Leewood – Produced Water & Brine Management Ponds

Review of Environmental Factors

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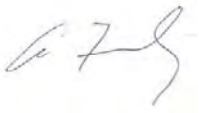
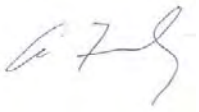
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Executive Summary

Overview

Santos Limited (Santos), for and on behalf of the titleholders of Petroleum Assessment Lease 2 (PAL 2), is proposing to construct and operate produced water and brine management ponds at a property known as "Leewood" together with associated infrastructure within PAL 2 (the proposed activity).

The proposed activity is permissible without development consent and requires assessment and determination under Part 5 of the *Environmental Planning and Assessment Act 1979* (EP&A Act). The Division of Resources and Energy (DRE) within the Department of Trade & Investment, Regional Infrastructure and Services (DTIRIS) and other statutory bodies are determining authorities for the proposed activity.

RPS Australia East Pty Ltd (RPS) has prepared this Review of Environmental Factors (REF) to assess the potential environmental impacts of the proposed activity. The REF addresses the requirements of section 111 of the EP&A Act, clause 228 of the *Environmental Planning and Assessment Regulation 2000* and the *ESG2: Environmental Impact Assessment Guidelines* (DTIRIS 2012).

Proposed activity scope

The proposed activity involves the construction of one 300 megalitre (ML) brine pond and one 300 ML brine or produced water pond (collectively referred to as the Leewood ponds) on a Santos owned property known as “Leewood”, located on the Newell Highway approximately 24 kilometres south west of Narrabri, NSW. It also involves the construction of two water flow lines from Leewood to the existing Bibblewindi Water Management Facility, located approximately 15 kilometres to the south of Leewood in the Pilliga State Forest. Additional surface infrastructure, including a water distribution manifold, water pump skids, local power supply and water holding tanks, also form part of the proposed activity.

Operation of the proposed activity will involve the transfer and storage of produced water and brine from Bibblewindi Water Management Facility to Leewood, as well as the transfer and storage of produced water from pilot wells once they are returned to operation.

Treatment of the produced water does not form part of the proposed activity. Santos is proposing to construct additional water treatment infrastructure, including a reverse osmosis plant, brine concentrator and brine crystalliser, to replace the existing Bibblewindi Water Management Facility in the future. The construction and operation of this additional water treatment infrastructure will be subject to further approvals and environmental impact assessment and does not form part of the proposed activity under this REF.

The proposed activity will take approximately six months to construct and will operate for the duration of Santos’ coal seam gas (CSG) exploration activities in PAL 2 and Petroleum Exploration Licence 238 (PEL 238). The proposed activity has a design life of 25 years; however operation beyond the period of exploration would be subject to further environmental assessment and the approval of a petroleum production project. Should this not occur, the proposed activity would be decommissioned and the project area rehabilitated in accordance with the conditions of PAL 2.

Justification

The primary purpose of the proposed activity is to enable produced water and brine to be transferred from the existing Bibblewindi Water Management Facility located in the Pilliga State Forest, to the new Leewood

ponds, which are located outside the Pilliga State Forest. It will also enable the existing, approved pilot appraisal program within PAL 2 and PEL 238 to continue. The transfer of produced water and brine to Leewood will allow Santos to locate the produced water and brine storage ponds outside of the Pilliga, thereby reducing the risk of adverse environmental impact on the forest environment from the water storage activities.

The proposed activity may also facilitate, subject to further approvals, additional water treatment infrastructure replacing the existing Bibblewindi Water Management Facility to be located outside of the Pilliga State Forest near the ponds and the rehabilitation of the existing ponds within the Pilliga. The produced water and brine ponds are designed to be used with future water treatment infrastructure.

Potential environmental impacts

Soil quality and land stability

The proposed activity will involve disturbance, including vegetation clearing, topsoil stripping and earthworks, of up to 68.72 hectares of land. This will increase the erosion potential of the site and may result in loss of topsoil or spoil. Soil contamination may occur as a result of spilled chemicals or hazardous substances during the construction works. Impacts to soils may also occur in the unlikely event of dam failure or overflow during operation. With the implementation of the mitigation measures identified in the REF, such as appropriate erosion and sediment control, management of topsoil and chemicals, the potential impacts to soil quality and land stability are expected to be low adverse as defined in the ESG2 Guidelines.

Groundwater

Potential impacts on groundwater sources include contamination due to spills of chemical, fuels or oils if not cleaned up properly during construction and in the unlikely event of dam overflow or failure during operation. There are also potential risks associated with drilling the water bore, including cross contamination of aquifers or contamination of aquifers by drilling mud/fluid and groundwater drawdown. Risks to groundwater associated with the horizontal direction drilling (HDD) of the Newell Highway are anticipated to be negligible given groundwater is unlikely to be intercepted. With the implementation of the mitigation measures identified in the REF, such as implementing a comprehensive groundwater monitoring system and undertaking pond inspections, the potential impacts to groundwater are expected to be negligible to low adverse.

Surface water

Increased erosion of the site during construction and operation may result in increased sediment loads in surface runoff and increased turbidity and suspended sediment in receiving waters. The quality of surface waters may also be degraded as a result of spilled chemicals or hazardous substances, dam overflow or failure, spilled drilling mud, discharge of general site wastewater, litter, or pollutants and contaminants released during flooding of the site during construction or operation. With the implementation of the mitigation measures identified in the REF, including those measures identified to protect soils and groundwater, the potential impacts to surface water are expected to be negligible to low adverse.

Air quality and greenhouse gases

The primary air pollutants from the proposed activity will include dust, exhaust emissions from plant and vehicles during construction and release of hydrocarbons during operation. These emissions will be unlikely to impact the nearest sensitive receptors to the site. The primary greenhouse gas emissions from the proposed activity will include exhaust from plant, machinery and vehicles (carbon dioxide), and hydrocarbon (methane) release. These emissions will not significantly contribute to State or National greenhouse gas

emissions. With the implementation of the mitigation measures identified in the REF, including dust suppression during construction and regular vehicle maintenance, the potential impacts to air quality are expected to be negligible to low adverse.

Noise

The proposed activity will generate noise during site preparation and construction. Noise generated during operation will be minimal. The nearest residence to the proposed ponds is located on the adjoining property to the west of Leewood, approximately 750 metres away. Consultation with the land owner has confirmed that this residence is not permanently occupied. The closest permanent residence is located approximately 1.5 kilometres to the north of the proposed ponds.

Noise consultants Noise Measurement Services (NMS) carried out noise source modelling of excavation equipment (bulldozer) during construction of the Leewood ponds. Modelling demonstrates that the closest residences (including the residence located approximately 750 metres to the west) are unlikely to be noise affected by excavation (by 1 bulldozer) at the Leewood ponds, both during and outside of standard construction hours. Should more than one excavator be utilised, the residential property to the west may be slightly noise affected outside of standard construction hours, however the exceedance would be minor. At no point would any residence be highly noise affected (i.e. noise levels exceed 75dBA) at any time).

Impacts will be managed through appropriate construction and noise management techniques, ongoing consultation prior to and during construction and noise monitoring. Ongoing consultation with affected landowners will ensure impacts are being managed appropriately.

There may be some noise disturbance to recreational users of the State forest during the construction period, however these will be temporary and users will be able to utilise other areas of the State forest not affected by noise during this time. With the implementation of the mitigation measures identified in the REF, potential noise impacts are expected to be low adverse.

Waste

The proposed activity will generate various waste streams during construction, including vegetation waste, drilling mud/fluid, general refuse, sewage waste, excess pond liner material and used chemical or fuel containers. Waste generated during operation would predominantly comprise general refuse and sewage waste from the site office.

Potential impacts associated with the generation and management of waste include leaching of chemicals and other pollutants to water and soils, littering and odour. With the implementation of the mitigation measures identified in the REF, including implementation of appropriate waste management strategies, potential impacts from waste are expected to be low adverse.

Hazardous substance and chemical use

Potential impacts associated with the use and storage of chemicals and hazardous substances during construction and operation include outbreak of fire, and pollution of land, water and air. Such impacts will be minor and localised due to the small volumes of chemicals stored on site and the low potential for spills to occur. With the implementation of the mitigation measures identified in the REF, including appropriate handling and storing of chemicals, the potential impacts from hazardous substance and chemical use are expected to be negligible to low adverse.

Flora and fauna

The proposed activity will require disturbance of up to 49 hectares of land at Leewood and up to 19.38 hectares along the previously disturbed right of way. The area of disturbance along the right of way will be allowed to regenerate naturally after flowline installation has been completed and will therefore only be a temporary impact.

Vegetation that will be disturbed as part of the proposed activity is not listed under either the *Threatened Species Conservation Act 1995* (TSC Act) or *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) and does not comprise high quality habitat. Two threatened ecological communities (TECs) have been identified within the project area, however these will not be impacted by the proposed activity. A number of threatened fauna species were identified within, or in close proximity to, the project area.

No TSC Act or EPBC Act listed threatened species, populations, ecological communities, or their habitats, will be likely to be impacted by the proposed activity. With the implementation of the mitigation measures identified in the REF, including minimising land disturbance, appropriate handling of fauna and rehabilitation, potential impacts on flora and fauna are expected to be low adverse.

Community

The proposed activity could affect the safety of the community should the Leewood ponds overflow of fail, however this is considered unlikely given the design of the ponds and the comprehensive monitoring program proposed to identify any potential issues prior to an incident occurring. Up to five persons could be affected in the unlikely event of dam failure during operation. The proposed activity may also temporarily increase noise and dust levels and generate additional traffic along the Newell Highway and other State forest roads during construction. It will also introduce other potential hazards to the project area, such as moving vehicles, plant and machinery, and chemicals, fuels and oils, which may have safety implications. With the implementation of the mitigation measures identified in the REF, including appropriate construction management practices, access restrictions to work areas and appropriate pond design and management, these impacts are expected to be medium adverse.

Potential benefits of the proposed activity will include economic benefits to Narrabri and the surrounding region through the introduction of a temporary workforce, sourcing of local contractors and the purchase of materials, fuels and consumables.

Natural resources

Forestry operations and agriculture are the two key land uses relevant to the project area. Impacts to forestry operations are expected to be minor. All works will be undertaken in consultation with Forests NSW and in accordance with the Occupation Permit issued under the *Forestry Act 1916.*

Leewood is not currently used for agricultural purposes and it is not proposed that it will be during the construction or operational phases of the proposed activity. The property is not identified as Strategic Agricultural Land (SAL). Cattle grazing is not economically viable at Leewood due to the quality of the existing unimproved pasture and the property size. While the proposed activity will have an impact on potential future agricultural production at Leewood, the impact on production value will be negligible in terms of the gross value of livestock production in the Narrabri LGA.

Potential impacts on natural resources are expected to be low adverse.

Cultural heritage

The proposed activity will not impact on any known Aboriginal or European cultural heritage sites, objects or places. Two European heritage items have been identified on Leewood; however these will be avoided by the proposed activity. There is some potential for unknown Aboriginal or European cultural heritage sites, objects or places to be uncovered during site preparation (including clearing and earthworks). With the implementation of the mitigation measures identified in the REF, including the establishment of exclusion areas and visual barriers around the heritage items, potential impacts on Aboriginal and European cultural heritage are expected to be low adverse.

Conclusion

A range of potential impacts to the environment and community may be associated with the proposed activity. These have been considered in detail in the REF. The proposed activity has been located and designed to avoid significant environmental and heritage constraints and to reduce impacts to the surrounding community. On balance, the proposed activity will have a low adverse impact on the environment and community.

The proposed activity is not likely to significantly affect the environment or any threatened species, populations or ecological communities, their habitats or critical habitat and does not require preparation of an environmental impact statement or species impact statement.

1.0 INTRODUCTION

1.1 Background

Santos Limited (Santos) for and on behalf of the titleholders of Petroleum Assessment Lease 2 (PAL 2) is proposing to construct and operate produced water and brine management ponds at a property known as "Leewood" together with associated infrastructure within PAL 2 (the proposed activity).

RPS Australia East Pty Ltd (RPS) has prepared this Review of Environmental Factors (REF) to assess the potential environmental impacts of the proposed activity. The REF addresses the requirements of section 111 of the EP&A Act, clause 228 of the *Environmental Planning and Assessment Regulation 2000* and the *ESG2: Environmental Impact Assessment Guidelines* (DTIRIS 2012).

The proposed activity involves the construction of one 300 megalitre (ML) brine pond and one 300 ML brine or produced water pond (collectively referred to as the Leewood ponds) on a Santos owned property known as “Leewood”, located on the Newell Highway approximately 24 kilometres south west of Narrabri, NSW. It also involves the construction of two water flow lines from Leewood to the existing Bibblewindi Water Management Facility, located approximately 15 kilometres to the south of Leewood in the Pilliga State Forest. Additional surface infrastructure, including a water distribution manifold, water pumping skids, local power supply and water holding tanks, also form part of the proposed activity.

Operation of the proposed activity will involve the transfer and storage of produced water and brine currently stored at Bibblewindi Water Management Facility to the Leewood ponds, as well as the transfer and storage of produced water from pilot wells in PAL 2 and Petroleum Exploration Licence 238 (PEL 238) once they are returned to operation.

The Bibblewindi Water Management Facility was constructed and operated under existing water management operations of the Petroleum Operations Plan approved in accordance with condition 2 of PAL 2. The activity was assessed by the (now) Division of Resources and Energy (DRE) within the Department of Trade & Investment, Regional Infrastructure and Services (DTIRIS). It was approved in October 2008 and extended in October 2010.

The Bibblewindi Water Management Facility was constructed to service pilot wells in PEL 238 and Petroleum Assessment Lease (PAL 2). In December 2011, operating pilot wells in PEL 238 and PAL 2 were temporarily shut in and the Bibblewindi Water Treatment Facility was shut down pending a review of the existing water management infrastructure. Following extensive operational review of the water treatment infrastructure, in particular the water storage ponds, a program of remediation and rehabilitation was planned and is currently being implemented.

A significant inventory of produced water is contained in ponds at the Bibblewindi Water Management Facility from prior operations. Transferring the existing inventory of produced water and brine from the Bibblewindi Water Management Facility to the proposed Leewood ponds will be the first step in Santos’ locating and centralising their water handling and treatment facilities outside of the State forest.

The transfer of produced water and brine from Bibblewindi to the Leewood ponds will also facilitate the future rehabilitation of the ponds.

Santos is also proposing to construct additional water treatment infrastructure at Leewood, including a reverse osmosis plant, brine concentrator and brine crystalliser, to replace the existing Bibblewindi Water Management Facility in the future and to treat the produced water and brine to be stored in the Leewood

ponds. The water treatment infrastructure will be designed to treat and manage over the longer term the water to be stored in the ponds at Leewood. The construction and operation of this additional water treatment infrastructure will be subject to further approvals and environmental impact assessment and does not form part of the proposed activity for which Santos is seeking approval under this REF. Santos is proposing to construct the produced water and brine ponds and associated infrastructure in advance of the additional water treatment infrastructure to enable the removal from the Pilliga of the produced water currently stored in the ponds at the Bibblewindi Water Management Facility as a matter of priority.

The proposed activity is permissible without consent and requires assessment and determination under Part 5 of the *Environmental Planning and Assessment Act 1979* (EP&A Act). The Division of Resources and Energy within the Department of Trade & Investment, Regional Infrastructure and Services (DTIRIS) (DRE) is one of the determining authorities for the proposed activity because approval is required for a petroleum operations plan and in turn the proposed activity under the conditions of PAL 2. Other determining authorities include Roads and Maritime Services (RMS) and the NSW Office of Water.

This REF has been prepared in accordance with clause 228 of the *Environmental Planning and Assessment Regulation 2000* and provides consideration of the environmental impacts of the proposed activity as required by section 111 of the EP&A Act.

