SLR Heggies. October 2010.

Letter to Olsen Environmental Consulting Pty Limited.

"Drill Site Location AI19. Core Seam Gas Drilling, Illawarra NSW. Noise and Vibration Assessment."

APPENDIX IV. Niche Environment and Heritage. November 2010.

Letter to Olsen Environmental Consulting Pty Limited.

"Apex Energy Gas Exploration Project: Submission from NSW DECCW".

APPENDIX V. SLR Heggies. December 2010.

Letter to Olsen Environmental Consulting Pty Limited.

“Comments on DECCW’s Adequacy of Environmental Assessment Proposed Modification to Apex Energy Gas Exploration Project”.

1 EXECUTIVE SUMMARY AND CONCLUSION

This document is an Environmental Assessment of Borehole AI19, which forms part of the Illawarra Coal Seam Gas Exploration Drilling and Gas Monitoring Program to be undertaken by Apex Energy NL (Apex). It has been prepared to meet the requirements of Section 75W of Part 3A of the ***Environmental Planning and Assessment Act, 1979***.

Apex received Project Approval for the construction and operation of exploration boreholes at 15 locations within PEL 444 and PEL 442. The Director-General of the Department of Planning issued Project Approval for Application No. 07_0103 on 23rd September 2009, under delegation from the Minister for Planning. This Environmental Assessment of the new borehole supports a request to the Minister to modify that Project Approval.

The modification is required to accommodate changes to the Project Approval that will flow from the construction and operation of the new borehole. The request to the Minister is submitted in accordance with Section 75W of the ***Environmental Planning and Assessment Act 1979***.

The construction and operation of the 15 boreholes constituted the initial stage of the Illawarra Coal Seam Gas Exploration Drilling and Gas Monitoring Program and is proposed by Apex as holder of majority interest in the PELs. The drilling operator shall be Ormil Operations Pty Ltd, a subsidiary of ASX-listed Ormil Energy Limited, which holds a minority interest in the PELs through a subsidiary, Sydney Basin CBM Pty Ltd and is farming into further interest in the PELs by funding a staged Works Program entered into with Apex.

The Project is fully described in the Environmental Assessment titled "Illawarra Coal Seam Gas Exploration Drilling and Gas Monitoring Program" and dated March 2009, which was prepared by Olsen Consulting Group Pty Ltd. The Environmental Assessment Report was supported by eight Appendices, which included detailed environmental impact assessment and management of the project in relation to such topics as flora, fauna, soils, water, acoustics, archaeology and heritage.

Subsequent investigation and planning by Apex has identified the need for an additional cored exploration and gas monitoring borehole. The additional borehole is required to enable collection of core samples from unmined coal seams within PEL 444. Initial work would involve re-opening of a closed fire trail to provide vehicular access to the proposed site. A drill pad would be prepared at the borehole site. This would enable the core hole to be drilled and then flow, pressure and permeability testing to be undertaken using the core hole. When these activities are completed the core hole would be cemented to the surface. The site would be retained pending the outcome of investigations of the core samples and the gas monitoring. Should the results not warrant further use of the site borehole site and access track, they would be rehabilitated fully. If the results indicate further use of the site is warranted, the access track and the borehole site would be maintained in an accessible condition. Any further use of the site additional to obtaining core samples and gas testing would be subject to another Project Approval Application and associated Environmental Assessment.

This Environmental Assessment describes the location and features of the additional borehole at AI19 and provides an impact assessment and management proposals for its construction and operation. Environmental management proposals and commitments already made by Apex and approved by the Minister for Planning will enable the inclusion of Borehole AI19 into the overall gas exploration and monitoring program.

Apex believes that the activities at the proposed borehole site are similar to activities already approved for the 15-hole gas monitoring project and will not significantly alter the overall environmental impact of the project.

This current EA is set out in a logical format as described in the following paragraphs.

Section 2 defines the location of AI19 within Petroleum Exploration Licence No. 444 (PEL 444).

The objective of the overall project is to determine gas potential in all seams of the Illawarra Coal Measures, as well as goaf gas that has collected in abandoned Bulli Seam workings. Determination of gas potential will require measurement and testing of gas quality and quantity from the borehole. Borehole AI19 will contribute to this objective.

Section 3 describes the details of the borehole site layout and construction. Activity at Borehole Site AI19 would involve a typical drilling operation commonly used in coal exploration for underground mines throughout the State and typical of many such boreholes already drilled in the NSW Southern Coalfield. Drilling will establish a borehole enabling core collection for subsequent gas content analysis. Some gas flow, pressure and permeability testing will be undertaken during the coring activity. The borehole will be filled with cement immediately the testing has been completed. Depending on test results, the access track and borehole site will either be completely rehabilitated or remain in an accessible state for future use. Any future use would be subject to a separate Project Approval Application and associated Environmental Assessment.

Apex has approval to drill 15 boreholes from the surface down to various levels within and to the base of the Illawarra Coal Measures. Some of the boreholes will provide access to old mine workings and these will enable determination of goaf gas quantities and quality. The remaining boreholes will intersect coal and will enable in-situ coal gas quantities and quality to be defined. All boreholes will enable gas extraction rates to be measured. Boreholes that intersect coal will enable a series of horizontal radial boreholes to be drilled parallel to the Measures from the vertical borehole. This drilling would be undertaken at some time in the future and is not currently approved. Additional approval would be sought at that time. The number of horizontal radial boreholes drilled will depend on the measurable gas reserves.

Apex is requesting the Minister for Planning to modify the existing approval to allow the drilling of an additional borehole at AI19.

Access to the AI19 drilling site will be via an existing closed fire trail. Apex has selected the proposed borehole site to minimise surface disturbance and to facilitate environmental management of the drilling and gas measuring activities.

Should this proposed exploration program (consisting of 16 borehole sites including AI19) identify potential gas reserves Apex intend to seek additional approval to develop the reserve.

Any future development of the gas reserves would require a pipe-based gas collection system. Apex has not identified any obvious environmental constraints that would preclude any of the currently proposed boreholes (including AI19) and gas collection system routes from this future development. Any future development of gas production wells would be subject of another approval application and does not form part of this request to modify the Project Approval.

Exploration data collection requires AI19 to be located at a specific site to ensure that it intersects the required strata and avoids existing mine workings and previously defined geological anomalies. However, there is sufficient flexibility to move the proposed site in order to avoid significant surface features. Apex has undertaken a detailed surface inspection with the landowner ((Sydney Catchment Authority (SCA)) together with specialist flora, fauna, archaeology and water consultants in order to select an appropriate borehole site for AI19. The nominated site can be varied should other significant surface features be identified prior to commencing borehole drilling.

Apex is still in negotiations with SCA, as the landholder in relation to access to AI19 site and must negotiate access arrangements with SCA prior to drilling commencing. Apex currently has land access consent from SCA for 5 of the currently approved sites and shall conclude arrangements for AI19 following completion of the process associated with this Section 75W Modification Application.

Up to 6 people will be on site during drilling operations and it will take approximately 6 weeks to drill the borehole and undertake the necessary on-site gas monitoring and testing. This would be preceded by approximately 4 weeks to establish the access and site preparations. After the core samples are obtained, evaluation of the test and core results will occur off-site. Evaluation of the results is expected to take a further 6 weeks.

Section 4 details the environmental impact assessment of the construction and operation of AI19 and how that will be accommodated in the environmental management of the overall project. The various issues addressed in this Section are summarised in the following paragraphs.

Dust.

Any dust generated during the drilling and the gas monitoring phases of the program will be insignificant.

Surface Water Quality.

Sediment controls built in accordance with the Landcom publication, **“Soils and Construction” Volume 1, 4th Edition, March 2004**, will be implemented to control surface water quality. A Site Water Management Plan will be developed and implemented.

Soils.

Topsoils will be stored for use in rehabilitation.

Acoustics.

Borehole AI19 is located 800 m from the nearest residence. Noise levels emitted during the drilling should meet all DECCW criteria. During drilling operations all equipment will be checked and maintained to ensure acceptable noise characteristics. Any residents living nearby will be advised prior to the drilling. Monitoring will confirm compliance with acoustic criteria and predictions.

Flora and Fauna.

The proposal to construct and operate Borehole AI19 will involve limited clearing affecting approximately 0.66 ha of existing native vegetation which consists of regrowth native vegetation along a previous fire track. A Species Impact Statement under the **Threatened Species Conservation Act 1995** (TSCA) or a Referral for Matters of National Significance under the TSCA and the **Environment Protection and Biodiversity Conservation Act 1999** (EPBC) were not necessary for any threatened flora or fauna within the area of the proposed activities. The proposed works are unlikely to have a significant impact on any threatened species, endangered ecological communities or populations. However, commitments are made to minimise any disturbance on the ecological values of the area.

Traffic.

Due to the small number of employees and the limited construction time, significant traffic impacts are not expected. Traffic safety rules and procedures will be developed to ensure public and employee safety during all operational stages of the program.

Waste Management.

All waste will be disposed of at appropriately licensed facilities off site. Recycling will be encouraged.

Archaeology, History and Heritage.

The proposal is not predicted to significantly impact archaeological or cultural heritage values within the proposed borehole location.

Visual Effects.

Due to the isolated location and access restrictions, it is unlikely that the proposed drilling and gas monitoring operations at Borehole AI19 would be greatly noticeable or offensive to a general member of the public when viewed from the surrounding area.

Section 5 describes the Environmental Management System that Apex will implement to ensure appropriate environmental management of the Program including the new Borehole Site AI19. This Section also includes the Statement of

Commitments, which indicates the measures Apex will undertake to minimise impacts on the environment.

Appendices I to III contain the supporting specialist consultant reports and correspondence assisting with the assessment of issues related to the acoustic, flora, fauna, archaeological and water components of the environment. **Appendices IV and V** contain specialist consultant responses to matters raised by Government Departments and Agencies in relation to the Draft EA.

Borehole Site AI19 has been selected by Apex as suitable for the proposal and to minimise disturbance of significant surface features. Specialist consultants were commissioned to assess potential environmental impact and to recommend amelioration measures to eliminate or minimise any potential impacts. The site is located to ensure the Program objectives can be achieved and that future development of the borehole as a gas production well and establishment of a pipe-based gas collection system can be installed without significant environmental impact. Benefits will flow to both the proponent and the local and state community through increased knowledge of available gas reserves.

In conclusion, this Environmental Assessment does not identify any environmental issues that would preclude modification of the existing Project Approval to accommodate construction and operation of Borehole Site AI19 as proposed.

2 LOCATION OF BOREHOLE AI19

Figure 1 shows the location of proposed Borehole Site AI19 in relation to the previously approved boreholes. AI19 is located in the north western sector of the PEL approximately 1 km from Darkes Forest Road within the upper reaches of the Forest Gully catchment. The site is within a Sydney Catchment Authority (SCA) Special Area.

The proposed borehole is located outside the approved project envelope and **Figure 1** shows the project envelope modified to include the access track and borehole site for AI19.

The borehole and access track are located on SCA land identified as Lot 1 DP830604.

Figure 2 shows the location of AI19 in more detail and shows Fire Trail No 9A which will be used for access to the drill site. The Figure also shows Darkes Forest Road and the nearest residences along the western side of Darkes Forest Road. These residences are highlighted in yellow and are approximately 800 m minimum distant from the borehole site.

Figure 2 shows the location of an upland swamp in the vicinity of the borehole site. The exact location of the proposed borehole at AI19 is given by the following co-ordinates.

Easting: 307877

Northing: 6212410

Latitude: -34.2117 S

Longitude: 150.9145 E.

The borehole will be located within an area of approximate dimensions 50 m wide by 70 m long. This is the maximum area required. Within this area not all vegetation would be cleared. Only the minimum area necessary to undertake the drilling activity safely will be cleared. This clearing will never exceed an area of 40 x 40 m and hence this is the appropriate area for assessment. Within SCA land a basic fence consisting of steel droppers connected with flagging tape will delineate the 50 x 70 m area. The pre-construction site inspection and the Site Layout Plan developed during the inspection will accurately define the disturbed area for each borehole site. Emphasis will be placed on minimising the level of disturbance required for each site.

The exact boundary of the area will be determined at a pre-drilling site inspection attended by representatives from the company, drilling contractor, specialist environmental consultants and landowner (SCA). The AI19 site is located adjacent to a closed fire trail and the cleared area will be orientated along the fire trail in order to minimise the clearing of relatively undisturbed natural vegetation. The site and fire trail will be rehabilitated upon completion of all activity at the site.

A field inspection was undertaken on Monday 23rd August 2010. Participants in the inspection included representatives from Apex (the proponent), Olsen Environmental Consulting (preparation of project environmental documentation), Sydney Catchment Authority (owner/manager of the land directly affected), Niche Environment and Heritage (flora, fauna and archaeology), and Ecoengineers (soils and water). SLR Heggies provided an assessment of the likely acoustic impacts associated with construction and operation of AI19 and the access track. The field inspection enabled a detailed environmental impact assessment of the access track, the proposed borehole site and the broader local environment. It also enabled the stakeholders to agree on a more precise borehole site location.

Proposed Borehole AI19 Illawarra Coal Seam Gas Exploration Drilling and Gas Monitoring Program

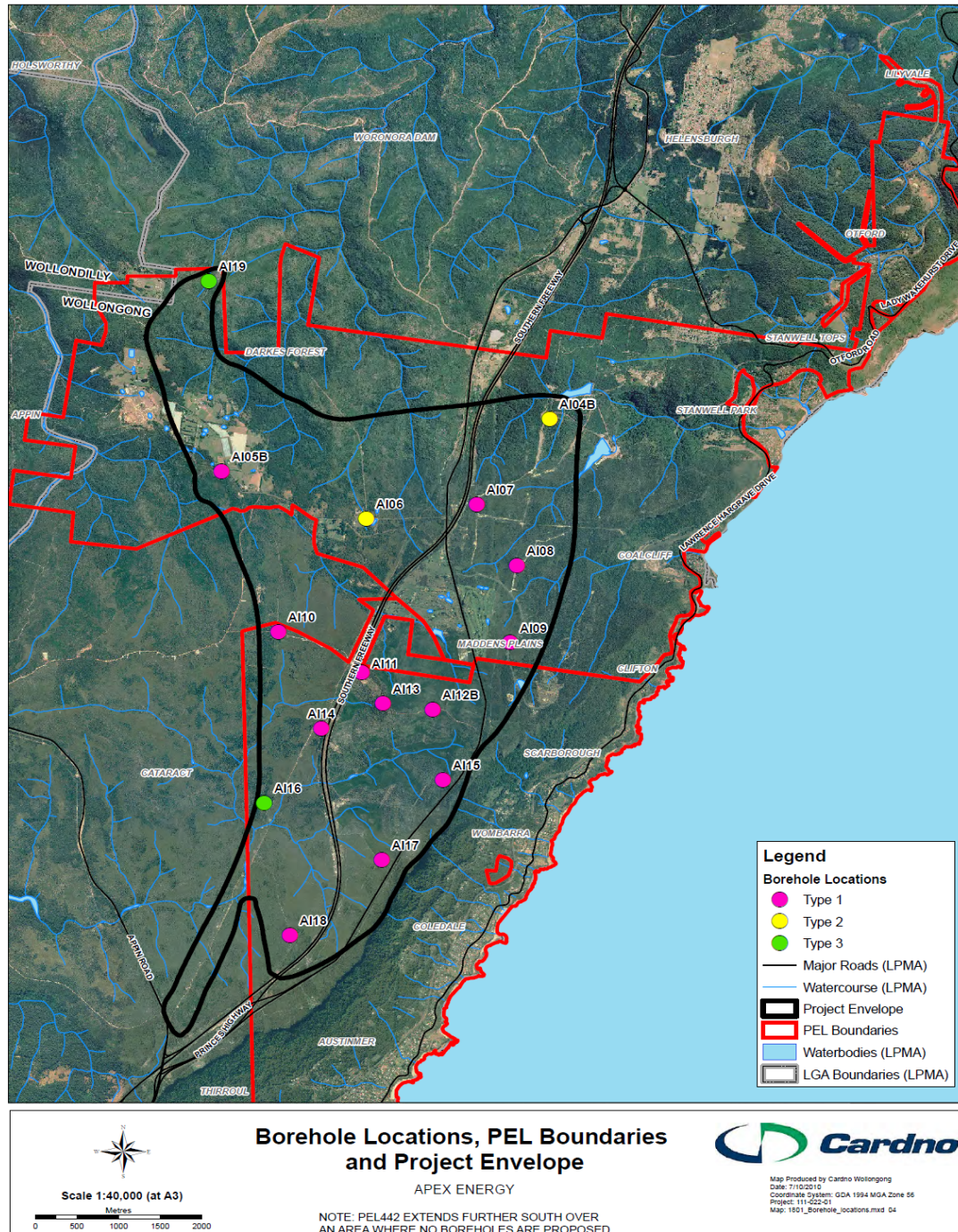


Figure 1
Location of AI19 in Relation to Previously Approved Borehole Sites

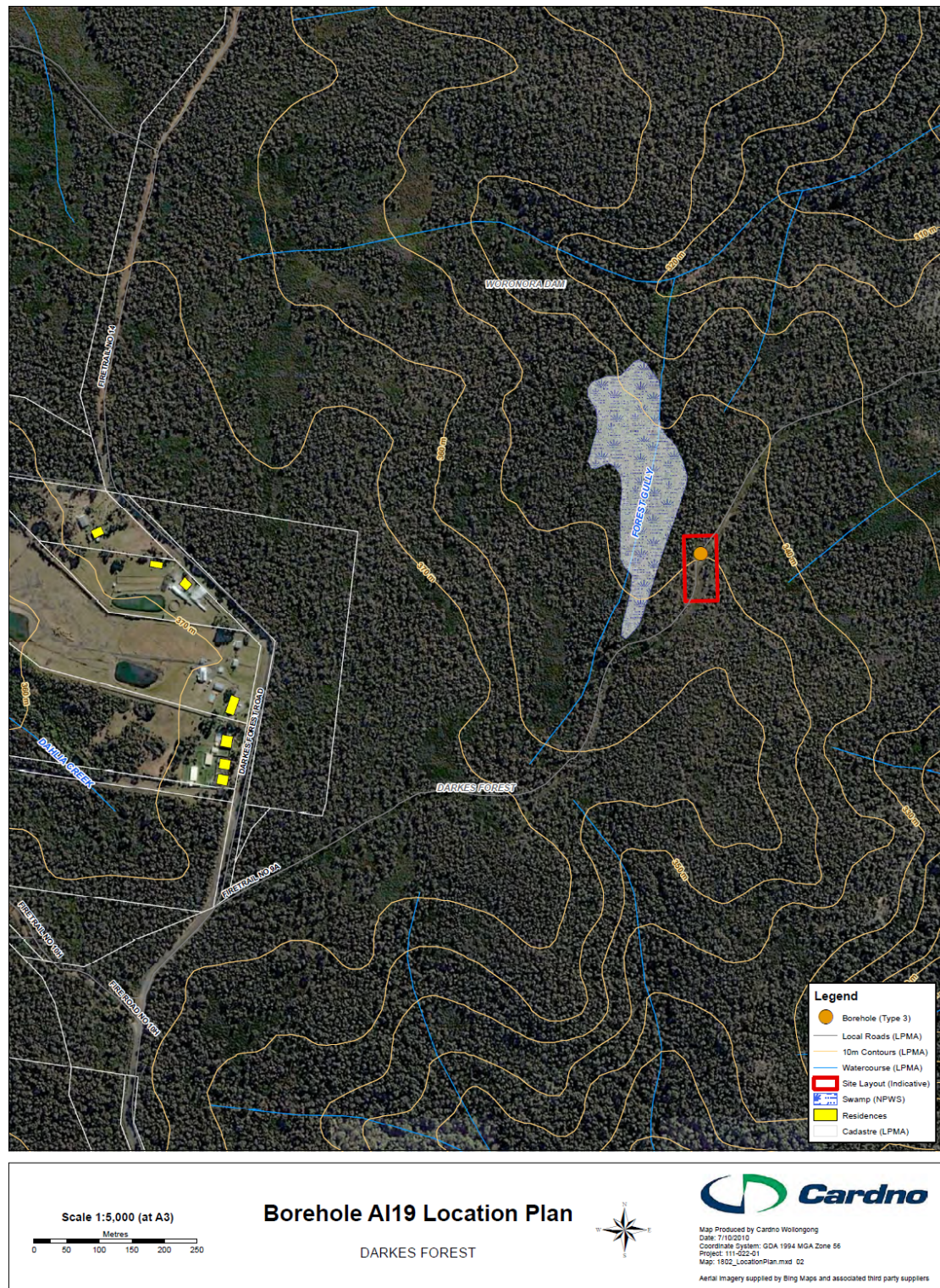


Figure 2
Location Plan AI19

3.1 Borehole Type

The proposed core borehole at AI19 will provide access to un-mined coal and adjacent stratigraphy. Consequently, it will be a Type 3 borehole.



Figure 4 shows a typical site layout for all the proposed boreholes in the Apex Gas Exploration and Monitoring Project. The typical layout includes provision of a run-on flow diversion drain. However, this will not be required for AI19. This layout provides the basis for environmental assessment. If environmental benefits and improvements can be achieved, actual site layout may be modified at the time of construction with the agreement of SCA.

Proposed Borehole AI19 Illawarra Coal Seam Gas Exploration Drilling and Gas Monitoring Program

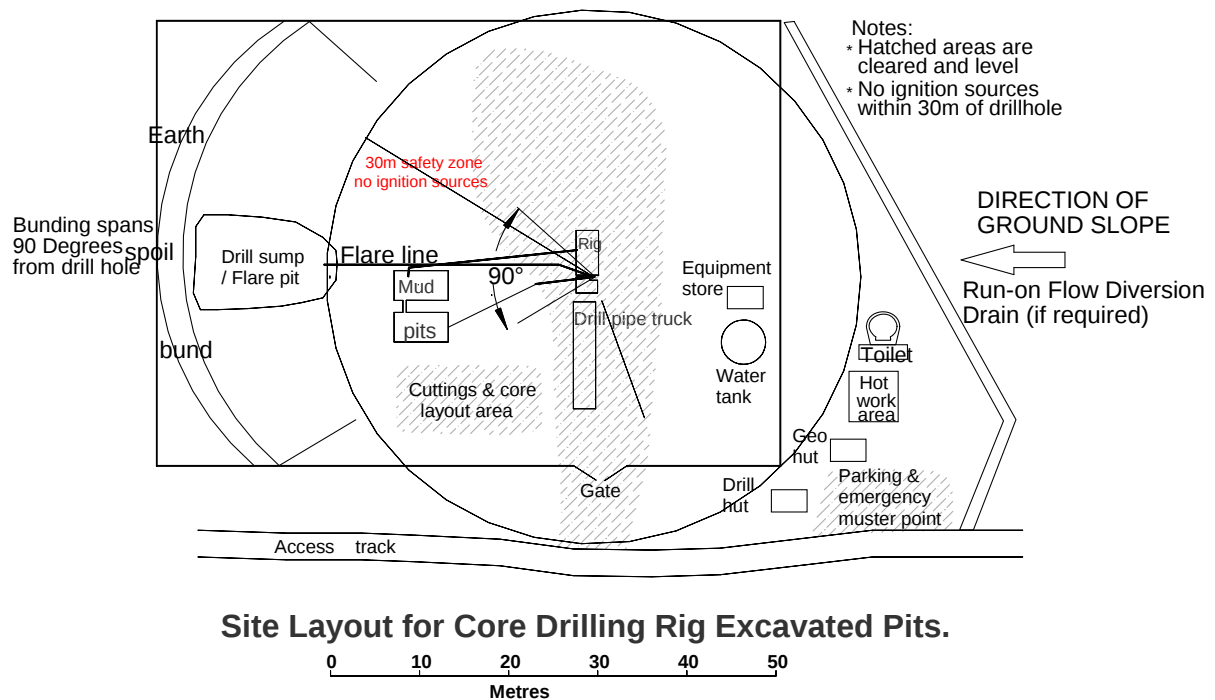


Figure 4
Site Layout for Core Drilling Using In-Ground Fluid Pits.
 Source: Earth Resources Australia Pty Limited and Ecoengineers Pty Ltd.

Borehole AI19 will require a blow-out prevention (BOP) device on the wellhead which is secured to steel casing cemented in to a depth of at least 10% of the estimated final depth, or as required under the **Petroleum Act 1991**.

Apart from the BOP casing requirement, AI19 will have a diameter of 100 mm and will be identical to many coal exploration boreholes drilled in the region.

It is proposed to undertake the drilling program on a continuous basis operating the drilling rig 24 hours per day and seven days per week.

Rigs and ancillary equipment and drill site operations must comply with all safety and environmental requirements of the **Petroleum Act 1991** and associated legislation administered by the Department of Industry and Investment (DII). The typical drill site layout is shown in **Figure 4**. Actual site layout will contain the components identified in this figure, but may be varied at the time of installation should environmental and/or safety benefits result. Any variation would be subject to the agreement of SCA at the time of installation. This will enable flexibility to avoid unnecessary disturbance of significant surface features.

Borehole AI19 will be sealed in accordance with DII requirements and supervised by their Inspectorate Branch.

Borehole AI19 drill site will be designed in accordance with the specific site requirements. The design will incorporate risk management techniques and will involve input from relevant stakeholders in order to ensure their requirements are

met. The pre-establishment liaison and planning will result in a site-specific Management Plan that will ensure the site is managed appropriately.

3.3 Gas Monitoring

Gas monitoring and testing are integral components of this program. For AI19, gas testing will be undertaken by the drilling team during and immediately after the coring activity.

3.4 Project Timing

Subject to Apex reaching agreement with SCA to enable access to AI19, it is proposed to establish access to the site and the surface area of the borehole site in early 2011. Site establishment will be immediately preceded by a site inspection with SCA, the drill operator, Apex and the relevant environmental consultants. The commencement timing is also subject to drill rig availability.

Once the access is established, a core hole will be drilled at AI19. This will enable core samples to be obtained and also enable the drilling team to carry out flow, pressure and permeability testing on site. It is anticipated that site establishment will take up to 4 weeks and the drilling and testing will take approximately 6 weeks.

Once the testing is completed, the core hole would be filled with concrete. The access track and site would be retained until core and gas testing results have been assessed. It is expected that this will take a further 6 weeks approximately.

Subject to the assessment results, the site will be either totally rehabilitated or retained for possible future use for extended gas flow testing and eventual gas production well. These possible future uses would be subject to a separate application for approval.

3.5 Site Access

AI19 will be accessed along a fire trail that has been closed and rehabilitated. Apex will re-open the fire trail along the previous alignment. Fire trail re-opening will be undertaken with access agreement and planning input from the SCA.

Apex will commission a suitably experienced contractor to undertake the earthworks and erosion control in re-establishing the fire trail.

The cleared route for the track will be 5 m wide, allowing for table drains and running surface. Passing bays will be provided approximately every 100 m along the track. These will be long enough to enable trucks to pass with safety. Their exact location will be determined at a site inspection with SCA at the time of construction.

The initial activity in re-establishing access along the fire trail will be to remove the existing vegetation by slashing. Slashed vegetation will be stockpiled at various locations along the trail to be used later to assist with revegetation.

After slashing, the fire trail will be inspected with the SCA and final cut and fill arrangements will be established. Emphasis will be placed on minimising soil disturbance. Consequently the bulk of the road works will be undertaken with a

grader working existing road surface material augmented by introduced road formation material suitable for use in the vicinity.

Appropriate table drains will be installed to direct water from the track surface. In steeper sections, crossover drains may be required to direct runoff water.

A locked security gate will be established at the intersection of the fire trail and Darkes Forest Road. The gate will be located at sufficient distance from the intersection to enable heavy vehicles to be parked off the road when entering and leaving the site. Wing fences will be maintained adjacent to the gate to deter illegal access to the site and to enhance site security.

At the completion of site activities, the fire trail will be closed. The track surface would be scarified and any erosion control earthworks installed. Remnant slashed material would be redistributed over the surface of the track, together with brush cut from adjacent vegetation. Additional seeding or planting of tube stock may be required and would be determined in conjunction with SCA at the time.

3.6 Site Security and Safety

The borehole sites associated with the project are remote and conspicuous. This means that the exposure to theft and vandalism is potentially high and Apex has considered measures to reduce this risk. Many of the areas for the proposed wells have traditionally been subject to theft and vandalism and as such security will be carefully managed.

Theft

Steps will be taken to reduce the risk of theft. These measures will include;

- High perimeter fencing around well heads and pits/poly water tanks.
- Locked gates.
- Substantial fasteners to deter theft of instruments and solar panels.
- Regular inspections.
- Deterrent signage.
- Keeping valuable equipment to a minimum.

Vandalism

Vandalism has been a local issue and measures to deter vandalism would include;

- Regular inspections of the well site at random times.
- Deterrent signage.
- High perimeter fencing around well heads and pits/poly water tanks.
- Locked gates.

Safety

Measure to reduce safety risk would include;

- Fire fighting facilities incorporating:
 - o Fire extinguishers.
 - o Water supply for fire fighting (from a tank).
 - o Reduced fuel source management.
 - o Heat screens.
- High perimeter fencing around well heads and pits/poly water tanks.
- Locked gates.
- Fit for purpose equipment.
- Regular inspections.
- Lockable valves to prevent adverse tampering.
- Safety devices that are consistent with good oil field practice.
 - o Non-return valves.
 - o Safety signage i.e.
 - Access for authorised persons.
 - Contact phone details (Apex, Rural Fire Service, SCA etc).
 - No smoking within 30m radius of fence.
 - Valve purpose.
 - Schematic diagrams for well head equipment.
 - Reticulation pipes below ground where possible.

Fire Management

Apex will implement risk management procedures to Australian Standards and individual Site Management Plans (SMP). Operations will be carried out in accordance with the ***Petroleum (Onshore) Act 1991***, the ***Petroleum (Onshore) Regulation 2007*** and the Schedule of Onshore Petroleum Exploration and Production Safety Requirements (the Schedule). As such full cooperation with the various regulatory authorities and local services such as the Rural Fire Service (RFS) will be developed and maintained. Each well site will form part of Emergency Response Procedures (ERP) detailed in clause 210 of the Schedule. These safety measures will be developed using proper risk management protocols and procedures in full consultation with all stakeholders including the RFS.

Table 3.1 details some measure that would be considered during the development of an Emergency Response Procedure and Site Management Plans.

Table 3.1. Potential Fire Prevention and Protection Measures

Point	Issue	Comments
1	Fire caused during well construction and/or subsequent operations on site	Drilling operations for each well site will be in accordance with a Site Management Plan (SMP) developed using proper risk management techniques in cooperation and consultation with all necessary stakeholders (Apex, RFS, contractor, land owner etc). The SMP will detail fire prevention and protection methods required during such operations. Operation will include drilling, maintenance, monitoring and flaring.
2	Bush fires	Measures as per SMP and Emergency Response Plan (ERP) including; • Fuel reduction • Fire breaks • Heat shielding • Fit for purpose equipment • Fire fighting measures within the perimeter fence - o Fire extinguishers - o Water hose (supplied from a tank) • No vegetation within fence (gravel base) • Safety signage including contact telephone numbers.
3	Fires caused by vandalism	Vandalism has been a local issue and measure to deter vandalism would include; • Regular inspections of AI19 (times varied) • Deterrent signage (prosecutions etc) • High perimeter fencing around well heads and pits/poly water tanks. • Locked gates.
4	Fire caused by well head equipment.	All equipment will be designed and installed as per good oilfield practice, be fit for purpose and maintained to a standard.

3.7 Environmental Planning Background

Department of Planning

The proposed 15 borehole gas drilling program constituted a Major Project under the ***State Environmental Planning Policy (Major Project) 2005***. Consequently, the exploration proposal was assessed in accordance with Part 3A of the ***Environmental Planning and Assessment Act, 1979*** (EP&A Act).

In July 2007, Apex lodged a Major Project Application with the Department of Planning. A Preliminary Environmental Assessment supported the Major Project Application. The Preliminary Environmental Assessment was prepared in accordance with Department of Planning Guidelines and requirements existing at that time.

The Department of Planning reviewed the Major Project Application and Preliminary Environmental Assessment and provided the Director-General's environmental assessment requirements (DGRs) for the Program. The DGRs nominated the

requirements for the Environmental Assessment, key issues to be addressed, the level of assessment required in relation to these issues and any other requirements the Director-General determined as being relevant.

The DGRs were prepared by the Department of Planning having regard to any relevant existing guidelines, in addition to the information included in the Major Project Application and Preliminary Environmental Assessment.

The original Environmental Assessment of the Program was prepared to address the issues identified in the DGRs.

On 23rd September 2009, the Director-General conditionally approved the Project under the Minister for Planning's delegation dated 4th March 2009.

Subsequent to the approval, Apex identified the need for an additional borehole AI19. Clause 75W of the ***Environmental Planning and Assessment Act, 1979*** makes provision for the proponent to apply for a modification to an approval. This current request to modify the Project Approval is submitted in accordance with Clause 75W.

Wollongong City Council

All activity associated with AI19 will be undertaken within the Wollongong City Local Government Area. The area is subject to the provisions of the Wollongong Local Environmental Plan 1990 (LEP 1990). The zoning is 7(a) Environmental Protection Special Zone. In this zoning, mining is permitted with development consent. Because the proposal is being assessed in accordance with the provisions of Part 3A of the ***Environmental Planning and Assessment Act, 1979***, the Minister for Planning will be the determining Authority.

Sydney Catchment Authority

The proposed activity is located on Sydney Catchment Authority (SCA) land. It can only be undertaken with the agreement of SCA allowing Apex to access the land. Assuming access agreement with SCA is reached, the activities will be located within the Woronora Catchment. SCA have quite detailed conditions controlling access and activity to their Special Areas and Apex would have to liaise with SCA to obtain agreement with a series of requirements to enable the activities to proceed.

Department of Industry and Investment

The Department of Industry and Investment (DII) administer the ***Petroleum Act, 1991*** under which the Apex Petroleum Exploration Licences Nos. 442 and 444 have been granted. DII supervision of the activity will address areas associated with resource utilisation, safety, and environmental protection.

Department of Environment, Climate Change and Water

The Department of Environment, Climate Change and Water (DECCW) are responsible for fauna, flora and archaeological matters. Niche Environment and Heritage Pty Ltd have prepared an assessment report to predict likely impact on these matters. The report was prepared in accordance with specific DECCW requirements.

The level of ongoing involvement of the DECCW will be dependent upon the outcomes of the initial gas potential assessments.

Given the location and mining title covering this activity, an Environment Protection Licence from DECCW will not be required.

Roads and Traffic Authority

The proposed development will not create a new intersection onto public roads and will generate very small additional traffic flows through existing intersections. Consequently, the Roads and Traffic Authority (RTA) will not be required to approve any components of the proposal. Traffic Management Plans will be submitted to the RTA for approval. These plans will define the traffic management arrangements that Apex will implement to manage traffic flow onto and off public roads.

NSW Office of Water

The NSW Office of Water administers the **Water Act 1912** and the **Water Management Act 2000**. These Acts regulate and control water extraction and use in NSW. Any activity resulting in water extraction or aquifer interference requires a licence. The proposed drilling of AI19 will intercept ground waters and may require licences under these Acts. Apex acknowledges its statutory obligation to obtain all necessary licences under these Acts.

4 ENVIRONMENTAL IMPACT ASSESSMENT

4.1 Introduction

The following section addresses the environmental issues predicted in the original Preliminary Environmental Assessment and those issues required to be assessed by the Director-General's requirements (DGRs) for the March 2009 Environmental Assessment.

Table 4.1 was included in the Preliminary Environmental Assessment (July 2007) and provides a summary of the identified environmental issues and the level of assessment required.

Table 4.1. Summary of the Issues and the Level of Assessment

What are the key issues? Consider the Extent of the impacts. Nature of the impacts. Environmental sensitivity of the site.	What is the extent of the studies required to determine the level of risk?	What is the extent of the studies required to avoid, minimise or manage the impacts so the risks are acceptable?
1. Surface water quality management.	Comparison with similar activities.	Identify and commit to implementing standard operating control measures. Preparation of Water Management Plan. Determine neutral or beneficial effect.
2. Flora and Fauna impacts.	Undertake flora and fauna study in accordance with standard procedures. Minimise area cleared and implement selective clearing as required.	Undertake flora and fauna study in accordance with standard procedures. Minimise area cleared and implement selective clearing as required.
3. Archaeological, historical and heritage implications.	Undertake archaeological and heritage study in accordance with appropriate requirements and incorporate findings into project design.	Undertake archaeological and heritage study in accordance with appropriate requirements and incorporate findings into project design.
4. Dust and air quality.	Comparison with similar activities.	Identify and commit to implementing standard operating control measures.

What are the key issues? Consider the Extent of the impacts. Nature of the impacts. Environmental sensitivity of the site.	What is the extent of the studies required to determine the level of risk?	What is the extent of the studies required to avoid, minimise or manage the impacts so the risks are acceptable?
5. Noise and Vibration.	Comparison with similar activities.	Identify and commit to implementing standard operating control measures.
6. Waste.	Determine waste streams and volumes and identify appropriate management response.	Determine waste streams and volumes and identify appropriate management response. Develop Waste Management Plan.
7. Soil management.	Comparison with similar activities.	Identify and commit to implementing standard operating control measures.
8. Greenhouse Gases.	Comparison of predicted emissions with national and international emissions.	Identify and commit to implementing standard operating control measures to minimise greenhouse emissions.
9. Rehabilitation.	Comparison with similar activities.	Identify and commit to implementing standard operating control measures.

Apex have undertaken assessment of the proposed borehole AI19 with due consideration of the elements identified in **Table 4.1**.

4.2 Water Quality

Ecoengineers were commissioned by Apex to identify water-related impacts associated with the construction and operation of AI19. Ecoengineers assessment and recommendations are included in a letter to Olsen Environmental Consulting which is included as **Appendix I** in this EA. Their assessment and recommendations supplement their findings in their previous report entitled: 'Assessment and Management of Water-Related Impacts – Illawarra Coal Seam Gas Exploration Program dated September 2008 for Apex Energy NL. The September 2008 report addressed soil and water management issues associated with the 15 boreholes which already have project approval. It is appended to the original EA.

Ecoengineers inspected the proposed site for borehole AI19 during dry weather on Monday 23 August 2010 with representatives from Sydney Catchment Authority, Apex, Olsen Environmental Consulting, several ecological consultants from Niche Environment and Heritage Pty Ltd and a representative of the Illawarra Aboriginal Land Council.

Their assessment of potential water related impacts has involved:

- field examination of the local topography, noting all proximate drainage lines and main drainage direction;
- satellite and aerial photographic investigation of any proximate hydrological features e.g. upland swamps or creeks;
- field assessment of any prior site disturbance i.e. excavations or soil scraping and baring to the area, inspection of soil type for erodibility; and
- satellite and aerial photographic identification of any significant water-related features further down gradient of the proposed drill site.

Ecoengineers noted that AI19 is within the Metropolitan SCA Special Areas. The site has been previously disturbed by prior clearing for SCA Fire Road No. 9A which originates on Darkes Forest Road and proceeds in a weakly meandering manner across mixed upland forest, heath land and swamp to the northeast. It is located at the western edge of the fire road almost exactly 1.00 km from Darkes Forest Road.

The slope of the site is very low (<5%) and falls gently to the northeast broadly in the direction of the fire road.

Due to the presence of the fire road there is a relatively minor requirement for clearing of trees at the borehole site. The (temporary) stormwater detention basin will be constructed on or adjacent to the fire road north of the borehole with a minor deviation around it.

During and immediately following the clearing of the site, and prior to the commencement of drilling, there is a low potential for soil erosion due to site run-off with negligible potential for run-on from upslope.

However, there is a significant upland swamp approximately 60 m due west of the borehole location. This description of the swamp as significant relates to its location and size. The flora and fauna significance of the upland swamp is discussed in Section 4.3.1 and fully described in Appendix II.

Clearing will not encroach into the swamp. The low profile temporary stormwater drains and flow control bunding proposed for the project will be constructed to ensure that:

- no run on from the Fire Road access way south of the borehole location enters the swamp; and
- no dirty runoff generated within the project site enters the swamp.

These measures will ensure that runoff water from drill site AI19 does not flow towards the swamp. Flows will be directed towards the north of the site away from the swamp area.

The boundary of the swamp is shown on **Figure 2** and the following photographs indicate the current condition of the swamp vegetation and habitat.



Photograph 1

View to South from Western Edge of Swamp. Borehole Located Approximately 100 m to left of photograph.

Given the very low slope and small size of the drilling site area, loss of significant sediment off-site would be unlikely provided there was adequate stormwater bunding detention volume provided.

Ecoengineers concluded that a maximum bunding height of 660 mm on the down slope side i.e. across the Fire Road continuation would be sufficient. The bund wall will be constructed creating a detention volume of approximately 190 m³. This detention volume provides for capture of a 20-year, 6 hour rainfall event with total rainfall approximately 42 mm. This volume does not include any storage in the drilling pit, which will provide further storage capacity.

Silt stop fencing will be installed at various strategic locations on site determined at the pre-construction site inspections.

Ecoengineers emphasised that their assessment and recommendations of Borehole Site AI19 are to be considered as supplementary to their original report entitled, "Assessment and Management of Water-related Impacts – Illawarra Coal Seam Gas Exploration Program", dated September 2008. Reference to the detailed soil and water management recommendations made in that report, especially in Sections 3 and 4 will be made and all specific soil and water management measures detailed in the report must, as appropriate, be applied to the Borehole AI19 site also.

Apex will implement the recommendations made by Ecoengineers.



Photograph 2
View Looking West from Same Location as in Photograph 1.



Photograph 3
View Looking Towards Northwest



Photograph 4

View Looking Towards North

The NSW Office of Water (NOW) have recently (August 2010) published Guidelines for Controlled Activities. These Guidelines are listed below:

- Riparian Corridors (and Associated Vegetation Management Plans)
- Watercourse crossings
- Laying pipes and cables in watercourses
- Outlet structures and
- In-stream works.

Although Part 3A Major Projects are exempt from requiring a controlled activity approval under Section 91 of the **Water Management Act 2000**, the Guidelines do provide a sound mechanism for impact assessment.

The Guidelines have been considered in relation to construction and operation of AI19. The access track and borehole site are located on a ridge line. NOW recommends a vegetated core riparian zone be managed and that the width of that zone be based on the watercourse order as classified under the Strahler System of ordering watercourses and based on current 1:25000 topographic maps. Apex reviewed the new series Topographic and Orthophoto Map for Appin in the 1:25000 series (Ref 9029-1S Third Edition). This Map shows that because of their location on the ridge line the access track and borehole site do not directly impact on any 1st Order stream. The closest first order stream is approximately 35 metres from the access track.

As a consequence of the ridge line location it is not proposed to cross any watercourses, lay pipes or cables within a watercourse, provide an outlet structure or undertake any in-stream works. Consequently, Apex has concluded that the NOW

Guidelines for Controlled Activities are not triggered by any activity proposed for the construction and operation of borehole AI19 including access arrangements.

4.3 Flora and Fauna

Apex commissioned Niche Environment and Heritage to undertake a flora and fauna assessment of the proposed construction and operation of Borehole Site AI19. Their Niche Report “Ecological and Cultural Heritage Assessment” is attached as **Appendix II**.

The Niche Report supports the modification of the Project Approval and finds no basis for significant flora and fauna impact as a result of the proposal.

Following a review of the Draft EA Apex received comments from Government Departments and Agencies. Niche was commissioned to prepare a response and their subsequent letter and attachment is included as **Appendix IV**.

4.3.1 Flora

A total of 0.66 ha of vegetated area will be disturbed for the current proposal. The proposal will involve the primary disturbance of 0.16 ha of vegetation at the borehole site. Site works will involve levelling a drill pad, development of drill sumps and soil containment and erosion and sediment control. Approximately 0.50 ha of secondary disturbance of rehabilitated vegetation along the disused Fire Road is required (1000 m x 5.0 m wide).

Existing National Parks and Wildlife Service vegetation mapping of the region (NPWS 2003) shows three vegetation communities occurring throughout the study area, namely;

- Exposed Sandstone Scribbly Gum Woodland,
- Upland Swamp - Fringing Eucalypt Woodland, and
- Upland Swamp – Sedgeland Heath Complex.

The distribution of these communities is shown in Figure 5 of the Niche Report and is discussed in detail in Section 3.2 of the same report.

None of these vegetation communities are currently listed as Endangered Ecological Communities on either the ***Threatened Species Conservation Act 1995*** (TSC Act) or the ***Environment Protection and Biodiversity Conservation Act 1999*** (EPBC Act).

Niche noted that:

- The majority of the length of the overgrown Fire Road 9A traverses the Exposed Sandstone Scribbly Gum Woodland vegetation community. Further the borehole site is located within this vegetation community. In all an estimated total of 0.16 ha of this community will be disturbed for the development of the borehole site and a further 0.34ha of this vegetation community which is regenerating on the abandoned fire road will be disturbed by the proposal.
- Approximately 250 m of the overgrown Fire Road 9A traverses the Upland Swamp Fringing Eucalypt Woodland vegetation community and could be considered to represent this community in its regenerating state. In all an estimated total of 0.13 ha of this community will be disturbed for the development on the abandoned fire road.
- Within the study area, approximately 80m of the overgrown Fire Road 9A traverses the Upland Swamp-Banksia Thicket vegetation community and could be considered to represent this community in its regenerating state. In all an estimated total of 0.04 ha of this community will be disturbed for the development on the abandoned fire road.

O'Hares Creek Shale Forest Community occurs in the vicinity of the proposed borehole. It is located approximately 300m south west of the commencement of the site access road and is on the opposite side of Darkes Forest Road. **Figure 5** shows the location of the Community. It will not be impacted either directly or indirectly by the proposal.

One threatened plant, *Pultenaea aristata* (Prickly Bush-pea) was recorded in the study area during the field surveys. *P. aristata* is listed as Vulnerable on both the TSC Act and the EPBD Act.

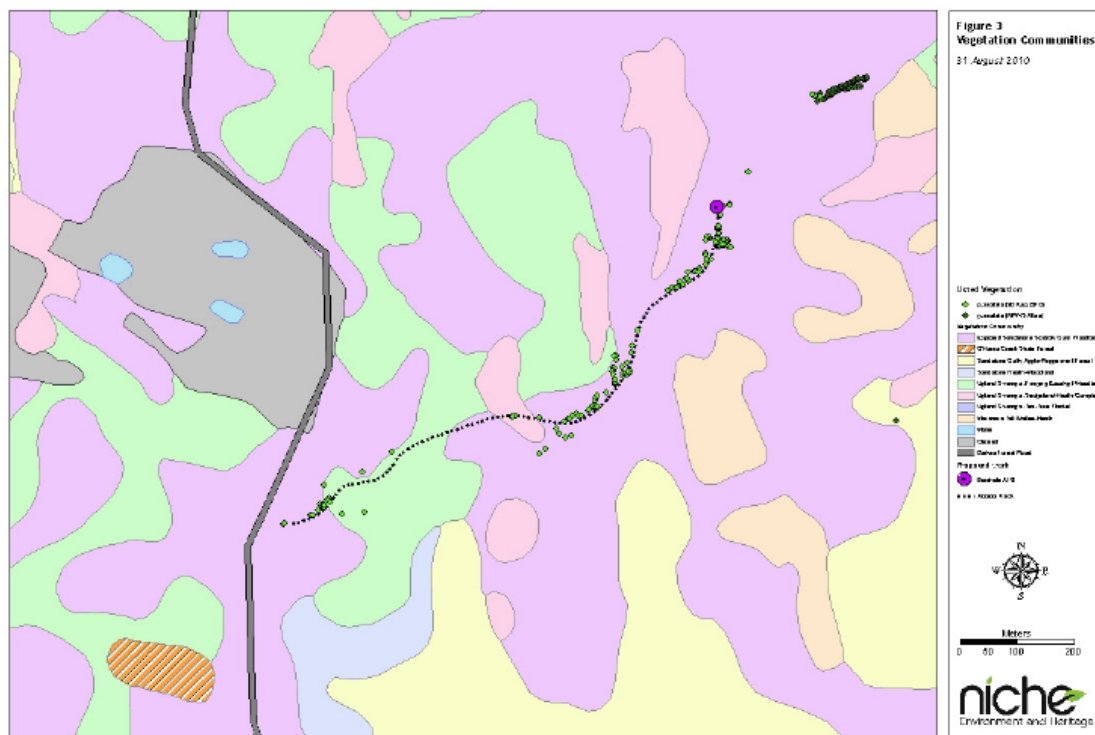
The species is often associated with the upland swamp vegetation complex and has been recorded from several locations within the sub-communities of Banksia Thicket and Restioid Heath. The species is also known to occur in association with areas of impeded drainage and creek lines within sandstone woodland and gully forest plant communities (NPWS, 2003).

The species was found to be a common shrub species along the access track and at the borehole site as well as in the vegetation surrounding these areas. Niche estimated that many hundreds and possible thousands of individual plants occur in the locality with only a small proportion of this larger population being subject to disturbance by the proposal.

This species is known to occur in localised but none the less quite large populations on the Woronora Plateau with some populations estimated to be in the thousands and possibly tens of thousands.

No other threatened plants were recorded or are considered likely to occur within the disturbance footprint.

- Utilisation of existing tracks; and
- Implementation of an Environmental Management Plan for the project.



Note: This Community is shown on the Original Figure 5 in the Niche Report which is Appendix II of this EA. The shading has been modified to enable easier identification.

- Soils will not be stockpiled on the side of the existing fire road during re-development as this would increase the potential for the placement of soil on threatened plants which would otherwise be avoided by the road development works.
- Best practice sediment and erosion control will be employed at the borehole site and also along sections of the access track which have erosion potential.

- Any superfluous drill water will be removed from the Catchment area and disposed of at an appropriate site. Dirty water will not be discharged into vegetation adjacent to the borehole site.
- Seed bearing material will be harvested from disturbed vegetation for use in the management and rehabilitation of vegetation on the disturbed development footprint.
- At the site of the proposed borehole AI19 all trees which have the potential to contain hollows and any small sandstone outcrops will be avoided and if necessary fenced off using flagging tape and wooden stakes to ensure clearing contractors avoid these habitats.
- All vehicles, including drill rigs and clearing equipment, will be subject to full wash down procedures before entering the Catchment lands.
- Rehabilitation of the access road and the borehole site will be undertaken immediately upon decommissioning.

4.3.2 Fauna

Nine animal species were recorded during the field survey. None of these species are threatened and one, the Rusa Deer, is introduced.

Seven native bird species were recorded from the study area including:

- The Yellow-tailed Black Cockatoo,
- Eastern Rosella,
- Crimson Rosella,
- Sulphur-crested Cockatoo,
- Black-faced Cuckoo-shrike,
- Eastern Spine-bill, and
- Willie Wag-tail.

One mammal species, the Swamp Wallaby was also recorded.

Fauna habitat of the site is primarily restricted to the thick, regenerating, shrub layer occurring along the access track and the open woodland at the borehole site. A number of sandstone rock outcrops occur in close proximity to the borehole site but they will not be impacted by the proposal.

Mature trees will not be disturbed or removed by the proposal. The access track is devoid of trees as trees were completely removed from the access track for its construction in the past. The borehole site contains predominantly smaller trees which are devoid of hollows.

Small areas of eroded track (along the abandoned fire trail) present possible opportunities for rain water to pool during storm events though any such pooling opportunities would be very limited and not likely to provide significant habitat for amphibian species.

The scale of the proposal is very small, and the potential for loss of limiting habitat for threatened species is low.

No threatened fauna were recorded during the field surveys.

A total of four threatened fauna species are considered to have a high or moderate likelihood of occurrence in the study area and have habitat requirements that will be affected by the proposal. These threatened fauna are;

- The Eastern Bristlebird,
- Eastern Ground Parrot,
- Red-crowned Toadlet, and
- Giant Burrowing Frog.

None of these species have been previously recorded in the study area. Nevertheless, impact assessments under the guidelines for Part 3A for these species are provided in Appendix G of the Niche Report.

The Guidelines for threatened species assessment under Part 3A of the EP&A Act state that development applications must contain a justification based upon the listed key thresholds:

- Whether or not the proposal, including actions to avoid or mitigate impacts or compensate to prevent unavoidable impacts, will maintain or improve biodiversity values.
- Whether or not the proposal is likely to reduce the long-term viability of a local population of a threatened species, population or ecological community.
- Whether or not the proposal is likely to accelerate the extinction of a threatened species, population or ecological community or place it at risk of extinction.
- Whether or not the proposal will affect critical habitat.

These key thresholds are addressed in **Table 4.2**.

Three of the affected threatened fauna are listed on the EPBC Act;

- Eastern Bristlebird,
- Eastern Ground Parrot, and

- Giant Burrowing Frog).

Apart from the loss of removal or modification of 0.66 ha of vegetation, it is considered unlikely that the proposal will result in the loss of limiting foraging or breeding resources or the death or injury of individuals. Thus potential for impacts to threatened animal species is highly limited given the nature of the proposal.

The amelioration measures discussed at the end of Section 4.3.1 will also assist fauna protection.

Table 4.2. Assessment of Key Thresholds under Part 3A of the EP& A Act.

Threatened Biota	Maintain or improve biodiversity values.	Reduction in the long-term viability of a local population of the species, population or ecological community.	Accelerate extinction of the species, population or ecological community	Will critical habitat be affected?
Threatened Flora				
<i>Pultenaea aristata</i>	Likely to reduce the total population in the immediate vicinity of the proposal. Loss is considered negligible in the context of the estimate local and regional population.	Unlikely to reduce long term viability	Unlikely	No
Threatened Fauna				
Eastern Bristlebird	Likely to maintain biodiversity values	Unlikely to reduce long term viability	Unlikely	No
Eastern Ground Parrot	Likely to maintain biodiversity values	Unlikely to reduce long term viability	Unlikely	No
Red-crowned Toadlet	Likely to maintain biodiversity values	Unlikely to reduce long term viability	Unlikely	No
Giant Burrowing Frog	Likely to maintain biodiversity values	Unlikely to reduce long term viability	Unlikely	No

4.4 Archaeology, History and Heritage

Apex commissioned Niche Environment and Heritage to undertake a heritage assessment of the proposed construction and operation of Borehole Site AI19. Their Niche Report “Ecological and Cultural Heritage Assessment” is attached as **Appendix II**.

A review of the DECCW Aboriginal Heritage Information Management System (AHIMS) was undertaken prior to undertaking the site assessment. Other references including recent assessments undertaken as part of BHP Billiton’s Bulli Seam Part 3A Development Application were also reviewed.

An assessment of the borehole site and the access road to the site was undertaken on Monday 23 August 2010 in the presence of representatives of Apex Energy, Olsen Environmental Consulting, the Sydney Catchment Authority, the Illawarra Local Aboriginal Land Council and Niche Environment and Heritage.

The survey focussed on the location of the proposed borehole as the access track has been subject to significant disturbance in the past during its construction and the soil profile has been altered.

A representative from the Illawarra Local Aboriginal Land Council (ILALC) (Jon Kirby) assisted with the site field survey and provided input into the cultural heritage assessment. Specifically, Mr Kirby did not raise any concerns regarding the proposal insofar as it may impact items of cultural heritage significance. A copy of the Niche Report will be provided to the representative and the ILALC for comment.

There are no previous records of any Archaeological sites in close proximity to the boreholes site or the access track. No new sites were recorded during the current survey.

There are a number of registered Aboriginal sites within 500 metres of the proposed borehole location. The potential for vibration damage and annoyance was assessed during the initial EA (Refer Section 5 of Appendix IV of March 2009 EA, "Apex Energy, Illawarra Exploration Drilling and Gas Monitoring Project: Noise and Vibration Assessment, December 2008). For houses and buildings as close as 115 metres to a borehole, the likelihood of vibration damage was assessed as negligible. This was because the levels of vibration predicted were orders of magnitude lower than the appropriate criteria. It is highly unlikely that drilling borehole AI19 will cause vibration damage to the registered Aboriginal sites.

Niche concluded that the proposed development of Borehole AI19 is not considered likely to impact on any archaeological sites or cultural values. No further archaeological assessment is considered necessary for the proposed development of Borehole AI19.

4.5 Air Quality and Dust

Dust is a potential issue during the drilling program. All drilling rigs are fitted with dust attenuation devices to ensure Occupational Health and Safety requirements for the drill operators are achieved. This will ensure that there would be no adverse impact upon human health or the environment.

Where necessary, a water cart or fixed spray arrangements will be used on site to reduce dust generation on bare areas around the borehole. In addition, the number of vehicles accessing the site will be controlled. This will be required by Sydney Catchment Authority (SCA) and forms part of the Standard Conditions which SCA will insist Apex agree to before granting entry to the Special Area.

Borehole AI19 is isolated from the public and is located approximately 800 m from the nearest residence. Given the isolated nature of the borehole and the minimum

time of operations Apex believes that odour will not be an issue for the proposed Borehole AI19.

4.6 Acoustics

Acoustic and vibration issues are not predicted to be problematic for AI19. The site is located approximately 800 m from the nearest residence and is separated from that residence by naturally vegetated terrain together with a topographic high.

SLR Heggies were commissioned to undertake a noise impact assessment for the construction and operational activities at AI19. They drew on the initial noise and vibration impact assessment undertaken in December 2008 by Heggies for the original 15 borehole project. A copy of their assessment is included as **Appendix III**.

Following a review of the Draft EA Apex received comments from Government Departments and Agencies. Heggies was commissioned to prepare a response and their subsequent letter is included as **Appendix V**.

4.6.1 Establishing Existing Noise Environment

Between 4th and 15th December 2008 a background noise monitoring program at three unattended and two operator-attended locations was undertaken in accordance with DECC requirements and the DGRs. The noise measurement procedures employed throughout the monitoring program were in accordance with the requirements of AS 1055-1997 ***“Acoustics -Description and Measurement of Environmental Noise”*** and the ***EPA Industrial Noise Policy, 2000*** (INP).

The results of the unattended and operator-attended noise monitoring for Location 1, which has similar characteristics to AI19 are summarised in **Table 4.3**.

4.6.2 Noise Assessment

Noise modelling for this assessment was undertaken using the SoundPLAN computer noise modelling software. The noise modelling took into account ground topography and was based on the representative source noise levels listed in Table 8 and Table 9 of the December 2008 Heggies Report. In accordance with the INP requirements, predictive noise modelling was computed for both calm and noise enhancing weather conditions.

The calculated operational noise levels predictions were based on a typical drill site layout (**Figure 4**). The drill site sound power levels were obtained through measurements of representative drill rigs conducted by Heggies on 7th November 2008.

Location 1 is the Glenburnie Orchard residence north east of AI05 and adjacent to Darkes Forest Road.

The calculated construction noise levels will inevitably depend upon the number of plant items and equipment operating at any one time and their location relative to the receiver of interest. Predicted noise levels were based on typical operations using appropriate plant placed within the works area. In practice, construction noise levels

will vary due to the fact that plant and equipment will move about the site and will not all be operating concurrently.

Table 4.3. Unattended Statistical Ambient Noise Levels (4th December 2008 to 15th December 2008)

Time	Noise Parameter	Location 1
Daytime (dBA)	LA ₁	59
	LA ₁₀	49
	LA ₉₀	35
	LA _{eq}	53
Evening (dBA)	LA ₁	55
	LA ₁₀	44
	LA ₉₀	35
	LA _{eq}	53
Night	LA ₁	43
	LA ₁₀	40
	LA ₉₀	31
	LA _{eq}	43

4.6.2.1 Construction Noise

The following main construction phases would be associated with AI19:

- A general site establishment phase including
 - (a) Clearing of existing vegetation,
 - (b) Setting up working areas and boundary fences, and,
 - (c) The construction of contractor's temporary facilities
- Drill assembly/setup.

The duration of the construction activity at any drill site would be less than 4 weeks. For this timeframe the DECC's airborne noise objective for residential receivers indicates that noise from construction activities should be managed such that the LA₁₀ noise level, measured over a period of not less than 15 minutes, should not exceed the background LA₉₀ noise level by more than 20 dBA.

For commercial and retail buildings, it is generally accepted that receivers are 5 dBA to 10 dBA less sensitive to construction noise emissions than residential receivers.

For commercial and retail receivers a conservative $LA_{10}(15\text{minute})$ noise objective of $LA_{90}(15\text{minute})$ RBL + 25 dBA was adopted.

Table 4.4. presents the daytime construction noise goals for residential and commercial receivers potentially affected by construction and operation of AI19. Site AI19 was similar to Site 1 monitored in the original Heggies noise and vibration assessment.

As this EA is for a Proposed Additional Borehole at Site AI19 only, and therefore was an addendum of the original EA for the overall project (dated March 2009), SLR Heggies considered it appropriate to adopt the same noise impact assessment procedures as followed in the original EA and thereby maintain consistency. However, since the original EA was distributed DECCW have issued Interim Construction Noise Guidelines and that Department requested that the acoustic assessment for Borehole AI19 should be undertaken with consideration of these subsequent Guidelines.

Table 4.4 Daytime Construction Noise Goals

Background Noise Monitoring Location	Residential Receivers	Commercial Receivers
Location 1 (AI19)	55dBA	60dBA

Table 4.5 shows that project construction noise emission levels at AI19 are predicted to comply with the construction noise goals.

Table 4.5. Predicted Construction-related Noise Levels

Drill Site	Typical Nearest Receiver	Approximate Distance from site	LA_{10} Daytime Construction Noise Objective	Predicted LA_{10} Daytime Construction Noise Level	Assessment
AI19	329 Darkes Forest Road	800m	55 dBA	39 dBA	Complies

If the procedures outlined in the most recent DECCW's Guidelines are adopted for the EA modification, then the $LA_{eq}(15\text{minute})$ daytime construction noise objective becomes 45 dBA for the DECCW's "Recommended standard hours", which are Monday to Friday 7.00 am to 6.00 pm, Saturday 8.00 am to 1.00 pm.

Reference to **Table 4.5** indicates that the predicted LA_{10} daytime construction noise level of the construction activities at AI19 is 39 dBA. On the basis of a minus 3 dBA adjustment to convert the LA_{10} to an LA_{eq} noise level, the predicted noise level is 9 dB lower than the construction noise level objective, based on the DECCW's ICNG.

4.6.2.2 Operational Noise

The duration of drilling operations are anticipated to be up to 6 weeks.

The INP outlines industrial noise criteria in two categories, an intrusive criterion and an amenity criterion. The intrusive criteria are more stringent than the amenity criteria and if the intrusive criteria are achieved the amenity criteria would also be achieved

The intrusive criteria $LA_{eq}(15 \text{ minute})$ should not exceed the RBL by more than 5dBA. **Table 4.6** presents a summary of the time specific intrusive criteria.

Table 4.6. Location and Time Specific Intrusive Criteria

Background Noise Monitoring Location	Daytime LA_{eq} . (15 minute) (dBA)	Evening time. LA_{eq} (15 minute) (dBA)	Night-time. LA_{eq} (15 minute) (dBA)
Location 1 (AI19)	40	40	36

For assessment purposes;

- Daytime is 0700hours to 1800 hours Monday to Saturday or 0800 hours to 1800 hours Sundays and Public Holidays;
- Evening is 1800 hours to 2200 hours; and
- Night-time is 2200 hours to 0700 hours Monday to Saturday and 2200 hours to 0800 hours Sunday and Public Holidays.