1.2 Structure of REF

This REF has been prepared having consideration to the *ESG2: Environmental Impact Assessment Guidelines; For exploration, mining and petroleum production activities subject to Part 5 of the Environmental Planning and Assessment Act 1979.*

This REF comprises the following:

- **Section 1** Introduces the proposed activity and provides an overview of the REF.
- **Section 2** Provides an overview of the proposed activity, including consultation activities.
- **Section 3** Provides an overview of the site.
- **Section 4** Discusses the existing environment in detail.
- **Section 5** Discusses the relevant legislation associated with the proposed activity.
- **Section 6** Considers the potential environmental impacts of the proposed activity and recommends mitigation measures to ensure these impacts are appropriately managed.
- **Section 7** Provides a summary of the potential impacts.
- **Section 8** Concludes the impact assessment.
- **Section 9** Provides the Statement of Commitments for the proposed activity.

The following technical investigations and inputs have been prepared to assist in the preparation of this REF, and are appended:

- Ecological Assessment, prepared by RPS
- Cultural Heritage Due Diligence Report, prepared by RPS
- Agricultural Impact Assessment, prepared by RPS
- Transport Assessment, prepared by GTA Consultants

- Civil design drawings for flowline and Bibblewindi, prepared by Aurecon
- Pond design drawings, prepared by Golder Associates
- Dam Failure Impact Assessment, prepared by Golder Associates
- Geotechnical Investigation (Leewood), prepared by Golder Associates
- Flood Study (Leewood), prepared by Golder Associates.

2.0 THE PROPOSED ACTIVITY

2.1 Summary of the activity

The proposed activity involves the construction of one 300 megalitre (ML) brine pond and one 300 ML brine or produced water pond on a Santos owned property (Leewood). It also involves the construction of two water flow lines from Leewood to the existing Bibblewindi Water Management Facility. Additional surface infrastructure, including a water distribution manifold, water pump skids, local power supply and water holding tanks, also form part of the proposed activity.

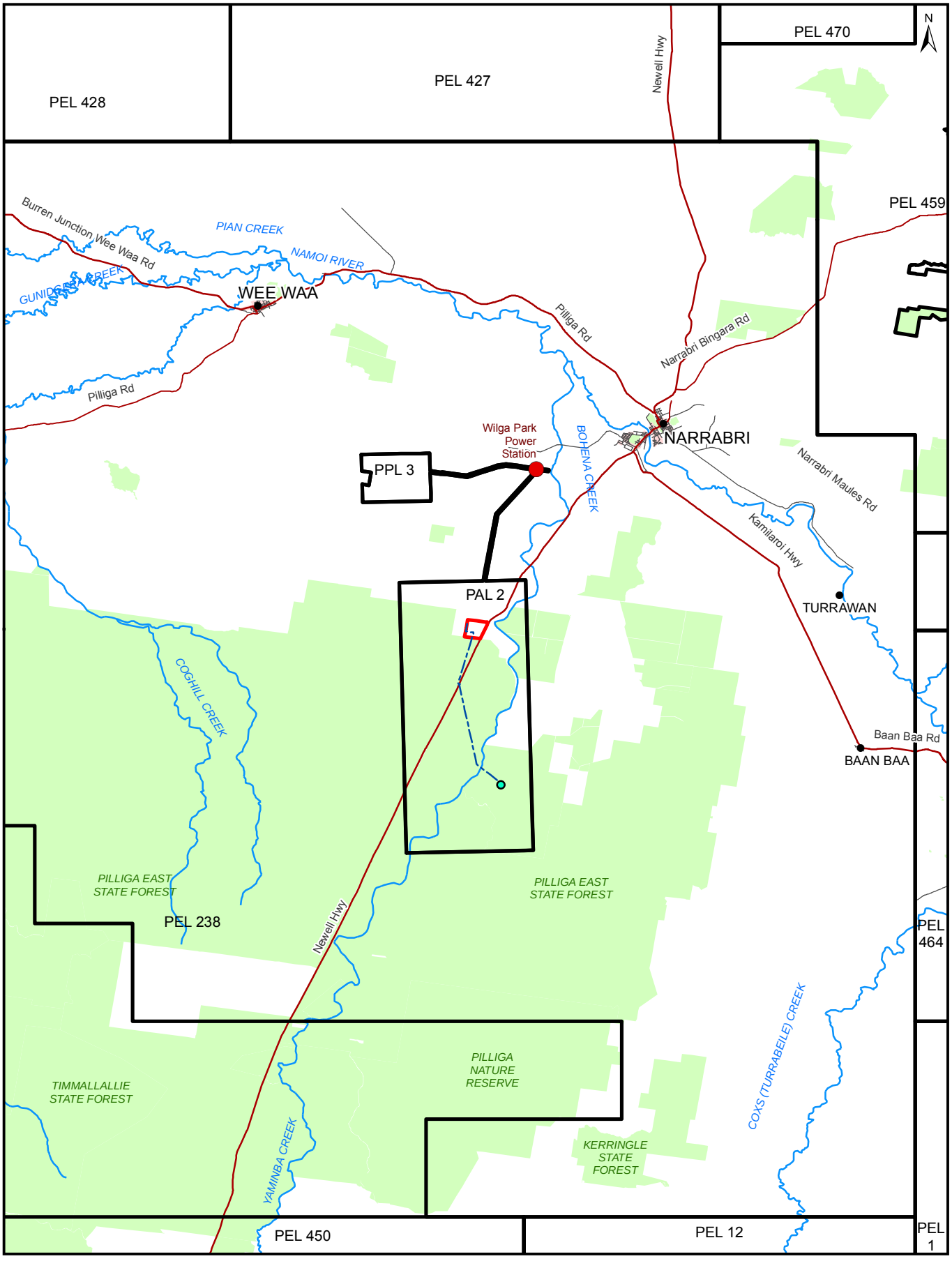
The scope of work is summarised below:

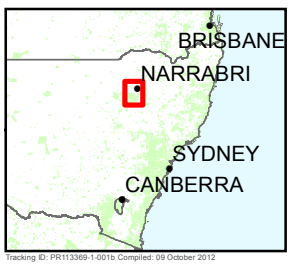
- A produced water flow line and return flow line of approximately 16 kilometres in length, linking the proposed brine pond at Leewood to the existing Bibblewindi Water Management Facility in the Pilliga State Forest. These flow lines are to be located predominantly within the previously cleared right of way associated with the existing gas flow line which links Wilga Park Power Station with the Bibblewindi Water Management Facility.
- Additional piping to connect existing water gathering systems terminating at the Bibblewindi Water Management Facility to new infrastructure.
- One five ML produced water tank with associated water pumping skids and local power supply, to be located within the existing disturbed area at Bibblewindi Water Management Facility.
- One 300 ML brine or produced water pond at Leewood.
- One 300 ML brine pond at Leewood.
- A produced water distribution manifold and associated piping at Leewood, to allow water distribution into produced water and brine storage ponds.
- Associated construction equipment compound, site offices and car parking areas at Leewood.
- Following construction, transfer and storage of produced water and brine currently stored at the Bibblewindi Water Management Facility to the Leewood ponds.

The proposed activity is expected to take approximately six months to construct. Operation of the proposed activity will involve the transfer and storage of produced water and brine from Bibblewindi Water Management Facility to Leewood, as well as the transfer and storage of produced water from existing pilot wells in PAL 2 and PEL 238 once they are returned to operation. The treatment and management of the produced water and brine to be stored in the Leewood ponds will be subject to further applications for approval and environmental assessment. The proposed activity will operate for the duration of Santos' coal seam gas (CSG) exploration activities in PAL 2 and PEL 238. The proposed activity has a design life of 25 years, however operation beyond the period of exploration would be subject to further environmental assessment and the approval of a petroleum production project. Should this not occur, the proposed activity would be decommissioned and the project area rehabilitated in accordance with the conditions of PAL 2.

2.2 Regional location and context

The project area is located within the Narrabri Shire local government area (LGA) and within PAL 2. The location and regional context of the project area is illustrated in Figure 2-1.





Tracking ID: PR113369-1-001b Compiled: 09 October 2012

N

5 0 5 10

Kilometres

APPROX SCALE 500,000 @ A4

GDA 1994

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DATA SOURCES

Base topographic data © Commonwealth of Australia (Geoscience Australia) 2006.

LEGEND

Leewood Water Treatment Facility

- Bibblewindi
- Flow Line (Right of Way)
- Leewood
- Town / Locality
- Power Station
- Highway
- Main Road
- Local Road
- Built UpArea
- State Forest / Reserve / Park

RPS

FIGURE 2-1

Regional Context and Location

The project area comprises three distinct components, described below and discussed further in sections 3.0 and 4.0:

- "Leewood", a property located along the Newell Highway, approximately 24 kilometres south west of Narrabri (referred to as Leewood throughout).
- Part of the Bibblewindi Water Management Facility, located approximately 15 kilometres south of Leewood in the Pilliga State Forest (referred to as Bibblewindi throughout).
- A 16 kilometre cleared right of way associated with an existing gas flow line through the Pilliga State Forest, from Leewood to the Bibblewindi Water Management Facility (referred to as the right of way throughout).

References to the "project area" within the REF include all these components.

2.3 Stakeholder consultation

2.3.1 Consultation activities

Current and planned consultation for the proposed activity, and results of this consultation, are summarised in Table 2-1.

Table 2-1 Consultation activities undertaken for the proposed activity and results

Stakeholder	Date	Consultation	Results of consultation
Landowner (Forests NSW)	Ongoing	Santos have continued to hold face to face meetings with Forests NSW on a regular basis to advise them of any construction activities proposed at Leewood or associated with the proposed water flow line. These meetings will continue to occur regularly in the lead up to and for the duration of the proposed activity. An offer was made to Forests NSW to include them in any formal scouts of project activities, however this was declined. NSW Forestry will receive a written Notice of Commencement of any activities prior to those activities commencing.	Feedback from NSW Forestry Staff is that they are receiving adequate information on the project from Santos.
Local councils	20 November 2012	A general update on the work program going forward for any petroleum activities to be undertaken by the Santos Group within the area was held with the Narrabri Shire council on Tuesday 20 November 2012 where the proposed activity was described. On 15 November 2012 Santos contacted the General Manager of the Narrabri Shire Council to advise of a media release for the proposed activity and advising a copy of the media release would be sent to the Council.	Feedback was received from the Mayor of Narrabri Council that he would like a briefing on the proposed activity. This has been arranged for 11 December 2012. A Councillor of Narrabri Shire posed a question during the consultation: does Santos have a design which includes a lining underneath the flow line to manage leakages that may occur. A response will be provided to the Councillor shortly.
Adjoining, and/or affected, landholders	5 & 14 October 2012, ongoing	There are eight properties adjoining Leewood. Four properties are private properties, one is owned by Crown & Castle (3251516-Newell no. 5) who in turn sub-lease the land to service providers Telstra & Vodafone (a utility service provider). Two lots are occupied by NSW Forestry. Letters were delivered to all properties on 5 October 2012 advising of a formal scout occurring at	After delivery of the letter on 5th October 2012 one of the adjoining private landholders advised Santos he did not believe he had been provided with early advice on the proposed activity. A

Stakeholder	Date	Consultation	Results of consultation
		Leewood and along the right of way. Santos has undertaken full day scouts with two affected landholders on the 13 and 15 November 2012. Santos has been asked by a third landholder to schedule a similar tour of Bibblewindi and the Leewood. This date is currently being finalised. On 14 October 2012 a further letter was provided to all o f the landholders advising of the proposed activity. Landholders will be updated in writing of any future activities that are to occur at Leewood. All adjoining landowners will be notified by a Notice of Commencement of Activities prior to construction commencing.	face to face meeting was held with the landowner and all issues were addressed. No other feedback has been received from the landholders concerned
Adjoining, and/or affected, authorisation or title holder	-	PAL 2 adjoins PEL 238 on all sides. The titleholders are same for both the PAL and the PEL. Santos is undertaking the proposed activity on behalf of the titleholders of PAL 2.	-
Media and Government Affairs	November 2012	A copy of the Narrabri Community Consultation Committee presentation (see below) on the construction of the proposed activity has been placed on the Santos public website. The local media (i.e. the Gunnedah local paper and the Tamworth North Daily Leader) were alerted to the media release and the Editor of the Narrabri newspaper was given a tour of the Leewood site to help understand the activities. A story was then placed in that newspaper. The media release provided to the local member for Parkes, Mark Coulton, the local member for Barwon Kevin Humphries and the local member for Tamworth Kevin Anderson as well as parliamentary staff from key ministerial offices including the Minister for Resources and Energy, Planning and the Deputy Premier.	Updated information will be provided to all of these parties for the duration of the proposed activity.
Affected infrastructure authorities (electricity, telecommunications, water, pipeline, road, rail, port authorities	-	Optus will be contacted in relation to the proposed crossing of their fibre optic cable adjacent to the Newell Highway. There are no other utilities providers that will be impacted by the proposed activity. No infrastructure connections, including water, sewer or electricity, are proposed. The RMS in Narrabri will be consulted with by Santos prior to the commencement of any activities on use of roads and access along roads.	Updated information will be provided once complete.
Relevant government agencies	Ongoing	A discussion and consultation meeting was held with officers of DRE on 14 September 2012 during which Santos provided preliminary advice on proposed activity. A consultation meeting was held with the Department of Planning & Infrastructure in June 2012 to advise of the proposed activity. Further consultation with government agencies will be undertaken on a regular basis during the proposed activity. On 25 September 2012 an inspection of Leewood was undertaken by Santos and DRE. A further meeting was held with DRE on 25 September 2012 to consult on the proposed activity. An inspection of Leewood was undertaken with the NSW Environmental Protection Agency (EPA) on 29 October	Further updated information on all future meetings will be provided once those meetings have occurred.

Stakeholder	Date	Consultation	Results of consultation
		2012.	
Local Aboriginal communities	September – October 2012, ongoing	The Narrabri Local Aboriginal Land Council was consulted during the first half of 2012 and a further meeting is to be held with local elders on 19 December 2012. This will be lead by Santos' Aboriginal advisor for New South Wales. Santos has had discussions with Native Title Services Corporation, which is the native title Representative Body for NSW. They have also engaged with the Gomeroi native title applicants in preliminary negotiations to a native title agreement (refer section 5.1.2). Santos is hosting a full day detailed technical project briefing and field visit for the Gomeroi registered applicants in January 2013. The Community Consultation Committee (CCC) Narrabri Shire includes two Aboriginal people as general community member (see below).	An update of information gathered from the December 2012 consultation will be provided.
The general community	9 October 2012 and 14 November 2012, ongoing	The Santos CCC Narrabri Shire was formed by Santos in August 2012 and meets on a monthly basis. The last meeting was held on 11 December 2012 and the design of the Leewood ponds was discussed. Refer to section 2.3.2 for further discussion. Community Open Days are to be held on 22-23 November 2012 in Narrabri and Gunnedah to allow for community consultation on the proposed activities. A Community Forum is to be held in Narrabri on 29 November 2012 to provide further information on the proposed activity.	Refer to section 2.3.2.

2.3.2 Community Consultation Committee

On 9 October 2012 the third CCC meeting was held. At this meeting information was provided to the CCC advising that Santos had purchased a property at Leewood which may be used for operational activities in the future.

A CCC meeting was held on 14 November 2012. At this meeting Santos presented an update on the proposed activity. The following issues were raised by the CCC on 14 November. The following table outlines the issues raised and Santos' response.

Table 2-2 Outcomes from CCC on 14 November 2012

Issue	Response
1. Planning of the new site at "Leewood: many applications for approval including analysis of the proposed dam do not take into consideration all issues that may arise during the life of the project, i.e. a heavy rain event. How is water managed during such an event? Would there be any run off from the site and how would Santos ensure that brine water did not run-off?	Santos explained that approvals for the design of the dam were sought from the DSC for the NSW Government, who assess the design and operating levels of the dam, ensuring the dam has a conservative and safe freeboard. Santos advised the CCC that it will take the Committee through the proposed facility design at the next Narrabri CCC meet in December.
2. What type of matting would be lining the dam wall?	Santos advised that the dams are using a new design of wall dam lining which would prevent erosion. Details will be given at the December meeting.
3. Will there be any more evaporation ponds built in the area, and why aren't tanks being used?	Santos advised that it is not feasible to hold the water in tanks as there would need to be hundreds of tanks erected. The Leewood ponds would not be evaporation ponds but storage ponds with some naturally occurring evaporation, prior to treatment.