Table 4.7 lists indicative operational noise levels for both calm and noise enhancing weather conditions at the nearest receiver to drill site AI19. Noise enhancing weather conditions are assumed to be a wind speed of 3 m/s in a direction from the source to the receiver. The nearest receiver is identified as 329 Darkes Forest Road and is located 800 m from the drill site.

SLR Heggies concluded that while drilling is operational, compliance is likely at the nearest receivers to drill site AI19 during all periods. They also noted that the predicted noise levels are for the worst case surface drilling scenario and once the drill penetrates deeper, the predicted noise levels will decrease.

The drilling operation is proposed to be undertaken 24 hours per day over 7 days per week. This raises the potential to create sleep disturbance. The DECCW's most recent policy considers sleep disturbance as the emergence of the $LA1(1\text{minute})$ level above the $LA90(15\text{minute})$ level at the time. Appropriate screening criteria for sleep disturbance are determined to be an $LA1(1\text{minute})$ level 15 dBA above the Rating Background Level (RBL) for the night-time period (10.00 pm to 7.00 am).

When the criterion is not met, a more detailed analysis may be required which should cover the maximum noise level or LA1(1minute), the extent that the maximum noise level exceeds the background level and the number of times this occurs during the night-time period. Some guidance on possible impacts is contained in the review of research results in the appendices to the NSW Environmental Criteria for Road Traffic Noise (ECRTN).

Other factors that may be important in assessing the extent of impacts on sleep include:

- How often high noise events will occur.
- Time of day (normally between 10.00 pm and 7.00 pm).
- Whether there are times of the day when there is a clear change in the noise environment (such as during early morning shoulder periods).

Table 4.7. Indicative Drilling Operational Noise Levels.

Time	LA _{eq} Operational Noise Objectives	Predicted Calm LA _{eq} Operational Noise Levels	Predicted Worst LA _{eq} Operational Noise Levels	Assessment
Daytime	40 dBA	24 dBA	30 dBA	Complies
Evening	40 dBA	24 dBA	30 dBA	Complies
Night-time	36 dBA	24 dBA	30 dBA	Complies

There are no specific criteria for sleep disturbance nominated in the INP, in the INP Application Notes, the ECRTN, or in the ICNG. This is consistent with the statement in the ECRTN that “*at the current level of understanding, it is not possible to establish absolute noise level criteria that would correlate to an acceptable level of sleep disturbance*”.

A substantial portion of the ECRTN is a review of international sleep disturbance research, indicating that:

- A maximum internal noise levels below 50-55dB(A) are unlikely to cause awakening reactions, and
- One or two noise events per night with maximum internal noise levels 65-70dB(A) are not likely to significantly affect health and wellbeing.

Based on the DECCW’s “screening” criterion of RBL + 15 dBA for sleep disturbance, the criterion at the potentially most affected residence on Darkes Forest Road to borehole location AI19 is 46 dBA.

The worst case predicted night-time LAeq(15minute) noise level from the subject operation is 30 dBA.

Given that, based on the drill noise monitoring results conducted by Heggies in November 2008, the subject operational LA1(1minute) noise levels are likely to be less than 10 dBA above the LAeq levels, compliance with the 46 dBA LA1(1minute) criterion will be met.

Apex will implement a range of strategies to reduce noise effects. In accordance with the INP there are essentially three main mitigation strategies for noise control:

- Controlling noise at the source,
- Controlling the transmission of noise, and,
- Controlling noise at the receiver.

Controlling noise at the source.

There are two approaches:

- Best Management Practice (BMP), and
- Best Available Technology Economically Achievable (BATEA).

BMP is the adoption of particular operational procedures that minimise noise while retaining productive efficiency. When an appropriate mitigation strategy that incorporates expensive engineering solutions is being considered, the extent to which cheaper, non engineering-oriented BMP can contribute to the required reduction of noise should be taken into account.

Controlling the transmission of noise.

There are two approaches: the use of barriers and implementing land-use controls which attenuate noise by increasing the distance between source and receiver.

Controlling noise at the receiver.

The two approaches to controlling noise at the receiver involve either negotiating an agreement with the landholder and/or implementing acoustic treatment of dwellings to control noise.

Apex will implement appropriate BMP and BATEA practices.

Monitoring would be undertaken during drilling operations to confirm that the criteria are being achieved. Should this monitoring demonstrate non-compliance, Apex would undertake investigations and planned actions to ameliorate the non-compliance.

Should these approaches not resolve any acoustic issues satisfactorily, drilling would be limited to those times of day when criteria are met after implementation of amelioration measures.

4.7 Waste Management

During the drilling program, waste will be generated on site from the following sources:

- Packaging from materials and supplies,
- Wastewater from temporary office and toilet facilities,
- General office waste, and,
- Vehicle servicing wastes.

Packaging wastes will be separated into metal, wood and other recyclable streams. These separated waste materials will be recycled in an approved manner. Non-recyclable materials will be collected separately and will be disposed off-site in an approved waste facility.

Vehicle servicing wastes will consist of oils and greases together with assorted hydrocarbon containers. Mobile vehicles will not be serviced on site. This will be undertaken at appropriate off site workshops. Any oils, greases and containers will be collected for recycling.

4.8 Soil Management

Topsoil from the area surrounding the borehole will be stripped and stockpiled prior to the commencement of drilling. This topsoil will be used to resurface disturbed areas prior to revegetation.

The topsoil will be stockpiled in an appropriate area. Sedimentation fences will be used to prevent sediment from entering water courses during rain. Subsoil material may be moved around the site to provide a flat drill pad. The topsoil will be returned to any cut and fill batters requiring revegetation during site rehabilitation.

The site will be covered with brush obtained from surrounding vegetation and seeded with native flora species consistent with those currently surrounding the site. The details of site revegetation will be determined in liaison with SCA at the time.

4.9 Greenhouse Gases.

There will be minimal emission of greenhouse gases during the drilling of the cored hole at AI19 related to;

- Diesel combustion during borehole establishment; and
- Off-site emissions associated with extraction operations occurring due to on-site diesel use.

The gas testing proposed for AI19 will not result in major gas emissions and will not require any flaring of gas.

4.10 Rehabilitation

Rehabilitation of the borehole site is required by the Petroleum Exploration Licence (PEL). Once the core samples have been obtained and the gas testing completed, the borehole will be filled with concrete.

The site would be retained pending the outcome of investigations of the core samples and the gas monitoring. Should the results not warrant further use of the borehole site and access track, they would be fully rehabilitated. If the results indicate further use of the site is warranted, the access track and the borehole site would be maintained in an accessible condition. Any further use of the site additional to obtaining core samples and gas testing would be subject to another Project Approval Application and associated Environmental Assessment.

The rehabilitation works will include:

- Removal of surface infrastructure,
- The filling of the borehole,
- Top soil stockpiles spread over the area, and,
- Revegetation of the area with native flora.

Final Land Use

Borehole AI19 will be located on SCA Special Area and will be returned to naturally vegetated catchment area in accordance with the requirements of SCA. There are no other alternative future land uses and this will be confirmed when final rehabilitation and revegetation is undertaken in accordance with SCA supervision and instruction. At that time other land use options may be requested and these will be considered at that time. As a result of discussions with SCA it is considered that SCA is most unlikely to make such a request.

Rehabilitation Objectives

The overall rehabilitation objective will be to return the disturbed area to a state where it has a sustainable land use and is stable, non-polluting and provides for long term safety of the affected area.

Apex will rehabilitate the site in accordance with the directions and requirements of SCA. It will be undertaken in accordance with the Vegetation Clearing and Rehabilitation Management Plan that has to be prepared by Apex in accordance with Condition 7 of Schedule 3 of the project Approval dated 23rd September 2009. This Plan has to be approved by the Director-General of the department of Planning before construction of the first borehole commences. It must include a description of the procedures for revegetating and rehabilitating the areas of disturbance and it must provide completion criteria, including a monitoring timetable, and measures that would be implemented to ensure the criteria are achieved.

Strategic Completion Criteria

These criteria will be developed in conjunction with SCA and included in the Vegetation Clearing and Management Plan described in the previous section headed Rehabilitation Objectives. The criteria will be based on the rehabilitation objectives.

Sustainability and stability criteria will report on such areas as vegetation survival, soil management to optimise revegetation establishment and survival, ground cover and erosion control.

Safety criteria will address issues associated with sealing of the shaft in accordance with DII instructions and requirements, leaving the site without physical hazardous components and removal of waste materials. These criteria would be assessed in a site safety review at the completion of all site activity.

Non-polluting criteria will include measures such as removal of all waste materials, and vegetation establishment and survival.

Rehabilitation Methodology

The approach to rehabilitation will be directed at returning native vegetation to disturbed areas. This will be encouraged by correct storage and return of topsoils and topsoil material to disturbed areas.

Compacted areas will be ripped to appropriate depths to dissipate compaction and to promote root penetration of the site. After topsoiling, disturbed areas will be covered with brush collected from adjacent vegetation. This will provide a seed source and microhabitats for seed collection, germination and protection during the early stages of development. Additional seeding and/or planting of nursery raised stock will be undertaken in liaison with SCA when and if required. Any sown seed or seed used to raise nursery stock would be collected from the immediate area to ensure provenance consistency.

Conceptual Landform Plan

The objective will be to return the site to the existing contours. Site AI19 will not require significant surface contour modifications and any such modifications will be removed at the completion of site activities. Apex considers that a plan showing final contours is not required in this case.

The target vegetation/habitat outcomes are to reproduce the existing habitats and vegetation adjacent to the site. Again, Apex does not consider it is necessary to provide a plan showing this proposed outcome.

DII will impose rehabilitation bond requirements on Apex. This will ensure that there are finances available to the DII to enable them to rehabilitate disturbed areas should that need arise.

Apex has also committed to repair any damaged SCA roads and tracks as a result of their exploration activities within the catchment areas.

4.11 Traffic

Traffic will be generated as a result of establishing the borehole, gas monitoring and regular inspections of the boreholes for safety and maintenance purposes.

Access to the site will be required by the vehicle mounted drilling rig, service vehicles and by small vehicles transporting operators to and from the site.

The drill rig would access and leave the site only on one occasion. Heavy vehicles would be required to access the site daily for delivery of supplies, removal of excess

water and delivery of fresh water. A maximum of 2 heavy vehicles per day would be required for this function.

Small vehicle access would be required to enable the workforce and Apex supervisory personnel to get to and from the site. This is estimated to require up to 5 light vehicles per day.

Borehole establishment, core sampling and gas testing would occur over a 10 week period. An additional 6 weeks will be required to assess the core and gas monitoring results. At the end of this latter six week period, the need to fully rehabilitate or retain the site will be determined. If rehabilitation is required, it will be undertaken as soon as possible.

The access road intersects with Darkes Forest Road at a gentle curve which provides good site distance in either direction. Darkes Forest Road does not provide through access and the level of existing traffic is very low consisting predominantly of local traffic.

The security gate on the access road will be set back from Darkes Forest Road in order to provide adequate area for off-road parking of all vehicles as they enter and leave Darkes Forest Road.

Traffic safety rules and procedures will be developed to ensure public and employee safety during all operational stages of the program.

5 ENVIRONMENTAL MANAGEMENT

To provide suitable environmental management of the proposal Apex will implement a number of actions that are discussed in this section. Reference to Apex in this section includes any other companies or individuals with whom Apex may enter an arrangement to participate in the development.

Apex acknowledges the importance to manage the environmental implications of the Illawarra Coal Seam Gas Drilling and Gas Monitoring Program. Apex have longer term plans to develop gas reserves in the NSW Southern Coalfields and intend to operate the overall exploration and monitoring program, including AI19, in a way that demonstrates their commitment to appropriate environmental management. Apex considers this to be an essential factor in establishing support for their longer term aspirations with Government and the general community.

Environmental management of the program will be achieved through an integrated series of policies, plans and procedures and a suitable management structure that clearly defines responsibility, accountability and reporting requirements. The policies, plans and procedures will be supported by training of staff and contractors to ensure they all have the appropriate knowledge and skills.

The main objective for the environmental management of the Program will include establishing Apex as an environmentally responsible company.

Apex will establish a simple Project Management Structure to ensure effective environmental management of the Program. The Apex Directors responsible for the Program would be responsible for all matters relating to environmental management. The Directors have appointed an Exploration Manager who has the day to day responsibility of ensuring that all site activities are undertaken in accordance with the various policies, plans and procedures. The Exploration Manager will co-ordinate environmental performance monitoring to measure adherence to approval and licence conditions and compliance with applicable legislation.

Apex will appoint an Environmental Manager for advice and recommendations and to undertake an internal auditing and inspection role as required.

Apex will operate the Program in accordance with a Health Safety and Environmental Policy. This Policy will be supported by a range of Plans and Procedures that will define how Apex will operate the Program.

Prior to establishing the borehole sites, the Drilling Contractor will prepare a Site Environmental Management Plan. This Plan will address a range of environmental issues for which the Contractor is responsible, including the management of site water, fuels and oils, chemicals and wastes.

Each drill site will be designed in accordance with the specific site requirements. The design will incorporate risk management techniques and will involve input from relevant stakeholders in order to ensure their requirements are met. Pre-establishment liaison and planning will result in a site-specific Management Plan that will identify how all aspects of the site will be managed.

Gas flows will occur in accordance with a Well Testing and Flaring Management Plan that will be created using a standard risk management approach including consultation with Government and industry experts. The Well Testing and Flaring Management Plan will be authorised by DII prior to any release of gas.

Other documented work arrangements will be developed as required.

The Exploration Manager will be responsible for ensuring that all Program personnel are suitably trained, and possess the necessary skills to undertake their designated activities with due consideration of environmental considerations.

Borehole AI19 has been positioned to minimise vegetation clearing and soil disturbance and compaction. Any cleared vegetation and topsoil will be stockpiled and respread over the site on completion of operations. Vehicle access will be restricted to defined parking and unloading areas.

Drilling will require excavation of a sump to collect cuttings and expelled water. Following completion of drilling, the sump will be allowed to settle. The sump would be backfilled with material originally excavated from it and the disturbed area covered with topsoil and any remnant vegetation.

Following completion of operations all excavations will be backfilled and the site rehabilitated. Any excavations will be backfilled with the original spoil and compacted in layers. Topsoil will be re-spread over the site. The site will be left slightly proud to allow for settling. Cleared vegetation will be spread over the disturbed area to promote revegetation and to provide erosion protection.

Silt fences will be erected where appropriate and maintained until a suitable level of rehabilitation has been achieved.

On-site storage of fuel and lubricants will be kept to a minimum and safely stored on site in bunded pallets. Hydrocarbon spill kits will be available on site.

If practicable, and if agreed by the landowner (SCA), water requirements will be pumped to the site. Otherwise water will be brought in by tanker and stored in above ground tanks.

Drilling equipment will be required to be clean of soil and free of oil leaks prior to entering the site. Any oil leaks that develop will require immediate repair and drilling contractors will be required to have a supply of oil absorbent material on hand.

Apex does not intend to use additives in the drilling of cored holes such as AI19. However, there may be a need to add some KCl to the drilling fluid to provide clay stability. Should KCl additions be necessary, Apex will ensure that the drilling fluids are removed from site at the completion of drilling and the water containing KCl disposed of in an appropriate manner.

All packaging, damaged or surplus equipment and drilling supplies will be removed from site prior to or at the completion of operations. To maintain hygiene and minimise scavenging by wildlife, food wastes and similar will be deposited in securely- capped bins and removed daily.

A “portaloo” will be installed on site and maintained on a regular basis. Potable water will be available on site for personnel use.

Fire precautions will include spark arrestors on the drilling rig, and no smoking or sources of ignition within 30m of the wellhead. There will be fire extinguishers on the drilling rig. Apex will provide cleared areas for hot work (grinding, cutting and welding) and a “butt bin” for smoking. All hot work will be done with an observer standing by and fire extinguishers on hand.

Drilling activity will occur every day over 24 hours per day.

The site boundary will be marked by coloured tape suspended between steel droppers with warning signs.

Exploration well testing may produce groundwater from the seams and it is not possible to predict the volume and quality of this water. It is proposed that such water be stored in the ground sumps or in above ground tanks and removed off-site by tanker or temporary above ground poly-pipe. Local experience with coal exploration boreholes confirm minimal groundwater make up. Ultimate disposal will comply with DECCW requirements. The exploration program will provide details of water quality and quantity to assist planning of any future activities.

Borehole AI19 is within a SCA Special Area and will require prior approval from SCA to enter and conduct operations. Apex agrees to adhere to all safety and environmental requirements set out in any SCA Access Standard Conditions to which they are a party.

Wireline geophysical operations require the use of small radioactive sources. These are under the control of the contracted logging engineer who must comply with all legislative requirements as to their use.

Apex is not expecting any subsidence to occur as a result of the Coal Seam Gas Exploration and Gas Monitoring Program. Very minor amounts of gas are planned to be extracted. Should the Program identify commercial gas quality and quantity, Apex would lodge an additional application for Major Project Approval. This would address subsidence issues if there is any likelihood of potential occurrence. Apex does not expect subsidence to occur in the Southern Coalfields as a result of seam and goaf gas extraction.

Table 5.1 contains all the commitments and measures Apex has made and will undertake to minimise impacts on the environment. Many of the measures and commitments are included in the original Environmental Assessment in Section 6 (Page 98). Table 5.1 also includes measures and commitments that Apex has made as a result of Government and community comment on the original EA.

These measures and commitments also form part of the Project Approval and the relevant ones will apply to Borehole Site AI19.

Table 5.1. Project Commitments

Action	Timing
1. During drilling operations actions will be undertaken to protect aquifers from any operational impacts.	During borehole establishment and drilling.
2. Use of any of the boreholes for future gas production is dependent on exploration outcome and appropriate prior approvals.	Potential future activity.
3. Holes will require a blow-out prevention (BOP) device on the wellhead which is secured to steel casing cemented in to a depth of at least 10% of the estimated final hole depth, or as required under the Petroleum Act 1991 .	During borehole drilling.
4. Each drill site will be designed in accordance with the specific site requirements. The design will incorporate risk management techniques and will involve input from relevant stakeholders in order to ensure their requirements are met. The pre-establishment liaison and planning will result in a site specific Management Plan that will ensure the site is managed appropriately.	Prior to drilling.
5. Gas flows will occur in accordance with a Well-testing and Flaring Management Plan that will be created using a standard risk management approach including consultation with Government and industry experts. The Well-testing and Flaring Management Plan will be authorised by DPI-Mineral Resources prior to any release of gas.	During gas monitoring.
6. Flaring will be undertaken in a purpose built mobile gas flaring chamber.	During gas monitoring.
7. Apex proposes to undertake additional exploration and gas data acquisition at some time in the near future. This future activity will be dependent on the initial results and involves two main technologies. The first involves zero radius drilling through coal seams from existing core boreholes. The second promotes methanogenic bacteriological activity. These will be subject to further approval in a separate application and assessment process.	Potential future activity.
8. The final location of each borehole will be confirmed after consideration of detailed environmental assessment of each site.	Prior to drilling
9. Apex would liaise with SCA to obtain agreement with a series of requirements to enable the activities to proceed.	Prior to drilling.
10. Boreholes have been sited to minimise vegetation clearing and soil disturbance and compaction.	Completed.
11. Any cleared vegetation and topsoil will be stockpiled and re-spread over the site on completion of operations.	During site clearing.
12. Vehicles will be restricted to defined parking and unloading areas.	During drilling.

Proposed Borehole AI19 Illawarra Coal Seam Gas Exploration Drilling and Gas Monitoring Program

Action	Timing
13. Exploration hole drilling will require excavation of a sump to collect cuttings and expelled water. Following completion of drilling, the sump will be allowed to settle. The sump would be backfilled with material originally excavated from it and the disturbed area covered with topsoil and any remnant vegetation.	During and immediately following drilling.
14. Following completion of operations all excavations will be backfilled and the site rehabilitated.	Following completion of all operations at each site.
15. All bores will be cased to protect any higher yielding or higher quality aquifer than the gas producing strata. Apex believes the only aquifer of a critical nature is the Hawkesbury Sandstone which hosts upland swamps.	As required during drilling.
16. Silt fences will be erected where appropriate and maintained until a suitable level of rehabilitation has been achieved. All silt fencing will be removed when no longer required.	Prior to and during drilling.
17. On-site storage of fuel and lubricants will be kept to a minimum and safely stored on site in bunded pallets. Hydrocarbon spill kits will be available on site.	During drilling.
18. Drilling equipment will be required to be clean of soil and free of oil leaks prior to entering the site.	Prior to drilling.
19. Any oil leaks that develop will require immediate repair and drilling contractors will be required to have a supply of oil absorbent material on hand.	During drilling.
20. Apex will comply with all legislative requirements in respect of licensing any encountered groundwater resources. In the event of encountering any significant groundwaters/aquifers an application for licensing of a water well would be made.	Prior to and during drilling.
21. Apex will ensure that the drilling fluids are removed from site at the completion of drilling and the water containing KCl disposed of in an appropriate manner.	At the completion of drilling.
22. All packaging, damaged or surplus equipment and drilling supplies will be removed from site prior to or at the completion of operations. Food wastes and similar will be deposited in secure capped bins and removed on a daily basis to maintain hygiene and minimise scavenging by wildlife.	During and immediately following drilling.
23. Fire precautions will include spark arrestors on the drilling rig, and no smoking or sources of ignition within 30m of the wellhead. There will be fire extinguishers on the drilling rig. Apex will provide cleared areas for hot work (grinding, cutting and welding) and a "butt bin" for smoking. All hot work will be done with an observer standing by and fire extinguishers on hand.	During all site activities.
24. A "portaloo" will be installed on site and maintained on a regular basis.	During drilling.

Proposed Borehole AI19 Illawarra Coal Seam Gas Exploration Drilling and Gas Monitoring Program

Action	Timing
25. Where possible, the drilling activity will occur every day over 24 hours per day.	During drilling
26. Within SCA areas, the site boundary will be marked by coloured tape suspended between steel droppers with warning signs. In open areas Apex will provide temporary security fencing and warning signs around the boundary of each site.	During drilling and gas monitoring.
27. Exploration well testing may produce groundwater from the seams. It is proposed that such water be stored in the ground sumps or in above ground tanks and removed off-site by tanker or temporary above ground poly-pipe. Ultimate disposal will comply with DECC requirements.	During gas testing.
28. All safety and environmental requirements set out in the SCA Access Agreement will be adhered to.	During all site activity.
29. The exploration program will provide details of water quality and quantity to assist planning of any future activities.	Data collection to assist potential future activity.
30. A sedimentation fence will be constructed immediately down slope of the drill sites. The sedimentation fences will be installed in accordance with requirements as described in "Soils and Construction", hip pocket handbook, 1 st Edition, dated March 2004.	Prior to drilling commencing and first stage of site set up.
31. Should any surface drains and/or sedimentation basins be required during construction, they will be constructed in accordance with the Landcom publication, "Soils and Construction" Volume 1, Fourth Edition, March 2004 and and the DECC (2008) publication, Managing Urban Stormwater; Soils and Construction - Volume 2A: Installation of Services, Volume 2C: Unsealed Roads and Volume 2E Mines and Quarries.	During site establishment and during drilling and gas monitoring.
32. The construction contractor will prepare a Site Environmental Management Plan that will address site water management details.	Prior to site access.
33. On-site storage of fuel, lubricants, potassium chloride and any other chemicals would be kept to a minimum and these items would be stored in bunded pallets.	During drilling.
34. In the event of a spill of produced groundwater onsite which is not contained within site sumps or above ground tanks, a water quality sampling and testing service would be employed to ensure that any 'normal' stormwater runoff retained by the bund wall has not been contaminated and, if it has, that prompt removal by tanker would occur.	During drilling and gas monitoring.
35. For core drilling sites, where excavated sumps are used for the circulation of drilling fluid, if possible drilling fluid would be confined within the mud pits and temporarily covered with say a tarpaulin so that mixing with stormwater is prevented.	During core drilling.

Proposed Borehole AI19 Illawarra Coal Seam Gas Exploration Drilling and Gas Monitoring Program

Action	Timing
36. Significant amounts of produced groundwaters which can be confined within on-site tanks or pits would have pH and EC monitored prior to tinkering away off site. All wastewater generated from the borehole drilling activities (apart from that recycled during drilling) must be removed from the drill site and transported for disposal outside of the Special Area.	During drilling and gas monitoring.
37. To assess requirements for management of excessive volumes of produced groundwaters i.e. volumes which have not been successfully confined within on site tanks or pits and are contained behind the site bund wall, water samples would be collected to determine water quality in the event of possible loss of containment. This would be done by measuring pH and EC onsite, and collection by an appropriately trained person of samples to be sent to a NATA-accredited laboratory for determination of key chemical analytes as identified in Table 4.2 of the March 2009 EA.	During drilling and gas monitoring.
38. On demand, water quality sampling and analysis would be conducted in the unlikely event that there is any uncontrolled release from the site water containment system.	During drilling and gas monitoring.
39. There will be no discharge of polluted waters to either surface waters or groundwaters from the site activities.	During site activities.
40. The plant species <i>Darwinia grandiflora</i> was recorded at borehole AI10 within Coastal Upland Swamp. The exact location of this species will be flagged, so it can be adequately protected and avoided by the proposal during and after construction of the borehole. A suitably qualified ecologist will be on site during the initial borehole site set up, to ensure this species is not impacted by the proposal.	Prior to drilling commencing.
41. Apex will adjust the location of boreholes and access tracks to avoid native trees and significant habitat features such as sandstone outcropping, where required.	Prior to drilling commencing.
42. Trees with hollows would be retained and protected, with no drilling within the critical root zone (extending to 2m beyond the drip line) of the trees.	Determined prior to drilling commencing.
43. Access to boreholes AI10, AI16, and AI18 may require trimming of branches along existing fire trails. Such branch trimming would be limited and restricted to smaller branches that do not support hollows. Should large branches with hollows be required to be removed, a suitably qualified ecologist would be on site during clearing to ensure no resident fauna are harmed. Cleared branches would be placed in adjoining vegetation, as they will provide fauna habitat.	Prior to drilling commencing.

Proposed Borehole AI19 Illawarra Coal Seam Gas Exploration Drilling and Gas Monitoring Program

Action	Timing
44. Access to boreholes AI10, AI16 and AI18 will involve two creek crossings. These crossings will use established crossings along the established Fire Road 10Q and will not divert into other areas of the creeklines. Caution would be taken to prevent sedimentation run off and minimise disturbance along the creek.	Prior to drilling commencing and during all site activities.
45. Apex shall provide updates (by email or fax) to SCA on the progress of the drilling program on SRA land once per week.	During drilling on SCA land.
46. Where possible, proposed boreholes and access tracks would be located within existing cleared areas.	Prior to drilling commencing.
47. Sediment and erosion control measures would be implemented on all sites to prevent erosion during and after construction.	Prior to and during site activities.
48. Disturbance to native vegetation would be minimised, or, where disturbance is unavoidable, borehole sites would be rehabilitated using locally sourced tubestock and brush-matting. Rehabilitation would be undertaken by suitably qualified bush regenerators.	Prior to, during and after site activities.
49. Where clearing of native vegetation is unavoidable, native shrubs, logs and bush-rock would be stockpiled on the side of the proposed boreholes and access routes and replaced following completion of the works.	Prior to any site clearing.
50. If required, bush regeneration and weed control would be undertaken to ensure the flora and fauna of the locality are protected throughout the construction and operation phases of the proposal. This is particularly important for boreholes where intact native vegetation will be disturbed. Any bush regeneration and weed control would be undertaken by suitably qualified bush regenerators.	Prior to, during and after site activities.
51. Apex will repair any damage NPWS access roads and tracks.	As and if required.
52. Any chemicals used on site would be taken off site after use and disposed of appropriately.	During drilling and gas monitoring.
53. Machinery and vehicles would be washed down prior to use on site to avoid the transmission of weed seed or disease into areas of intact native vegetation.	Prior to machinery and vehicles being used on site.
54. A suitably qualified ecologist would be on site during the initial site set up for each borehole, to ensure significant habitat features and species are not impacted by the proposal.	Prior to drilling commencing and during site confirmation.
55. During construction Apex will ensure that all diesel motors are noise attenuated to minimise noise impacts during construction. Testing operation will be largely inaudible and will not require mitigation.	During drilling and gas monitoring.
56. Within 3 months of the completion of each borehole on SCA land or within any other time agreed to by SCA, Apex will provide a report to SCA detailing compliance with the safeguards and mitigation measures detailed in the EA, EMP and as specified in any conditions of approval.	Within 3 months of the completion of a borehole on SCA land.

Proposed Borehole AI19 Illawarra Coal Seam Gas Exploration Drilling and Gas Monitoring Program

Action	Timing
57. Apex will install screening of the site compounds to mask visual intrusion into the landscape. This may include measures such as fixing green shade cloth to the compound site fence to merge the bulk of the fence into surrounding vegetation or planting of local native plant species as a screen around the fence where sufficient depth of soil exists.	During site establishment.
58. No archaeological constraints have been identified within the project study area. Should unanticipated Aboriginal objects be identified during project works, all works should cease in the vicinity of the find and an archaeologist should be called to assess the find.	During all site activities.
59. No historic heritage constraints have been identified within the project study area. Should unanticipated historic relics be identified during project works, all works would cease in the vicinity of the find and an archaeologist would be commissioned to assess the find.	During all site activities.
60. Where necessary, a water cart will be used on site to reduce dust generation.	During site establishment and drilling.
61. Apex will implement appropriate BMP and BATEA practices. They will provide noise barriers at AI05 and AI06 to reduce noise levels experienced at the nearest residences. In addition, they will attempt to negotiate agreements with the affected residents should the barriers not enable the noise criteria to be met.	During site establishment and drilling
62. Appropriate monitoring would be undertaken during drilling operations to confirm that the criteria are being achieved. Should this monitoring demonstrate non-compliance, Apex would undertake investigations and plan actions to ameliorate the non-compliance.	During drilling.
63. Should the approaches described in commitments 61 and 62 not resolve the noise issues, drilling would be limited to those times of day when criteria are met.	During drilling at AI05 and AI06.
64. All construction work (ie. prior to drilling) will be conducted between 7am and 6pm Monday to Friday and between 7am and 1pm Saturdays and at no time Sundays and public holidays, unless inaudible at any residential properties.”.	During site construction.
65. Packaging wastes will be separated into metal, wood and other recyclable streams. These separated waste materials will be recycled in an approved manner.	During all site activities.
66. Non-recyclable materials will be collected separately and will be disposed off-site in an approved waste facility.	During all site activities.
67. Wastewater from the temporary site buildings will be collected on-site prior to transport off-site for disposal at an appropriately authorised disposal facility.	During all site activities.

Proposed Borehole AI19 Illawarra Coal Seam Gas Exploration Drilling and Gas Monitoring Program

Action	Timing
68. Vehicle-servicing wastes will consist of oils and greases together with assorted hydrocarbon containers. Mobile vehicles will not be serviced on site. This will be undertaken at appropriate off-site workshops. Any oils, greases and containers will be collected for recycling.	During all site activities.
69. Adequate spill control equipment/materials shall be available at drill sites.	During drilling and whenever liquids are stored on site.
70. Topsoil from the area surrounding the borehole will be stripped and stockpiled prior to the commencement of drilling. This topsoil will be used to resurface disturbed areas prior to revegetation.	During site establishment.
71. The site will be seeded with native flora species consistent with those currently surrounding the site.	During site rehabilitation at the completion of site activities.
72. Flaring of coal seam gas is proposed for implementation at each of the boreholes. While it is expected that between 90% and 100% of coal seam gas flow will be flared, the potential for some venting directly to the atmosphere exists.	During gas monitoring.
73. Rehabilitation of the borehole sites is required by the PEL. Boreholes that are not required for future gas production would be rehabilitated.	At the completion of site activities.
74. Apex will instruct all contractors and employees in the procedures for passing through the gates safely.	Prior to accessing each borehole site.
75. Apex shall detail and implement an evacuation and response plan for fire preparedness.	Before and during drilling.
76. Apex or its contractors will notify SCA of incidents causing or threatening material harm to personnel, the environment or SCA operations as soon as practicable after the person becomes aware of the incident.	During drilling operations.
77. Apex will meet with SCA prior to the completion of the work period at each site on SCA land to ensure that the site is decommissioned to the satisfaction of SCA and to determine site specific rehabilitation requirements and offset requirements. General rehabilitation measures are listed in the SCA submission.	After drilling on SCA land.
78. Traffic safety rules and procedures would be developed to ensure public and employee safety during all operational stages of the program.	Prior to accessing each borehole site.

APPENDIX I

Ecoengineers Pty Ltd. August 2010

Letter to Olsen Environmental Consulting Pty Limited

“Proposed Extra Apex Energy Coal Seam Gas Exploration Borehole AI19 off Darkes Forest Road, Darkes Forest”.



ECOENGINEERS Pty Ltd
9 Sunninghill Circuit
Mount Ousley NSW
Australia 2519
Tel: 61 2 4227 4174 Fax: 61 2 4227 5154
www.ecoengineers.com
ABN 74 078 666 510

30 August 2010

Mr. David Olsen
Olsen Environmental Consulting Pty Ltd
26 Paltarra Place
CORDEAUX HEIGHTS NSW 2526

**RE: PROPOSED EXTRA APEX ENERGY COAL SEAM GAS EXPLORATION
BOREHOLE AI19 OFF DARKES FOREST ROAD, DARKES FOREST.**

Thank you engaging Ecoengineers to conduct a soil and water-related environmental assessment of the proposed additional Apex Energy coal seam gas exploration borehole AI19 at Darkes Forest.

We inspected the proposed site for borehole AI19 during dry weather on Monday 23 August 2010 with you, Mr. Chris Rogers of Apex, several ecological consultants from Niche Environment and Heritage Pty Ltd and a representative of the Illawarra Aboriginal Land Council. The following information represents our assessment of the site and its soil and water management requirements during the exploration drilling program.

Our assessment and recommendations contained herein are to be considered as supplementary to our report entitled: 'Assessment and Management of Water-Related Impacts – Illawarra Coal Seam Gas Exploration Program dated September 2008 for Apex Energy NL.

Our assessment of potential water related impacts has involved:

1. field examination of the local topography, noting all proximate drainage lines and main drainage direction;
2. satellite and aerial photographic investigation of any proximate hydrological features e.g. upland swamps or creeks;
3. field assessment of any prior site disturbance i.e. excavations or soil scraping and baring to the area, inspection of soil type for erodibility; and
4. satellite and aerial photographic identification of any significant water-related features further down gradient of the proposed drill site.

For the site, GPS-based geographic coordinates were recorded, and a photographic record made, with photographs showing the landscape looking in each compass direction from the proposed location of the borehole.

Assessment

Date of Inspection: 20/08/10

Borehole MGA coordinates:

Easting: 307877

Northing: 6212410

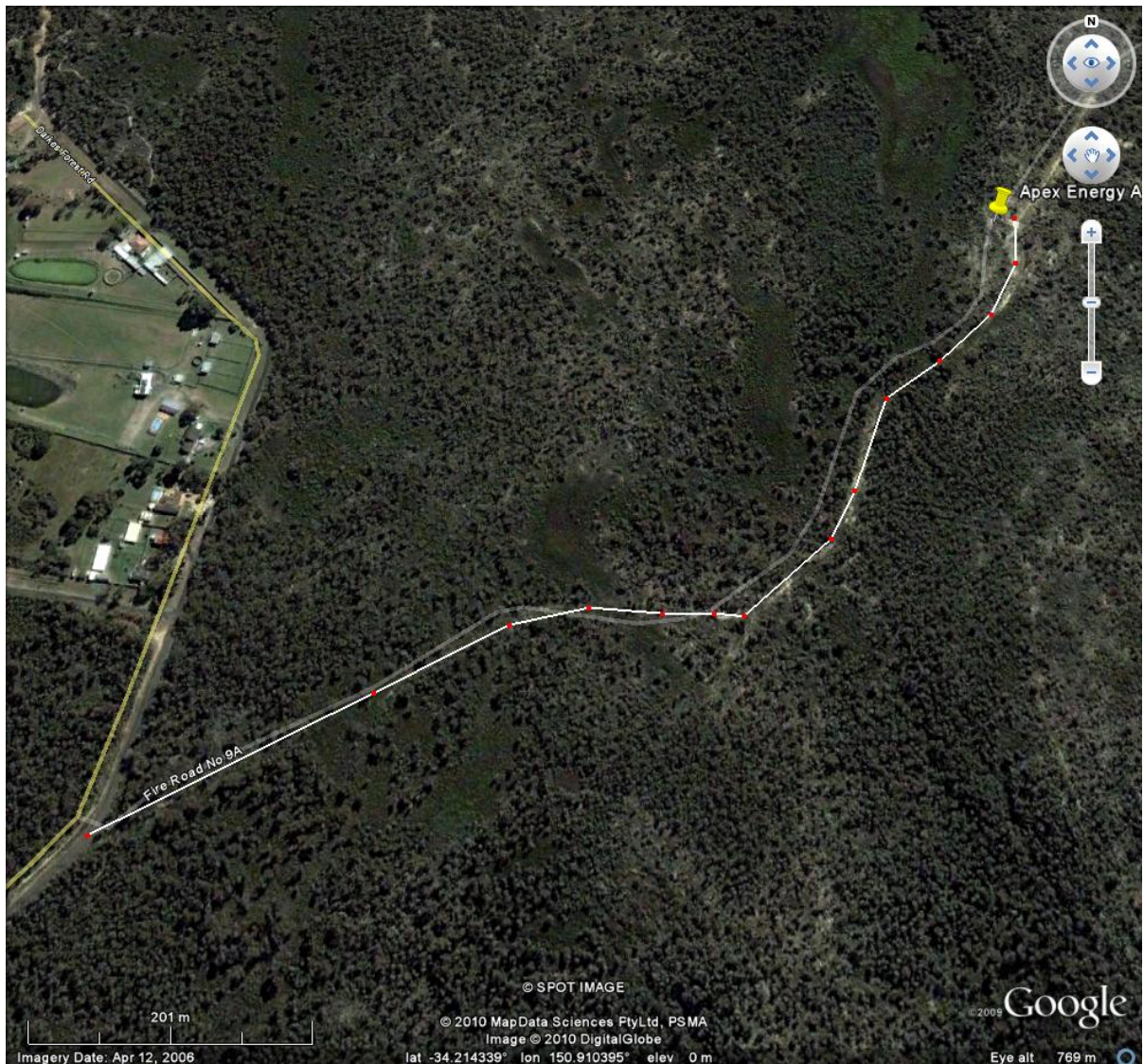
Latitude: -34.2117 S

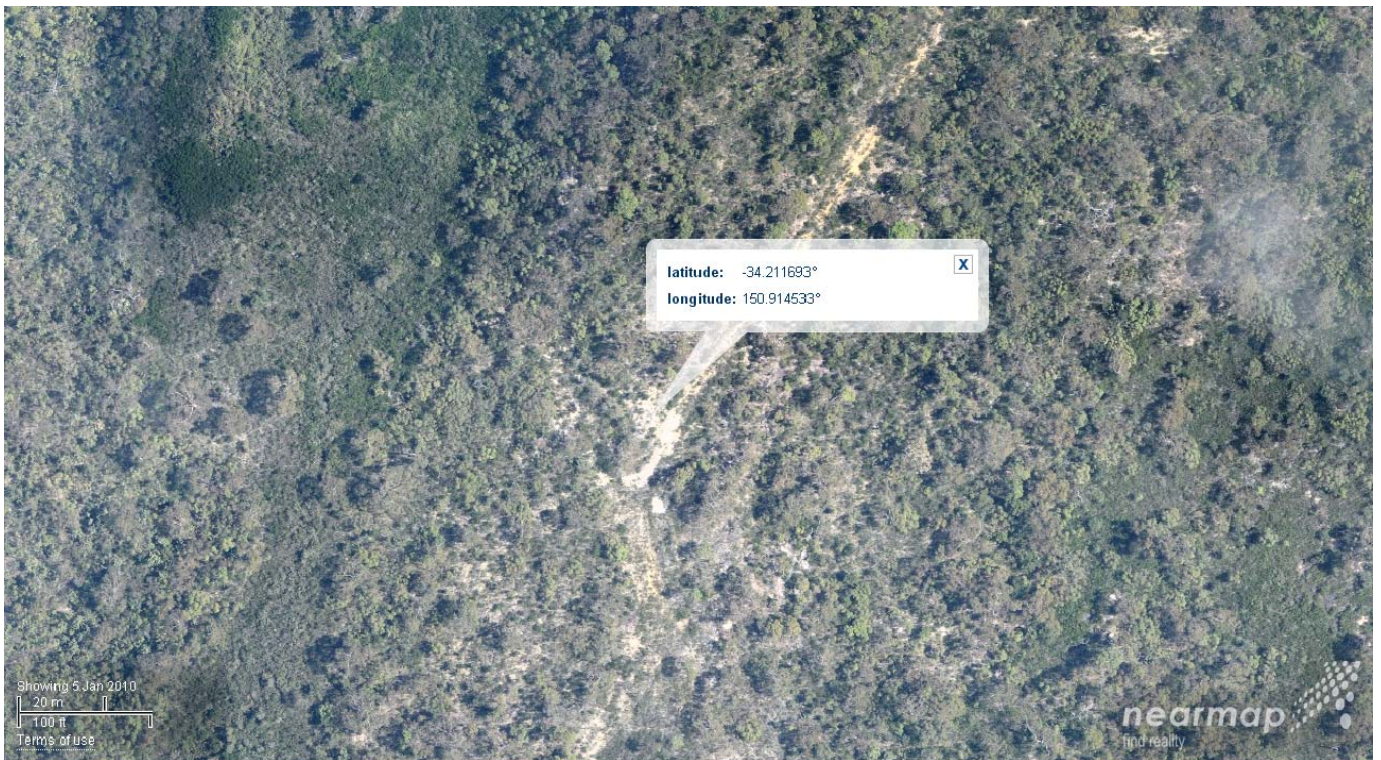
Longitude: 150.9145 E

Hole Type: Open hole

Workings: Un-mined coal lying between old Coalcliff Mine Goaf and N-S running dyke.

AI119 is within the Metropolitan SCA Special Areas. The site has been previously disturbed by prior clearing for SCA Fire Road No. 9A which originates on Darkes Forest Road and proceeds in a weakly meandering manner across mixed upland forest, heathland and swamp to the northeast. It is located almost exactly 1.00 km along the fire road from Darkes Forest Road at western edge of the road as shown below.





Present typical surface vegetation at borehole site



Local soils immediately around the proposed borehole for a distance of at least 25 m are shallow, sandy residual, poorly differentiated soils derived from weathering of Hawkesbury Sandstone. Depth to bedrock is generally <0.5 m within the project area.



The slope of the site is very low (<5%) and falls gently to the northeast broadly in the direction of the (continuation of) the fire road.

Due to the presence of the fire road there is a relatively minor requirement for clearing of trees and the (temporary) stormwater detention basin could easily be constructed on or adjacent to the fire road north of the borehole with a minor deviation around it.

During and immediately following the clearing of the site, and prior to the commencement of drilling, there is a low potential for soil erosion due to site run-off with negligible potential for run-on from upslope.

However, there is a significant upland swamp approximately 60 m due west of the borehole location. Clearing should not encroach into that area and the low profile temporary stormwater drains and flow control bunding required for the project should be such as to ensure that:

- no run on from the Fire Road access way south of the borehole location enters the swamp; and
- no dirty runoff generated within the project site enters the swamp

Given the very low slope and small size of the drilling site area, loss of significant sediment off-site would be unlikely provided there was adequate stormwater bunding detention volume provided.

A maximum bunding height of 660 mm on the down slope side i.e. across the Fire Road continuation would be sufficient.

This bund wall height means that the detention volume is approximately 190 m³, (not including the storage available in the mud pit) allowing for capture of a 20-year, 6 hour rainfall event of total rainfall approximately 42 mm.

Our assessment and recommendations contained herein are to be considered as supplementary to our report entitled: "Assessment and Management of Water-Related Impacts – Illawarra Coal Seam Gas Exploration Program" dated September 2008 for Apex Energy NL.

Reference to the detailed soil and water management recommendations made in that report, especially in Sections 3 and 4 should be made and all specific soil and water management measures detailed in the report must, as appropriate, be applied to the Borehole AI19 site also.

Sincerely

Dr. Stephen A. Short
Director

APPENDIX II

Niche Environment and Heritage. August 2010

“Ecological and Cultural Heritage Assessment”.



ECOLOGICAL AND CULTURAL HERITAGE ASSESSMENT

Apex Energy - Borehole AI19

August 2010

DOCUMENT CONTROL

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Matthew Richardson	Jamie Reeves & Matthew Richardson

Internal Review	Name
	Rhidian Harrington

External Review	Name
	David Olsen – Olsen Environmental Consulting Chris Rogers – Apex Energy

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Prepared for:	Organisation
Apex Energy c/o David Olsen	Olsen Environmental Consulting Pty Limited davidolsen@ocg.net.au

Front Cover Photograph: Overgrown access track leading to the Borehole AI 19 Borehole Site. Photo © Niche Environment and Heritage Pty Ltd.

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1 INTRODUCTION

1.1 Background

Apex Energy intends to develop a gas extraction borehole known as borehole AI19 to the east of Darkes Forest Road within the Woronora Catchment Area near Darkes Forest NSW (Figure 1).

The proposed borehole is in addition to an existing borehole and gas exploration program which has previously been subject to a detailed environmental assessment, the details of which have not been reproduced in this report. The existing environmental assessment is available on the webpage of Olsen Consulting Group (<http://www.ocg.net.au/projects.htm>) and, as such, this report does not reproduce the information regarding the project. This report serves as an addendum to the existing environmental assessment and should be read together with the original reports.

The existing program has been approved under Part 3A of the NSW *Environmental Planning and Assessment Act* (EP&A Act) 1979. This report supports a modification to the consent of the existing approval under the same legislation.

1.2 Definitions

The following definitions are taken from the Department of Environment, Climate Change and Water (DECCW) *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: is 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 Legislative Context

The assessment of this project has been carried out for approval under Part 3A of the NSW EP&A Act. The NSW TSC Act and the Commonwealth EPBC Act have been considered in relation to threatened flora and fauna.

Other legislation which is relevant to the biodiversity conservation includes the *Native Vegetation Act* (NV Act) 2003, the *National Parks and Wildlife Act* (NPW Act) 1974 and *State Environmental Planning Policy No.44* (SEPP 44) *Koala Habitat Protection*.

Part 6 of the NPW Act establishes a regime for the protection and recording of Aboriginal heritage in NSW. The *Heritage Act* 1977 (NSW) and instruments enacted under the EPA&A Act (LEPs, SEPPs)

operate to protect non-Aboriginal heritage in NSW. Whilst statutory approval is not required under either of these Acts when seeking approval under Part 3A of the EP&A Act the principles and objectives of the Acts have been considered in this assessment.

1.4 The Proposal and the Study Area

The proposal involves the development of a single borehole site which will require development of a drill site (approximately 40 x 40 m) and the reopening of an existing fire road (Fire Road 9A) (Figure 1). The fire road has been abandoned for many years and has substantially self-rehabilitated with native shrubs, sedges and grasses. Accessing the borehole site would involve clearing this vegetation and possibly upgrading the fire road to enable safe access to the site.

In summary, the proposal will involve the primary disturbance of 0.16 ha of vegetation at the borehole site. Site works will involve levelling a drill pad, development of drill sumps and soil containment, and erosion and sediment control.

Approximately 0.5 ha of secondary disturbance of rehabilitated vegetation along the disused fire road is required (1 km long x 5 m wide).

A total of 0.66 ha of vegetated area will be disturbed for the current proposal.

1.5 Approach of this Assessment

The primary aim of this ecological assessment is to describe the ecological and archaeological values, identify ecological or cultural constraints, assess the impacts of the proposal against the guidelines for assessment under Part 3A.

The specific objectives of this assessment include the following:

Ecological Assessment

- ☐ Undertake a background review of relevant literature and a review of relevant databases;
- ☐ Undertake targeted survey for individuals or habitat of threatened plant or animal species which are known or are considered to have the potential to occur in the study area;
- ☐ Describe the ecological values of the site;
- ☐ Quantify and describe ecological impacts at the site;
- ☐ Assess the significance of the impacts of the proposal for threatened species under the EP&A Act and the EPBC Act; and
- ☐ Provide recommendations to avoid, mitigate and offset impacts of the proposal.

Archaeological Assessment

- ☐ Undertake a background review of relevant literature and conduct searches of relevant heritage databases, including the DECCW Aboriginal Heritage Information Management System (AHIMS);
- ☐ Consult with the Aboriginal community by building on the consultation conducted as part of the previous assessment;

- ☐ Undertake a thorough archaeological survey of the study area;
- ☐ Record any cultural and/or archaeological sites that occur in the study area;
- ☐ Assess the cultural heritage significance of the individual sites (if there are any) and the study area in accordance with the Burra Charter (Australia ICOMOS 1999) and DECCW Standards and Guidelines Kit (NPWS 1997);
- ☐ Determine the potential impacts from the proposal to the cultural heritage value of individual sites and the cultural landscape as a whole;
- ☐ Provide recommendations to avoid impacts and conserve values, or to mitigate impacts where avoidance is not possible.

1.6 Limitations of this Assessment

The field survey was undertaken as a habitat based assessment and did not include more detailed techniques such as trapping and spotlighting (fauna). Some plant species are cryptic and can only be detected when flowering at certain times of the year and the majority of fauna are difficult to detect without using specialised trapping techniques. However, habitat assessments are an efficient method of assessing impacts from developments as they do not require individual species to be surveyed for, only the habitat for those species. This means that time-consuming and costly trapping surveys are not required as a species is assumed to be present if potential habitat for that species is present.

Habitat assessments can be considered to be a more conservative method of assessment as a species is assumed to be present if its habitat is present. The alternative is to conduct extensive trapping surveys, and if a species is not detected, assume it is not present. Numerous threatened animal (and plant) species are cryptic or difficult to detect and failure to capture them through trapping surveys (no matter how extensive) does not necessarily mean they are not present. Using a habitat-based approach to assessment means that all species that could potentially occur on a site are considered compared with dismissing some species because they were not detected through trapping surveys, even though they may be present.

Given the relatively small and concentrated size of the proposed impact footprint of the site and proposed access track all proposed impact areas were sampled. This basically involved sampling the borehole site and the proposed access track separately, by walking sampling transects (survey units) and identifying and then inspecting areas of visibility and exposure.

Overall, the strategy provides the opportunity for a detailed survey and sample of the study area. The sampling strategy is justified because overall the landscape is one of low archaeological visibility and exposure, so there is limited value in a more intensive strategy that needlessly observes thick undergrowth. Similarly given the nature of the site (particularly the access track which has previously been subject to a total alteration of the soil profile for its construction) the current survey effort is considered adequate.

2 ARCHAEOLOGICAL ASSESSMENT

2.1 Methodology - Archaeological Assessment

Review of Existing Archaeological Records

A review of the DECCW Aboriginal Heritage Information Management System (AHIMS) was undertaken prior to the site assessment for this project. Other references, including recent assessments undertaken as part of BHP Billiton's Bulli Seam Operations Part 3A Development Application (Biosis Research 2009), were also reviewed.

The AHIMS search was conducted on 31 August. The search covered an area of 2 x 2 km centred on the proposed borehole. The search returned 22 records in this area, comprising open grinding groove sites and enclosed sandstone shelter sites. These results are typical for the region, with most sites being present at the margin of swamps (grinding grooves) or in drainage lines (sandstone shelter sites). The closest site to the proposed works is a sandstone shelter, approximately 220 m from the existing access track. There are no sites within 500 m of the proposed borehole location (Figure 6).

Field Survey

An assessment of the borehole site and the access road to the site was undertaken on Monday 23 August 2010 in the presence of representatives of Apex Energy, Olsen Environmental Consulting, the Sydney Catchment Authority, the Illawarra Local Aboriginal Land Council and Niche Environment and Heritage.

The survey focussed on the location of the proposed borehole as the access track has been subject to significant disturbance in the past during its construction and the soil profile has been altered.

Aboriginal Community Involvement

Jon Kirby from the Illawarra Local Aboriginal Land Council (ILALC) assisted with the site field survey and provided input into the cultural heritage assessment. Mr Kirby did not raise any concerns regarding the proposal insofar as it may impact items of cultural heritage significance. A copy of this report will be provided to the ILALC for comment.

2.2 Results - Archaeological Assessment

There are no previous records of any Archaeological sites in close proximity to the boreholes site or the access track (see Figure 6).

No new sites were recorded during the current survey.

The access track and proposed borehole location do not occur on landforms that may be considered to have archaeological sensitivity.

2.3 Impact Assessment and Conclusion

The proposed development of Borehole AI19 is not considered likely to impact on any archaeological sites or cultural values. No further assessment is considered necessary for the proposed development of Borehole AI19.

3 NATIVE VEGETATION

3.1 Methodology - Native Vegetation

Review of Existing Vegetation Mapping

The review informed the development of the list of native vegetation types which are known to occur within the study area and the broader locality.

The key source of native vegetation data was the Vegetation of the Warragamba, Woronora and Metropolitan Special Areas (NPWS 2003) and supporting documents.

Field Survey

Base vegetation maps utilising information from NPWS (2003) and the accompanying report and aerial photography were used in the field for classifying the vegetation communities on site. This was done using a rapid assessment of structure and composition of the various vegetation units on-site. Full floristic floristic plots, Braun-Blanquet cover-abundance scores and multi-variate analyses were viewed as unnecessary for the purposes of this assessment.

3.2 Results - Native Vegetation

Existing vegetation mapping of the region (NPWS 2003) shows three vegetation communities occurring throughout the study area, namely; Exposed Sandstone Scribbly Gum Woodland, Upland Swamp - Fringing Eucalypt Woodland and Upland Swamp - Sedgeland Heath Complex (Figure 5).

Although detailed vegetation survey techniques such as vegetation quadrats were not used in the current assessment, it is more likely that the Sedgeland Heath Complex has been incorrectly mapped and it should in fact be Upland Swamp - Banksia Thicket. This conclusion is based on the dominance of *Banksia ericifolia* in the area mapped as Sedgeland Heath Complex. Upland Swamp - Banksia Thicket has been described below. It is also likely, for the same reason, that much of the Upland Swamp - Fringing Eucalypt Woodland would in fact be better described as Upland Swamp - Banksia Thicket.

The reality however is that in an undisturbed situation the Upland Swamp vegetation variants intergrade to some degree often without a clear ecotone or boundary. In the current assessment, in the area where upland swamp vegetation is 're-claiming' the abandoned fire road, it is difficult to clearly distinguish these vegetation communities in their regenerating state. Notwithstanding this fact, the vegetation boundaries as they are defined in NPWS (2003) have been retained in Figure 5 with the only major departure being the description of Upland Swamp - Banksia Thicket in the place of Upland Swamp - Sedgeland Heath Complex.

None of these vegetation communities are currently listed as Endangered Ecological Communities on either the TSC or EPBC Acts.

3.3 Vegetation Community Descriptions¹

Exposed Sandstone Scribbly Gum Woodland

The ridges and exposed slopes across the Hawkesbury Sandstones of the Woronora Plateau support a low open woodland complex. A combination of different Scribbly Gums (*Eucalyptus sclerophylla*, *E. racemosa*, *E. haemastoma* and hybrids between each) occurs with *E. oblonga*, *Corymbia gummifera*, *E. sieberi* and *E. piperita*. *Angophora costata* occurs occasionally within this complex north from Bulli Tops. The density of the shrub layer is variable depending on fire history. Species present can include *Banksia spinulosa* var. *spinulosa*, *Leptospermum trinervium*, *Isopogon anemonifolius*, *Acacia ulicifolia*, *Hakea dactyloides*, *Eriostemon australasius* and *Bossiaea heterophylla*. The ground cover is not dense, with species such as *Lomandra glauca* and *Entolasia stricta*, and small shrubs including *Dampiera stricta* and tangles of *Caustis flexuosa* frequently encountered.

Impact from proposed development

Within the study area, the majority of the length of the overgrown Fire Road 9A traverses this vegetation community. Further, the borehole site is located within this vegetation community. In all an estimated total of 0.16 ha of this community will be disturbed for the development of the borehole site and a further 0.34 ha of this vegetation community, which is regenerating on the abandoned Fire Road, will be disturbed by the proposal.

Upland Swamp - Fringing Eucalypt Woodland

Fringing Eucalypt Woodland has been delineated to highlight the ecotone between the Upland Swamps communities and the surrounding Sandstone Woodlands. The transition between the two can be either abrupt or very gradual. In the case of the latter, a very open woodland with a canopy cover less than ten percent consisting of widely spaced *Eucalyptus racemosa*, *E. oblonga* or *E. sieberi* is present. The understorey characteristics are transitional, with some sites sharing greater similarity with the drier components of Restioid Heaths than Exposed Sandstone Scribbly Gum Woodland.

Impact from proposed development

Within the study area, approximately 250 m of the overgrown Fire Road 9A traverses this vegetation community and could be considered to represent this community in its regenerating state. In all an estimated total of 0.13 ha of this community will be disturbed for the development on the abandoned fire road.

Upland Swamp - Banksia Thicket

Banksia Thicket describes a low dense heath that forms on the fringes of the upland swamp complex within the O'Hares Creek Catchment. These thickets extend beyond this catchment to cover similar habitat across the Woronora Plateau. These thickets are typified by an abundance of *Banksia ericifolia* subsp. *ericifolia* and *Hakea dactyloides* that occur in combination with *B. oblongifolia*, *Pultenaea aristata* and *Dillwynia floribunda*. Species common to Upland Swamps and Exposed Sandstone Scribbly Gum Woodlands occur in the understorey. *Empodisma minus*, *Dampiera stricta*, *Entolasia stricta*, *Selaginella stricta* and *Leptocarpus tenax* feature within a highly variable ground cover.

¹ Vegetation Community Descriptions follow NPWS (2003).

Impact from proposed development

Within the study area, approximately 80 m of the overgrown Fire Road 9A traverses this vegetation community and could be considered to represent this community in its regenerating state. In all an estimated total of 0.04 ha of this community will be disturbed for the development on the abandoned fire road.

4 FLORA SPECIES

4.1 Methodology - Flora

Literature and Database Review

The literature and database review informed the development of the assessment of affected species in Section 6. Database searches were conducted in August 2010.

The following were used in preparing this review:

- DECCW Atlas of NSW Wildlife.
- DEWHA protected matters search tool.

Threatened Flora Likelihood of Occurrence

Appendix C lists the threatened flora within the locality (10 km radius) which were determined from records on the Atlas of NSW Wildlife and from the EPBC Act Protected Matters Search environmental reporting tool. The list of affected species is determined from this analysis.

In order to adequately determine the relevant level of assessment to apply to the list of affected species, further analysis of the likelihood of those species occurring within the subject site is required.

Five categories for 'likelihood' are used to determine the final list of potentially affected species to be considered in the impact assessment. Affected species considered in the impact assessment are those species in the 'Known' or 'High' categories. This likelihood criteria considers known records, presence or absence of important habitat features on the subject site, results of the field surveys and professional judgement. The categories are outlined in Table 1 below.

Table 1: Likelihood of occurrence criteria - threatened flora

Likelihood rating	Criteria
Known	the species was observed within the study area
High	it is likely that a species inhabits or utilises habitat within the study area
Moderate	potential habitat for a species occurs on the site. Adequate field survey would determine if there is a 'high' or 'low' likelihood of occurrence for the species within the study area
Low	it is unlikely that the species inhabits the study
None	the habitat within the study area is unsuitable for the species

Field Survey

Targeted surveys to locate threatened flora were conducted using the random meander technique as prescribed in Cropper (1993). Where a threatened plant population is found, more extensive searches are conducted and where necessary total population counts and/or

estimates are made. The initial site assessment was undertaken on Monday 23 August 2010. Further detailed surveys for threatened plant species were undertaken on Monday 30 August 2010. Threatened flora encountered were recorded using a hand held GPS (Garmin 60).

4.2 Results - Flora

A list of 96 flora species recorded from the study area is provided in Appendix 1. One introduced species was recorded.

Subject Threatened Flora

A total of 27 subject threatened flora listed on the TSC and/or EPBC Acts, or their habitats, have been previously recorded within 10 km of the subject site (Appendix C).

Affected Threatened Flora

One threatened plant, *Pultenaea aristata* (Prickly Bush-pea) was recorded in the study area during the field surveys. *P. aristata* is listed as Vulnerable on both the TSC and EPBC Acts. Information pertaining to *P. aristata* below has been derived from DECCW (2003).

Pultenaea aristata is a small erect shrub, usually less than 40 cm tall, with leaves 8 to 22 mm long and 1 to 2 mm wide. The leaves are linear with a distinctive long bristle tapering to a sharp point. Flowers of the Prickly Bush-pea appear in yellow to light orange terminal heads between September and October.

The species is often associated with the upland swamp vegetation complex and has been recorded from several locations within the sub-communities of Banksia Thicket and Restioid Heath. The species is also known to occur in association with areas of impeded drainage and creek lines within sandstone woodland and gully forest plant communities (NPWS, 2003).

The species was found to be a common shrub species both along the access track and at the borehole site as well as in the vegetation surrounding these areas. It was therefore not possible to either map the extent of the local population of this species or to accurately record the population size. It is estimated that many hundreds and possible thousands of individual plants occur in the locality with only a small proportion of this larger population being subject to disturbance by the proposal.

Figure 2 shows the distribution of *P. aristata* within the study area. A hand held GPS was used to record the distribution of the species along the access road and at the borehole site and within close proximity to these areas. Figure 2 also shows the location of previously recorded individuals of this species along the access track to the north-east of the proposed borehole site. These records were confirmed in part during the current assessment as indicated by the contemporary records in Figure 2. While there is little to no information regarding the pollination and dispersal biology of this species, given the number of plants in the locality and their likely distribution in close proximity to the access track and borehole site, it is likely that the plants to the north-east of the borehole site are part of the much larger population in the locality.

This species is known to occur in localised, but nonetheless quite large populations on the Worrnora Plateau, with some populations estimated to be in the thousands and possibly tens of thousands (pers. obs.).

No other threatened plants were recorded or are considered likely to occur within the disturbance footprint for the proposed works.

5 FAUNA SPECIES

5.1 Methodology - Fauna

Literature and Database Review

The literature and database review informed the development of the assessment of affected threatened fauna in Section 6.2. Database searches were conducted in August 2010.

The following were used in preparing this review:

- DECCW Atlas of NSW Wildlife.
- DEWHA protected matters search tool.

Fauna Likelihood of Occurrence

Appendix 4 lists the subject threatened fauna within the locality (10 km radius) which were determined from records on the Atlas of NSW Wildlife and from the EPBC Act Protected Matters Search environmental reporting tool.

In order to adequately determine the final list of affected fauna and therefore the relevant level of assessment to apply to the list of potentially affected species (affected flora or fauna), further analysis of the likelihood of those species occurring within the subject site is required. A similar approach was used to determine potential affected flora.