Issue	Response
4. Will the dam wall break?	Santos advised that it is prepared to give a more extended presentation on the construction of the Leewood ponds and speak about soil conditions and soil types that are taken into consideration.

The proposed activity was discussed in detail with the CCC at the subsequent meeting on 11 December 2012. The CCC posed a range of questions relating to the following areas of interest, including:

- rainfall records
- site soil test data
- pond and spillway design
- staffing, access and monitoring during operations
- future well development plans.

Santos provided a response to the questions they could during the meeting. For those questions that required additional information, Santos will be providing that information directly to the CCC.

2.3.3 Ongoing consultation arrangements

Further consultation will occur in accordance with Table 2-1.

Santos' Community Engagement Team Leader for NSW has prepared a plan to inform and consult with all relevant landholders and community members on the CSG activities in the area surrounding the project area. This plan will come into effect once the proposed activity is approved. The Santos Community Engagement Team Leader is a representative of the Santos Community Consultation Committee Narrabri Shire and plans to further advise this committee on the proposed activity.

The Santos Community Consultation Committee Narrabri Shire will continue to meet on a monthly basis and ongoing updates of the proposed activities will be presented. Santos' Land Access team will continue to engage and consult with neighbouring landholders and Forests NSW. Santos will conduct a community open day in Narrabri to outline its exploration drilling program in the area.

2.3.4 Stakeholder conflict management

Santos' primary approach to conflict management is open and proactive communications with all stakeholders as outlined in the consultation plan outlined above. Santos is well established within the local community in terms of its offices and resident employees, approximately 15 of whom were born and raised locally.

All of Santos' landholder and local community face-to-face contact personnel live in the community and are well known. Santos employees are in daily contact with members of the community in the towns and out in the field. Written communications to directly affected landholders are either preceded by or immediately followed up by personal contact with the landholder by one of the local community liaison staff members in order to ensure that the information provided has been received and is understood by recipients as well as to gather their response/feedback. Santos has a telephone number available 1800 071 278 for community members to lodge enquiries. Enquiries may also be lodged at: http://www.santos.com/contactnsw. These activities are reviewed each day and a report provided to the Santos Energy NSW Community & Government Affairs team to discuss, review and respond.

The stakeholder communications plan for the proposed activity is approved by the senior management of Santos Eastern Australia Business and will be subject to weekly and monthly review by Santos' NSW management.

For the proposed activity, Santos will maintain a database of:

- all project related concerns or complaints received from individual members of the community or representative bodies;
- the response provided or action taken; and
- tracking notes on progress to resolution.

Santos has well established dispute escalation and resolution procedures in place that are designed to identify and apply special focus to any matters which are not readily resolved successfully by its community relations officers and local management.

In addition, despite the substantial environment protection improvements and rehabilitation works involved in the exploration program, Santos is aware of the potential for anti-CSG protest action at some sites which may lead to some cases of civil disobedience. Santos has in place a civil disobedience response management plan as part of its ongoing safety management processes. This plan has been developed in consultation with the relevant authorities.

2.4 Justification of activity

2.4.1 Objectives

The objectives of the proposed activity are to:

- establish a purpose built, centralised water storage facility outside of the State forest
- facilitate remediation of existing infrastructure at the existing Bibblewindi Water Management Facility
- reduce environmental risk in the longer term to the State forest.

2.4.2 Strategic Need

The proposed activity is necessary to facilitate Santos centralising their water handling and treatment operations outside of the Pilliga State forest and to reduce the potential for their operations to impact on the forest environment. Such impacts may include the contamination of soils, surface water and groundwater, as well as impacts to vegetation and wildlife.

A significant inventory of produced water is contained in ponds at the Bibblewindi Water Management Facility from prior operations. Transferring the existing inventory of produced water and brine from the Bibblewindi Water Management Facility to the proposed Leewood ponds will be the first step in Santos' centralisation of their water handling and treatment facilities outside of the State forest.

The transfer of produced water and brine from Bibblewindi to the Leewood ponds will also facilitate the future rehabilitation of the ponds.

The proposed activity is consistent with the *Strategic Regional Land Use Plan New England North West* (DP&I 2012) (SRLUP) which recognises the region's potential for CSG production and identifies the site and surrounding land as having high CSG resources. The SRLUP states that development of the gas industry in the region will bring capital investment and economic benefits, and has the potential to play a significant role in the delivery of reliable energy in a carbon strained economy, provide security of supply for domestic gas and alleviate the state's reliance on imported gas.

The SRLUP emphasises the importance of protecting valuable agricultural land and natural environments. The proposed activity will not impact on valuable agricultural land and has been designed to have minimal impacts to biodiversity. The proposed activity will also reduce potential environmental risks in the Pilliga State forest associated with the current facilities at Bibblewindi. Further discussion of potential impacts on biodiversity and agricultural land is provided in sections 6.2.1 and 6.4.1 of the REF respectively.

2.4.3 Method and scale

The proposed activity will enable produced water and brine to be transferred from the existing Bibblewindi Water Management Facility to the new Leewood ponds, which are located outside the Pilliga State Forest. The transfer of produced water and brine to Leewood will facilitate Santos centralising their water handling and treatment operations outside of the Pilliga, thereby reducing the risk of adverse environmental impact on the forest environment. Draining of the existing ponds at the Bibblewindi Water Management Facility will also facilitate their rehabilitation.

Santos is also proposing to construct additional water treatment infrastructure at Leewood, including a reverse osmosis plant, brine concentrator and brine crystalliser, to replace the existing Bibblewindi Water Management Facility in the future to treat the produced water and brine to be stored in the Leewood ponds. The water treatment infrastructure is currently being planned and will be designed to treat and manage over the longer term the water to be stored in the ponds at Leewood. It will involve a comprehensive long term water management plan for PAL 2 and PEL 238 operations. The construction and operation of this additional water treatment infrastructure will be subject to further approvals and environmental impact assessment and does not form part of the proposed activity for which Santos is seeking approval under this REF. Santos is proposing to construct the produced water and brine ponds and associated infrastructure in advance of the additional water treatment infrastructure to enable the removal from the Pilliga of the produced water currently stored in the ponds at the Bibblewindi Water Management Facility as a matter of priority.

The proposed activity has been designed to adequately cater for Santos' existing approved operations in PAL 2 and PEL 238. The proposed activity may also be augmented (subject to further approvals) to cater for any future activities which may be proposed within Santos' licence/lease areas.

2.4.4 Location

The proposed activity has been located with the aim of minimising impacts on the Pilliga State forest and to viable agricultural land. This has been a key objective of the overall project.

Existing disturbed areas within the State forest have been utilised wherever possible, including the existing right of way and Bibblewindi. The only areas outside the extent of existing disturbance are at the Newell Highway crossing and where the flowline reaches Bibblewindi. These additional areas of disturbance are necessary due to safety or physical constraints.

The Leewood ponds will be located on an agricultural property outside of the State forest. Leewood is not located within Strategic Agricultural Land (SAL) and does not represent a viable agricultural property (refer 4.1.5 and 6.4). Relocating the existing water treatment facilities from Bibblewindi to Leewood (outside the State forest) will reduce the environmental risk to the State forest and enable rehabilitation of existing facilities.

2.4.5 Consistency with ecologically sustainable development

The proposed activity is considered to be justified in terms of its consistency with the principles of ecologically sustainable development (ESD). ESD is a primary object of the EP&A Act and is defined under

section 4 of the EP&A Act as having the same meaning as section 6(2) of the *Protection of the Environment Administration Act 1991,* being:

…ecologically sustainable development requires the effective integration of economic and environmental considerations in decision-making processes. Ecologically sustainable development can be achieved through the implementation of the following principles and programs:

(a) the precautionary principle—namely, that if there are threats of serious or irreversible environmental damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation,

(b) inter-generational equity—namely, that the present generation should ensure that the health, diversity and productivity of the environment are maintained or enhanced for the benefit of future generations,

(c) conservation of biological diversity and ecological integrity—namely, that conservation of biological diversity and ecological integrity should be a fundamental consideration,

(d) improved valuation, pricing and incentive mechanisms—namely, that environmental factors should be included in the valuation of assets and services.

The proposed activity's consistency with these principles is outlined in Table 2-3.

Table 2-3 Consistency of proposed activity with ESD principles

Principle	Proposed activity's consistency
Precautionary principle	A precautionary approach was taken during the design phases of the proposed activity, which aimed to avoid significant environmental constraints, thereby minimising the risk of serious or irreversible harm to the environment as a result of the proposed activity. During the environmental assessment process, investigation into a range of issues was carried out to determine the full potential impacts of the proposed activity. This included commissioning cultural heritage, ecological, flooding, transport, agricultural and geotechnical studies, and drawing on information from technical specialists including engineers, geologists and hydrogeologists. The Leewood ponds design exceeds the minimum design standards in NSW to ensure potential impacts are minimised and residual impacts managed appropriately.
Intergenerational equity	The proposed activity has been designed in accordance with sustainable management principles. It will assist in providing a comprehensive water treatment solution for Santos' activities in the area, to ensure that potential impacts of the activities are not left to be addressed by future generations. The proposed activity will not consume significant quantities of non-renewable resources.
Conservation of biological diversity and ecological integrity	The proposed activity has been located and designed to avoid potential impacts to biodiversity and ecological integrity. The Leewood ponds have been situated such that the sensitive vegetation will not be impacted by the proposed activity. The flowlines will utilise an existing cleared right of way so as to minimise the removal of significant areas of vegetation. Works at Bibblewindi will be contained within an existing cleared area. Some areas of non-significant vegetation may be removed to facilitate the proposed activity, however this will not result in significant impacts to any threatened species, population or ecological community, or their habitat.
Improved valuation, pricing and incentive mechanisms	While clear and widely accepted standards have not yet been established for the application of this principle, Santos acknowledges and accepts the financial costs associated with all the measures required for the proposed activity to avoid, minimise, mitigate and manage potential impacts of the proposed activity.

2.5 Alternatives

The proposed activity is necessary to reduce environmental risk in the longer term to the State forest and facilitate remediation of existing infrastructure at the existing Bibblewindi Water Management Facility.

Santos undertook an analysis of feasible alternatives to carrying out the proposed activity. There were no lower impact alternatives to the proposed activity available that would adequately achieve the project objectives. The location of the ponds within Leewood was determined based on the geotechnical conditions, environmental site constraints and potential future land uses on the property. No other sites outside of the State forest were feasible to accommodate the Leewood ponds, as all properties in the vicinity are in private ownership.

To achieve the project objectives, three alternatives were considered, as follows:

- Alternative A – Do nothing.
- Alternative B – Upgrade and restore existing Bibblewindi Pond 3 and upgrade existing water treatment plant at the Bibblewindi Water Management Facility to manage water.
- Alternative C – Install flowlines and new ponds at Leewood, transfer produced water and brine from Bibblewindi to the Leewood ponds and remediate existing ponds at Bibblewindi Water Management Facility.

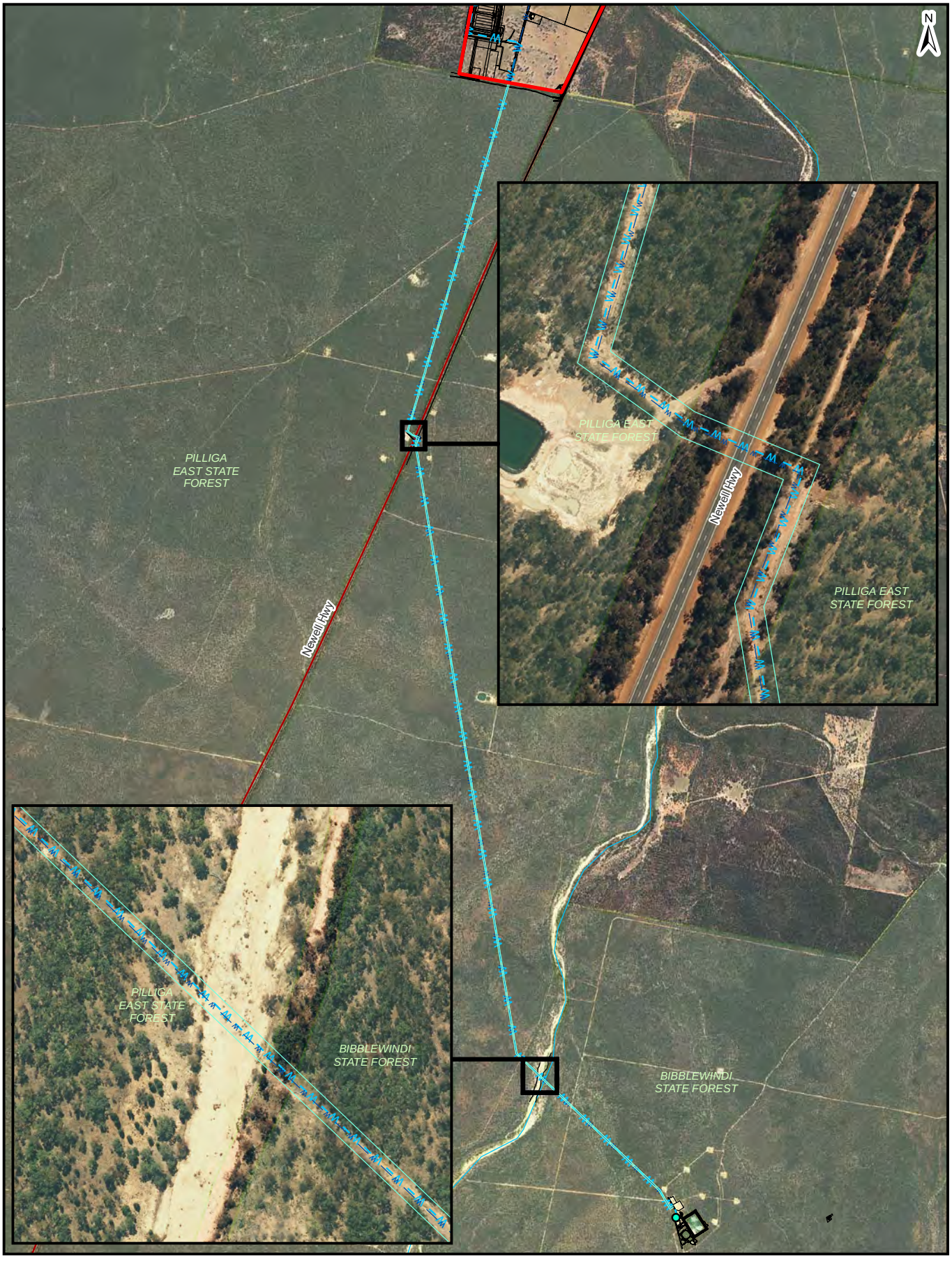
A comparison of the alternatives concluded that Alternative C is the preferred option. Alternatives A and B were discounted as they would not reduce environmental risks to the State forest and would not facilitate remediation of existing infrastructure at the existing Bibblewindi Water Management Facility.

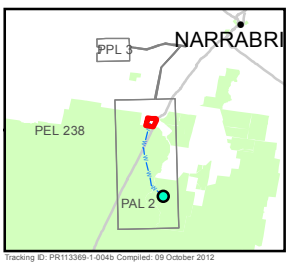
The advantages of Alternative C include:

- The environmental risk to the State forest would be reduced by relocating water storage ponds outside of the State Forest.
- The environmental risk to the State forest would be removed in a much shorter timeframe than possible under Alternative B.
- Restoration of Bibblewindi Pond 3 (as per Alternative B) would still require an interim water storage solution during upgrade works.
- Alternative C would enable the implementation of a comprehensive suite of long term treatment options not possible at the Bibblewindi Water Management Facility due to space limitations.

2.6 Description of the activity

The following sections describe the key components of the proposed activity, outline the construction process and discuss the operation of the proposed activity. The proposed works at Leewood, Bibblewindi and along the right of way are illustrated in Figures 2-2, 2-3 and 2-4.





Tracking ID: PR113369-1-004b Compiled: 09 October 2012

N

500 0 500 1,000

Metres

APPROX SCALE 65,000 @ A4

GDA 1994 MGA Zone 55

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DATA SOURCES

Base topographic data © Commonwealth of Australia (Geoscience Australia) 2006.