Five categories for 'likelihood' are used to determine the final list of affected species to be considered in the impact assessment. Affected species considered in the impact assessment are those species in the 'Known' or 'High' categories. This likelihood criteria considers known records, presence or absence of important habitat features on the subject site, results of the field surveys and professional judgement. The list of affected fauna species is determined from this analysis.

The categories are outlined in Table 2 below

Table 2: Likelihood of occurrence criteria - threatened fauna

Likelihood rating	Criteria
Known	the species was observed within the study area
High	it is likely that a species inhabits or utilises habitat within the study area
Moderate	potential habitat for a species occurs on the site and the species may occasionally utilise that habitat. Species unlikely to be dependent on the habitat present within the study area
Low	it is unlikely that the species inhabits the study area. If present at the site the species would likely be a transient visitor. The site contains only very common habitat for this species which the species would not rely on for its ongoing local existence
None	the habitat within the study area is unsuitable for the species

Field Survey

The field survey effort for fauna was considered commensurate to the size and condition of the subject site and included habitat-based assessment, incidental fauna observations (including tracks, scats and other traces). The initial site assessment was undertaken on Monday 23 August 2010.

5.2 Results - Fauna

Nine animal species were recorded during the field survey of which one, the Rusa Deer, is introduced.

Seven native bird species were recorded from the study area including: The Yellow-tailed Black Cockatoo, Eastern Rosella, Crimson Rosella, Sulphur-crested Cockatoo, Black-faced Cuckoo-shrike, Eastern Spine-bill and Willie Wagtail.

One mammal species, the Swamp Wallaby, was also recorded from the study area.

Fauna Habitat

Fauna habitat of the subject site is primarily restricted to the thick, regenerating, shrub layer occurring along the access track and the open woodland at the borehole site.

A number of sandstone rock outcrops occur in close proximity to the borehole site but they will not be impacted by the proposal.

Mature trees will not be disturbed or removed by the proposal. The access track is devoid of trees as trees were completely removed from the access track for its construction in the past. The borehole site contains predominantly smaller trees which are devoid of hollows. The recommendations below outline the procedure for avoiding hollow bearing limbs or trees for the development of the borehole which will ensure that 'hollow habitat' type is avoided.

Small areas of eroded track (along the abandoned fire trail) present possible opportunities for rain water to pool during storm events, although any such pooling opportunities would be very limited and not likely to provide significant habitat for amphibian species.

Subject Threatened Fauna

A total of 58 subject threatened fauna listed on the TSC and/or EPBC Acts, or their habitats, have previously been recorded within 10 km of the subject site (Appendix D). After considering the habitat requirements of these species with the habitat of the subject site a total of 50 species were considered to have at least potential habitat within the study area.

Affected Threatened Fauna

Although the study area is considered to contain potential habitat for 50 threatened animal species, only four species are considered to be affected species (Table 3). These species have been considered further on the basis that they have been recorded previously in close proximity to the study area or because the proposed development is considered likely to

impact or remove limited habitat for the species that may impact the local distribution of the species if present within the study area.

Further consideration of the impacts of the proposal on these species is contained in Section 6.2 and Appendix D.

Table 3. Affected Threatened Fauna

Species	TSC Act	EPBC Act	Likelihood of Occurrence
Birds			
Eastern Bristlebird	E	E	Moderate
Eastern Ground Parrot	V	E	Moderate
Amphibians			
Red-crowned Toadlet	V	-	Moderate
Giant Burrowing Frog	V	V	Moderate

E = Endangered; V = Vulnerable

6 IMPACT ASSESSMENT

6.1 Predicted Impacts

Direct Impacts of the proposal include:

- Unavoidable removal of 0.66 ha of native vegetation.

Indirect impacts of the proposal will largely be mitigated by the on-site Environmental Management Plan (EMP), but may include:

- The spread of weeds and disease;
- Erosion and sedimentation from soil disturbance; and
- Increased human activity.

Indirect impacts from vegetation disturbance can also include edge effects which extend into the retained vegetation from the 'new' edge of the vegetation which is left after clearing has occurred. Typically edge effects may extend up to 50 m from the edge of the vegetation into the remnant vegetation.

It is acknowledged that the predominant disturbance activities associated with the proposed development will be related to the re-opening of the existing fire road. That being the case, the edge effects associated with the fire road's existence are already in place although in some areas these edge effects are mitigated by the natural revegetation of the fire road. The proposal is not considered likely to increase the edge effects associated with the fire road above that which previously existed when the fire road was open and actively used.

6.2 Assessment under Part 3A of the EP&A Act

Vegetation

The proposal will not impact any Endangered Ecological Community.

Flora

One threatened plant, *Pultenaea aristata* was recorded in the study area.

Fauna

Developments can impact upon fauna in a number of ways. The significance of an impact will be greatest if any of the following situations occur;

- Death or injury of individuals;
- Loss or disturbance of limiting foraging resources;
- Loss or disturbance of limiting breeding resources.

Limiting resources are those that are important for a particular species survival. For example animals that only feed on certain types of plants or only breed in certain habitats such as deep water pools in flowing creeks.

The scale of the proposal is very small, and the potential for loss of limiting habitat for threatened species is low.

No threatened fauna were recorded during the field surveys.

A total of four threatened animal species are considered to have a high or moderate likelihood of occurrence in the study area and have habitat requirements that will be affected by the proposal. These affected threatened fauna are; the Eastern Bristlebird, Eastern Ground Parrot, Red-crowned Toadlet and Giant burrowing Frog.

None of these species have been previously recorded in the study area.

Nevertheless, impact assessments under the guidelines for Part 3A for these species is provided in Appendix G.

Including the loss or modification of 0.66 ha of vegetation, it is considered unlikely that the proposal will result in the loss of limiting foraging or breeding resources or the death or injury of individuals. Thus potential for impacts to threatened animal species is highly limited given the nature of the proposal.

Part 3A Key Thresholds

The Guidelines for threatened species assessment under Part 3A of the EP&A Act state that development applications must contain a justification based upon the listed key thresholds (DEC & DPI 2005):

- Whether or not the proposal, including actions to avoid or mitigate impacts or compensate to prevent unavoidable impacts, will maintain or improve biodiversity values.
- Whether or not the proposal is likely to reduce the long-term viability of a local population of a threatened species, population or ecological community.
- Whether or not the proposal is likely to accelerate the extinction of a threatened species, population or ecological community or place it at risk of extinction.
- Whether or not the proposal will affect critical habitat.

These key thresholds are addressed in Table 4.

Table 4. Assessment of Key Thresholds under Part 3A of the EP& A Act.

Threatened Biota	Maintain or improve biodiversity values.	Reduction in the long-term viability of a local population of the species, population or ecological community.	Accelerate extinction of the species, population or ecological community	Will critical habitat be affected?
Threatened Flora				
<i>Pultenaea aristata</i>	Likely to reduce the total population in the immediate vicinity of the proposal. Loss is considered negligible in the context of the estimate local and regional population.	Unlikely to reduce long term viability	Unlikely	No
Threatened Fauna				
Eastern Bristlebird	Likely to maintain biodiversity values	Unlikely to reduce long term viability	Unlikely	No
Eastern Ground Parrot	Likely to maintain biodiversity values	Unlikely to reduce long term viability	Unlikely	No
Red-crowned Toadlet	Likely to maintain biodiversity values	Unlikely to reduce long term viability	Unlikely	No
Giant Burrowing Frog	Likely to maintain biodiversity values	Unlikely to reduce long term viability	Unlikely	No

6.3 Assessment of Significance under the EPBC Act

Flora

One threatened plant listed on the EPBC Act was recorded in the study area, *Pultenaea aristata* (Endangered on the EPBC Act), has been assessed as an affected species on the basis of its presence within the development footprint.

Fauna

Three of the affected threatened fauna determined in Section 5.2 are listed on the EPBC Act (Eastern Bristlebird, Eastern Ground Parrot and Giant burrowing Frog).

7 AMELIORATION MEASURES

7.1 Avoid and Mitigate

Actions that have been taken to avoid and mitigate impacts include:

1. Utilisation of existing tracks; and
2. Implementation of an Environmental Management Plan for the project.

The following measures are also recommended to further reduce potential impacts to native vegetation, fauna habitats and animals species:

1. Soils should not be stockpiled on the side of the existing fire road during re-development as this will increase the potential for the placement of soil on threatened plants which would otherwise be avoided by the road development works.
2. Best practice sediment and erosion control should be employed at the borehole site and also along sections of the access track which have erosion potential.
3. Any superfluous drill water should be removed from the Catchment area and disposed of at an appropriate site. Dirty water should not be discharged into vegetation adjacent to the borehole site.
4. Seed bearing material should be harvested from disturbed vegetation for use in the management and rehabilitation of vegetation on the disturbed development footprint.
5. At the site of the proposed borehole AI19 all trees which have the potential to contain hollows and any small sandstone outcrops should be avoided and if necessary fenced off using flagging tape and wooden stakes to ensure clearing contractors avoid these values.
6. All vehicles, including drill rigs and clearing equipment, should be subject to full wash down procedures before entering the Catchment lands.
7. Rehabilitation of the access road and the borehole sites should be undertaken immediately upon decommissioning.

8 CONCLUSION

The proposed development of borehole AI19 and the access track to the borehole site will involve the disturbance of 0.66 ha of predominantly re-growth native vegetation. The re-growth vegetation extends for the length of the site's access track which has been sited on the now abandoned Fire Road A9. The proposed borehole site is bisected by the abandoned fire road, but other than that the borehole site will disturb approximately 0.16 ha of previously undisturbed vegetation.

Archaeological Assessment

The proposed development of Borehole AI19 is not considered likely to impact on any archaeological sites or cultural values. No further assessment is considered necessary for the proposed development of Borehole AI19.

Ecological Assessment

The proposal will result in the removal of individuals of one threatened species, *Pultenaea aristata*, and a small area of habitat for a number of other threatened species listed on the TSC and EPBC Acts.

Impact assessments and assessment of significance undertaken for *Pultenaea aristata* and other species which may potentially be impacted by the proposal indicated that the impact on threatened species, populations and ecological communities is unlikely to lead to a significant impact on any of these values.

Further assessments under the TSC Act or a referral of the project to the Commonwealth Department of Environment, Water, Heritage and the Arts are not considered necessary at this time.

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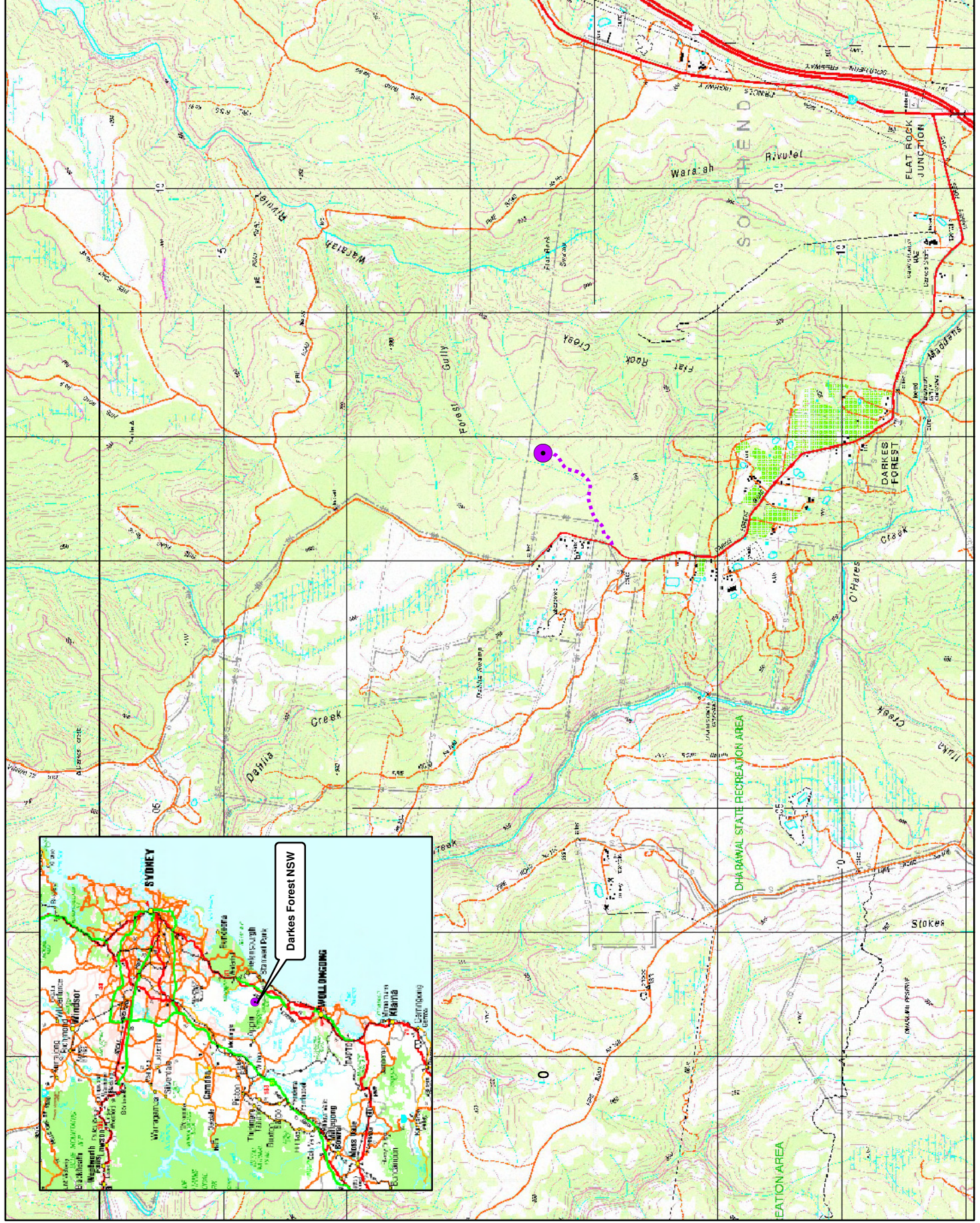
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FIGURES

Figure 1. Study Area in a Regional Context

Figure 1.
Location
31 August 2010



Proposed work

Borehole AI19

Access Track



Kilometers



0 0.25 0.5 1

niche Environment and Heritage

Figure 2. Distribution of *Pultenaea aristata*

Figure 2
p. aristata distribution
 31 August 2010

Listed Vegetation

- p. aristata (30 Aug 2010)
- p. aristata (NPWS Atlas)

Proposed work

- Borehole A119
- Access Track

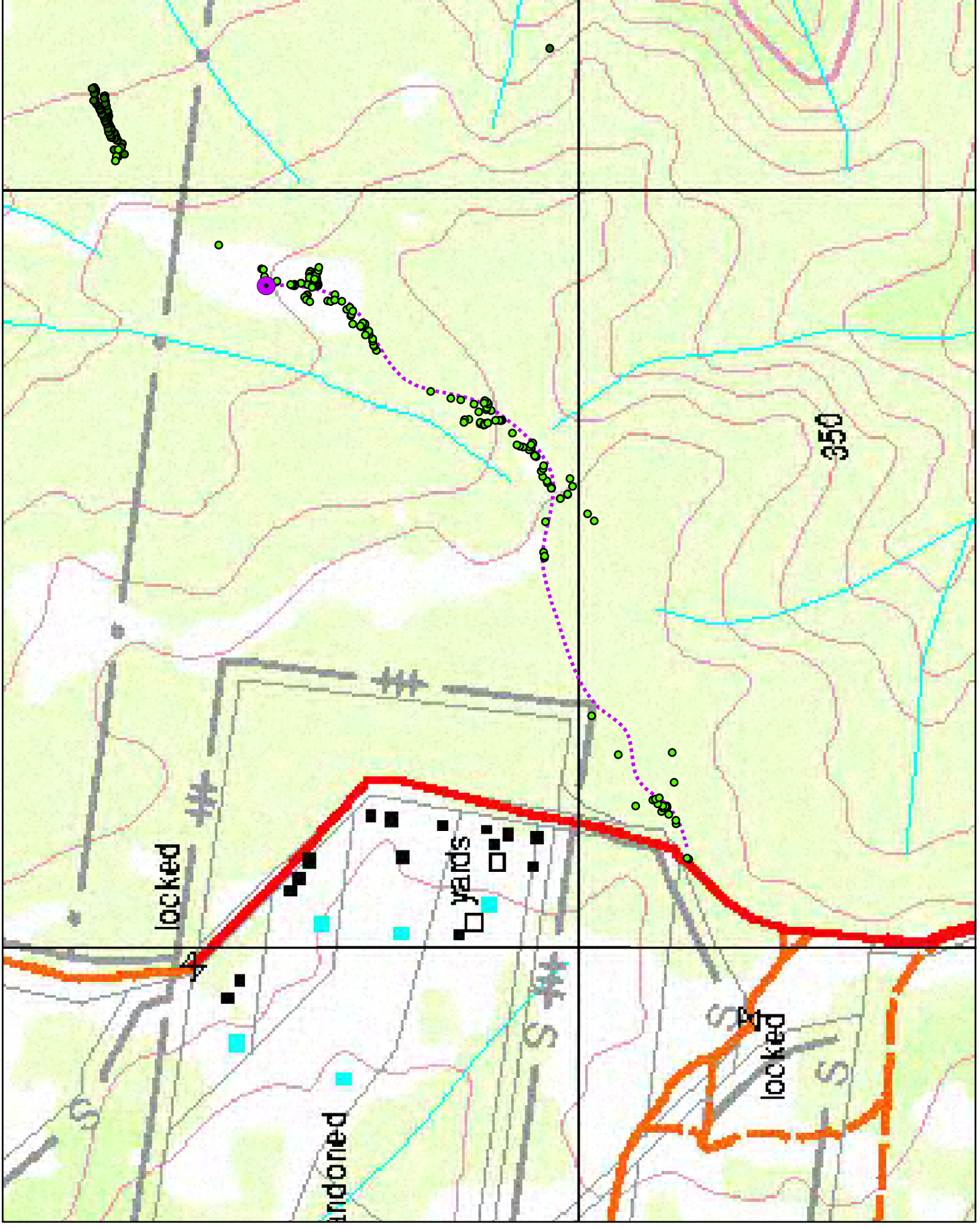
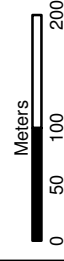


Figure 3. Vegetation of the Study Area

Figure 3
Vegetation Communities
 31 August 2010

- Listed Vegetation**
- *p. aristata* (30 Aug 2010)
 - *p. aristata* (NPWS Atlas)
- Vegetation Community**
- Exposed Sandstone Scribbly Gum Woodland
 - O'Hares Creek Shale Forest
 - Sandstone Gully Apple-Peppermint Forest
 - Sandstone Heath-Woodland
 - Upland Swamps: Fringing Eucalypt Woodland
 - Upland Swamps: Sedgeland-Heath Complex
 - Upland Swamps: Tea-Tree Thicket
 - Woronora Tall Mallee-Heath
 - Water
 - Cleared
 - Darkes Forest Road
- Proposed work**
- Borehole A119
 - Access Track

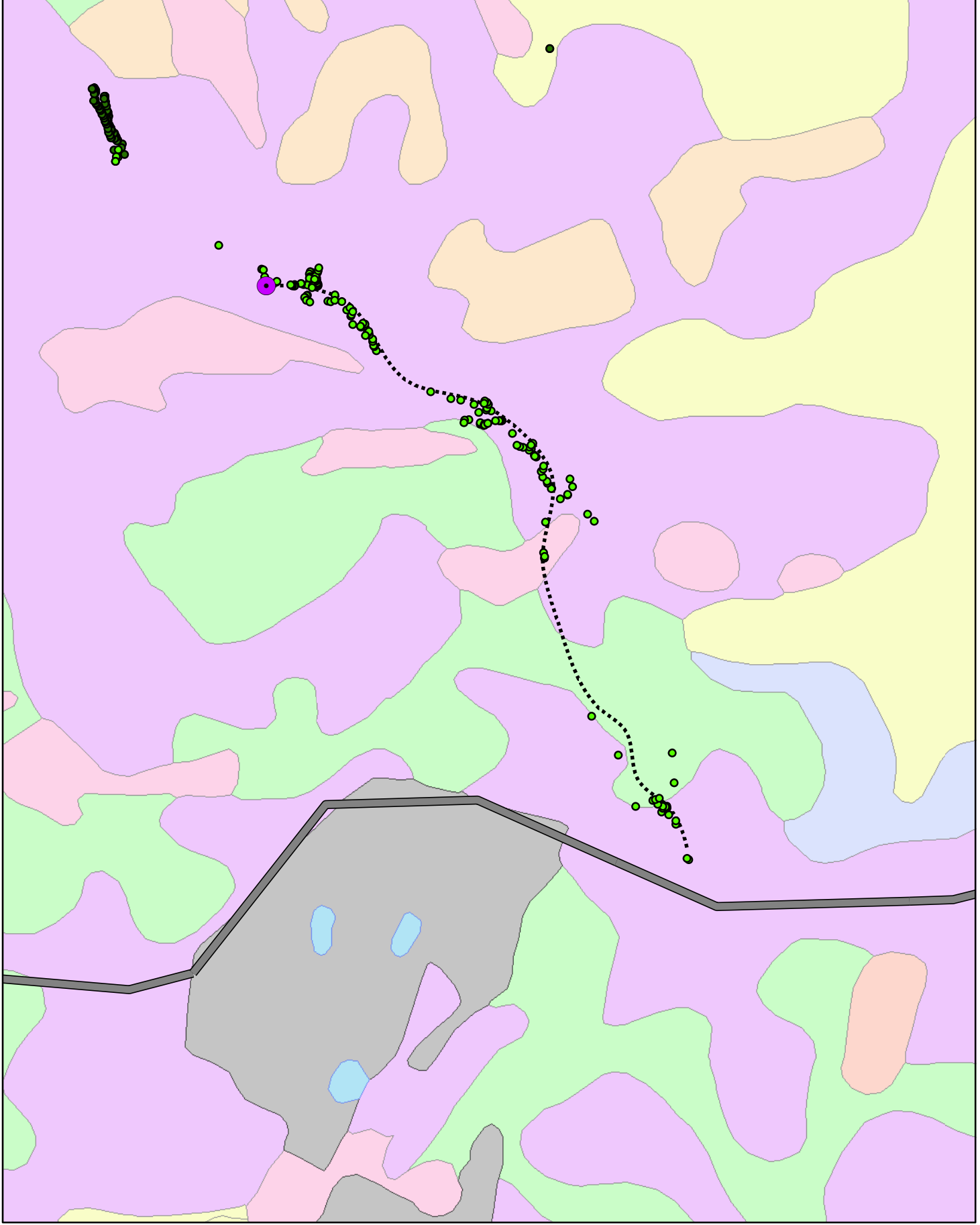
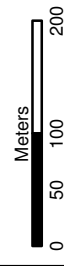
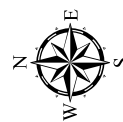


Figure 4. Threatened Flora within 10 km of the Subject Site

Figure 4
Threatened Flora
31 August 2010

- Threatened Flora**
- Scientific name**
- *Acacia baileyi* subsp. *aspera*
 - *Acacia bynoeana*
 - *Astrichtia crassifolia*
 - *Callistemon linearifolius*
 - *Callitriche endlicheri*
 - *Chorizanthe parriviridis*
 - *Daphnandra* sp. *C. Illawarra*
 - *Epacris purpurascens* var. *purpurascens*
 - *Genoplesium baileyi*
 - *Grevillea parriviridis*
 - *Habrostridium exaltatum* subsp. *exaltatum* var. *exaltatum*
 - *Leucopogon exaltatum*
 - *Melaleuca deanei*
 - *Personia hirsuta*
 - *Pomadouria adnata*
 - *Prostanthera maritima*
 - *Pultenaea aristata*
 - *Strydom paniculatum*
- Proposed work**
- Borehole A119
 - Access Track



Kilometers
0 0.5 1 2 3

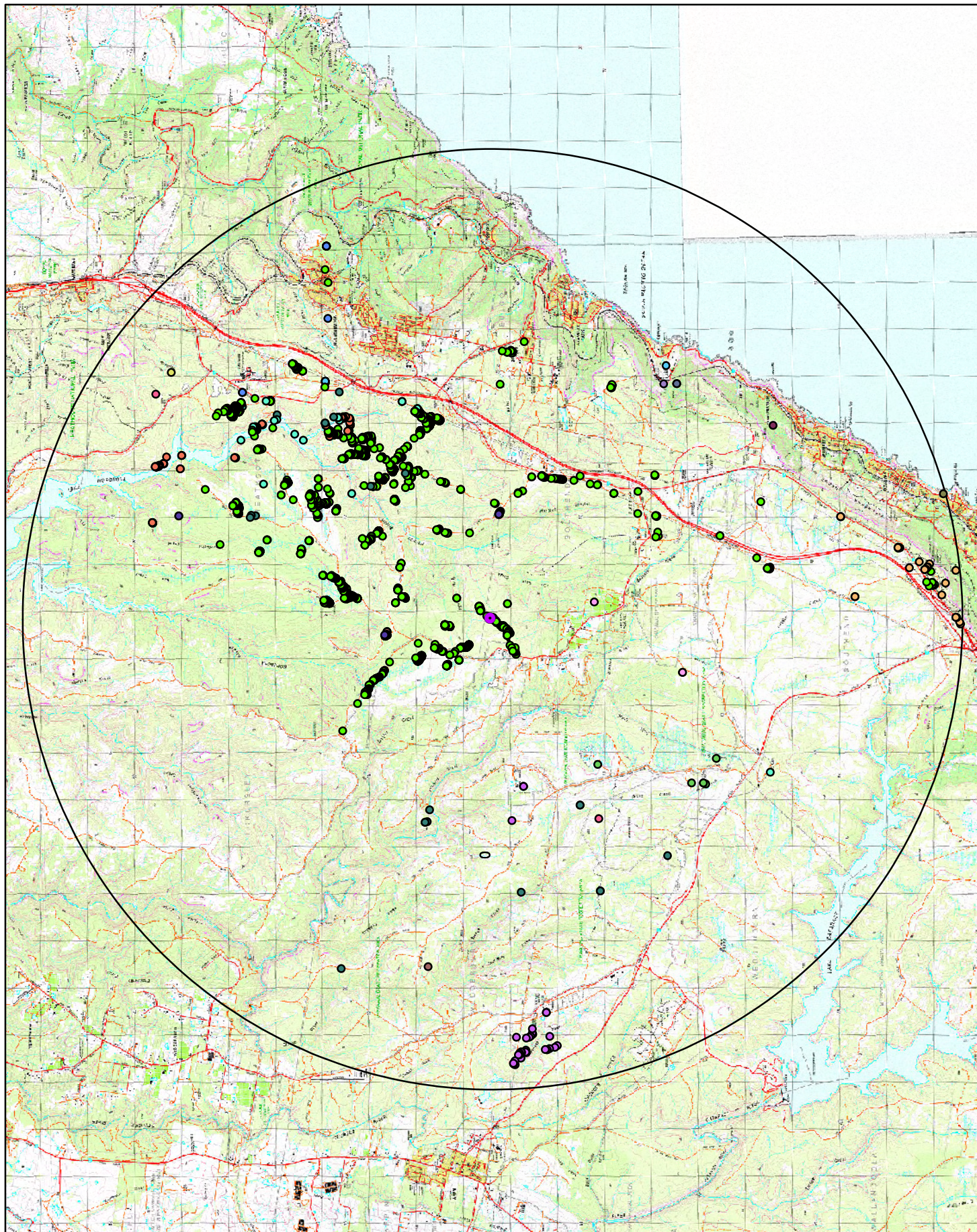


Figure 5. Threatened Fauna within 10 km of the Subject Site

Figure 5
Threatened Fauna
31 August 2010

Threatened Fauna
Common name

- Australian Fur-seal
- Barking Owl
- Broad-headed Snake
- Brown Treecreeper
- Eastern Banting-bat
- Eastern False Pipistrelle
- Eastern Freetail-bat
- Eastern Ground Parrot
- Eastern Pygmy-possum
- Eastern Quoll
- Flame Robin
- Gang-gang Cockatoo
- Giant Burrowing Frog
- Glossy Black-Cockatoo
- Greater Broad-nosed Bat
- Green and Golden Bell Frog
- Grey-headed Flying-fox
- Koala
- Little Eagle
- Little Lorikeet
- Littlejohn's Tree Frog
- Masked Owl
- Powerful Owl
- Red-crowned Toadlet
- Regent Honeyeater
- Rose-crowned Fruit Dove
- Rosenberg's Quarna
- Scarlet Robin
- Sooty Albatross
- Sooty Owl
- Sooty Oystercatcher
- Sooty Tern
- Southern Myotis
- Spotted-tailed Quoll
- Square-tailed Kite
- Squirrel Glider
- Turquoise Parrot
- Varied Sittella
- Wandering Albatross
- Yellow-bellied Glider