LEGEND

Leewood Water Treatment Facility

- Bibblewindi
- W Proposed Leewood Flowline (Indicative)
- Right of Way (Indicative)
- Exsiting Flowline
- Leewood
- Highway
- Watercourse
- State Forest

RPS

FIGURE 2-2

Proposed Works on the Right of Way





Tracking ID: PR113369-1-003b Compiled: 09 October 2012

N

100 0 100 200

Metres

APPROX SCALE 12,500 @ A4

GDA 1994 MGA Zone 55

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DATA SOURCES

Base topographic data © Commonwealth of Australia (Geoscience Australia) 2006.

LEGEND

Leewood Water Treatment Facility

- Bibblewindi
- W Proposed Leewood Flowline (Indicative)
- Right of Way (Indicative)
- Exsiting Flowline
- Leewood
- Highway
- State Forest

RPS

FIGURE 2-3

Proposed Works At Leewood





Tracking ID: PR113369-1-005c Compiled: 05 November 2012

N

50 0 50 100

Metres

APPROX SCALE 4,000 @ A4

GDA 1994 MGA Zone 55

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DATA SOURCES

Base topographic data © Commonwealth of Australia (Geoscience Australia) 2006. Proposed works digitised from Aurecon dwg 7081-40-067E

LEGEND

- W Proposed Leewood Flowline (Indicative)
- Right of Way (Indicative)
- W Exsiting Flowline

Bibblewind Proposed Works

- 5ML Tank
- Concrete Bund
- Future Gas Supply
- Transfer Pumping Station

RPS

FIGURE 2-4

Proposed Works at Bibblewindi

2.6.1 Basis of design

The following sections outline the site conditions and parameters that formed the basis of the design of the various components of the proposed activity.

2.6.1.1 Site conditions

Table 2-4 details the ambient climatic conditions for the site. The proposed activity has been designed based on these conditions.

Table 2-4 Site conditions

Design Parameter	Basis/Justification	Value
Design maximum ambient temperature (for performance issues, eg engine power)	Based on Bureau of Meteorology Highest Maximum Temperature of 43.4°C for Narrabri West Post Office	43.5ºC
Maximum surface metal temperature due to solar radiation (exposed – black bulb) (for materials selection, flange rating)	Based on experience	70 ºC
Design minimum ambient temperature (for materials selection, especially embrittlement)	Based on Bureau of Meteorology Lowest Minimum Temperature of -6°C for Narrabri West Post Office	-6 ºC
Design ground temperature range	Based on ground temperature data from Bureau of Meteorology for Narrabri West Post Office	12ºC to 29ºC
Relative humidity		37-84%
Evaporation Rate (Average)	Based on Mean Daily Evaporation data from year 1948-2010 (Narrabri West Post Office)	4.8 mm
Maximum design solar radiation intensity		1.1kW/m^2
Precipitation	Based on the mean annual rainfall at Narrabri West Post Office, weather recording stations report	659.7mm/year
Precipitation	Based on the highest recorded daily rainfall at Narrabri West Post Office	188.0mm/day
Wet Bulb Temperature		24 ºC

2.6.1.2 Water quality parameters

The following table provides the composition of water that has been used as the basis for the design of the Leewood ponds. The table provides the likely maximum concentration of each parameter contained within the pond.

Table 2-5 Water quality parameters

		Produced Water Pond	Brine Pond
Parameter	Units	Maximum concentration	Maximum concentration
Total Dissolved Solids (TDS)	mg/L	31,000	250,000
Temperature	°C	30	40-50
pH		8.75	12
Total Suspended Solids (TSS)	mg/L	70	-
Turbidity	NTU	100	-
Total Algae Count	Cells/mL	700,000	-
Carbonate (CO3)	mg/L as CaCO3	780	102,000
Bicarbonate (HCO3)	mg/L as CaCO3	13,970	40,000
Chloride (Cl)	mg/L	3,950	36,000

		Produced Water Pond	Brine Pond
Sodium (Na)	mg/L	9,300	112,000
Sulphate (SO4)	mg/L	64	183
Calcium (Ca)	mg/L	10	126
Magnesium (Mg)	mg/L	7	72
Potassium (K)	mg/L	70	792
Strontium (Sr)	mg/L	2.8	22
Barium (Ba)	mg/L	17	228
Fluoride (F)	mg/L	10	103
Silica (SiO2)	mg/L	27	414
Boron (B)	mg/L	1.7	15
Iron (Fe, dissolved)	mg/L	0.58	5
Cyanide (Total)	mg/L	0.009	0.1
Manganese (Total)	mg/L	0.06	0.2
Aluminium (Total)	mg/L	1.0	3
Phosphorus (Total)	mg/L	0.92	3
Ammonia	mg/L as N	18	52
Nitrate	mg/L as N	0.10	2
Nitrogen (Total)	mg/L	26	254
Copper (Total)	mg/L	0.26	1
Zinc (Total)	mg/L	0.31	1
Arsenic (Total)	mg/L	0.054	0.2
Chromium (Total)	mg/L	0.0679	0.2
Hexavalent Chromium	mg/L	<0.05	-
Cadmium (Total)	mg/L	0.06	0.2
Mercury (Total)	mg/L	0.022	0.06
Molybdenum (Total)	mg/L	0.0056	0.02
Nickel (Total)	mg/L	0.028	0.08
Antimony (Total)	mg/L	0.0006	0.002
Selenium (Total)	mg/L	0.068	0.3
Uranium (Total)	mg/L	0.0003	0.002
Lead (Total)	mg/L	0.015	0.1

2.6.1.3 Gas composition

Table 2-6 details the gas composition used in the design of gas conditioning and power generation infrastructure.

Table 2-6 Gas composition

Parameter	Unit	Min	Max
Raw Gas Pressure (at inlet to conditioning skid)	kPa	150	350
Raw Gas Temperature	ºC	20	35
Specific gravity	-	0.57	0.57
Typical Raw Gas Composition – excludes liquid carry over			

Parameter	Unit	Min	Max
Carbon dioxide (CO_2)	mol%	5	10
Nitrogen (N_2)	mol%	5	5
Methane (CH_4)	mol%	90	85
Ethane (C_2H_6)	mol%	<0.1	<0.1
Oxygen (O_2)	mol%	<0.1	<0.1
Total		100	100

2.6.1.4 Pilot water production and modelling

The Leewood ponds have been designed to cater for the transfer of produced water and brine from Bibblewindi and the existing pilot wells in PEL 238 and PAL 2, once they are returned to operation. They have also been designed to cater for additional future exploration operations (which would be subject to further approvals). It should be noted that the ponds have been designed to cater for the trucking of water from pilot wells for direct transfer into the ponds, however these activities would be subject to further approvals and environmental impact assessment and do not form part of the proposed activity under this REF.

The residual water in Bibblewindi ponds 1, 2 and 3 will be transferred to the Leewood brine pond via Bibblewindi Pond 3. This is expected to be approximately 150ML.

A Goldsim water balance model was developed to model the water balance of the Leewood ponds. This model uses appraisal pilot water production and historical weather data (100 years) to model the long term storage over time in the Leewood ponds, inclusive of rainfall and evaporation. The pilot water production data was developed in consultation with the reservoir engineering and includes production estimates for the existing and proposed pilot wells.

The appraisal pilots are scheduled to be started in a sequence and this sequence is subject to the final work over program for existing wells and drilling program for new wells. The pipeline connection timeline will determine the final water production curve, though based on the current modelling the water production begins at approximately 0.7 ML per day and reaches a peak of 1.3 ML per day approximately a year later. The entire water production based on the above program and timeline lasts for approximately three years (refer Figure 2-5).

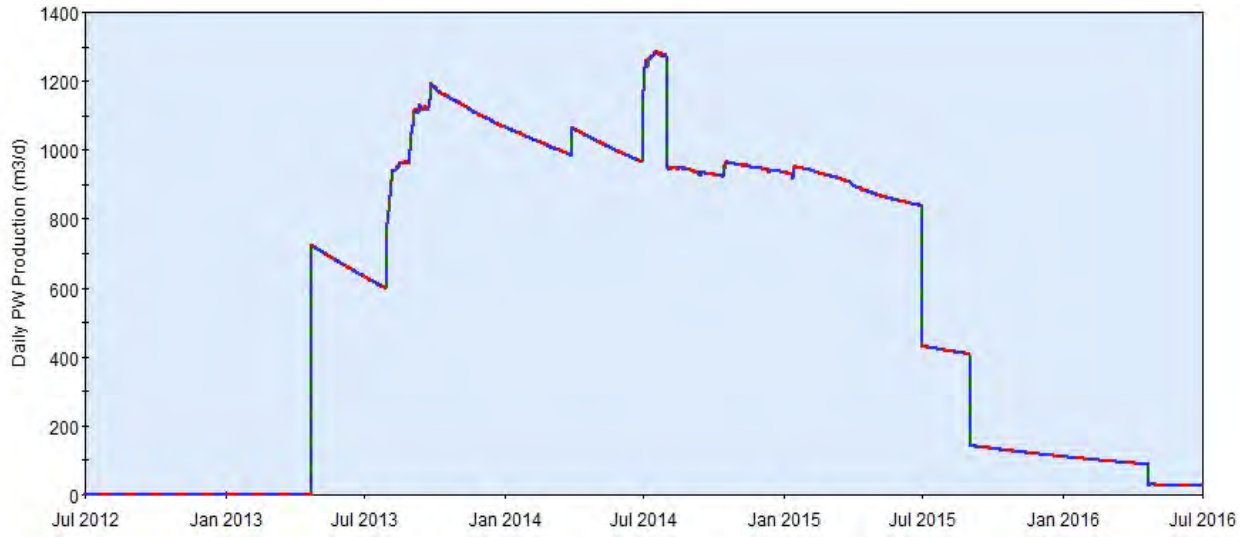


Figure 2-5 Water production curve

The following figure demonstrates the proposed inputs and outputs of the Leewood ponds.

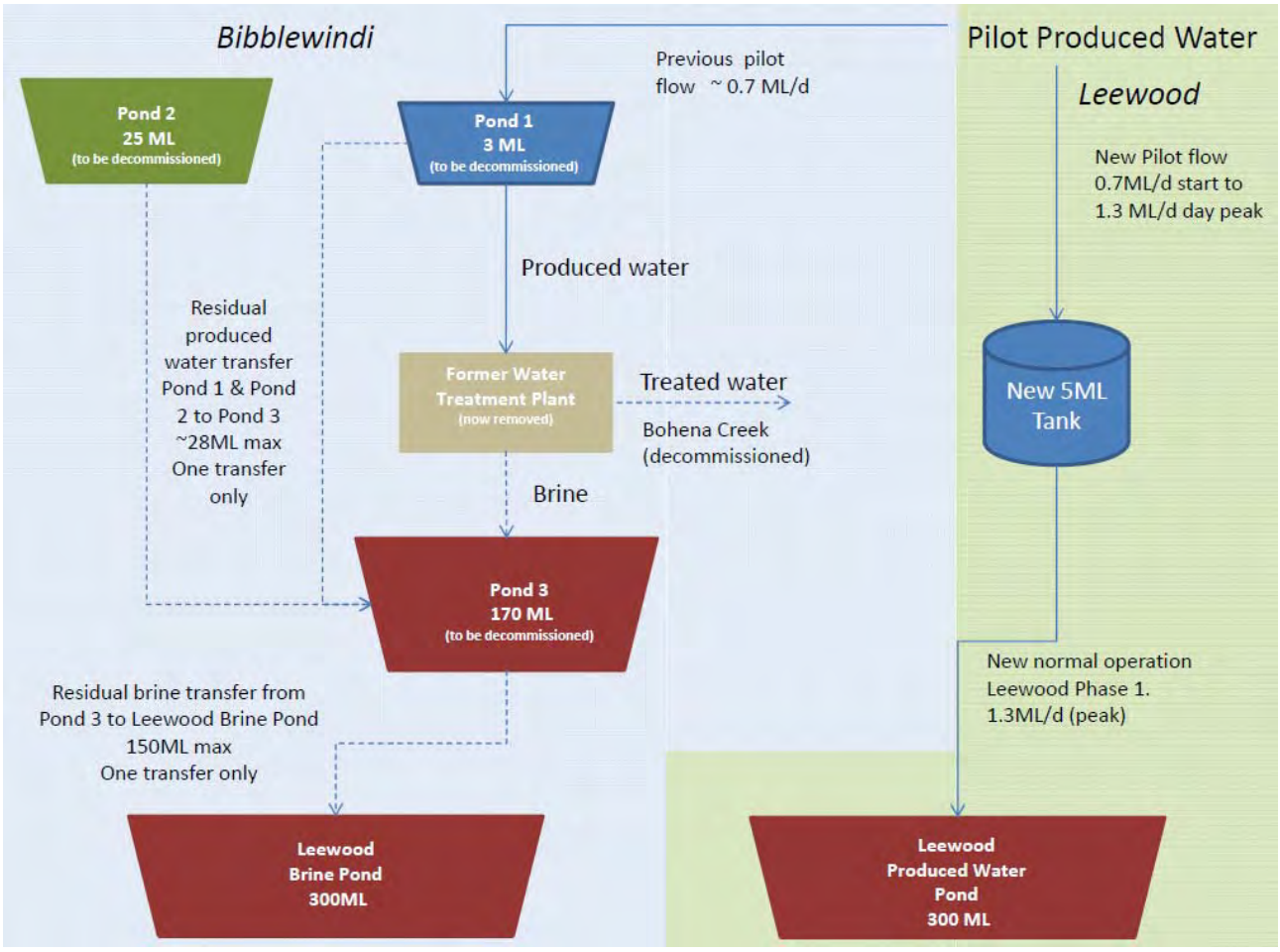


Figure 2-6 Water inputs and water balance

2.6.2 Concept design

2.6.2.1 Connection piping, tank and water pumping skids (Bibblewindi)

The existing water gathering systems associated with appraisal pilots within PEL 238 and PAL 2 will require new connections to the proposed activity, to enable produced water to be directed to the Leewood ponds. It is proposed to connect the existing water gathering systems to the new five ML water balancing tank via DN250 HDPE pipeline at Bibblewindi, which will have a design flow rate sufficient to convey flows anticipated from the existing wells (which are currently shut-in).

The purpose of this tank is to allow minor amounts of entailed gas in the produced water to break out and render it non-hazardous, prior to transfer to Leewood. The tank will comprise a galvanised steel panel tank with an internal polypropylene bladder. It will have roof bracing for structural integrity, but no roof panelling, to allow ventilation.

The tank will be contained within an earthen bund of volume 110% of the total tank storage volume (i.e. 5.5 ML). The bund will contain a spill in the event of a tank rupture or overflow. The bund is to be formed using a geosynthetic clay liner (GCL) across the footprint to lower permeability, alongside the clayey sand and sandy clays already found on site, as far as possible. Approximately 2800m^3 of material is required for construction of the bund with all material is proposed to be won from site.

The tank will include level sensors and transmitters to:

- Alert operators in the event of a tank high level and to initiate operator intervention.
- Close the tank discharge valve in the event of low tank level to avoid air entrainment and pump damage.
- Modulate discharge flow rate to maintain a tank level setpoint.

The outlet pipe from the tank will convey water to a manifold outside of the bunded area. The manifold will include:

- Suction lines to a pump skid to pump flow to Leewood.
- A gravity bypass line to enable gravity flow to Leewood.
- A connection to a flow line from Bibblewindi Pond 3 to enable its dewatering.

While the hydraulic grade line of the flow line from Bibblewindi to the Leewood ponds will enable some gravity flow, pumped assistance will also be required to achieve the ultimate water transfer flow rate. A water pumping skid is proposed to achieve the produced water and brine transfer. The concept design includes:

- Duty /standby electric driven pumps on a steel skid mounted on a concrete slab.
- Variable speed drives to enable flow control to achieve a level set-point in the tank.
- High suction pumps to enable dewatering of the existing Bibblewindi Pond 3.
- Non return valves on the gravity bypass and Bibblewindi Pond 3 dewater line to avoid recirculating pumped flow to the tank or Bibblewindi Pond 3.

2.6.2.2 Flowlines

Two flowlines are proposed between Bibblewindi and Leewood as indicated on the drawings in Appendix 1:

- a DN355 HDPE flowline to convey produced water from the Bibblewindi transfer pump station to Leewood
- a DN160 HDPE flowline to provide additional conveyance capacity for rapid dewatering of Bibblewindi Pond 3.

The flowlines are proposed to be installed within the existing cleared right of way, which is approximately 12 metres wide and 16 kilometres long. The new flowlines will be offset by a minimum of two metres from the existing gas flowline.

The flowlines will be enclosed within a nominal 900 millimetre (mm) diameter pipe for the section of the route that is installed beneath the Newell Highway by horizontal directional drilling (HDD) (see section 2.6.3.6).

High point vents will be provided at high points in the flowlines to vent entrapped air during commissioning and pumping operations.

Table 2-7 provides a summary of the proposed flow line details.

Table 2-7 Flowline details

Description\Location	Bibblewindi – Leewood Flowline	Leewood – Bibblewindi Flowline
Design flow rate ML/d (L/s)	10 (115.7)	1 (11.6)
Pipeline material	PE100, SDR 11 (PN 16)	PE100, SDR 11 (PN 16)
Diameter (mm)	OD 355	OD 160
Minimum depth of cover (mm)	1000	1000

2.6.2.3 Fuel gas conditioning skid

A new fuel gas conditioning skid (FGCS) will be provided at Bibblewindi to pre-treat field gas. The skid will remove all liquid droplets and solid contaminants from the gas, and adjust the gas temperature to the injection requirements. The FGCS will be supplied by field gas from a proposed connection to an existing field gas flowline within the Bibblewindi site. The new FGCS will be located on a reinforced concrete slab foundation.

Water drainage from the new FGCS will be directed to a concrete sump with a submersible pump to pump the drain water to the tank.

2.6.2.4 Leewood ponds

The Leewood ponds comprise one 300 ML produced water pond and one 300 ML brine pond. Each pond comprises two separate cells, or compartments. Golder Associates were engaged by Santos to undertake the design of the Leewood ponds. Further details of pond designs are provided in Appendix 2 and key design parameters included in Table 2-8.

Design

Water balance modelling and hydraulic design was undertaken to inform the design of the Leewood ponds. This was undertaken in accordance with the QLD Department of Environment and Resource Management "Manual for Assessing Hazard Categories and Hydraulic Performance of Dams" (DERM 2012 manual) and the NSW Dam Safety Committee (DSC) requirements.

The DERM 2012 manual sets out more stringent criteria for dam design than the DSC requirements. Santos adopted a precautionary approach and used the DERM manual as a basis for the design of the Leewood ponds. As required under the *Dams Safety Act 1978*, the preliminary design of the Leewood ponds was provided to the DSC for approval (refer section 5.0).

Preliminary designs indicate that the Leewood ponds will fall within the DSC "Significant" category, and the DERM 2012 "High Hazard" category. This will be confirmed following a more detailed analysis and in consultation with the DSC.

The conceptual hydraulic design establishes a maximum operating water level (MOWL), spillway invert level and embankment crest level for each of the Leewood ponds (refer Table 2-8). The MOWL sets a level which when reached, will trigger operational changes to reduce the water level.

The design storage allowance (DSA) is the volume between the MOWL and the spillway invert level. The required DSA volume and spillway capacity design is dependent on the dam category. The spillway capacity is designed to pass 0.01% AEP flows and DSA volume is sized to provide storage for a volume equivalent to 1% AEP, in accordance with DERM 2012 requirements for ponds of High hazard category.

The DSA for the Leewood Pond has been estimated based on daily rainfall data over the last 100 year period and conservative assumptions, including 100% runoff and no evaporation during rainfall periods.

Table 2-8 Pond design details

Parameter	Brine Pond	Produced Water Pond
Total Footprint (Disturbance Area)	231,550 square metres	
Embankment crest level (metres)	250.40	251.05
Crest width (metres)	5	5
Storage at MOWL (ML)	300	300

Parameter	Brine Pond	Produced Water Pond
DSA (MOWL depth below spillway invert) (metres)	0.68	0.72
Spillway level (metres)	249.80	250.45
External batter	1V:4H	1V:4H
Internal batter	1V:4H	1V:4H
Spillway flood capacity	1:10 000 AEP	1:10 000 AEP

The Environmental Containment Freeboard (ECF) is the vertical distance between the MOWL and the spillway crest level. It is designed to maximise the containment of stored water and minimise the number and size of potentially damaging outflows during flood events over the life of a dam. This freeboard is normally set to contain the rainfall volume produced by a 72 hour storm of a certain AEP, without spilling (which at the Leewood site would equate to a rainfall depth of approximately 155 mm). The ponds are designed with an ECF which exceeds this requirement. The ECFs for the Leewood ponds are sufficient to provide storage in excess of the 48 hour 1:20,000 ARI event (assumed to be 650.5 mm) or approximately three 48 hour 1:100 year ARI events.

The pond design details are illustrated in Figure 2-7 and Figure 2-8.

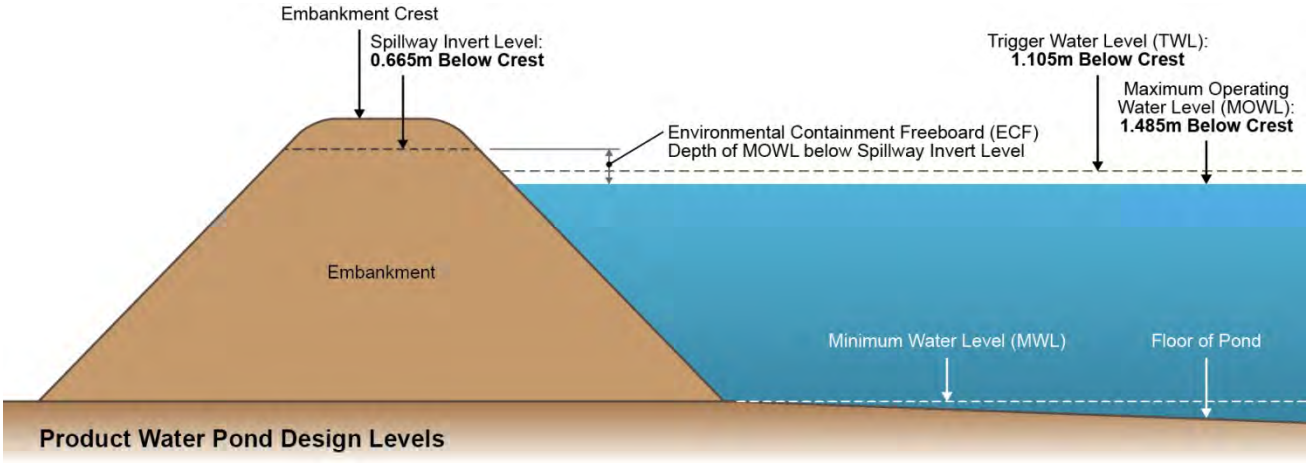


Figure 2-7 Produced water pond design levels

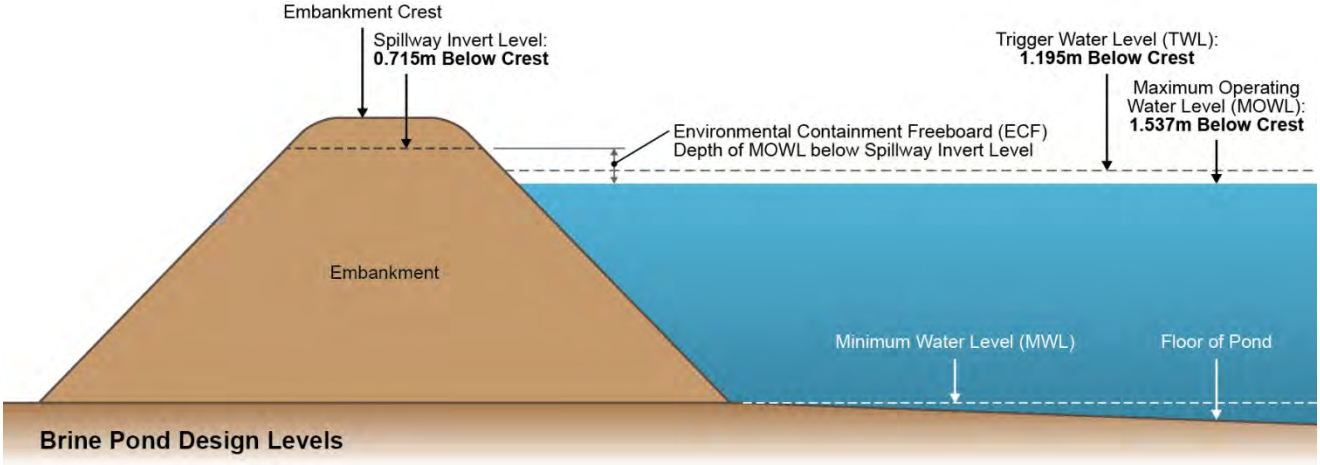


Figure 2-8 Brine pond design levels

Pond embankment

The pond embankment will be constructed of a ring dam comprising homogenous site-won earth fill with 1v:4h batter slopes (internal and external).

The final height of the embankment will be the minimum practical to achieve an earthworks balance and include a five metres crest width for access purposes. The crest will be capped with a 150 mm layer of gravel.

Pond liner

The ponds liner system will comprise a primary polyethylene geomembrane liner, underlain by a leak detection system, underlain by a secondary liner. The secondary liner will be underlain by 300 mm of smooth clayey sub grade, free from obstructions or protrusions.

The pond liner systems have been designed to take into account the following:

- Estimated design life of 25 years.
- A continuous full time construction quality assurance plan during geomembrane installation to control the quality of the installation and the number and size and hence liner leakage rate.
- The 1.5 mm thick geomembrane liners will be anchored at the pond embankment crests.
- Permanent ballasts designed to resist wind uplift of the geomembrane liner.

The proposed leak collection system will transfer any produced water or brine collected below the liner directly back into the pond. The system will include an alarm to notify Santos of sudden changes in pump operational trends, which will signal a potential incident or breakdown.

Ancillary facilities

A site office will be constructed in the area to the south of the ponds, which will comprise office space and amenities for employees. It is anticipated that this office will remain for the duration of operation.

2.6.2.5 Water distribution piping and pond outlet pumps

A new water distribution manifold is proposed at Leewood which will be used to distribute water to flowlines leading to the Leewood ponds (see example Plate 2-1). Flowlines from the manifold will be in-ground polyethylene flowlines with valving to enable selective discharge of the water to the individual ponds.

The ponds will include a series of pumps on floating pontoons located within each pond compartment. The pontoons will be arranged in pairs next to the dividing bund of each pond. Each pair of pontoons will include a discharge pipe, extending down the outer embankment and into a pipe corridor along the toe of the east embankment. The pipes will enable direct flow to the water treatment plant should it be constructed via a set of valves located at the south end of the ponds.

Pumps will be designed for 24 hour operation. A pump control system will be included, which will be likely to include a supervisory control and data acquisition (SCADA) system. This will enable the remote control of the pumps and some valves and includes alarms for pump manual override options and emergency shut-down.



Plate 2-1 Example of water distribution manifold

2.6.3 Construction activities

2.6.3.1 Construction program

It is anticipated that construction activities will take place over a period of approximately six months, weather depending. The following preliminary milestones have been identified for key activities associated with the various components of the proposed activity:

- Award of contract packages – December 2012.
- Procurement period: December 2012 – February 2013.
- Mobilisation & construction of ponds: March 2013 – September 2013.
- Mobilisation & construction of flowline: April 2013 – September 2013.
- Commissioning: September 2013.
- Operation: October 2013.

Construction of the various components of the proposed activity will be run concurrently or closely staged wherever possible. Construction of the various components will be managed by a Principal Contractor and potential staging options are outlined in the following table.

Table 2-9 Potential construction staging

	Leewood & Flowline	Bibblewindi
Stage 1	site establishment and mobilisation	site establishment and mobilisation
Stage 2	upgrade works on Old Mill Road and intersection works at the Newell Highway (12 days)	transfer station and earth bund construction
Stage 3	Leewood Ponds construction	electrical and instrumentation works (40 days)
Stage 4	flow line installation (less than 40 days)	communication equipment installation (30 days)
Stage 5	demobilisation	demobilisation

2.6.3.2 Staff and hours of operation

The total number of staff required for the construction period will vary between each stage of works with an estimated maximum of 45.

Construction hours are anticipated to be 7am till 6pm, seven days a week.

2.6.3.3 Identification of services

Various existing services are located both below and above ground within the project area. The location, type and depth, or height, of all existing services will be confirmed and marked out in the interests of safety and protection of existing services prior to construction. Services include:

- electrical
- water
- gas
- compressed air.

All above ground services which will be affected by construction will be located and isolated prior to construction commencing. Confirming the location of existing underground services can be achieved using a variety of techniques including:

- as built record drawings
- use of cable avoidance tools (CAT)
- non-destructive investigation.

Where non-destructive investigation is required this will be carried out using a technique commonly referred to as potholing. Potholing typically consists of vacuum excavation where either air or water pressure is used to break up the soil and a vacuum device to collect the spoil.

2.6.3.4 Pond construction

Table 2-10 outlines a typical pond construction process. The precise construction methodology for the ponds will be determined by the construction contractor appointed by Santos. It is anticipated that the construction of the ponds will take approximately six months, weather dependent.

Table 2-10 Typical pond construction process

Stage	Activities
Preliminaries	▪ Site establishment including mobilisation, installation of temporary security fencing, amenities and exclusion fencing. ▪ Vegetation removal and removal of existing infrastructure (i.e. farm fences, farm dams). ▪ Construction of sedimentation ponds and silt fences. ▪ Clear, strip and stockpile topsoil in designated area for use in site restoration on completion of works. ▪ Construction of stormwater diversion drains.
Earthworks	▪ Excavate soils from the pond footprint down to almost sub grade levels in a staged manner. ▪ Select and stockpile excavated materials in designated areas. ▪ Install outlet pipe from sump locations to proposed pump stations. ▪ Commence embankment earthworks construction. Place and compact materials obtained from excavated material stockpiles to form embankments, access ramps and pond soil liner. ▪ Shape and grade embankments as per design.

Stage	Activities
	▪ Excavate remaining soil from pond footprint to sub grade levels and form internal pond floor as per design levels. ▪ Construction of internal sumps, underliner extraction pump stations and rising mains. ▪ Final shaping of outer embankments as per design to shed stormwater. ▪ Construction of toe drains. ▪ Construction of crest capping layer including screening and blending of materials. ▪ Construction of erosion protection (Hydro Seeding) for external side slopes.
Pond Lining	▪ Final sub grade preparation prior to installation of geosynthetics and quality assurance inspections. ▪ Installation of underliner drainage system including installation of geosynthetics within the sump. ▪ Excavation of anchor trenches. ▪ Installation of pond liner geosynthetics in a staged manner including placement of ballast bags as per design. ▪ Backfill anchor trenches.
Miscellaneous	▪ Spillway construction including concrete works. ▪ Installation of inlet pipes, floating pontoon units with outlet pipes, water level sensors and safety ladders. ▪ Commissioning of mechanical and electrical works. ▪ Instrumentation. ▪ Construction of access track around the perimeter of the ponds. ▪ Installation of groundwater monitoring bores. ▪ Demobilising.

Equipment required onsite during construction will likely comprise the following:

- scrapers
- graders
- compactors
- dozers
- excavators
- bobcat
- water trucks
- utility vehicles.

2.6.3.5 Construction water

Water will be required for dust control and general moisture maintenance during construction of the proposed activity. Water required at Bibblewindi will be sourced from existing licensed water bores located nearby. Water required for pond construction will be sourced from a proposed water bore to be located at Leewood, which is subject to separate approvals from NSW Office of Water (NOW).

The preliminary location of the water bore is adjacent to the gas flowline easement which traverses the property. The water bore will target the Pilliga Sandstone with an anticipated total depth of approximately 300 metres. The total depth will not be greater than the base of the Pilliga sandstone and will depend on conditions encountered during drilling. The proposed rate of extraction is anticipated to be approximately 30 ML per year with a minimum extraction rate of five litres per second.