Proposed work

- Brewhole A119
- Access Track



Kilometers
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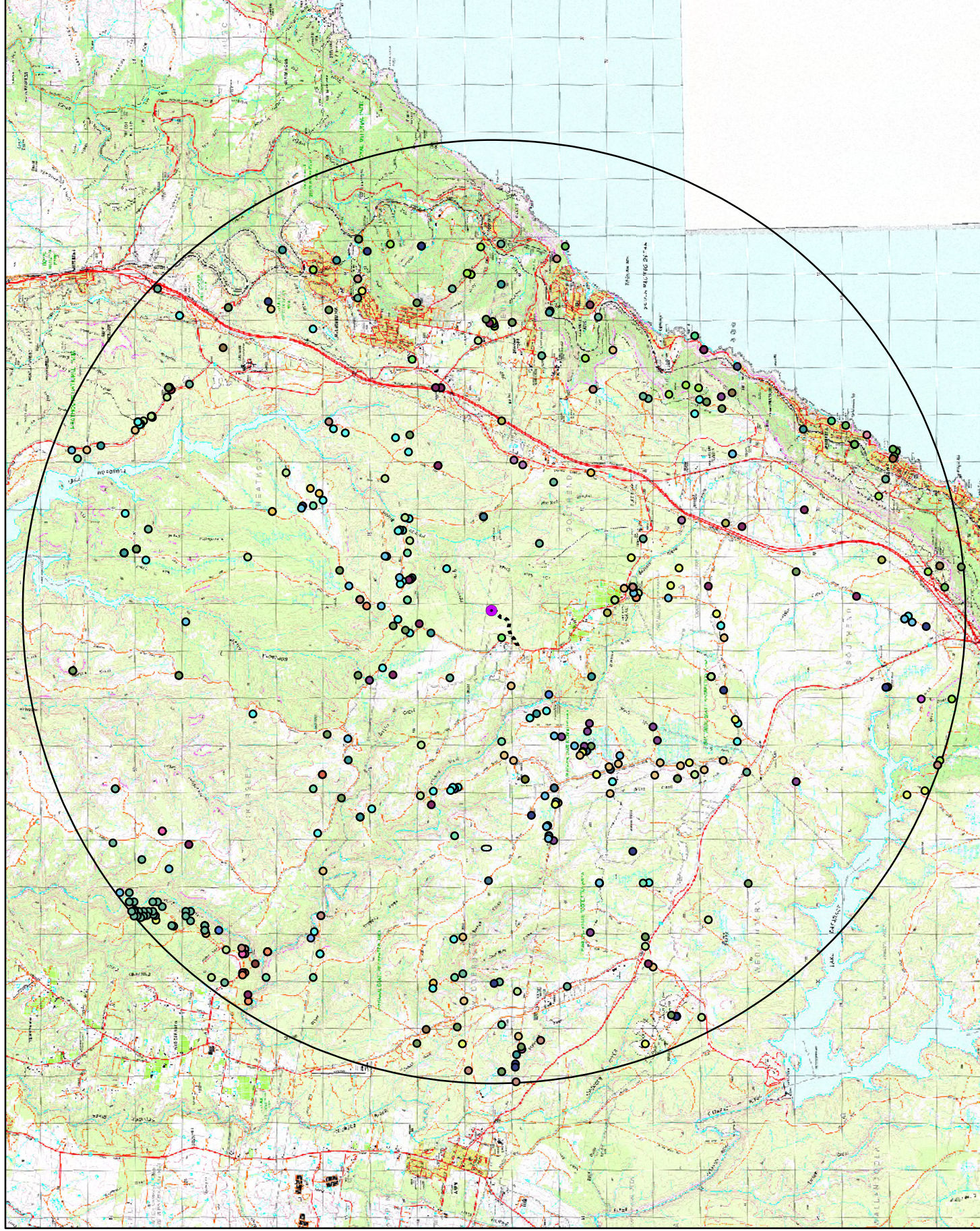
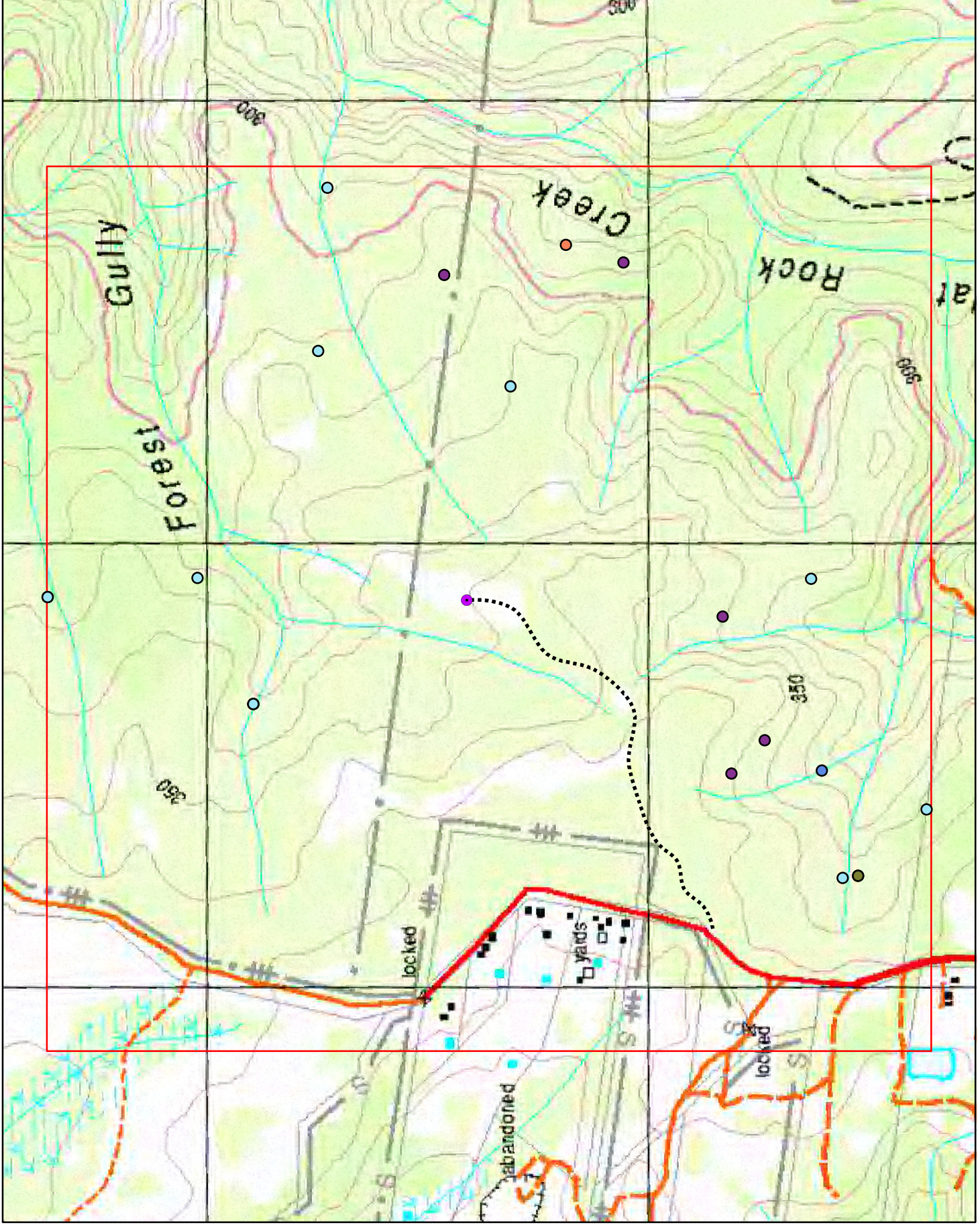
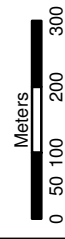
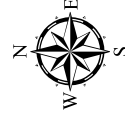


Figure 6: Results of the AHIMS Search for the Study Area

Figure 6
Aboriginal Heritage Sites
 31 August 2010

- Aboriginal Heritage Sites**
- Axe Grinding Groove
 - Axe Grinding Groove, Rock Engraving
 - Axe Grinding Groove, Shelter with Deposit
 - Rock Engraving
 - Shelter with Art
 - Shelter with Deposit
 - AHIMS Search Area
 - Proposed work**
 - Borehole A119
 - Access Track



APPENDICIES

Appendix A: Flora Recorded from the Study Area

Family	Species	Introduced	TSC	EPBC	ROTAP
Apiaceae	<i>Actinotus minor</i>				
Apiaceae	<i>Platysace linearifolia</i>				
Apiaceae	<i>Xanthosia tridentata</i>				
Baueraceae	<i>Bauera rubioides</i>				
Casuarinaceae	<i>Allocasuarina littoralis</i>				
Cyperaceae	<i>Caustis flexuosa</i>				
Cyperaceae	<i>Lepidosperma</i> spp.				
Cyperaceae	<i>Ptilothrix deusta</i>				
Cyperaceae	<i>Schoenus brevifolius</i>				
Dennstaedtiaceae	<i>Pteridium esculentum</i>				
Dilleniaceae	<i>Hibbertia empetrifolia</i> subsp. <i>empetrifolia</i>				
Dilleniaceae	<i>Hibbertia riparia</i>				
Doryanthaceae	<i>Doryanthes excelsa</i>				
Droseraceae	<i>Drosera peltata</i>				
Epacridaceae	<i>Epacris microphylla</i> var. <i>microphylla</i>				
Epacridaceae	<i>Leucopogon microphyllus</i>				
Epacridaceae	<i>Sprengelia incarnata</i>				
Epacridaceae	<i>Woolisia pungens</i>				
Euphorbiaceae	<i>Amperea xiphoclada</i>				
Euphorbiaceae	<i>Phyllanthus hirtellus</i>				
Fabaceae (Faboideae)	<i>Bossiaea heterophylla</i>				
Fabaceae (Faboideae)	<i>Bossiaea obcordata</i>				
Fabaceae (Faboideae)	<i>Bossiaea scolopendria</i>				
Fabaceae (Faboideae)	<i>Desmodium varians</i>				
Fabaceae (Faboideae)	<i>Dillwynia floribunda</i>				
Fabaceae (Faboideae)	<i>Dillwynia retorta</i>				
Fabaceae (Faboideae)	<i>Gompholobium glabratum</i>				
Fabaceae (Faboideae)	<i>Gompholobium grandiflorum</i>				
Fabaceae (Faboideae)	<i>Gompholobium minus</i>				
Fabaceae (Faboideae)	<i>Hovea linearis</i>				
Fabaceae (Faboideae)	<i>Mirbelia rubiifolia</i>				
Fabaceae (Faboideae)	<i>Mirbelia speciosa</i> subsp. <i>speciosa</i>				
Fabaceae (Faboideae)	<i>Pultenaea aristata</i>		V	V	
Fabaceae (Faboideae)	<i>Pultenaea elliptica</i>				
Fabaceae (Faboideae)	<i>Pultenaea villosa</i>				
Fabaceae (Mimosoideae)	<i>Acacia linifolia</i>				
Fabaceae (Mimosoideae)	<i>Acacia myrtifolia</i>				
Fabaceae (Mimosoideae)	<i>Acacia suaveolens</i>				
Fabaceae (Mimosoideae)	<i>Acacia terminalis</i>				
Fabaceae (Mimosoideae)	<i>Acacia ulicifolia</i>				
Goodeniaceae	<i>Dampiera purpurea</i>				
Haloragaceae	<i>Gonocarpus teucrioides</i>				
Iridaceae	<i>Patersonia glabrata</i>				
Lauraceae	<i>Cassytha glabella</i> forma <i>glabella</i>				
Lindsaeaceae	<i>Lindsaea linearis</i>				
Loganiaceae	<i>Mitrasacme polymorpha</i>				
Lomandraceae	<i>Lomandra filiformis</i> subsp. <i>coriacea</i>				
Lomandraceae	<i>Lomandra glauca</i>				

Family	Species	Introduced	TSC	EPBC	ROTAP
Lomandraceae	<i>Lomandra longifolia</i>				
Lomandraceae	<i>Lomandra obliqua</i>				
Myrtaceae	<i>Angophora costata</i>				
Myrtaceae	<i>Corymbia gummifera</i>				
Myrtaceae	<i>Darwinia grandiflora</i>				ROTAP: 2RCi
Myrtaceae	<i>Eucalyptus sclerophylla</i>				
Myrtaceae	<i>Eucalyptus sieberi</i>				
Myrtaceae	<i>Kunzea ambigua</i>				
Myrtaceae	<i>Leptospermum continentale</i>				
Myrtaceae	<i>Micromyrtus ciliata</i>				
Oleaceae	<i>Oxalis stricta</i>				
Orchidaceae	<i>Glossodia minor</i>				
Pittosporaceae	<i>Billardiera scandens</i>				
Poaceae	<i>Entolasia stricta</i>				
Proteaceae	<i>Banksia ericifolia</i> subsp. <i>ericifolia</i>				
Proteaceae	<i>Banksia marginata</i>				
Proteaceae	<i>Banksia oblongifolia</i>				
Proteaceae	<i>Banksia robur</i>				
Proteaceae	<i>Banksia serrata</i>				
Proteaceae	<i>Banksia spinulosa</i>				
Proteaceae	<i>Conospermum ellipticum</i>				
Proteaceae	<i>Conospermum longifolium</i> subsp. <i>angustifolium</i>				
Proteaceae	<i>Grevillea mucronulata</i>				
Proteaceae	<i>Grevillea oleoides</i>				
Proteaceae	<i>Grevillea sphacelata</i>				
Proteaceae	<i>Hakea dactyloides</i>				
Proteaceae	<i>Hakea gibbosa</i>				
Proteaceae	<i>Hakea sericea</i>				
Proteaceae	<i>Hakea teretifolia</i>				
Proteaceae	<i>Isopogon anemonifolius</i>				
Proteaceae	<i>Isopogon anethifolius</i>				
Proteaceae	<i>Lambertia formosa</i>				
Proteaceae	<i>Lomatia silaifolia</i>				
Proteaceae	<i>Persoonia lanceolata</i>				
Proteaceae	<i>Persoonia levis</i>				
Proteaceae	<i>Persoonia linearis</i>				
Proteaceae	<i>Petrophile pulchella</i>				
Proteaceae	<i>Petrophile sessilis</i>				
Proteaceae	<i>Xylomelum pyriforme</i>				
Rutaceae	<i>Eriostemon australasius</i>				
Santalaceae	<i>Exocarpos cupressiformis</i>				
Stylidiaceae	<i>Stylidium lineare</i>				
Stylidiaceae	<i>Stylidium</i> spp.				
Thymelaeaceae	<i>Pimelea linifolia</i>				
Xanthorrhoeaceae	<i>Xanthorrhoea media</i>				
Xyridaceae	<i>Xyris operculata</i>				
	<i>Andropogon virginicus</i>				
	<i>Leionema diosmeum</i>				

Appendix B: Fauna Recorded from the Study Area

Scientific Name	Observation Type
Native Birds	
Yellow-tailed Black Cockatoo	O
Eastern Rosella,	O
Crimson Rosella	O
Sulphur-crested Cockatoo	O
Black-faced Cuckoo-shrike,	O
Eastern Spine-bill	O
Willie Wag-tail	O
Native Mammals	
Swamp Wallaby (<i>Wallabia bicolor</i>)	I
Introduced Mammals	
Rusa Deer (<i>Cervus timorensis</i>)	I

Key: O=observed; H=heard; I=indirect evidence

Appendix C: Threatened Flora Likelihood of Occurrence

Species	EPBC Act	TSC Act	Habitat	Likelihood of Occurrence
<i>Acacia baueri</i> subsp. <i>aspera</i> .	V		Occurs in low, damp heathlands, often on exposed rocky outcrops over a wide range of climatic and topographical conditions. Appears to prefer open conditions; rarely observed where there is any shrub or tree canopy development; and many of the observations of this species have been made following fire, suggesting the species prefers early successional habitats.	Low
<i>Acacia bynoeana</i> Bynoe's Wattle	V	E1	Grows mainly in heath and dry sclerophyll forest in sandy soils. Mainly south of Dora Creek-Morisset area to Berrima and the Illawarra region, west to the Blue Mountains, also recorded from near Kurri Kurri in the Hunter Valley and from Morton National Park. ROTAP: 3VC-	Low
<i>Astrotricha crassifolia</i>	V	V	Occurs in dry sclerophyll woodland on sandstone. Thick-leaf Starhair grows on dry ridgetops to 300 m altitude (Benson & McDougall, 1993) and is associated with very rich heath, or dry sclerophyll woodland (Harden, 1992). Vegetation associations include typical sandstone genera such as <i>Hakea</i> , <i>Banksia</i> and <i>Xylomelum</i> (Benson & McDougall, 1993).	Low - Moderate
<i>Caladenia tessellata</i> Tessellated Spider Orchid	V	E1	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	Low
<i>Callistemon linearifolius</i> Netted Bottlebrush	-	V	Recorded from the Georges River to the Hawkesbury and north to the Nelson Bay area of NSW. Recorded in 2000 at Coalcliff in the northern Illawarra. Grows in dry sclerophyll forest on the coast and adjacent ranges. Flowers spring – summer. ROTAP: 2RCi	Low
<i>Callitris endlicheri</i>		endangered population	Throughout its range, the species is usually found on stony hills or ridges, common, from the plains to the coastal ranges. The Woronora Plateau population is restricted to a single outcrop of sandstone c. 2 ha in area. The soils at this site are skeletal sandy loams and the heathlands on sandstone outcrops in the area are restricted and highly distinctive.	Low
<i>Chorizema parviflorum</i>		endangered population	All known sites (excluding the site at Austinner) occupy woodland or forest dominated by Forest Red Gum (<i>Eucalyptus tereticornis</i>) and/or Woollybutt (<i>E. longifolia</i>).	None
<i>Cryptostylis hunteriana</i>	V	V	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 (<i>Eucalyptus sclerophylla</i>), Silvertop Ash (<i>E. sieberi</i>), Red Bloodwood (<i>Corymbia gummifera</i>) and Black Sheoak (<i>Allocasuarina littoralis</i>); appears to prefer open areas in the understorey of this community and is often found in association with the Large Tongue Orchid (<i>C. subulata</i>) and the Tartan Tongue Orchid (<i>C. erecta</i>).	Low
<i>Daphnandra</i> sp. <i>C 'Illawarra'</i>	V	V	Occupies the rocky hillsides and gullies of the Illawarra lowlands, occasionally extending onto the upper escarpment slopes. Associated vegetation includes rainforest and moist eucalypt forest. Associated soils are loams and clay loams derived from volcanic and fertile sedimentary rocks.	Low – none
<i>Epacris purpurascens</i> var. <i>purpurascens</i>	-	V	Grows in sclerophyll forest, scrubs and swamps on sandstone from Gosford and Sydney districts. ROTAP: 2KC-	Low
<i>Eucalyptus camfieldii</i>	V	<i>Genoplesium baueri</i>	Poor coastal country in shallow sandy soils overlying Hawkesbury sandstone. Coastal heath mostly on exposed sandy ridges. Occurs mostly in small scattered stands near the boundary of tall coastal heaths and low open woodland of the slightly more fertile inland areas. Associated species frequently include stunted species of <i>E. oblonga</i> Narrow-leaved Stringybark, <i>E. capitellata</i> Brown Stringybark and <i>E. haemastoma</i> Scribbly Gum.	Low
<i>Genoplesium baueri</i>		V	Grows in sparse sclerophyll forest and moss gardens over sandstone.	Low - none

Species	EPBC Act	TSC Act	Habitat	Likelihood of Occurrence
<i>Grevillea parviflora</i> ssp. <i>parviflora</i> Small-flower Grevillea	V	V	Grows in healthy associations or shrubby woodland, in sandy or light clay soils usually over shale substrates. Occurs west and south of Sydney from west of Prospect (where now almost certainly extinct), Kemps Creek and lower Georges River south to Camden, Appin and Cordeaux Dam, with disjunct northern populations south of Putty and near Cessnock and Cooranbong, possibly also south of Moss Vale.	Low
<i>Haloragis exalata</i> subsp. <i>exalata</i>	V	V	Square Raspwort appears to require protected and shaded damp situations in riparian habitats.	None
<i>Leucopogon exolasius</i> Woronora Beard-heath	V	V	Grows in woodland on sandstone. Restricted to the Woronora and Grose Rivers and Stokes Creek, Royal National Park. ROTAP: 2VC-	None
<i>Melaleuca biconvexa</i>	V	V	Biconvex Paperbark generally grows in damp places, often near streams or low-lying areas on alluvial soils of low slopes or sheltered aspects.	None
<i>Melaleuca deanei</i> Dean's Melaleuca	V	V	Grows in wet heath on sandstone in coastal districts from Berowra to Nowra. ROTAP: 3RC-	Moderate
<i>Persoonia hirsuta</i> Hairy Geebung	E	E	Occurs from Gosford to Royal National Park and in the Putty district from Hill Top to Glen Davis. It grows in woodland to dry sclerophyll forest on sandstone, at 350–600 m altitude. ROTAP: 3KCi	Moderate
<i>Pimelea curviflora</i>	V	V	Occurs on shaley/lateritic soils over sandstone and shale/sandstone transition soils on ridgetops and upper slopes amongst woodlands.	Low
<i>Pomaderris adnata</i>		E	Occurs near the edge of the plateau behind the Illawarra escarpment.	Low - none
<i>Pomaderris brunnea</i> Rufous Pomaderris	V	V	Brown Pomaderris grows in moist woodland or forest on clay and alluvial soils of flood plains and creek lines in association with <i>Eucalyptus amplifolia</i> , <i>Angophora floribunda</i> , <i>Acacia parramattensis</i> , <i>Bursaria spinosa</i> and <i>Kunzea ambigua</i> . ROTAP: 2VC-	Low
<i>Prostanthera densa</i>	V	V	Villous Mintbush is generally grows in sclerophyll forest and shrubland on coastal headlands and near coastal ranges, chiefly on sandstone, and rocky slopes near the sea.	Low-none
<i>Prostanthera marifolia</i>	Extinct	Critically Endangered	<i>Prostanthera marifolia</i> is currently only known from the northern Sydney suburb of Seaforth and has a very highly restricted distribution within the Sydney Basin Bioregion. The single population is fragmented by urbanisation into three small sites. All known sites are within an area of 2x2 km. Two of the sites are within the local government area of Manly and one site is in the LGA of Warringah. Occurs in localised patches in or in close proximity to the endangered Duffys Forest ecological community.	Low-none
<i>Pterostylis saxicola</i> Sydney Plains Greenhood	E	E	Restricted to western Sydney between Freemans Reach in the north and Picton in the south. 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 <i>Pterostylis saxicola</i> occurs are sclerophyll forest or woodland on shale/sandstone transition soils or shale soils.	Low
<i>Pultenaea aristata</i> Prickly Bush-pea	V	V	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	None
<i>Syzygium paniculatum</i> Magenta Lilly Pilly	V	E	The Magenta Lilly Pilly occurs on gravels, sands, silts and clays in riverside gallery rainforests and remnant littoral rainforest communities in a narrow, coastal strip from Bulaideleh to Conjola State Forest. ROTAP: 3VCI	None
<i>Thelymitra</i> sp. Kangaloon Kangaloon Sun-orchid	Z	-	Recorded from shallow black peaty soil in coastal heath on sandstone. <i>Thelymitra</i> sp. <i>Kangaloon</i> is a terrestrial orchid endemic to New South Wales, and is known from three locations near Robertson in the Southern Highlands.	None

Appendix D: Threatened Fauna Likelihood of Occurrence

Species	TSC Act	EPBC Act	Habitat	Likelihood of Occurrence
Amphibians				
<i>Heleioporus australiacus</i> Giant Burrowing Frog	V	V	Occurs in heath, upland swamps, woodland and open forest with sandy soil substrates. Primarily inhabits areas adjacent to perennial streams, but can often travel several hundred metres from burrows to breeding sites (DEC 2005ac). Burrows into deep soil and emerges after heavy rain to feed. Distributed from the NSW central coast to eastern Victoria, but is most common on the Sydney sandstone. Is found from the coast to the Great Dividing Range (DEC 2005ac). Considered further in the impact assessment on the basis of upland swamp vegetation in close proximity to the development footprint.	Moderate
<i>Litoria aurea</i> Green and Golden Bell Frog	E	V	Inhabits marshes, dams and stream-sides, particularly those containing bullrushes (<i>Typha</i> spp.) or spikerushes (<i>Eleocharis</i> spp.). Often occurs in highly disturbed areas. Known from coastal or near coastal populations in NSW (DEC 2005af).	Low - none
<i>Litoria littlejohni</i> Littlejohn's Tree Frog	V	V	Occurs along permanent rocky streams with thick fringing vegetation associated with eucalypt woodlands and heaths among sandstone outcrops. Breeding occurs in slow flowing pools. Distributed from the Watagan mountains in NSW to north-eastern Victoria (DEC 2005ap).	None
<i>Litoria raniformis</i> Growling Grass Frog	E	V	This species is found mostly amongst emergent vegetation (Robinson 1993), including <i>Typha</i> sp. (bullrush), <i>Phragmites</i> sp. (reeds) and <i>Eleocharis</i> sp. (sedges), in or at the edges of still or slow-flowing water bodies such as lagoons, swamps, lakes, ponds and farm dams (NSW DEC 2005a). The Growling Grass Frog can be found floating in warmer waters in temperatures between 18–25°C.	None
<i>Mixophyes balbus</i> Stuttering Frog	E	V	Occurs in rainforest and wet open forest in the foothills and escarpment on the eastern side of the Great Dividing Range. Breeding occurs in summer after heavy rain in streams. Distributed from southern Queensland to Victoria (DEC 2005bm).	Low
<i>Pseudophryne australis</i> Red-crowned Toadlet	V	-	The Red-crowned Toadlet has a restricted distribution. It is confined to the Sydney Basin, from Pokolbin in the north, the Nowra area to the south, and west to Mt Victoria in the Blue Mountains. 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. Inhabits periodically wet drainage lines below sandstone ridges that often have shale lenses or cappings. Shelters under rocks and amongst masses of dense vegetation or thick piles of leaf litter. Considered further in the impact assessment on the basis of upland swamp vegetation in close proximity to the development footprint.	Moderate
Reptiles				
<i>Hoplocephalus bungaroides</i> Broad-headed Snake	E	V	This species inhabits sandstone outcropping, sheltering in rock crevices and under rocks for most of the year and tree hollows in the summer. This species is confined to the Sydney Basin and found mainly associated with Hawkesbury, Shoalhaven and Narrabeen sandstones (DEC 2005k)	Low

Species	TSC Act	EPBC Act	Habitat	Likelihood of Occurrence
<i>Varanus rosenbergi</i> Rosenberg's Goanna	V	-	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. Individuals require large areas of habitat. Feeds on carion, birds, eggs, reptiles and small mammals. Shelters in hollow logs, rock crevices and in burrows, which they may dig for themselves, or they may use other species' burrows, such as rabbit warrens. Runs along the ground when pursued (as opposed to the Lace Monitor, which climbs trees). Lays up to 14 eggs in a termite mound; the hatchlings dig themselves out of the mounds. Generally slow moving; on the tablelands likely only to be seen on the hottest days. Not considered further in the impact assessment as the habitat that this species may utilise within the development footprint is common foraging habitat that will not reduce the potential for the species to occur locally should the borehole and access track be developed.	Moderate
Birds				
<i>Callocephalon fimbriatum</i> Gang-gang Cockatoo	V	-	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 (DEC 2005aa) Breeding occurs in tree hollows. In NSW this species is distributed from the south coast to the Hunter region (DEC 2005aa).	Low
<i>Calyptrorhynchus lathamii</i> Glossy Black-Cockatoo	V	-	Inhabits dry open forests on the coast and Great Dividing Range especially where stands of she-oaks (<i>Allocasurina</i> sp.) occur. Breeding occurs in tree hollows (DEC 2005ad).	Low
<i>Climacteris picumnus victoriae</i> Brown Treecreeper (eastern subspecies)	V	-	Occurs in Eucalypt woodlands and dry open forest with a grassy understorey on the inland slopes and plains. Hollows in standing dead or live trees and tree stumps are essential for nesting. (DEC 2005l). Not considered further in the impact assessment as the habitat that this species may utilise within the development footprint is common foraging habitat that will not reduce the potential for the species to occur locally should the borehole and access track be developed.	Moderate
<i>Daphoenositta chrysoptera</i> Varied Sittella	V	-	Inhabits open forest and woodland, mallee, tea-tree scrub, inland <i>Acacia</i> scrub (Pizzey and Knight 2007). Distributed throughout the whole of NSW, absent from deserts and open grassland (NSW Scientific Committee 2010).	Low
<i>Dasyornis brachypterus</i> Eastern Bristlebird	E	E	Habitat is characterised by dense, low vegetation including heath and open woodland with a heathy understorey; in northern NSW occurs in open forest with tussocky grass understorey; all of these vegetation types are fire prone. Considered further in this assessment as recent records of this species from the Holsworthy Military Area indicate a renewed presence in the region.	Moderate
<i>Diomedea exulans</i> Wandering Albatross	E	V	Entirely marine.	None
<i>Glossopsitta pusilla</i> Little Lorikeet	V	-	Inhabits dry sclerophyll forest and woodland, timbered watercourses and large trees in open country (Pizzey and Knight 2007). In NSW this species is distributed from the coast to the western slopes of the Great Dividing Range (NSW Scientific Committee 2009).	Low

Species	TSC Act	EPBC Act	Habitat	Likelihood of Occurrence
<i>Haematopus fuliginosus</i> Sooty Oystercatcher	V	-	Favours rocky headlands, rocky shelves, exposed reefs with rock pools, beaches and muddy estuaries. Foages on exposed rock or coral at low tide for foods such as limpets and mussels.	None
<i>Hieraetus morphnoides</i> Little Eagle	V	-	Inhabits woodland, open eucalypt forest, river red gums on watercourses and Acacia woodlands (Pizzey and Knight 2007). Widespread throughout Australia except for heavily forest escarpments of the Great Dividing Range (NSW Scientific Committee 2010).	Low
<i>Lathamus discolor</i> Swift Parrot	E	EM	This species is an autumn and winter migrant to mainland Australia, breeding occurs only in Tasmania (Pizzey and Knight 1997). In NSW this species is found in areas with heavily flowering Eucalypts or lerp infested trees. Favoured feed trees include <i>Eucalyptus robusta</i> , <i>Corymbia maculata</i> , <i>C. gummifera</i> , <i>E. sideroxylo</i> , <i>E. albens</i> , <i>E. microcarpa</i> , <i>E. moluccana</i> and <i>E. pilularis</i> (DEC 2005bo).	Low
<i>Lophoichthya isura</i> Square-tailed Kite	V	M	Found in dry woodlands, open forests, rainforest and timbered watercourses (DEC 2005bj). In NSW this species is resident in the north, north-east and along major west flowing river systems and is a breeding migrant to the south coast (DEC 2005bi).	Low
<i>Neophema pulchella</i> Turquoise Parrot	V	-	Inhabits open grassy woodland, edges of eucalypt woodland adjoining clearings, near permanent water and forested hills, timbered ridges and creeks in farmland (DEC 2005br; Pizzey and Knight 2007). Found from coastal plains to the western slopes of the Great Dividing Range from southern Queensland to Northern Victoria (DEC 2005br).	Low
<i>Ninox connivers</i> Barking Owl	V	-	Inhabits eucalypt woodland, open forest, swamp woodlands and, especially in inland areas, timber along watercourses. Denser vegetation is used occasionally for roosting (DEC 2005). Occurs sparsely in NSW, absent from deserts and rare in coastal escarpments (DEC 2005e). . Not considered further in the impact assessment as the habitat that this species may utilise within the development footprint is common foraging habitat that will not reduce the potential for the species to occur locally should the borehole and access track be developed.	Moderate
<i>Ninox strenua</i> Powerful Owl	V	-	The Powerful Owl inhabits a range of vegetation types, from woodland and open sclerophyll forest to tall open wet forest and rainforest (DEC 2005az). Mostly found within 200 km of the coast from central Queensland to south western Victoria (Pizzey and Knight 2007). . Not considered further in the impact assessment as the habitat that this species may utilise within the development footprint is common foraging habitat that will not reduce the potential for the species to occur locally should the borehole and access track be developed.	Moderate
<i>Petroica boodang</i> Scarlet Robin	V	-	The Scarlet Robin breeds in drier eucalypt forests and temperate woodlands, often on ridges and slopes, within an open understorey of shrubs and grasses and sometimes in open areas (NSW Scientific Committee 2010). Migrates to more open areas in winter. Occupies the coast and inland slopes of NSW from the Northern Tablelands to the Riverina (Pizzey and Knight 2007).	Low
<i>Petroica phoenicea</i> Flame Robin	V	-	Breeds in the timbered foothills and upper slopes of the Great Dividing Range, preferring an open understorey in moist Eucalypt forests and woodlands (NSW Scientific Committee 2010). Migrates to lowland areas in winter. In NSW this species is distributed from the Northern Tablelands to the Riverina (Pizzey and Knight 2007).	Low