The anticipated drilling methodology will include:

- installation of surface conductor casing to prevent infiltration of shallow ground and surface waters and provide stability to the upper part of borehole during drilling operations
- drilling of 100 mm nominal diameter pilot hole to total depth
- reaming out of pilot hole to required depth based on pilot hole results
- installation of production casing and stainless screen to final depth
- placement of gravel pack around screen interval
- addition of bentonite and grout seal to the remainder of open annulus, ensuring that the grout seal is across the boundary between the Pilliga Sandstone and overlying sediments
- borehole development including screen jetting and airlift surging.

The bore will be drilled using mud rotary techniques, with drilling muds/fluids recirculated and contained in either an above ground mud tank system or in excavated and lined mud pits. Upon completion of drilling operations, the fluids and drill cuttings remaining in the mud tanks/pits will be appropriately disposed of.

It is anticipated that water sourced from the bore will be stored in a small turkeys nest dam to be established to the north of the ponds for use during construction.

For the duration of construction of the water flow line, a water truck will be located near the site to provide adequate dust suppression along access and egress pathways, where required.

2.6.3.6 Flowline construction

Ploughing

Both flowlines are proposed to be “ploughed” into a common trench using a proprietary pipe installation plough to a nominal depth of 1000 mm.

Cable and flowline ploughing is a trenchless technology which is growing in use in Australia, and is effectively used by many companies around the world. The technique is particularly suitable for sparsely populated rural areas where long flowlines with few connections are required.

Due to the diameter of the main transfer flowline, installation will be undertaken in various stages:

- Survey. Prior to installation the flowline route will be surveyed and the location of all existing services, constraints and potential environmental issues established.
- Ripping. The route must be ‘ripped’ to confirm there is no rock within the flowline corridor. Where rock is encountered it will be removed and replaced with suitable material that does not present risk of damage to the plough or associated equipment.
- Fusion bonding. HDPE flowlines are joined using a technique known as fusion bonding. In preparation of the ploughing works the flowline will be bonded and laid out adjacent to the flowline route (Plate 2-2). Typically the entire flowline length will be bonded together before the ploughing team start work. Up to two kilometres of flowline can be bonded per day.
- Installation. A blade on the plough forms and clears the laying bed at specific depths up to 2.7 metres. The machine’s movement is accurately guided using GPS technology. The plough’s ripper and pipe insertion unit is pulled through the ground and the pipe is continuously laid as the machine moves forward (Plate 2-3).
- Reinstatement. The ground closes in naturally following the ploughing. Post installation, a small ‘hump’ may be created which will be lightly compacted using suitable plant.

Using this technique to install flowlines below ground water level can be undertaken with minimal environmental impact. The technique removes the requirement for traditional installation trenches to be formed, improving site safety, reducing timing and reducing the environmental impact of the installation. There is no dewatering required, a narrower construction corridor is required and there is minimal disruption to the top soil.



Plate 2-2 Laying of flowline



Plate 2-3 Example of plough

Bohena Creek crossing

Due to the nature of the site terrain there may be localised areas where traditional cut and cover trenching is required to achieve additional depth and service crossings where required. These locations will be determined during the construction phase.

One major creek crossing at Bohena Creek will be associated with the flowline installation, which is located approximately 2.5 kilometres north of Bibblewindi.

It is proposed that the creek crossing is completed using ploughing to minimise the disturbance to the environment. Small, flat waters can be crossed using the ploughing technique and pipes can easily be installed in embankments. As the creek normally runs dry, the crossing will not be undertaken during periods where there is flow to minimise impacts to the creek.

The intent of adopting the ploughing technique is to minimise the impact of the flowline installation as far as reasonably practicable. To facilitate installation the following will be required:

- Establish safe access, which may require minor modifications to the banks for access and egress depending on site specific conditions.
- Install the flowline using the plough to 2000 mm minimum depth of cover, in accordance with Santos standards.
- Reinstate any bank modifications to the same standard prior to installation, including revegetation. Where required this may involve the use of geotextiles or riprap in accordance with best practice and with a focus on minimising impact to the surrounding environment.

Newell Highway crossing

The flowline route crosses the Newell Highway approximately 10 kilometres north of Bibblewindi. To minimise impact to the operation of the highway and environment it is proposed to use HDD below the

highway. HDD is used for the steerable installation of new flowlines, ducts and cables. The term applies to a crossing in which a pilot bore is drilled, and then enlarged to the size required for the product pipe. A typical HDD schematic profile is shown in Figure 2-9.

The direction of the drilling head can be adjusted at any stage during the initial pilot bore to steer around or under obstacles, such as an existing Optus fibre optic cable located in the vicinity and the highway table drains.

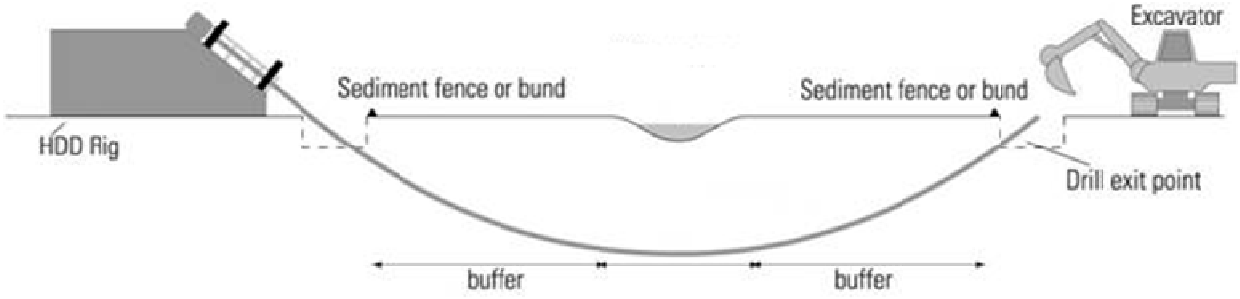


Figure 2-9 Schematic Profile of Horizontal Directional Drilling

The crossing will comprise a DN800 HDPE 'sleeve', through which the flowlines will be inserted. It is anticipated that installation of the DN800 pipe sleeve will include the following:

- A work area will be established on one side of the highway and the drill rig set up.
- Launch and receive pits will be excavated at either side of the highway to collar the hole and collect drill slurry and cuttings. These pit dimensions will vary according to the size of the rig selected by the contractor however are anticipated to be approximately 10 metre x 10 metre due to the diameter of the main crossing pipe. Slurry and cuttings will be removed from the pits for disposal at a licensed waste facility.
- A pilot hole will be drilled along the required path to provide steering information.
- The bore will be reamed in a single or multi-stage operation, eventually accommodating the DN800 product pipe.
- During the final 'pullback' stage, the flowlines will be attached to the reamer by a swivel connector, and pulled into the enlarged bore as the drill string is withdrawn.

Most guided horizontal boring machines use a bentonite drilling fluid, which lubricates and stabilises the bore, and also conveys the excavated material in suspension. All fluids stored at site will be located in designated areas and provided with spill kits.

Refuelling of equipment required for the crossing will also be undertaken in a designated area.

2.6.3.7 Construction vehicle movements

Table 2-11 and Table 2-12 outline the likely traffic generation associated with staff movements during each stage of construction at both Leewood (including the right of way) and Bibblewindi. Three potential options have been considered as staff access arrangements will be determined once a construction contractor is appointed:

(1) Private vehicle use

(2) Company car pool

(3) Shuttle bus.

Table 2-11 Staff construction traffic for each construction stage at Leewood

Stage	Staff	Estimated number of vehicle trips per day		
		Private	Car Pool	Shuttle bus
1	5	8	6	n/a
2	5[1]	0	0	0
3	30	40	20	4 +4 bus
4	15	20	10	4 + 4 bus
5	5	8	6	n/a[2]

1: stage 2 staff will commute to site daily in small works vehicle and have been accounted for as construction traffic
2: a shuttle bus service will not be required during stage 1 and stage 5 given low staff numbers. Stage 1 and stage 5 construction vehicle volumes have been estimated and based on anticipated low staff numbers during machinery delivery/removal.

Table 2-12 Staff construction traffic for each construction stage at Bibblewindi

Stage	Staff	Estimated number of vehicle trips per day		
		Private	Car Pool	Shuttle bus
1	5	8	6	n/a
2	12	16	8	n/a
3	9	12	6	n/a
4	6	8	4	n/a
5	5	8	6	n/a

Table 2-13 outlines the anticipated construction vehicle movements associated with each stage of construction at Leewood (including flowline installation) and at Bibblewindi.

Table 2-13 Construction traffic volumes for each construction stage

Stage	Number of construction vehicles		Vehicle type/activity
	Leewood	Bibblewindi	
1	10	8	▪ delivery of earthmoving machinery to site, including scrapers/ graders/ compactors, bulldozer (by 19-25m articulated low loader) ▪ delivery of HDD drill rig and plough for flow line ▪ Leewood – delivery of crushed rock or gravel to surface internal roads, lay-down area and car park area (truck-and-dog combination) ▪ delivery of site equipment/ generators/ sheds/ portable ▪ toilets (various vehicles as appropriate)
2	30	8	▪ delivery of earth moving machinery to site (grader/ roller) (19-25m articulated low loader) ▪ Leewood – delivery of crushed rock or gravel to Leewood (truck-and-dog combination), delivery of material for earthworks, laying of asphalt ▪ Bibblewindi – concrete deliveries ▪ delivery of diesel fuel
3	8	2	▪ delivery of diesel fuel ▪ Leewood – delivery of generators/ pond lining material/pumps/ pontoons/ telemetry
4	8	2	▪ delivery of 12m sections of piping (19m articulated truck) ▪ delivery and removal of pipe handling equipment and machinery (19m articulated truck) ▪ delivery of diesel fuel
5	6	8	▪ removal of temporary construction facilities ▪ removal of earth moving machinery from site, including scrapers/ graders/ compactors bulldozer (19-25m articulated low loader)

2.6.3.8 Access and construction traffic management

Access to Leewood during construction and operation of the proposed activity will be from Old Mill Road (also known as Dog Proof Fence Road). Old Mill Road is a public road under the management of Forests NSW.

Access to the right of way will be via existing roads within the State forest, which intersect with the right of way at various locations. Some direct access to the right of way will be required directly from the Newell Highway (e.g. at the Newell Highway HDD crossing).

Access to Bibblewindi will be via X-Line Road, an existing State forest road which has been upgraded in the past. No further works to this intersection are considered necessary.

Works will be required to upgrade Old Mill Road to cater for additional traffic during construction, as illustrated in drawing 7081-40-068 in Appendix 1. The proposed upgrades will enable turning movements of vehicles up to 25 metre B-double trucks and will include:

- minor earthworks trimming to provide a consistent grade at the intersection
- drainage amendments to prevent surface water flow on to the Newell Highway
- spray seal surfacing of the first 30 metres of Old Mill Road to maintain a constant grade and minimise soil tracked onto the Newell Highway by departing vehicles
- installation of rumple strips to remove potential contaminants from vehicles leaving Old Mill Road
- upgrade of surface to Old Mill Road with clean gravel
- construct new access point from Old Mill Road into the site, including clearing of vegetation.

A site access plan during the construction phase of the proposed activity has been prepared and is provided as Appendix C of the Transport Assessment in Appendix 3. In summary, the following is proposed:

- during construction of ponds, works at Bibblewindi and flowline installation, signage will be placed on the Newell Highway (110 metres apart), with no speed reduction due to low traffic volumes and truck turning volumes
- when delivery/removal of large earth moving equipment necessitated slow movements via Old Mill Road at the Newell Highway, traffic control and road works speed limits will be implemented
- during upgrades at the Old Mill Road and Newell Highway intersection, signage and speed limits of between 40 and 60 kilometres per hour will be implemented through the work area and an 80 kilometres per hour speed limit installed in advance (to allow heavy vehicles to slow down).

Upgrades and maintenance works to access tracks within the State forest will be undertaken in accordance with the Occupation Permit.

2.6.4 Operation

Operation of proposed activity will involve the transfer of existing produced water and brine via the proposed transfer pump system from Bibblewindi to Leewood and storage of the produced water and brine at the Leewood ponds. It is anticipated that the produced water and brine from Bibblewindi will be stored in the brine pond at Leewood given its composition.

Operation of the proposed activity will also involve the transfer and storage of produced water from existing and approved pilot wells to the Leewood produced water pond once they are returned to operation.

Treatment of the produced water does not form part of the proposed activity, and will be the subject of further assessment and approval(s).

It is proposed that the transfer and storage of produced water and brine will be undertaken for a period of up to three years in the absence of water treatment. During this three year period, water levels within the ponds will be managed as per the following sections to ensure that the MOWL is not exceeded. Should any indicators predict an early fill of the pond at a date prior to the treatment facility commissioning, a turn down of water production rates from high producing pilot wells will be initiated to maintain a safe operational input rate to the ponds, proportional to evaporation and long term sustainable accumulation. As a last resort, should the pond reach a level that is predicted to be maximal for the near term, pilots will be shut in until the treatment facility is commissioned.

The proposed activity will be operational for the duration of Santos' CSG exploration activities within PEL 238 and PAL 2.

2.6.4.1 Operational activities

The primary operational activities associated with the proposed activity will involve routine monitoring and maintenance of the Leewood ponds and plant at Bibblewindi. In particular, the following activities are likely to be carried out:

- water level monitoring of ponds
- wildlife monitoring and control
- seepage collection system monitoring (under or between the liners)
- routine servicing, maintenance and monitoring of plant at Bibblewindi.

Further details in relation to the ongoing safety management of the Leewood ponds is discussed in section 2.6.5.

2.6.4.2 Staff and hours of operation

The operational workforce associated with the proposed activity is expected to be less than five staff. It is not expected that the operation of the proposed activity will generate the need for additional employment in the short term and staff will be sourced from the current Santos Narrabri workforce.

2.6.4.3 Operation vehicle movements

Access to Leewood during operation will be via either a new access driveway adjacent to the southern boundary or through the reinstatement of the existing site access towards the northern section of the property. Both these access points have suitable site access along the Newell Highway to permit safe ingress and egress.

Access to Bibblewindi will be via X-Line Road. Access to the right of way will be restricted and only used for regular inspections.

Levels of operational traffic associated with the proposed activity will be minor and irregular. Operational traffic will generally be associated with staff travelling to and from site, deliveries, maintenance activities and occasional visitors. Based on the likely number of staff accessing the site during operation, it is anticipated that there will be up to five vehicles arriving during each of the weekday AM and PM peak hours.

2.6.5 Ponds operational management

A specific water operations plan will be developed for the Leewood ponds, based on final design data and ongoing feedback and modelling from the pilot program. The manual will provide a guide for the hydraulic operation, monitoring and maintenance of the ponds and ensure that the ponds are managed as per design, in terms of total stored volume. A high level overview of the water operations plan content is as follows:

- Water management system operations description.
- Water production estimate and forecast procedure.
- Water production reporting and forecast template and reporting process.
- Trigger action response plans based on operating water level triggers as per certified pond design.
- Water rate reduction procedure describing the methods by which the water production rate will be reduced to maintain the water balance with sequential steps required before final shut down of the pilot operation.
- Water management emergency response processes.
- System shutdown and rehabilitation.

The DSC requires that the risks of pond failure are managed by the owner through the implementation of a safety management system (SMS) over the life of the ponds. The operations plan will detail the monitoring and reporting requirements of the SMS to suit the anticipated Significant Consequence Category of the Leewood ponds.

The key operational and monitoring requirements to be covered in the operations plan are discussed further below.

2.6.5.1 Operational requirements

Specific operational requirements for the ponds are presented in the following table.

Table 2-14 Pond operating and monitoring requirements

Issues	Requirement
Water level monitoring	The water level of each pond is required to be monitored continuously for control of the requirement environmental containment volume and operation of the pump stations. Level sensors shall be installed for management of pump controls and to provide protection against pond overflow. It is expected the sensor system will be monitored by means of telemetry.
Pond in and outflow measurement	Inflows and outflows from the ponds are required to be measured by means of flow meters.
Minimum operation level	The Leewood ponds are designed to operate with a minimum operating water level. The minimum operating level acts as ballast against wind uplift on the pond liner. Under no circumstance is the water to be lower than the minimum operating level unless specifically authorised under the control and supervision of the designer, or in the event of an emergency situation.
Maximum operation level	The operational water level of the ponds should be managed so that there is no exceedance of the maximum operating level under normal operating conditions. The maximum operating level is the safe operational level. In the event that the maximum operating level is exceeded all reasonable and practical measures are to be taken to prevent any further increase in the water level of the pond. All inflows to the pond will be isolated. This may include isolating/diverting the water supply feed to other storage ponds or water extraction by water tanker trucks to relocate or temporarily store the water. The storage between the maximum operating level and spillway level is intended to provide capacity to manage the effects of wave action on the stored water surface, and to contain the design rainfall event without discharge from the ponds.

Issues	Requirement
Spillway level	Upon any pond reaching the spillway level, control measures must be taken to contain the water where possible and only where this does not damage the integrity of the pond. Santos shall be responsible for all required correspondence with the DSC and NSW EPA upon the water level in the brine or produced water pond reaching or exceeding the spillway level.
Wildlife Monitoring and Control	The Leewood ponds have the potential to impact upon local fauna. The geomembrane pond liner will be slippery when wet and the slopes of the internal embankment of the ponds are relatively steep. This could prevent animals from exiting the pond if they should accidentally enter the pond enclosure. Animals attempting to extricate themselves from the pond may damage the pond liner. A security fence around the toe of the external embankment will be installed to limit ground dwelling fauna from entering the pond. The fence will be inspected regularly for damage and any repairs carried out to prevent animal access to the ponds. The ponds will include an additional measure in the form of astro-turf or netting strips on rough geomembrane at regular spacing around the perimeter which is intended to provide some means for animals to exit the ponds.
Seepage collection system monitoring	The ponds include liners with a seepage collection system below the liners. The seepage collection sumps are to be inspected weekly. In addition to the visual inspection, monitoring of water levels, sump pump activity and salinity of the collected water is to be monitored by means of sensors. The sumps will include an alarm system to notify Santos of sudden change in pump operational trends, to signal a potential event or breakdown of pumps.
Pipes and pump monitoring	Pipes and pumps need to be monitored and maintained to convey product water or brine to and from ponds. Pumps will be subjected to an inspection and maintenance program developed in consultation with the pump supplier to reflect the expected operating conditions, durability of components, and pumping efficiency of the system. This program will include inspection of valves, measurement units and electrical control systems.
Spill Reporting and Remediation	In the event that brine or product water has spilled from the Leewood ponds or the delivery pipelines, the following procedure is to be followed: 5. Ensure the spill has ceased and is contained. Follow emergency response management plan if the spill is uncontrolled or is released offsite. 6. Complete incident report and notify Santos' environmental department. The environmental department is to manage the incident from here on, including notification of the NSW Environment Protection Authority and follow up communications. 7. Photograph spill area and map extent of spill with a hand held global positioning system (GPS) device. Obtain land access approval prior to accessing areas beyond the site boundary. 8. Estimate spill volume based on mapped area and average depth. 9. Collect samples of spilled water, or soil which has been in contact with area of released water flow. 10. Collect samples of soil from area adjacent to spill area for "background" data. 11. Dispatch samples for independent laboratory testing. 12. Following agreement from the Santos' environmental manager and NSW EPA, excavate soil underlying spill area to a depth of at least 100 mm below visible impact depth, and stockpile and cover excavated material onsite for disposing offsite at suitable location (to suit results of laboratory testing and waste classification category of material). 13. Undertake validation sampling and testing of material from excavated surface to assess effectiveness of remediation. 14. Undertake additional excavation, validation testing and remediation as required. 15. Prepare report of incident for processing by Santos' environmental manager.

2.6.5.2 Surveillance inspections and reporting

The ponds will be subject to the DSC surveillance requirements for prescribed dams (as defined under the *Dams Safety Act 1978*, refer to section 5.2.11). The DSC provides guidelines for the preparation of surveillance reports. For a Significant Consequence Category pond with an embankment height up to 15 metres, an annual "Type 3" report is the minimum requirement of the DSC. The following information will be required to be included in the Type 3 report:

- condition of the embankment slopes and crest including:
  - » the location and extent of any slips, cracks, erosion, etc
  - » vegetation condition
  - » description of any leakage/seepage identified
- condition of the spillway
- condition and check of instrumentation used to monitor the ponds
- training of personnel involves in pond operations and monitoring
- review of pond Consequence Category
- any recommendations to make the ponds safe or address maintenance issues.

Santos will be required to present the findings and recommendations of the surveillance report to the DSC. In the event that the surveillance report identifies unsafe practices, the DSC may require a safety review to be undertaken. The safety review will address the issues raised by the DSC.

2.6.5.3 Routine monitoring and inspections

The monitoring aspects outlined in the following table will be undertaken for the Leewood ponds at the frequencies identified (as a minimum). Special/emergency inspections will be undertaken by a suitably qualified and experienced Dams Engineer and specialist of a particular feature of the ponds in the case of specific events (refer to Table 2-15 for the definition of a specific event).

Routine monitoring will only be undertaken by staff who have completed a Dams Surveillance Training Course. Records from all inspections will be provided to the person responsible for ponds operation and environmental personnel within Santos on a regular basis. If at any time during the operational life of the ponds routine monitoring identifies a significant change in condition or trend of measurements of the ponds an investigation will be conducted by an experienced Dams Engineer.

Table 2-15 Monitoring requirements

Monitoring aspect	Minimum frequency
Pond water level	Daily* (Continuous using sensors and remote monitoring)
Embankment seepage	▪ Daily for first fill then weekly up until 3 months after construction completion. ▪ Monthly thereafter*
Embankment erosion	Quarterly*
Seepage collection systems	▪ Daily for first fill ▪ Weekly thereafter*
Pond crest integrity and capping	Quarterly*
Hydraulic structures	Quarterly*
Pipe work and valves, including pipe discharges and outlets, pontoons and access gantry structures	Weekly*
Pond water quality	▪ Weekly * for pH, temperature and TDS ▪ Continuous if sensors and remote monitoring installed ▪ Monthly for other quality parameters
Rainfall and evaporation	Weekly*
Access and site roads	Quarterly*

Monitoring aspect	Minimum frequency
Pond liner condition	Monthly*
Embankment deformation	▪ Weekly up to 3 months after construction completion ▪ Monthly thereafter*
Vegetation growth on pond embankment and surrounds	▪ Weekly up to 3 months after construction completion ▪ Quarterly thereafter*
Environmental impacts	Quarterly*
Wildlife management systems (fences etc)	Quarterly*
Surface survey	Six months after the first fill and then every 2 years

** In the case of a Specific Event[1], or an Exceptional or Unusual Event[2], the monitoring shall be carried out immediately following the event.*

[1]A "Specific Event" includes a. Heavy rainfall event (defined as more or equal to 20 mm in a 24 hour period); or b. Protracted dry spell (defined as no rain for 90 days); or c. Water level reaching a critical height; or d. Earthquake.

[2]Exceptional and Unusual Events are all observations that may indicate dam operations have been affected. This includes, but not limited to: a. Animals trapped or dead in pond water; b. Fencing around dam compromised or breached; or c. Evidence of tempering with or vandalism of pond infrastructure.

2.6.5.4 Dam Safety Emergency Plan

A Dam Safety Emergency Plan (DSEP) will be prepared and submitted to the DSC for consideration. The DSEP will provide emergency response procedures that should be followed by operations staff responsible for the management of the Leewood ponds. It will be referred to in the event of a release of stored water or brine from the ponds which may present a risk to personnel and or/public and the surrounding environment.

In the event of a pond safety incident or failure, the DSC will be notified as soon as reasonably practical. The DSEP will include an inundation map to indicate the expected area that may be affected by a dam break of the ponds. The DSEP will also include any identified residences and other critical infrastructure that will be at risk from the dam break effects, and provide contact details of emergency response organisations.

A preliminary assessment of potential emergency scenarios and the mechanisms that may result in a release from the ponds is summarised in the following table.

Table 2-16 Potential Emergency Scenarios

Mechanism	Trigger/Indicator	Potential Result	Remediation
Static embankment movement	Tension cracks in embankment crest, settlement of embankment	Large settlement may result in loss of containment and overtopping during storm event. Cracks could indicate stability issues and possibly increased phreatic surface level within the embankment	Drain pond and remediate pond stability issues. Investigate potential seepage through liner and embankment soils
Seepage and or wet soils observed at embankment downstream toe	Hydrophilic vegetation and wet soil at the embankment toe	High phreatic surface in embankment may lead to slope stability issues	Drain pond and investigate integrity of the liner system
Dynamic Embankment movement	An earthquake induces shaking pond	Shaking of the embankment may result in settlement of the embankment crest and deformation of the batters	Repair embankment to restore design geometry
Embankment Overtopping	A large rain event exceeds the discharge capacity of the spillway or the spillway is blocked	May result in water flowing over the embankment and eroding a breach resulting in loss of containment	If possible, unblock spillway and drawdown pond
Large Defects in	Seepage observed flowing	Ongoing seepage may result in	Drain pond and repair

Mechanism	Trigger/Indicator	Potential Result	Remediation
Liner	from the seepage collection pips into the collection sumps	erosion through the embankment	liner defects

2.6.5.5 Groundwater monitoring

Groundwater monitoring will be undertaken at Leewood, to provide an ongoing assessment of the effectiveness of the environmental control measures implemented for the Leewood ponds and to limit risk of impact on any shallow aquifers.

A number of groundwater monitoring bores will be installed around the perimeter of the Leewood ponds. The precise locations of these bored will be determined based upon the outcomes of detailed design or conditions encountered during construction.

The proposed groundwater monitoring bores will be advanced to a minimum depth of 10 metres below ground surface. The depth of the monitoring bores may be adjusted based upon conditions encountered during the drilling of the bores. It is unlikely that groundwater will be intercepted in these bores unless significant leakage has occurred from the ponds.

Groundwater quality monitoring at the proposed groundwater monitoring bores will be undertaken if water is encountered in the bores.

The groundwater monitoring bores will be monitored after installation and prior to filling or commissioning of the Leewood ponds. If the initial round of monitoring does not encounter groundwater, the bores will be monitored in January and June of each year for the life of the Leewood ponds. If groundwater is encountered in the groundwater bores the frequency of monitoring will be reviewed by a suitable qualified and experienced person.

If at any time during the operational life of the Leewood ponds the results of groundwater monitoring indicate a significant variation from established baseline conditions an investigation will be conducted. If this investigation indicates that groundwater contamination has occurred an action plan to address the situation will be developed and enacted. An overall water monitoring program, inclusive of groundwater will be developed as part of the water operations plan for the Leewood Ponds during the detailed design process.

2.6.6 Electricity supply

A new FGCS will be provided at Bibblewindi. Power for the proposed water transfer infrastructure and existing operating facilities at Bibblewindi will be provided by two generators (duty-standby) with an emergency diesel back-up generator.

Diesel generators will be used at Leewood during construction and potentially operation (to power any required site offices).

2.6.7 Erosion and sediment control

2.6.7.1 General

Erosion and sediment control associated with the proposed activity will be undertaken in accordance with existing Santos standards and industry best practice.

Prior to commencement of work an assessment of the various site conditions will be undertaken by the Principal Contractor(s), in consultation with Santos. The Principal Contractor(s) will be required to submit an

erosion and sediment control management plan for approval by Santos. The site condition assessment will ensure that erosion and sediment control is managed to the highest possible standard as the works are undertaken, and the methodologies applied consistent with the *International Erosion Control Association of Australasia, Book 2, Best Practice Erosion and Sediment Control*. Each activity associated with the proposed activity will be considered on an individual basis to establish the most appropriate methods of control.

The assessment will consider the following, as a minimum:

- existing soil types (to determine the most appropriate method of control)
- topography
- water
- vegetation
- ecology
- entry and exit points for both drainage and sediment control.

Various technologies will be considered to manage sedimentation and erosion during construction, including:

- silt fences
- silt traps
- culverts, pipe networks and open drainage channels with associated velocity control
- sedimentation basins
- controlled discharges
- cellular confinement systems
- mulch anchoring on slopes
- erosion control blankets
- rumble strips and/or wheel washes
- regular reporting and inspection procedures.

All works will be undertaken to minimise the impact of erosion and sedimentation on the surrounding environment.

2.6.7.2 Leewood ponds

Specific erosion and sediment control has been developed for the construction and operation phases of the Leewood ponds.

Given the flat, low lying terrain at Leewood, diversion bunds are proposed along the western and southern perimeter of the ponds to intercept off site surface water runoff and direct flows towards the existing drainage path traversing the centre of the site. This drainage path flows to Mollee Creek, which is located downstream of Leewood.

The diversion bunds will be designed to meet with 1 in 10 year ARI design criteria. Their design will seek to maintain existing water flow conditions and include features such as dissipation aprons at their outlets to reduce velocity and limit impacts such as erosion, scouring or increased flood risk.

A sub-catchment located to the north west of the ponds will be diverted by one of the diversion bunds, which will flow in a northerly direction along the site boundary, with grades between 0.07% and 0.35%. A larger

sub catchment to the south and west of the ponds will be diverted by another diversion bund, which will flow in a southerly direction along the site boundary, with grades between 0.1% and 0.25%.

Toe drains are proposed at the base of the pond embankments and will convey embankment runoff to onsite sedimentation ponds. The toe drains are designed to accommodate the peak flow from a 1 in 10 year ARI rainfall event, with a freeboard to cater for the 1 in 100 year flow event.

Two sedimentation ponds are proposed to the south west and north east of the Leewood ponds. These ponds will capture sediment laden runoff from the Leewood Pond embankments and allow treatment and settlement of sediment prior to the discharge of surface water to the natural catchment.

The sedimentation ponds have been designed in accordance with the *International Erosion Control Association of Australasia, Book 2, Best Practice Erosion and Sediment Control*. The properties of the soils used in the embankment of the Leewood ponds will determine the design of the sedimentation ponds, which at this stage are likely to be designed as “Type F” basins in accordance with this guide. Type F basins are used for the treatment of fine grained soils and do not require the use of flocculating agents.

The south west sedimentation pond will collect embankment runoff from the western and southern embankments, while run-off from the northern and eastern embankments will be directed into the sedimentation pond located to the north east of the Leewood ponds.

Spillways will be located on the western embankment of the Leewood ponds and are designed to discharge into the western embankment toe drain. A toe drain overflow will be located at the northern extent of the western toe drain to direct potential spillway discharge in excess of 10% AEP away from the Leewood ponds.

2.6.8 Chemical storage

Diesel fuel will most likely need to be stored at both Leewood and Bibblewindi to support the generators providing power during construction and operation.

Double-skinned (self-bunded) tanks will be used at both sites. It is anticipated that storage capacity of 6,000 litres will be required at Bibblewindi and less than 10,000 litres will be required at Leewood. The diesel will be stored and labelled in accordance with the *Work Health and Safety Regulation (2011).*

Chemicals used in drilling fluids that will be required for the HDD drilling of the Newell Highway and drilling of the water bore will not be stored on site for any length of time.

2.6.9 Rehabilitation & landscape works

The project area will be progressively rehabilitated at the completion of works. Rehabilitation and reinstatement works undertaken at the completion of construction will include flowline reinstatement, pond embankment stabilisation and bank reinstatement at Bohena Creek.

The reinstatement of the right of way following ploughing will require only minor works as discussed in section 2.6.3.6. Those parts of the flowline that require trenching (if any) will be reinstated as soon as possible following installation of the flowline. The right of way will be allowed to regenerate following completion of works.

The most significant land disturbance associated with the proposed activity will be the construction of the ponds. Topsoil removed during the construction of the ponds will be stockpiled in the short term on the

western boundary of the property to be spread onto the pond embankments to encourage vegetation growth. Any excess topsoil will be stored along the eastern boundary of Leewood.

A landscape buffer of a minimum 10 metre width is proposed along the eastern boundary of the Newell Highway, between the topsoil stockpiles and the property boundary. This is to reduce visual impacts of the Leewood ponds from the Newell Highway in the longer term. A buffer will be planted with local endemic species.