Species	TSC Act	EPBC Act	Habitat	Likelihood of Occurrence
<i>Pezoporus wallicus</i> Eastern Ground Parrot	V	-	The Ground Parrot occurs in high rainfall coastal and near coastal low heathlands and sedgeland, generally below one metre in height and very dense (up to 90% projected foliage cover). These habitats provide a high abundance and diversity of food, adequate cover and suitable roosting and nesting opportunities for the Ground Parrot, which spends most of its time on or near the ground. When flushed, birds fly strongly and rapidly for up to several hundred metres, at a metre or less above the ground. This species has been considered further in the impact assessment on the basis that it has been recorded recently in the vicinity of Helensburgh and suitable habitat for this species occurs on or near to the proposed development footprint.	Moderate – High
<i>Phoebastria fusca</i> Sooty Albatross	V	V	Entirely marine	None
<i>Phalacrocorax melanoleucus</i> Rose-crowned Fruit-dove	V	-	Inhabits rainforest, monsoon forest, adjacent eucalypt forest, woodlands, mangroves in areas where fruit is plentiful (DEC 2005bd; Pizzey and Knight 2007). Distributed north of Newcastle in NSW on the coast and coastal ranges (DEC 2005bd).	None
<i>Rostratula benghalensis australis</i> Australian Painted Snipe	E	V	Prefers fringes of swamps, dams and nearby marshy areas where there is a cover of grasses, lignum, low scrub or open timber (DEC 2005d).	None
<i>Sterna fuscata</i> Sooty Tern	V	-	Large flocks can be seen soaring, skimming and dipping but seldom plunging in off shore waters. Breeds in large colonies in sand or coral scrapes on offshore islands and cays including Lord Howe and Norfolk Islands.	None
<i>Tyto novaehollandiae</i> Masked Owl	V	-	This species roosts and breeds in moist eucalypt forested gullies, requiring large tree hollows or sometimes caves. Recorded from the coast to the western plains of NSW (DEC 2005as).	Low
<i>Tyto tenebriosa</i> Sooty Owl	V	-	Found in tall wet forest and rainforest, requiring large hollow bearing trees for roosting (DEC 2005bf). Distributed in coastal eastern Australia, mostly east of the Great Dividing Range (Pizzey and Knight 2007).	Low
<i>Xanthomyza (Anthochaera) phrygia</i> Regent Honeyeater	E	EM	Inhabits dry open forest and woodland, particularly Box-Ironbark woodland, and riparian forests of River Sheoak. Key eucalypt species include Mugga Ironbark, Yellow Box, Blakely's Red Gum, White Box and Swamp Mahogany. Also utilises : <i>E. microcarpa</i> , <i>E. punctata</i> , <i>E. polyanthemus</i> , <i>E. mollucana</i> , <i>Corymbia robusta</i> , <i>E. crebra</i> , <i>E. caleyi</i> , <i>Corymbia maculata</i> , <i>E. mckleana</i> , <i>E. macrohyncha</i> , <i>E. laevopinea</i> , and <i>Angophora floribunda</i> . (DEC 2005bb).	Low
Migratory Birds				
<i>Haliaeetus leucogaster</i> White-bellied Sea-eagle	-	M	Found in coastal areas, terrestrial wetlands and major rivers and has been observed foraging in a number of other habitats (DEWHA 2010a). Distributed along the coastline of mainland Australia and Tasmania and along major rivers (Pizzey and Knight 2007).	Low
<i>Hiundapus caudacutus</i> White-throated Needletail	-	M	In Australia this species is almost exclusively aerial, and in NSW is found in coastal areas and to the western slopes of the Great Dividing Range (DEWHA 2010b).	Low

Species	TSC Act	EPBC Act	Habitat	Likelihood of Occurrence
<i>Apus pacificus</i> Fork-tailed Swift	-	M	Aerial species, observed from a range of habitats in Australia. Summer migrant to Australia, found all over the country (Pizzey and Knight 2007).	Low
<i>Merops ornatus</i> Rainbow Bee-eater	-	M	Occurs in grassland, open woodland, rainforest and shrublands. Often associated with water. Distributed throughout much of Australia (DEWHA 2010c).	Low
<i>Monarcha melanopsis</i> Black-faced Monarch	-	M	Occurs in rainforest, adjacent eucalypt woodland and coastal scrub. Distributed coastally in eastern Australia (Pizzey and Knight 2007).	Low
<i>Myiagra cyanoleuca</i> Satin Flycatcher	-	M	Inhabit heavily vegetated gullies in forests and tall woodlands, also coastal forests, woodlands, mangroves and gardens during migration (Pizzey and Knight 2007). Distributed from Cape York to Tasmania, breeding occurs in south eastern Australia (Pizzey and Knight 2007).	Low
<i>Rhipidura rufifrons</i> Rufous Fantail	-	M	Inhabit rainforest, gullies in Eucalypt forest, monsoon forest, paperbark forest and more open habitats during migration (Pizzey and Knight 2007). Mostly found east of the Great Dividing Range.	Low
<i>Ardea alba</i> Great Egret	-	M	Found in the shallows of estuaries, mudflats, rivers, freshwater wetlands, sewage ponds and irrigation areas (Pizzey and Knight 2007). Distributed across most of Australia except the Western Desert.	Low
<i>Ardea ibis</i> Cattle Egret	-	M	Found in grassland, paddocks and terrestrial wetlands, generally a spring migrant to south eastern Australia (Pizzey and Knight 2007).	Low
<i>Gallinago hardwickii</i> Latham's Snipe	-	M	Found in terrestrial wetlands, wet parts of paddocks and irrigated areas. Summer migrant to Australia, mostly found in the East (Pizzey and Knight 2007).	Low
Mammals				
<i>Arctocephalus pusillus doriferus</i> Australian Fur Seal	V		Marine Species	None
<i>Cercartetus nanus</i> Eastern Pygmy-possum	V	-	Found in rainforest through sclerophyll (including Box-ironbark) forest and woodland to heath, but in most areas woodlands and heath appear to be preferred, except in north-eastern NSW where they are most frequently encountered in rainforest. Require tree hollows, and feed on nectar. In NSW this species extends from the coast to the western slopes (DEC 2005w). Not considered further in the impact assessment as the habitat that this species may utilise within the development footprint is common foraging habitat that will not reduce the potential for the species to occur locally should the borehole and access track be developed.	Moderate

Species	TSC Act	EPBC Act	Habitat	Likelihood of Occurrence
<i>Chalinobius dwyeri</i> Large-eared Pied Bat	V	V	Occur in a range of forest types, including wet and dry sclerophyll forest and woodland, rainforest edges, sub alpine woodland and sandstone outcrop country (Churchill 2008). Roosts preferentially in the twilight areas of caves, crevices in cliffs and mines in colonies of three to 40 individuals, and has also been found roosting in abandoned fairy martin nests (Churchill 2008). In NSW this species is found north of Bungonia in the Southern Highlands including the Coast and inland ranges (Churchill 2008).	Low
<i>Dasyurus maculatus</i> Spotted-tailed Quoll	V	V	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. Individual animals use hollow-bearing trees, fallen logs, small caves, rock crevices, boulder fields and rocky-cliff faces as den sites (DEC 2005b).	Low
<i>Dasyurus viverrinus</i> Eastern Quoll	E	-	Occurs in dry sclerophyll forest, scrub, heathland and cultivated land.	Low
<i>Isodon obesulus obesulus</i> Southern Brown Bandicoot	E	E	Nest during the day in a shallow depression in the ground covered by leaf litter, grass or other plant material. Nests may be located under Grass trees <i>Xanthorrhoea</i> sp., blackberry bushes and other shrubs, or in rabbit burrows, found in wet and dry sclerophyll forest, heath and rainforest. In NSW this species is predominately found south of Sydney (DEC 2005bg). . Not considered further in the impact assessment as the habitat that this species may utilise within the development footprint is common foraging habitat that will not reduce the potential for the species to occur locally should the borehole and access track be developed.	Moderate
<i>Miniopterus schreibersii oceanensis</i> Eastern Bentwing-bat	V	-	Occurs in rainforest, wet and dry sclerophyll forest, monsoon forest, open woodland, Melaleuca forest and open grasslands (Churchill 2008). A cave dwelling species that forms maternity colonies in summer. Also roost in abandoned mines and road culverts (Churchill 2008). In NSW this species is distributed from north to south predominantly east of the Great Dividing Range (DEC 2005v).	Low
<i>Mormopterus norfolkensis</i> Eastern Freetail Bat	V	-	Occurs in dry eucalypt forest and woodland on the coastal side of the Great Dividing Range from the south coast of NSW to south-eastern Queensland (Churchill 2008). Roost in tree hollows mostly in hollow spouts of large mature trees, but has also been recorded in buildings (Churchill 2008).	Low
<i>Myotis macropus</i> Large-footed Myotis	V	-	Strongly associated with vegetated rivers, streams and permanent waterways and roost in a number of structures close to water sources such as tree hollows, caves, mines, among dense vegetation, road culverts and stormwater drains (Churchill 2008). Distributed along the coast throughout south-eastern and northern Australia and along major river systems such as the Murray River (Churchill 2008).	Low
<i>Petaurus australis</i> Yellow-bellied Glider	V	-	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. Distributed from the coast to the western slopes of the Great Dividing Range (DEC 2005bt).	Low
<i>Petaurus norfolkensis</i> Squirrel Glider	V	-	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 (DEC 2005bk). Prefer a mixed understorey with Acacias and Banksias for foraging and require abundant tree hollows (DEC 2005bk). Distributed from Northern Queensland to western Victoria.	Low

Species	TSC Act	EPBC Act	Habitat	Likelihood of Occurrence
<i>Petrogale penicillata</i> Brush-tailed Rock-wallaby	E	V	Found in steep areas such as rocky escarpments with complex cave and fissure structures. In NSW they occur in disjunct populations from the Queensland border in the north to the Shoalhaven in the south, with the population in the Warrumbungle Ranges being the western limit (DEC 2005n).	Low
<i>Phascogale cinerea</i> Koala	V	-	Inhabit eucalypt woodlands and forests. Feed on the foliage of more than 70 eucalypt species and 30 non-eucalypt species, but in any one area will select preferred browse species (DEC 2005an).	Low
<i>Potorous tridactylus</i> Long-nosed Potoroo	V	V	Inhabits coastal heaths and dry and wet sclerophyll forests, prefers dense understorey with occasional open areas is an essential part of habitat, and may consist of grass-trees, sedges, ferns or heath, or of low shrubs of tea-trees or Melaleuca. A sandy loam soil is also a common feature (DEC 2005aq). A predominantly coastal species is south eastern Australia (DEC 2005aq). Not considered further in the impact assessment as the habitat that this species may utilise within the development footprint is common foraging habitat that will not reduce the potential for the species to occur locally should the borehole and access track be developed.	Moderate
<i>Pteropus poliocephalus</i> Grey-headed Flying-fox	V	V	Form camps or colonies numbering up to thousands in dense vegetation such as mangrove, rainforest, sclerophyll forest, Casuarina stands and Melaleuca stands usually near water (Churchill 2008). Distributed from central Queensland to south-western Victoria (DEC 2005ak).	Low
<i>Scoteanax rueppellii</i> Greater Broad-nosed Bat	V	-	Roost in tree hollows, cracks or fissures, under exfoliating bark and occasionally in buildings in a variety of habitat including mature coastal forest, rainforest, open woodland, Melaleuca swamp woodland, tree lined creeks, remnant trees in cleared paddocks and wet and dry sclerophyll forest (Churchill 2008). In NSW this species is distributed from the Atherton Tablelands to the south coast (Churchill 2008).	Low

Appendix E: Resilience and Condition Assessment

DESCRIPTION OF BUSHLAND CONDITION	MANAGEMENT ACTIONS	RESILIENCE RATING	COLOUR CODE
RESILIENT AREAS – Soil profile intact. Natural regeneration pathways facilitated.			
- Virtually weed free. - All structural layers present unless structural alteration occurred from natural process, e.g., fire, storm, etc. - Area stable or stabilising after natural disturbance.	- Minimal input regeneration with maintenance weed management required. - Prevention of future impacts and inappropriate disturbances.	Very High	GREEN
- Relatively minor infestations of weeds. - All structural layers present unless alteration occurred from natural process OR unnatural disturbance of structural layer is not major. - Area stable or stabilising after disturbance.	- Low input regeneration with maintenance weed management required and smaller patches of primary and secondary management. - Prevention of future impacts and inappropriate disturbances.	High	BLUE
- Moderate-severe infestation of weeds. - Native area suffering and regeneration of native species being suppressed. - Structural absence or strong decline in condition of at least 1 vegetation layer (e.g. derived native pasture or grassland). - Loss of vegetation layer mainly attributed to weed invasion unless alteration occurred from natural disturbance OR a major unnatural disturbance event.	- Medium input regeneration with strategic primary, secondary and maintenance weed management required for patches. - Prevention of future impacts or inappropriate disturbances. - Additional "kick-start" possibly required promoting regeneration.	Moderate	ORANGE
- Bushland replaced by weed species. - Remaining native components under stress. - Structural absence or strong decline in at least 2 vegetation layers. - Loss of vegetation layer mainly attributed to weed invasion and major unnatural disturbance has occurred. - Original soil profile intact but regeneration suppressed by the high level of weed infestation. - Existing area approaching threshold levels of not returning to original state.	- High input regeneration with strategic primary, secondary and maintenance weed management required for large areas. - Consideration given to habitat value of retaining weed infestation and economic sustainability of implementing measures. - May require a "kick-start" or supplementary revegetation to approximate original system. - Prevention of future impacts or inappropriate disturbances.	Low	RED
NON-RESILIENT AREAS – Soil profile permanently altered. Natural regeneration pathways unlikely.			
- Reconstruction or type conversion area/zone requiring treatment. - Bushland replaced totally by weed species. - Soil profile disturbed and permanently altered resulting in loss of soil seed bank and plant propagules. - Area requiring treatment and importation of propagule material. - No regeneration capacity, natural regeneration pathways lost.	- High initial input with regular maintenance. - Reconstruction or type conversion required. - Consideration given to habitat value of weed infestation and economic sustainability of implementing measures.	Very Low (un-managed and degraded bushland)	YELLOW
- Reconstruction or type conversion area/zone commenced treatment. - Previously a yellow area before commencement of treatment, e.g., planted, direct seeded, soil capped, translocation, etc. - Nolor limited natural regeneration capacity after treatment.	- On-going high input maintenance weed management. - Reconstruction or type conversion has occurred (previously YELLOW).	Low (maintained restoration area)	PURPLE
Potential regeneration suppressed by management practices (e.g., parkland, cropping or exotic pasture).	Programmed maintenance, cropping or grazing.	Not bushland	BROWN

Appendix F: Assessment of Impacts on Threatened Species and Ecological Communities Under Part 3A of the EP&A Act

Threatened Flora

Pultenaea aristata

Pultenaea aristata is a small erect shrub, usually less than 40 cm tall, with leaves 8 to 22 mm long and 1 to 2 mm wide. The leaves are linear with a distinctive long bristle tapering to a sharp point. Flowers of the Prickly Bush-pea appear in yellow to light orange terminal heads between September and October.

Figure 2 shows the distribution of *P. aristata* within the study area. Figure 2 also shows the location of previously recorded individuals of this species along the access track to the north-east of the proposed borehole site.

While there is little to no information regarding the pollination and dispersal biology of this species, given the number of plants in the locality and their likely distribution in close proximity to the access track and borehole site, it is likely that the plants to the northeast of the borehole site are part of the much larger population in the locality.

This species is known to occur in localised, but nonetheless, large populations on the Woronora Plateau with some populations estimated to be in the thousands and possibly tens of thousands (pers. obs.).

How is the proposal likely to affect the lifecycle of a threatened species and/or population?

The proposal will result in the direct removal of individuals of this species.

Within the study area the species was found to be a common shrub species along the access track and at the borehole site as well as in the vegetation surrounding these areas. It was therefore not possible to either map the extent of the local population of this species or to accurately record its population size. It is estimated that many hundreds and possible thousands of individual plants occur in the locality with only a small proportion of this larger population being subject to disturbance by the proposal. The great majority of the population will not be impacted by the proposal either directly or indirectly.

How is the Proposal likely to affect the habitat of a threatened species, population or ecological community?

The proposal will result in the removal of 0.66 ha of vegetation which is considered to be either known or potential habitat for *Pultenaea aristata*.

In the context of the locality this area of vegetation is negligible given the relatively undisturbed nature of the Woronora Catchment which, as shown in Figure 4, is known habitat for this threatened species.

It should be noted that the proposed access track and borehole site will be fully rehabilitated at the completion of all works. That being the case, and given that the current localised distribution of this species occurs on and directly beside the existing abandoned and regenerating Fire road it is anticipated that the species would re-colonise

the access track and borehole site once the project is completed. This conclusion is based on the estimate that only a very small proportion of plants in the local population will be impacted by the proposal and will act as a source population for the regenerating area.

Therefore, the proposed development will have a relatively short term impact on a small area of known and potential habitat for *Pultenaea aristata*.

Does the Proposal affect any threatened species or populations that are at the limit of its known distribution?

Pultenaea aristata is restricted to the Woronora Plateau, a small area between Helensburgh, south of Sydney, and Mt Kiera above Wollongong.

The study area occurs within this known distribution and Figure 4 indicates that within 10 km of the borehole site at least, the local population is surrounded by records for the species in all directions. It should be noted that large populations of the species occurring within the O'Hare's Creek Catchment to the south west of the borehole site (pers. obs.) are not indicated on Figure 4, indicating that the NSW Wildlife Atlas does not include all known records in the local area.

How is the proposal likely to affect current disturbance regimes?

The proposal will lead to the re-opening of a previously disturbed area in the form of an abandoned fire road. Development of the borehole site will also lead to a small area of disturbance in a previously undisturbed site.

How is the Proposal likely to affect habitat connectivity?

The proposal will result in a disturbance footprint that will include a 5 m wide clearing running for approximately 1 km to the borehole site, which itself will result in a clearing of approximately 40 x 40 m.

Habitat connectivity in this area will be temporarily interrupted (i.e. for the life of the project) in a relatively minor way. That is to say that a 5 m wide clearing may limit the movements of some animal species such as small rodents, although a clearing of this nature is not likely to inhibit the movement of most fauna.

In relation to *Pulteneae aristata* habitat connectivity has the potential to be important for pollinator movement. The pollinators of this species are not known but smaller fauna or insects are the likely vectors. It is not known if a 5 m wide clearing would inhibit pollinator movements for this species. It is considered unlikely however that the creation of a very small clearing would result in a situation that would fragment an existing population such that the population was no longer able to exchange genetic material through pollination or disperse seed adequately.

Four main considerations should be noted:

1. there are sections of the regenerating fire road which are already devoid of vegetation and therefore will already act to inhibit pollinator movement in the area, if indeed any pollinators would be affected by these small widths of track devoid of vegetation.
2. the population of *Pulteneae aristata* within the study area exists despite previous disturbances which are almost identical to the disturbances proposed for the development of Borehole AI19.

3. the population of *Pulteneae aristata* within the study area is likely to have been present before (and after) the fire road was created. That is to say, the population displays no indication that the previous disturbance has inhibited its current existence in any manner, indeed a large number of individuals of this species were recorded within the abandoned fire road footprint itself.
4. the proposed development footprint will exist within a largely undisturbed landscape to the north, east and south (i.e. within a largely contiguous expanse of vegetation associated with the Woronora Catchment). This vegetation provides known and potential habitat for *P. aristata* which is extensive in the locality and, to a greater extent, the region and which will not be affected more broadly by the proposal.

How is the Proposal likely to affect critical habitat?

No critical habitat as listed on the TSC Act will be affected by the proposal.

Threatened Fauna

Eastern Bristlebird and Eastern Ground Parrot

Note: Information described for both the Eastern Bristlebird and the Eastern Ground Parrot below has been adapted from Biosphere Environmental Consultants (2009). The references cited in that report have been included below and included in the References section of this report.

The Eastern Ground Parrot lives in low heathland and sedgeland (Meredith, 1984; Meredith *et al.*, 1984, McFarland, 1989) as well as drier ridges and nearby grasslands (Pizzey and Knight, 2006). This shy species occurs as singles, pairs or open companies (Pizzey and Knight, 2006). Breeding takes place between September and December as well as in autumn in north-east NSW (*ibid.*). Nests, generally made into a cup shape with an entrance tunnel from bitten-off stems, are made on the ground beneath dense vegetation (e.g. tussock or stunted bush) and the clutch size averages 3 to 4 (McFarland, 1991a; Pizzey and Knight, 2006). The Eastern Ground Parrot feeds on the ground (Pizzey and Knight, 2006) and eats seeds from a wide range of herbs, graminoids and heath, the diet generally reflecting the range of available plants, but excludes seeds that need processing to remove woody husks (McFarland, 1991b). This species climbs low plants (Pizzey and Knight, 2006). The Eastern Ground Parrot is considered to be sedentary but undertakes local seasonal movements (*ibid.*). Threats relevant to this species include habitat loss and fragmentation (Higgins, 1999), however inappropriate fire regimes are considered to be the main threat (DECC, 2007a). The principal management action for this species on the Woronora Plateau is the maintenance of a mosaic of burn ages within suitable habitat (*ibid.*).

Eastern Ground Parrots have recently been recorded from the Tharawal State Conservation Area and the Cataract Catchment Area (records from 2008-2009 period as reported by Biosphere Environmental Consultants 2009).

The Eastern Bristlebird has been split into two subspecies (Schodde and Mason, 1999), *Dasyornis brachypterus monoides* (northern subspecies) and *Dasyornis brachypterus brachypterus* (southern subspecies) (NSW Scientific Committee, 2008a, 2008b). Current Preliminary Determinations by the NSW Scientific Committee propose to list the northern subspecies as a Critically Endangered species and the southern subspecies as an Endangered

species under the TSC Act. The northern subspecies of the Eastern Bristlebird inhabits thick, moist undergrowth which provides a refuge from fire (NSW Scientific Committee, 2008a). The primary habitat is grass tussocks (mainly Wild Sorghum) in open forest and woodland close to rainforest (ibid.). The southern subspecies inhabits thick undergrowth; dense, low vegetation including heathland, sedgeland, shrubland (often riparian or on swamp fringes), forest or woodland with a dense shrub layer, and temperate rainforest (NSW Scientific Committee 2008b).

The Eastern Bristlebird is considered to be a cover-dependent and fire-sensitive species (NPWS, 1999g). Age of habitat since fires is of particular importance with unburnt periods of 15 years or more necessary to optimise population density. Eastern Bristlebirds have low fecundity; generally laying a clutch of two eggs and raising only one fledgling (NPWS, 1999g). Eastern Bristlebird nests are elliptical domes constructed in low dense vegetation, usually in tufted plants (NPWS, 1999g). The diet of the Eastern Bristlebird includes ants, beetles and weevils (Baker, 1998). Individuals have a home range of more than 10 ha and are presumed to be sedentary (Baker, 1998). Potential threats to this species are thought to include loss of habitat (including indirect loss due to too frequent fires), predation by native and introduced predators, road-kills (known to occur in the Jervis Bay area), grazing by livestock and trampling of habitat (northern populations), off-road vehicle damage to habitat and invasion of habitat by weeds (NPWS, 1999g). Fragmentation and isolation characteristic of the Eastern Bristlebird populations may also be adversely affecting the species (ibid.).

Recent records for the Eastern Bristlebird are also known from the Holsworthy Military Area (Rob Kolano – ADF, 2010 pers. comm.).

In relation to the current proposal potential habitat for these two bird species occurs within the Upland Swamp Vegetation. There is some potential that these two species may forage within the thick shrub vegetation occurring and regenerating on the abandoned fire road, although neither of these two species are considered likely to use this vegetation as breeding habitat given the historic disturbance and the lack of structure and ground cover vegetation that occurs in good quality upland swamp habitats.

How is the proposal likely to affect the lifecycle of a threatened species and/or population?

The proposal is unlikely to have a direct impact on either of these species through the direct impact to individuals or to important breeding habitat.

Individuals are unlikely to be directly impacted as the machinery that will be used to remove the regenerating vegetation will be slow moving, noisy and cause ground vibration which is likely to disturb any individuals before the machinery could harm them.

Breeding habitat for both of these species is considered to be best represented by undisturbed upland Swamp vegetation occurring away from the access track and borehole site. Breeding habitat is considered unlikely to be impacted.

How is the Proposal likely to affect the habitat of a threatened species, population or ecological community?

The proposal has the potential to remove a small area of regenerating vegetation which is potential foraging habitat for these species. This habitat is also considered to be sub-

optimal as it is regularly sparse (compared to the more dense upland swamp vegetation away from the regenerating access track) and does not contain all layers of vegetation often represented in upland swamp vegetation (i.e. the ground cover grasses, sedges and herbs are often absent). This small area of sub-optimal habitat is not likely to be important for the lifecycle of either of these two species.

Does the Proposal affect any threatened species or populations that are at the limit of its known distribution?

Although the Eastern Bristlebird is known from southern QLD and Northern NSW the Illawarra population comprises an estimated 1,600 birds, mainly from Barren Grounds Nature Reserve, Budderoo National Park and the Jervis Bay area. The southern population in Nadgee Nature Reserve and Howe's Flat is around 200 birds. Further surveys are required in parts of Ben Boyd National Park and Sydney Catchment Authority lands to determine whether further populations of the Eastern Bristlebird occur in these areas (DECC 2010a).

For the Eastern Ground Parrot, the eastern subspecies (*wallicus*) inhabits south-eastern Australia from southern Queensland through NSW to western Victoria. It formerly occurred in South Australia, but was last recorded in 1945. In NSW populations have declined and contracted to islands of coastal or subcoastal heathland and sedgeland habitats. The species is found in small numbers on the north coast (Broadwater, Bundjalung and Yuraygir National Parks) and Myall Lakes National Park on the central coast. The largest populations occur on the NSW south coast, particularly Barren Grounds Nature Reserve, Budderoo National Park, the Jervis Bay area and Nadgee Nature Reserve. Small numbers are recorded at Morton and Ben Boyd National Parks and other areas on the south coast.

The study area is not at the known limit of distribution of either of these species though, notwithstanding the potential for these species to occur more widely within the Woronora Catchment, the Holsworthy Military Area, the Royal and Heathcote National Parks and also the Sydney Catchment lands, the study area comprises the northern limit of any 'Illawarra' population for both species.

How is the proposal likely to affect current disturbance regimes?

The proposal will lead to the re-opening of a previously disturbed area in the form of an abandoned fire road. Development of the borehole site will also lead to a small area of disturbance in a previously undisturbed site.

How is the Proposal likely to affect habitat connectivity?

The proposal will result in a disturbance footprint that will include a 5 m wide clearing running for approximately 1 km to the borehole site, which itself will result in a clearing of approximately 40 x 40 m.

Habitat connectivity in this area will be temporarily interrupted (i.e. for the life of the project) in a relatively minor way. That is to say that a 5 m wide clearing may limit the movements of some animal species such as small rodents, although a clearing of this nature is not likely to inhibit the movement of most fauna.

In relation to the Eastern Bristlebird and the Eastern Ground Parrot it is unknown if a 5 m wide road corridor would inhibit movement of these species, however the following points should be noted:

1. there are sections of the regenerating fire road which are already devoid of vegetation and therefore, if small areas of absent vegetation in an otherwise contiguous area of habitat act to inhibit movement of these birds than such clearings already exist within the study area.
2. the proposed development footprint will exist within a largely undisturbed landscape to the north, east and south (i.e. within a largely contiguous expanse of vegetation associated with the Woronora Catchment). This vegetation provides habitat which is extensive in the locality and, to a greater extent, the region and which will not be affected more broadly by the proposal.

It is unlikely that the proposal would affect habitat connectivity for either of these species.

How is the Proposal likely to affect critical habitat?

No critical habitat has been declared for either species.

Red-crowned Toadlet and Giant Burrowing Frog

Note: Information described for both the Red-crowned Toadlet and the Giant Burrowing Frog below has been adapted from Biosphere Environmental Consultants (2009). The references cited in that report have been included below and noted in the References section of this report. Other references for these species include DEC (2001) and DEC (2005ab).

The Red-crowned Toadlet has a unique terrestrial reproductive strategy: small nests are formed within decomposing accumulated leaf matter and clutch sizes are small, consisting of around 20-24 large eggs. The nests retain the eggs through the early stages of tadpole development; then rainfall events flush the embryos from the nest, and tadpoles complete development within transient pools. The timing of follow up rain events and duration of temporary pools is critical to reproductive success.

Many clutches are lost to desiccation through evaporation of the shallow pools and therefore recruitment is usually in low numbers (NPWS, 2001d). To offset this loss, females can lay multiple clutches and breed opportunistically when appropriate conditions prevail (*ibid.*). The Red-crowned Toadlet has been recorded calling in all months of the year, including winter, and eggs have been found in all months (NPWS 2001d). Midwinter breeding is infrequent and likely to occur during milder weather conditions that may prevail in the coastal part of its range in some years. The Red-crowned Toadlet can also be found breeding along eroded gutters or the verges of unsealed fire trails. In these locations, accumulations of leaf-litter in association with temporary pools mimics natural feeder stream breeding habitat.

When not breeding, Red-crowned Toadlets are thought to disperse over wider areas of their sandstone habitat and many individuals have been observed sheltering under cover that would be unsuitable for egg-laying. However, it is likely that such 'dispersion' is only in the order of a few tens of metres from suitable breeding areas.

Threats relevant to this species include habitat loss or degradation, high frequency fire, bush rock removal, Chytrid fungus disease, water pollution and changed hydrological regimes. Habitat alteration by longwall mining is also considered a threat to this species.

Much of the Giant Burrowing Frog's existence is spent burrowed underground sometimes beneath deep leaf-litter or in earth-filled rock crevices interspersed with brief periods of activity throughout the year during rainy weather. Burrows are excavated into the earth around, or associated with rocks fissures or boulders (NPWS, 2001c). It has also been reported that yabbie holes are utilised along the beds and banks of drying streams. The Giant Burrowing Frog mainly breeds between mid summer and autumn (Cogger, 2000). Males call from within or adjacent to the breeding burrows or amongst accumulated vegetation debris. Tadpoles develop in three to six months. The Giant Burrowing Frog is thought to have a large home range; having been recorded at considerable distances from suitable moist habitat and Individuals have been recorded to move up to 200 to 300 m in a night.

How is the proposal likely to affect the lifecycle of a threatened species and/or population?

The disturbance footprint is considered unlikely to contain suitable breeding habitat for either frog species and therefore breeding events are unlikely to be disturbed by the proposal.

Individuals of both of these species have the potential to traverse habitat such as sandstone ridge tops during or soon after rainfall events. The proposed works will be undertaken within Catchment lands which are regulated by the Sydney Catchment Authority who restrict access to the Catchment during and soon after significant rainfall events. It is therefore highly unlikely that the proposal will lead to direct impacts on individual frogs moving through the area in favourable conditions.

The proposal is considered unlikely to affect the lifecycle of these two threatened frog species.

How is the Proposal likely to affect the habitat of a threatened species, population or ecological community?

Habitat for these two species within the study area is restricted to the sandstone ridge top environment of both the access track and the proposed borehole site.

The proposal has the potential to remove a small area of regenerating vegetation which is potential foraging habitat for these species. This habitat is also considered to be sub-optimal as it is regularly sparse (compared to the more dense upland swamp vegetation away from the regenerating access track) and does not contain all layers of vegetation often represented in upland swamp vegetation (i.e. the ground cover grasses, sedges and herbs are often absent). This small area of sub-optimal habitat is not likely to be important for the lifecycle of either of these two species.

Does the Proposal affect any threatened species or populations that are at the limit of its known distribution?

The Red-crowned Toadlet has a restricted distribution. It is confined to the Sydney Basin, from Pokolbin in the north, the Nowra area to the south, and west to Mt Victoria in the Blue Mountains.

The Giant Burrowing Frog is distributed in south eastern NSW and Victoria, and appears to exist as two distinct populations: a northern population largely confined to the sandstone geology of the Sydney Basin and extending as far south as Ulladulla, and a southern population occurring from north of Narooma through to Walhalla, Victoria.

The study area is not at the limit of the known distribution for either of these two species.

How is the proposal likely to affect current disturbance regimes?

The proposal will lead to the re-opening of a previously disturbed area in the form of an abandoned fire road. Development of the borehole site will also lead to a small area of disturbance in a previously undisturbed site.

How is the Proposal likely to affect habitat connectivity?

The proposal will result in a disturbance footprint that will include a 5 m wide clearing running for approximately 1 km to the borehole site, which itself will result in a clearing of approximately 40 x 40 m.

Habitat connectivity in this area will be temporarily interrupted (i.e. for the life of the project) in a relatively minor way. That is to say that a 5 m wide clearing has the potential to limit the movements of some fauna species although a clearing of this nature is not likely to inhibit the movement of larger fauna.

In relation to the Red-crowned Taodlet and the Giant Burrowing Frog it is unknown if a 5 m wide road corridor would inhibit movement of these species, however the following points should be noted:

1. there are sections of the regenerating fire road which are already devoid of vegetation and therefore, if small areas of absent vegetation in an otherwise contiguous area of habitat act to inhibit movement of these frogs then such clearings already exist within the study area.
2. the proposed development footprint will exist within a largely undisturbed landscape to the north, east and south (i.e. within a largely contiguous expanse of vegetation associated with the Woronora Catchment). This vegetation provides habitat that is extensive in the locality and, to a greater extent, the region and which will not be affected more broadly by the proposal.

It is unlikely that the proposal would affect habitat connectivity for either of these species.

How is the Proposal likely to affect critical habitat?

No critical habitat has been declared for either species.

Appendix G: Assessments of Significance under the EPBC Act

Endangered Species - Eastern Ground Parrot and Eastern Bristlebird

An action is likely to have a significant impact on a critically endangered or endangered species if there is a real chance or possibility that it will:

- ***lead to a long-term decrease in the size of a population***

Neither the Eastern Ground Parrot nor the Eastern Bristlebird were recorded from the study area. For reasons cited in the assessments for these species above it is considered unlikely that the proposal will lead to a direct impact on individuals of either species.

The potential habitat for both of these species that occurs within the study area is considered to be sub optimal.

The proposal is considered unlikely to lead to a long term decrease in the size of a population of either the Eastern Ground Parrot or the Eastern Bristlebird.

- ***reduce the area of occupancy of the species***

Neither the Eastern Ground Parrot nor the Eastern Bristlebird are known to occupy the study area. The proposal will lead to the short-term removal of a very small area (0.66 ha) of habitat for both of these species. This represents a very small proportion of similar potential habitat in the region and which is contiguous within the surrounding Catchment areas, national parks, state conservation areas and vegetated rural holdings.

The proposal is unlikely to lead to a reduction in the area of occupancy for either the Eastern Ground Parrot nor the Eastern Bristlebird.

- ***fragment an existing population into two or more populations***

Known populations of Eastern Ground Parrot nor the Eastern Bristlebird are not known from the study area. Given the minor nature of the impact associated with the proposal it is considered highly unlikely that the proposal would lead to a fragmentation in populations of these species should they occur in the vicinity of the study area.

- ***adversely affect habitat critical to the survival of a species***

The proposed development footprint does not contain habitat critical to the survival of either the Eastern Ground Parrot or the Eastern Bristlebird.

- ***disrupt the breeding cycle of a population***

The proposed development is not likely to impact breeding habitat for either the Eastern Ground Parrot or the Eastern Bristlebird.

- ***modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline***

The proposal will result in the re-opening of a previously operational fire road which provides sub-optimal habitat for both species. The proposal is considered unlikely to lead to

a decline in the species through the modification of habitat for either the Eastern Ground Parrot or the Eastern Bristlebird.

- ***result in invasive species that are harmful to a critically endangered or endangered species becoming established in the endangered or critically endangered species' habitat***

All equipment will be subject to wash down procedures which will remove weed propagules and therefore remove the likelihood of the entry of weeds into the area.

The study area is already accessible to deer and the proposal will be unlikely to increase access for this species.

It is possible that re-opening the fire road may lead to increased opportunities for foxes and cats to access the study area, although it is highly likely that these species already exist within the catchment lands.

The proposal is unlikely to lead to a significant increase in invasive species gaining access to these endangered species.

- ***introduce disease that may cause the species to decline, or***

All equipment will be subject to wash down procedures which will remove soil which may contain disease pathogens and therefore remove the likelihood of the entry of disease into the area.

- ***interfere with the recovery of the species.***

The proposal is not likely to impact individuals or important habitat for either the Eastern Ground Parrot or the Eastern Bristlebird. The proposal is not likely to interfere with the recovery of these two species.

Vulnerable Species - Giant Burrowing Frog

An action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will:

- ***lead to a long-term decrease in the size of an important population of a species***

An 'important population' is a population that is necessary for a species' long-term survival and recovery. This may include populations identified as such in recovery plans, and/or that are:

- key source populations either for breeding or dispersal,
- populations that are necessary for maintaining genetic diversity, and/or
- populations that are near the limit of the species range.

The Giant Burrowing Frog was not recorded from the study area during the recent surveys although it has potential to utilise the study area on occasion.

The actual development footprint is considered highly unlikely to contain an important population of this species as the area lacks important breeding habitat and important sheltering habitat in the form of rock fissures or boulders. The proposal is considered

unlikely to lead to the long term decrease in the size of an important population of the Giant Burrowing Frog.

- ***reduce the area of occupancy of an important population***

The study area is not likely to contain an important population for this species.

- ***fragment an existing important population into two or more populations***

The construction of the narrow access road and borehole site would be highly unlikely to lead to the fragmentation of two or more populations of this species as the disturbance footprint is very small in the context of the extensive areas of high quality habitat for this species in the locality.

- ***adversely affect habitat critical to the survival of a species***

The area that will be disturbed by the current proposal has, for the most part, been previously disturbed. This area is not considered to be habitat that is critical to the survival of the species.

- ***disrupt the breeding cycle of an important population***

The proposal is not likely to impact breeding habitat for this species or prevent the movement of breeding adults.

- ***modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline***

The disturbance of 0.66 ha of sub-optimal foraging habitat for this species, in the context of the extensive area of high quality habitat for this species in the locality, is not likely to lead to a reduction in habitat quantity and quality such that the species is likely to decline.

- ***result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat***

All equipment will be subject to wash down procedures which will remove weed propagules and therefore remove the likelihood of the entry of weeds into the area.

The proposal is unlikely to lead to a significant increase in invasive species (particularly weeds) becoming established in the habitat of this species.

- ***introduce disease that may cause the species to decline, or***

All equipment will be subject to wash down procedures which will remove soil which may contain disease pathogens and therefore remove the likelihood of the entry of disease into the area.

- ***interfere substantially with the recovery of the species***

The proposal is considered highly unlikely to interference with the recovery of the species for the following reasons.

- ☐ The proposal is not likely to impact individuals of this species.
- ☐ Important breeding habitat for the species does not occur within the study area.

Vulnerable Species - *Pultenaea aristata*

An action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will:

- ***lead to a long-term decrease in the size of an important population of a species***

An 'important population' is a population that is necessary for a species' long-term survival and recovery. This may include populations identified as such in recovery plans, and/or that are:

- key source populations either for breeding or dispersal,
- populations that are necessary for maintaining genetic diversity, and/or
- populations that are near the limit of the species range.

The individuals of *Pultenaea aristata* that will be impacted by the proposal are likely to be part of a much broader population that exists within the locality. For reasons stated previously, the population of this species is considered to be extensive.

It is possible that individuals of this species that occur within the development footprint are part of an important population for *Pultenaea aristata*, but given the very high numbers of this species occurring in close proximity to the development footprint and the manner in which this species has re-colonised the abandoned fire road it is considered unlikely that the proposal will lead to a long term decrease in the size of an important population.

- ***reduce the area of occupancy of an important population***

The individuals of *Pultenaea aristata* that will be impacted by the proposal are likely to be part of a much larger population that exists within the locality. For reasons stated previously, the population of this species is considered to be extensive.

The area of occupancy for this species that has the potential to be impacted by the proposal is limited to 0.66 ha of known and potential habitat, although not all of that area was found to have the species present.

Habitat for this species is extensive in the area and the known population for this species in close proximity to the study area extends to the north, south and east of the disturbance footprint. Therefore the proposal is not likely to reduce the area of occupancy for an important population.

- ***fragment an existing important population into two or more populations***

The proposal will result in a disturbance footprint that will include a 5 m wide clearing running for approximately 1 km to the borehole site, which itself will result in a clearing of approximately 40 x 40 m. This clearing may result in the creation of a minor barrier for pollinators (although the pollen vectors for this species are not known). However, it is unlikely that the creation of a narrow clearing would result in a situation that would effectively fragment an existing population such that the exchange of genetic material through pollination or seed dispersal was interrupted.

- ***adversely affect habitat critical to the survival of a species***

The area that will be disturbed by the current proposal has, for the most part, been previously disturbed. This area is not considered to be habitat that is critical to the survival of the species.

- ***disrupt the breeding cycle of an important population***

The population of *Pultenaea aristata* in the vicinity of the proposed borehole site and access track is considered to be extensive. It is considered unlikely that the proposal would result in the disruption of the breeding cycle of the entire population.

- ***modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline***

Given the abundance of local and, more broadly, regional records for *Pultenaea aristata* and the distribution of high quality habitat in the locality, the proposal is unlikely to result in a situation where the availability of habitat for this species is affected such that the species would be likely to decline.

- ***result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat***

All equipment will be subject to wash down procedures which will remove weed propagules and therefore remove the likelihood of the entry of weeds into the area.

The proposal is unlikely to lead to a significant increase in invasive species (particularly weeds) becoming established in the habitat of this species.

- ***introduce disease that may cause the species to decline, or***

All equipment will be subject to wash down procedures which will remove soil which may contain disease pathogens and therefore remove the likelihood of the entry of disease into the area.

- ***interfere substantially with the recovery of the species***

The proposal is considered highly unlikely to lead to a substantial interference with the recovery of the species for the following reasons:

- ☐ The local population of this species is extensive,
- ☐ The majority of the local population of this species occurs within land that is effectively reserved for conservation or water management.

APPENDIX III

SLR Heggies. October 2010.

Letter to Olsen Environmental Consulting Pty Limited

“Drill Site Location AI19. Core Seam Gas Drilling, Illawarra NSW. Noise and Vibration Assessment.”

8 October 2010

10-7464 Noise Assessment Drill Site AI19 20101008

Olsen Environmental Consulting Pty Ltd
Unit 6
25 Victoria Street
WOLONGONG NSW 2500

Attention: Mr David Olsen

Dear David

**Drill Site Location AI19
Core Seam Gas Drilling, Illawarra NSW
Noise and Vibration Assessment**

1 INTRODUCTION

The Department of Environment, Climate Change and Water (DECCW) expressed concern about the potential noise impacts at the newly proposed borehole location AI19. The proposed new drill site is located approximately 800 m from the nearest residence located on Darkes Forest Road.

This report provides an acoustic assessment of the likely impacts associated with core drilling at the new drill site.

2 EXISTING NOISE ENVIRONMENT AND CORRESPONDING NOISE GOALS

A noise monitoring programme was undertaken between 4 December and 15 December 2008 and is presented in the Environmental Assessment in Section 4.6.1. Location One discussed in the Environmental Assessment is representative of the ambient noise environment at the nearest receivers to drill site AI19.

The relevant construction and operational noise goals are presented in the Environmental Assessment in Section 4.6.2.

3 NOISE ASSESSMENT – DRILL SITE AI19

Construction Noise

Section 4.6.2.1 in the Environmental Assessment describes the construction associated with each drill site.

Indicative “worst case” construction noise levels at the nearest sensitive receivers to drill site A119 are shown in **Table 1**. The noise level predictions have been calculated assuming adverse weather conditions (ie a wind speed of 3 m/s in a direction from the source to the receiver).

Table 1 Predicted Construction Related Noise Levels

Drill Site	Representative Background Noise Monitoring Location	Typical Nearest Receiver	Approximate Distance from Drill Site	LA10 Daytime Construction Noise Objectives	Predicted LA10 Construction Noise Levels	Assessment
A119	One	329 Darkes Forest Road	800 m	55 dBA	39 dBA	Complies

Review of the data presented in **Table 1** indicates that the project construction noise emission levels are predicted to comply with the construction noise goals at the nearest receivers to drill site A119.

Operational Noise

Indicative operational noise levels for both calm and noise enhancing weather conditions (ie a wind speed of 3 m/s in a direction from the source to the receiver) at the nearest receivers to drill site A119 are presented in **Table 2** to **Table 4**.

Table 2 Indicative Daytime¹ Drilling Operational Noise Levels

Drill Site, Corresponding Background Noise Monitoring Location	Typical Nearest Receiver	Distance to Receiver	LAeq Daytime Operational Noise Objectives	Predicted Calm LAeq Operational Noise Levels	Predicted Worst LAeq Operational Noise Levels	Assessment
A119 One	329 Darkes Forest Road	800 m	40 dBA	24 dBA	30 dBA	Complies

Notes: 1. Daytime: 0700 hours to 1800 hours (Monday to Saturday), or 0800 hours to 1800 hours (Sunday and public holidays).

Table 3 Indicative Evening¹ Drilling Operational Noise Levels

Drill Site, Corresponding Background Noise Monitoring Location	Typical Nearest Receiver	Distance to Receiver	LAeq Evening Operational Noise Objectives	Predicted Calm LAeq Operational Noise Levels	Predicted Worst LAeq Operational Noise Levels	Assessment
A119 One	329 Darkes Forest Road	800 m	40 dBA	24 dBA	30 dBA	Complies

Notes: 1. Evening: 1800 hours to 2200 hours.

Table 4 Indicative Night-time¹ Drilling Operational Noise Levels

Drill Site, Corresponding Background Noise Monitoring Location	Typical Nearest Receiver	Distance to Receiver	LAeq Evening Operational Noise Objectives (dBA)	Predicted Calm LAeq Operational Noise Levels (dBA)	Predicted Worst LAeq Operational Noise Levels (dBA)	Assessment
AI19 One	329 Darkes Forest Road	800 m	36 dBA	24 dBA	30 dBA	Complies

Notes: 1. Night-time: 2200 hours to 0700 hours (Monday to Saturday), 2200 hours to 0800 hours (Sunday and public holidays).

It is anticipated that while drilling is in operation, compliance is likely at the nearest receivers to drill site AI19 during all periods. It is also worth noting that the predicted noise levels are for a worst case “surface” scenario and once the drill penetrates deeper, the predicted noise levels will decrease.

4 POTENTIAL OPERATIONAL NOISE MITIGATION MEASURES

Although compliance is predicted during drilling operations at this site, Apex will still implement the following mitigation measures:

- Apex will implement appropriate Best Management Practice (BMP) and Best Available Technology Economically Achievable (BATEA) practices. These practices are fully described in the Environmental Assessment in Section 4.6.3.
- Appropriate monitoring will be undertaken during drilling operations to confirm that the criteria are being achieved. Should this monitoring demonstrate non-compliance, Apex would undertake investigations and planned actions to ameliorate the non-compliance.
- Should these approaches not resolve the acoustic issues satisfactorily, drilling would be limited to periods where criteria are met after implementation and amelioration measures.

I trust this report meets your current requirements. However, should you have any questions or require any additional information please feel free to call me on 9427 8100.

Regards,



MIKEL LACIS

Reviewed by: MB

APPENDIX IV

Niche Environment and Heritage. November 2010.

Letter to Olsen Environmental Consulting Pty Limited.

“Apex Energy Gas Exploration Project: Submission from NSW DECCW”.

28 November 2010

Attention: Mr David Olsen
Director
Olsen Environmental Consulting
PO Box 101
Figtree NSW 2525

Dear David

RE: Apex Energy Gas Exploration Project: Submission from the NSW DECCW

Thank you for the opportunity to provide a response to the submission from the NSW Department of Environment, Climate Change and Water (DECCW) regarding the ecological assessment undertaken for the Apex Energy Gas Exploration Project (development of Gas Well A119 only).

I have reviewed the elements of the submission pertaining to the ecological assessment and the cultural heritage assessment and provide a response in the following pages of this letter. I have cited the numbers used in the DECCW submission dated 22/11/2010 in my response for ease of comparison.

I trust that the response provided satisfies the concerns of the DECCW. I would be pleased to meet with the assessing officer should any outstanding concerns remain.

Yours sincerely



Matt Richardson

Director

Context:

It should be stated at the outset that the context of the assessment undertaken for the proposed Borehole A19 is important to understanding the level of ecological assessment required.

The proposed borehole and its access track (the development footprint) are to be located on an existing, albeit rehabilitated fire trail. The borehole site will be primarily contained within a previously disturbed area and the access track (and any overtaking lanes/areas) will be developed wholly within the footprint of the old fire trail and other tracks and trails adjacent to the fire trail.

In this context the environment of the subject site is considerably different from that of the surrounding area. In general the following can be stated:

1. the vegetation structure of the development footprint is significantly modified and retains, for the most part, a dense shrub groundcover and understorey with no overstorey or mature tree canopy.
2. where the development footprint is not covered in a dense shrub layer it is typically devoid of any vegetation (i.e. presents as cleared ground with an exposed soil groundcover).
3. there are no natural creeks or drainage lines within the development footprint.
4. the soils of the development footprint have been compacted significantly as a result of the tracks being used as a fire trail.
5. the area surrounding the development footprint is largely undisturbed native vegetation in good condition which is extensive and contiguous with the Dharawal State Conservation Area, the Holsworthy Military Area and the Woronora Catchment Area.

Issue 4: Targeted surveys - Threatened Fauna and Flora

It is our approach to threatened fauna assessments to consider even marginal habitat for threatened fauna as potential habitat for the purposes of the ecological assessments. The DECCW rightly points out that our report has identified potential habitat for 50 threatened fauna within the development footprint. On the basis of the contextual information provided above, this habitat is restricted to foraging habitat in the form of native shrubs only.

Our assessment approach also provides opportunity to discount threatened species from the impact assessment section of the report based on the likelihood that the habitat within the development footprint would be important for the ongoing survival of the species in the local context. Table 1 of our report describes this approach and Appendix D applies the approach to the subject threatened species.

In the absence of any data positively identifying the presence of any threatened species within the development footprint, the likelihood criteria is used to infer the need to undertake detailed impact assessments on the basis that a threatened species is presumed to utilise habitats in the Study Area if (a) its habitat is present and (b) the likelihood of the species occurring is moderate or high.

Section 5.1 of the Report confirms that targeted surveys for threatened fauna were not undertaken and that the survey effort was commensurate with the habitat present within the Development Footprint and that one days survey of the site was undertaken.

The level of assessment should not in any way be taken to mean that we have not considered threatened fauna likely to occur or forage within the development footprint. However, given the contextual information provided above it is entirely reasonable to conclude that the proposal will not impact important habitat (roosting, breeding or limiting) and as such the proposal will not result in impacts to threatened fauna that is likely to adversely affect them. Further, on the basis of the vast area of better quality habitat immediately adjacent to the Development Footprint for each of the threatened species considered in the assessment, the disturbance of a very small area of already modified habitat is not considered likely to have a significant impact on threatened fauna.

In relation to the three threatened plant species (apart from *Pultenaea aristata*) identified in the last paragraph on Page 2 of the submission, it should be noted that none of these plants are cryptic in nature and are readily detected even when not flowering. This is significant as the submission notes that the assessment was undertaken at an inappropriate time of year to detect them. The timing of survey identified for threatened species is typically timed to coincide with flowering times. On that account the following should be noted:

- ☐ *Pultenaea aristata* was not flowering at the time of the site surveys and yet it was detected easily.
- ☐ Over the past decade or so I have conducted a significant number of surveys for *Persoonia hirsuta* and *Acacia bynoeana* in the region, detecting individuals

and populations of the species at all times of the year (refer to records from (Biosis Research between 1998 and 2009)).

- ❑ *Melaleuca deanei* is not cryptic in nature and likely to be detected if present. Further, there are no local records of this species despite the previous detection of other threatened plant species (including *Pultenaea aristata*) along the same track within the Development Footprint by another botanist - see figures in the report. It would seem improbable that on at least three separate occasions (two in this assessment and at least one previous assessment - the source of the additional records along the track) that the species would remain undetected.
- ❑ It should also be noted that the current survey detected a large number of *Pultenaea aristata* on the access track to the borehole site that were not recorded in previous surveys. Although I acknowledge that threatened species can germinate at sites at different times, the current assessment demonstrates the veracity of the survey effort, which has detected additional records of threatened species in the local area.

Issue 5: O'Hares Creek Shale Forest

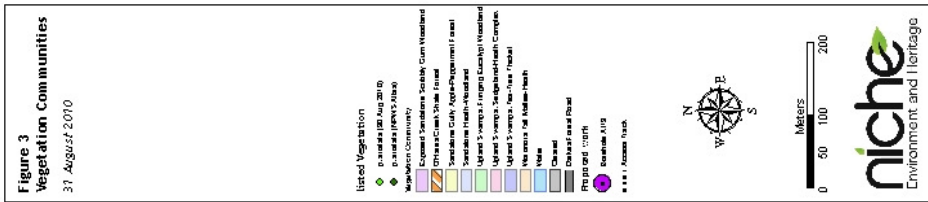
O'Hares Creek Shale Forest does occur in the vicinity of the development footprint as noted in the figures in the report. It will not be impacted either directly or indirectly by the proposal.

A revised version of Figure 3 from the report has been re-produced (see over) showing the location of this EEC in the context of the current proposal.

Issue 6: Targeted Surveys - in accordance with the Draft Guidelines

For reasons stated above detailed targeted threatened species surveys are not warranted for this project. The context of the proposal needs to be considered when making an assessment regarding the survey effort. A modified environment which provides limited habitat resources to threatened species (i.e. the existing disturbed, albeit regenerating fire trail) in the context of the high quality habitat in the immediate surrounds of the site is not an important habitat resource for threatened species (with the exception of *Pultenaea aristata* which is adequately assessed in the existing report).

I would be happy to provide further justification for the level of survey effort to date should the DECCW require further clarification. .



Issue 7: Likely Impacts

Likely impacts have been assessed in our report. Specifically, Section 1.4 of the report identifies the level of disturbance that will result from the proposal (calculated to be 0.66 ha of almost exclusively disturbed vegetation).

It is unclear what in-direct impacts the DECCW are concerned about, but I would be happy to consider them in a revised assessment providing that the context of the development footprint has been considered in the comments provided. That is to say, edge effects (and similar) or any concerns regarding runoff (which have been addressed and nullified by the assessment of Dr Short) are not likely to be important at this site given the previous disturbance history.

Issue 8 & 9: Discrepancies in the Report compared to the EA

DECCW rightly note that there are inconsistencies in the reports regarding the development footprint. It is acknowledged that these discrepancies are not helpful to the assessing departments view on the total footprint of the project.

To that end, based on discussions with the client, the following dimensions are those that should be assessed:

1. the borehole site's development footprint would not exceeding 40 x 40 m and that this area exceeds the total area required for the drill site.
2. that all passing bays/overtaking lanes along the access track will be confined to other existing tracks and or previously cleared areas.

It should be noted that the assessment has adequately assessed this footprint and further, that elements of the proposal including the passing bays are not set in concrete and can be moved if required. It should also be noted that the proposal states that a pre-disturbance site inspection will be undertaken at all sites (including the current site) to formally locate all works in order to minimise all possible environmental impacts, including to threatened species. This commitment is restated in the statement of commitments and is required in the existing approval (refer to Schedule 2, Condition 6).

The typical layout plans of the site show an area approximately 50 x 70 m. Within this area not all vegetation would be cleared. Only the minimum area necessary to undertake the drilling activity safely will be cleared. This clearing will never exceed an area of 40 x 40 m and hence this is the appropriate area for assessment. Within SCA land a basic fence consisting of steel droppers connected with flagging tape will

delineate the 50 x 70 m area. The pre-construction site inspection and the Site Layout Plan developed during the inspection will accurately define the disturbed area for each borehole site. Emphasis will be placed on minimising the level of disturbance required for each site.

Issue 10 & 11: Avoid, Mitigate Offset

DECCW 's approach to the protection of important environmental values is entirely appropriate for the current project and has already been taken into consideration. That is the following measures have been employed to avoid and mitigate impacts to the environment:

1. site location and design: the site of Borehole AI19 has been developed so that the great majority of the works will be contained within an existing disturbed footprint (albeit regenerating) along the closed fire trail. By using this site the proposal has avoided significant values such as mature vegetation (hollows etc), upland swamps and has contained the development footprint to an area which has previously been disturbed and which still retains elements of the disturbance such as compacted soils. The current location of the borehole and access tracks is considered to have the least impact on ecological values and no other location options are available that would further reduce impacts.
2. site selection works were undertaken in consultation with the Sydney Catchment Authority who were present at the site inspection and who provided on site advice as to how best reduce the development footprint.
3. in relation to the final site of all aspects of the proposal, a final site inspection with site set up personnel and the environmental experts will be undertaken to minimise further the impacts of the development.
4. the site will be fully rehabilitated following completion of the works and abandonment of the site, to the satisfaction of the Sydney Catchment Authority.
5. in relation to compensatory measures, despite the fact that the proposal will impact the threatened plant species *Pultenaea aristata* (albeit the impact assessment has been determined not to be significant in our assessment, a result which has not been disputed here) the disturbance of 0.66 ha of previously disturbed vegetation in a vast area of previously undisturbed and high quality vegetation/fauna habitat, compensatory actions are not considered to be warranted.

Issue 12: *Pultenaea aristata* - Typo in Appendix C

The DECCW rightly identifies that Appendix C should state *Pulteneae aristata* is present within the development footprint. This is an oversight. The body of the report (multiple references) and Appendices F and G correctly acknowledge the presence of the species within the development footprint.

Issue 13: Details required regarding site rehabilitation

The following commitments have been derived from the environmental assessment and existing project approval.

Disturbed areas will be scarified to address soil compaction. Available topsoil will be returned to the surface. The areas undergoing revegetation will be covered with brush obtained from the surrounding vegetation and seeded with native flora species consistent with those currently surrounding the site.

Section 4.8 Soil Management states that “The details of site revegetation will be determined in liaison with SCA at the time”.

Condition 7 of Schedule 3 of the Project Approval dated 23rd September 2009 requires Apex to have a suitably qualified expert prepare a Vegetation Clearing and Rehabilitation Management Plan. There is also a requirement to implement this Plan which must be approved by the Director-General prior to the commencement of construction at the first borehole site. The Plan must include a wide range of material including:

A description of procedures for revegetation and rehabilitating the areas of disturbance and provide completion criteria, including a monitoring timetable, and measures that would be implemented to ensure the criteria are achieved.

Condition 6 of Schedule 2 of the Project Approval dated 23rd September 2009 requires Apex to submit a Site Layout Plan for each site, prior to the commencement of construction at each site. This Plan must include initial rehabilitation works following construction. The Site Layout Plan will be developed during a site inspection by the property owner (in the case of Borehole AI19 this is the SCA) and relevant environmental experts, drilling company representatives and Apex representatives.

This process will ensure determination of the best approach to site rehabilitation and revegetation for each site based on site specific requirements determined at the time of activity.

Issue 14 and 15 - Cultural Heritage Assessment

A copy of the report will be supplied to the Illawarra Local Aboriginal Land Council for comment. Any and all comments received will be supplied to the NSW DoP.

APPENDIX V

SLR Heggies. December 2010.

Letter to Olsen Environmental Consulting Pty Limited.

“Comments on DECCW’s Adequacy of Environmental Assessment Proposed Modification to Apex Energy Gas Exploration Project”.

2 December 2010

10-7464 Apex DECCW 20101202

Olsen Environmental Consulting
Unit 6, 25 Victoria Street
WOLLONGONG NSW 2500

Attention: Mr David Olsen

Dear David

**Comments on DECCW's Adequacy of Environmental Assessment
Proposed Modification to Apex Energy Gas Exploration Project**

As discussed, I have read the DECCW's Adequacy of Environmental Assessment (AEA) in relation to the Proposed Modification to Apex Energy Gas Exploration Project (AEP) and summarise my comments in relation to noise as follows:

DECCW Comment

Noise

2. *Section 4.6.2.1 of the EA includes information on construction noise and uses the Industrial Noise Policy and SoundPlan modelling to predict the project construction noise goals. The EA states that the duration of the construction activity at any drill site would be less than four weeks and that construction noise levels should not exceed the background level by more than 20dB(A).*

The EA does not appear to have taken into consideration DECCW's Interim Construction Noise Guidelines (July 2009) which states that for major construction projects (greater than three weeks in duration) the noise management level should be Rated Background Level plus 10dB(A) during recommended standard hours. This significantly reduces the construction noise goals defined in the EA. DECCW requests that the noise impact assessment provided in the EA for construction activities be reviewed in accordance with the above guideline. A copy of the guideline can be obtained from DECCW's website at: <http://www.environment.nsw.gov.au/noise/constructnoise.htm>.

Response

As the subject EA (of October 2010) was for the Proposed Additional Borehole Site AI19 only, and therefore was an addendum of the original EA for the overall project (dated March 2009), it was considered appropriate to adopt the same noise impact assessment procedures as followed in the original EA and thereby maintain consistency.

Notwithstanding, if the procedures outlined in the DECCW's "Interim Construction Noise Guideline" (ICNG, July 2009) were adopted for the EA modification, then the LAeq(15minute) daytime construction noise objective becomes 45 dBA for the DECCW's "Recommended standard hours", which are Monday to Friday 7.00 am to 6.00 pm, Saturday 8.00 am to 1.00 pm.

Reference to Table 4.5 of the subject modification EA indicates that the predicted LA10 daytime construction noise level of the construction activities at AI19 is 39 dBA.

On the basis of a minus 3 dBA adjustment to convert the LA10 to an LAeq noise level, the predicted noise level is 9 dB lower than the construction noise level objective, based on the DECCW's ICNG.

It is noteworthy that the period of the subject construction works for AI19 is less than 4 weeks. This is a conservative estimate for impact assessment purposes and the actual construction period is likely to be less than this. Reference to the ICNG indicates that where the construction period is less than 3 weeks, only a qualitative (rather than a quantitative) construction noise impact assessment need be conducted.

DECCW Comment

3. *The noise impact assessment also does not address the issue of sleep disturbance. Given that the proposed drilling activities are to be carried out 24 hours a day, seven days a week Apex Energy must ensure that all appropriate noise mitigation measures are implemented to ensure compliance with the Department's sleep disturbance criteria.*

Response

The DECCW's most recent policy considers sleep disturbance as the emergence of the LA1(1minute) level above the LA90(15minute) level at the time. Appropriate screening criteria for sleep disturbance are determined to be an LA1(1minute) level 15 dBA above the Rating Background Level (RBL) for the night-time period (10.00 pm to 7.00 am).

When the criterion is not met, a more detailed analysis may be required which should cover the maximum noise level or LA1(1minute), the extent that the maximum noise level exceeds the background level and the number of times this occurs during the night-time period. Some guidance on possible impacts is contained in the review of research results in the appendices to the NSW Environmental Criteria for Road Traffic Noise (ECRTN).

Other factors that may be important in assessing the extent of impacts on sleep include:

- How often high noise events will occur.
- Time of day (normally between 10.00 pm and 7.00 pm).
- Whether there are times of the day when there is a clear change in the noise environment (such as during early morning shoulder periods).

It is noteworthy that there are no specific criteria for sleep disturbance nominated in the INP, in the INP Application Notes, the ECRTN, or in the ICNG. This is consistent with the statement in the ECRTN that "at the current level of understanding, it is not possible to establish absolute noise level criteria that would correlate to an acceptable level of sleep disturbance".

A substantial portion of the ECRTN is a review of international sleep disturbance research, indicating that:

- *A maximum internal noise levels below 50-55dB(A) are unlikely to cause awakening reactions, and*
- *One or two noise events per night with maximum internal noise levels 65-70dB(A) are not likely to significantly affect health and wellbeing.*

Based on the DECCW's "screening" criterion of RBL + 15 dBA for sleep disturbance, the criterion at the potentially most affected residence on Darkes Forest Road to borehole location AI19 is 46 dBA.

The worst case predicted night-time LAeq(15minute) noise level from the subject operation is 30 dBA.

Given that, based on the drill noise monitoring results conducted by Heggies in November 2008, the subject operational LA1(1minute) noise levels are likely to be less than 10 dBA above the LAeq levels, compliance with the 46 dBA LA1(1minute) criterion will be met.

I trust the above information satisfies your immediate requirements, however, should you have any queries or require further information please call me.

Yours sincerely

A handwritten signature in black ink, appearing to read 'Dick Godson'.

DICK GODSON
Technical Director