The Leewood ponds will be rehabilitated and all surface infrastructure decommissioned and removed once operational activities have ceased. As previously discussed, the proposed activity will operate for the duration of Santos' CSG exploration activities in PAL 2 and PEL 238. Any operation beyond the period of exploration would be subject to further environmental assessment and the approval of a petroleum production project. Should this not occur, the proposed activity would be decommissioned and the project area rehabilitated in accordance with the conditions of PAL 2.

The project area would be rehabilitated to its pre-operational condition (or better) and works would involve:

- Decommissioning existing infrastructure and removing temporary buildings and structures.
- Draining any remaining water from the ponds and disposing of it at an appropriately licensed facility.
- Treating any remaining sediment in the ponds and disposing of it at an appropriately licensed facility.
- Removing of the pond liner and disposing of it at an appropriately licensed facility.
- Undertaking earthworks to till gypsum into the soil and return the area to its original contours, including reinstatement of any drainage lines.
- Reseeding disturbed ground, where considered necessary and appropriate.
- Weed control.

Rehabilitation of those parts of the project area within the State forest will be undertaken in accordance with Schedule 3 (Plan of Management) of the Occupation Permit entered into with Forests NSW. This may include:

- Removal of foreign material.
- Deep ripping of any compacted areas.
- Scattering available woody debris across the site.
- Reinstate the original contour and drainage as far as practicable.
- Plant endemic early successional species such as wattle in the rip lines.
- Establish a photo-reference point and record revegetation progress at 3-month intervals.

A detailed rehabilitation strategy for the project area will be developed at the end of the life of the proposed activity.

2.7 Mitigation strategy

Santos has many years of experience in undertaking exploration activities for CSG. As a result, it has developed an extensive understanding of the steps and measures that should be taken to prevent or minimise its impact on the environment, human health and safety when undertaking exploration activities, including drilling activities.

Santos seeks to conduct its activities in a way that avoids and minimises potential impacts on the environment. This is based on developing a thorough understanding of the environment, and developing techniques tailored to specific locations. Santos' approach to sustainability seeks to do the following:

- Ensure that all employees and contractors receive appropriate training to fulfil their individual and environmental responsibilities.
- Proactively pursue the identification of all hazards and eliminate or, if not possible, manage the risk to as low as reasonably practicable.
- Establish annual environmental objectives and targets and implement programs to achieve them.
- As a minimum comply with relevant legal and other requirements.
- Incorporate environmental performance in the annual appraisal of employees and contractors and recognise accordingly.
- Implement strategies to minimise pollution, manage waste effectively, use water and energy efficiently and address relevant cultural heritage and biodiversity issues.

In addition, Santos uses compliance tracking and incident management systems throughout its operations. These internal systems will be applied to monitor performance against the commitments outlined in this REF.

A suite of mitigation measures and a statement of commitments have been developed, as outlined in sections 6.0 and 9.0 of this REF and are based on a hierarchy of impact avoidance and management of residual risks. The commitments will be applied when carrying out the proposed activity and are consistent with many of the principles used in the various guidelines in NSW in relation to biodiversity conservation, Aboriginal cultural and other heritage protection, pollution noise, dust, stormwater, sediment and erosion control, and waste management measures.

The following sections outline the strategies to be employed by Santos and contractors during the proposed activity to ensure appropriate management of water, groundwater, noise and waste.

2.7.1 Water source protection strategy

2.7.1.1 Surface water protection

Potential surface water impacts and mitigation measures are identified in section 6.1.3 of this REF.

The site management practices will minimise the risk of pollutants or contaminants being discharged to the environment. Drilling mud, drill cuttings, and chemicals, fuels and oils, will be contained in surface tanks, lined pits, bins and other appropriately bunded areas to ensure that surface runoff is clean.

As outlined in 2.6.7.1, erosion and sediment control associated with the proposed activity will be undertaken in accordance with existing Santos standards and industry best practice. Prior to commencement of work an assessment of the various site conditions will be undertaken by the Principal Contractor(s), in consultation with Santos. The Principal Contractor(s) will be required to submit an erosion and sediment control management plan for approval by Santos. The site condition assessment will ensure that erosion and sediment control is managed to the highest possible standard as the works are undertaken. Each activity associated with the proposed activity will be considered on an individual basis to establish the most appropriate methods of control.

The site will be regularly inspected by an appropriately qualified and/or experienced environmental professional during site establishment, construction and rehabilitation activities, to ensure that environmental protection measures are effective and that risks to surface waters from pollution are mitigated.

2.7.1.2 Groundwater protection

Potential groundwater impacts and mitigation measures are identified in section 6.1.2 of the REF.

Drilling operations for the water bore and HDD crossing will be in accordance with accepted industry practices and in accordance with the processes outlined in this REF. A driller licensed with the appropriate qualifications under the National Water Drillers Licensing Accreditation will be present to supervise the drilling though the aquifers and as required by regulations only to the limit of their technical capabilities in regards to water well drilling (unless exemptions are obtained). This will ensure that the appropriate knowledge of water legislation and regulation in NSW and technical skills are employed to avoid impacts to groundwater sources.

An overall water monitoring program, inclusive of groundwater (as per section 2.6.5.5 of the REF) will be developed and implemented for the Leewood Ponds during the detailed design process.

2.7.2 Waste management strategy

The proposed activity will generate a number of waste streams. The main waste types and estimated volumes generated during site establishment, construction and rehabilitation activities are identified in Table 2-17.

Table 2-17 Estimated waste volumes

Waste	Estimated volume
General site waste, such as packaging materials, excess liner and chemical/fuel/oil containers and domestic waste	Approx 200 m^3
Sewage waste	1.5 m^3/month
Mud contaminated cement slurry	Approx 50 m^3
Drilling mud	55,000 L (345 barrels)

General site waste and mud contaminated slurry will be segregated according to their classifications under the *Waste Classification Guidelines Part 1: Classifying Waste* (DECCW 2009) and stored in bins or skips on site. These wastes will be removed from the site at the completion of construction for disposal or recycling at an appropriately licensed waste management or recycling facility.

Sewage waste will be removed from the site, by a licensed contractor for treatment and disposal, as required.

At the completion of drilling at the HDD crossing and water bore, drilling mud will be removed from the site by a contractor licensed under the *Protection of the Environment Operations Act 1997* (POEO Act) to transport trackable wastes, with the appropriate waste transport certificates. The drilling mud will be taken to an appropriately approved and licensed facility for reuse or disposal.

Other waste management measures are identified in section 6.1.6.

2.7.3 Noise management strategy

The proposed activity will generate noise, particularly during site preparation and construction activities, which may occur up to 11 hours per day, seven days per week. The noise management approach will include:

- ensuring earthworks contractors have considered the location of the closest sensitive receivers in the

development of the earthworks plan

- consultation with potentially affected receivers
- monitoring of noise impacts
- implementation of feasible and reasonable work practices
- complaint management and response.

The potentially affected noise receivers, which include adjoining landowners, will be notified of the proposed activity prior to commencing works. This will include details of the timing and duration of noise generating activities.

Santos will aim to maintain noise levels at the rating background level (RBL) plus 10 dB(A) during standard working hours (7am to 6pm Monday to Friday and 8am to 1pm Saturday) and the RBL plus 5 dB(A) outside of standard working hours. The RBL at the site is assumed to be no more than 30 dB(A) based on background monitoring undertaken nearby.

Noise monitoring will be conducted at the commencement of construction activities to confirm noise levels. Where noise levels exceed the RBL plus 10 dB(A) during standard working hours, or the RBL plus 5 dB(A) outside of standard working hours, feasible and reasonable work practices will be implemented to reduce noise levels. Such practices may include:

- training contractors to operate plant and equipment in ways that minimise noise generation
- scheduling deliveries to occur during day time hours where practicable
- inspecting and maintaining equipment to ensure it is in good working order
- reducing throttle setting and turning off equipment when not in use.

In the event of a noise complaint, the source of the noise will be investigated. Where necessary, Santos will offer to conduct noise monitoring from the proposed activity at the affected receivers house. If it is determined that noise levels are unacceptable, further feasible and reasonable work practices or mitigation measures will be implemented.

2.8 Access arrangements

Leewood is a Santos owned property and therefore no access agreement is required for works on this land.

Works within the Pilliga State Forest will be undertaken in accordance with the Occupation Permit issued under section 31 of the *Forestry Act 1916.*

2.9 Other approval requirements

A number of other approvals are likely to be required for the proposed activity. These are discussed in detail in section 5.0 and summarised below.

- *Water Management Act 2000 (WMA)*: drilling of the proposed water bore will require a water supply works approval and water use approval in accordance with sections 89 and 90 of the WMA. A separate application for this has been submitted to NSW Office of Water (NOW). An aquifer access licence will also be required. NOW is not issuing aquifer access licences for the target water source. Santos will transfer existing licences to the works approval (once received) and source others within the market if required.
- *Dams Safety Act 1978:* the Leewood ponds are considered a prescribed structure under this Act. The pond designs have been referred to the Dam Safety Committee (DSC). Construction of the ponds cannot

commence until such time as the DSC have provided their approval.

- *Forestry Act 1916:* those works proposed in the Pilliga State Forest can only be undertaken in accordance with an Occupation Permit issued under section 31 of the *Forestry Act 1916.* An Occupation Permit is currently in place.
- *Roads Act 1993:* approvals under the *Roads Act 1993* will be required for upgrades to the intersection at Old Mill Road and Newell Highway and the HDD crossing of the Newell Highway.

3.0 THE PROJECT AREA

As discussed in section 2.2, the project area comprises three separate components; Leewood, the right of way and Bibblewindi. Figure 3-1 illustrates the extent of the project area.

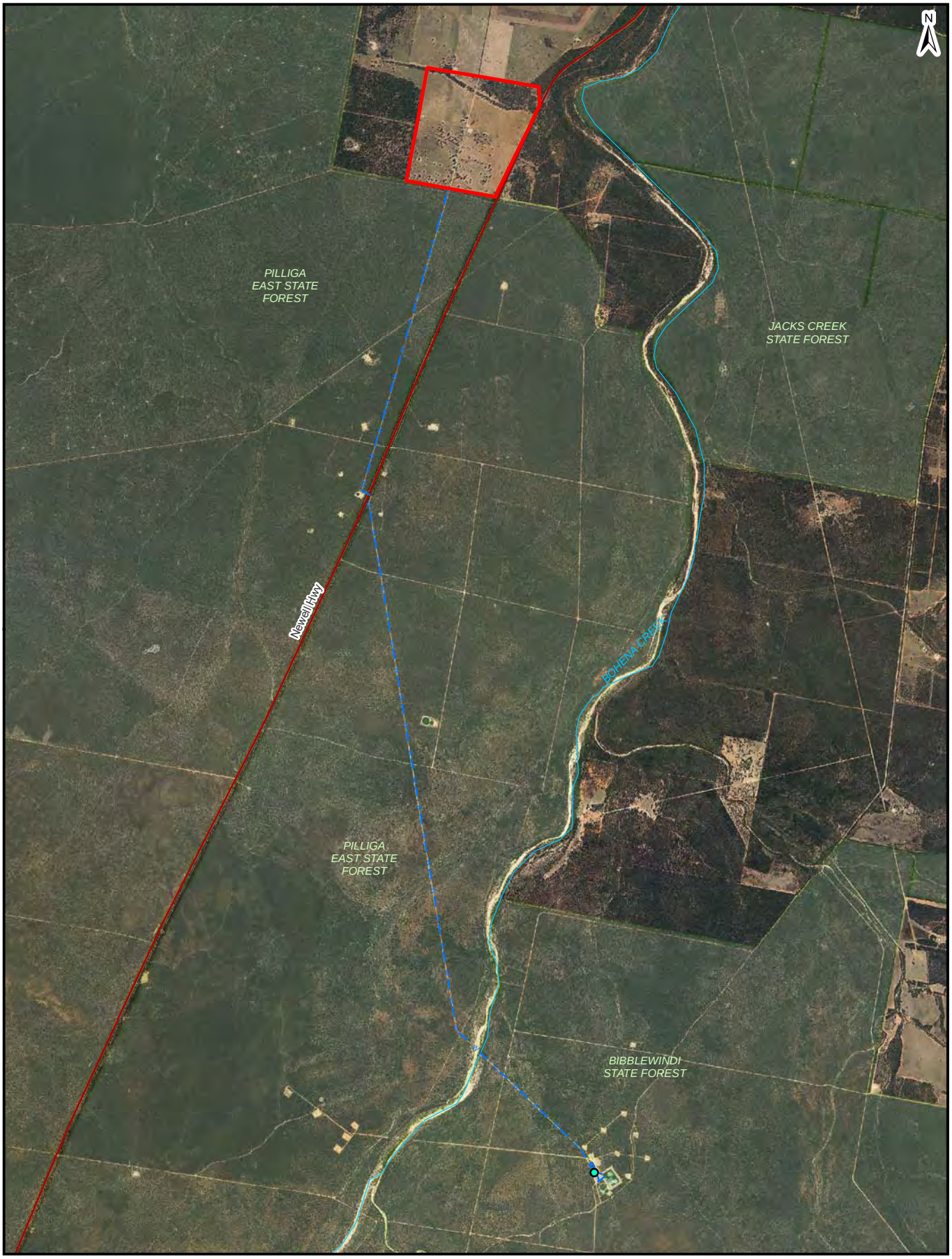
Leewood is formally described as Lot 1 DP 771141. A detailed survey of Leewood is provided in Appendix 4.

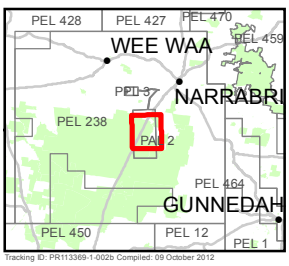
The proposed works at Bibblewindi are located within the existing water treatment plant enclosure in the Pilliga State Forest and to the west of Bibblewindi Pond 3. Coordinates (MGA) of a base station located on the south western corner of Bibblewindi Pond 3 are E753983.103 and N6607986.671 (refer Appendix 4 for survey detail).

The coordinates of the proposed flowline route along the existing right of way are detailed in Table 3-1 below and presented in the survey in Appendix 4.

Table 3-1 Proposed flowline route coordinates (coordinates in MGA)

Station	Easting	Northing
A (Bibblewindi)	E753652	N66605037
B	E753746	N6607061
C	E753777	N6607793
D	E753729	N6608008
D1	E753811	N6608072
E	E753675	N6608265
E1	E753747	N6608316
F	E753687	N6608317
F1	E 753728	N6608346
G	E753551	N6608544
H	E751793	N6610223
I	E751153	N6614023
J	E750715	N6616721
K	E750543	N66117766
L	E750447	N6617766
M	E750447	N6618543
N	E751176	N6620378
O (Leewood)	E751698	N6622177





Tracking ID: PR113369-1-002b Compiled: 09 October 2012

N

1 0 1 2

Kilometres

APPROX SCALE 75,000 @ A4

GDA 1994 MGA Zone 55

Disclaimer: While all reasonable care has been taken to ensure the information contained on this map is up to date and accurate, no guarantee is given that the information portrayed is free from error or omission. Please verify the accuracy of all information prior to use.

DATA SOURCES

Base topographic data © Commonwealth of Australia (Geoscience Australia) 2006.

LEGEND

Leewood Water Treatment Facility

Bibblewindi

Flow Line (Right of Way)

Leewood

Highway

Watercourse

State Forest

RPS

FIGURE 3-1

The Project Area

3.1 Leewood

Leewood is a Santos owned property, which is predominantly cleared of vegetation and has been used in the past for grazing activities. Plates 3-1 to 3-6 illustrate Leewood. It is currently accessed directly off the Newell Highway, towards its northern boundary and covers an area of approximately 246 hectares.

3.2 Right of way

The 16 kilometre right of way comprises a corridor approximately 12 metres wide, which was previously cleared as part of the installation of a gas flowline between Bibblewindi and the Wilga Park power station (located to the north of Leewood). The right of way is situated within State forest between Bibblewindi and Leewood.

The existing gas flowline is constructed from fibreglass, 250 mm in diameter and located at approximately 1200 mm depth. Warning signage exists along the route providing details of the gas flowline. Plates 3-7 to 3-10 illustrate the right of way.

3.3 Bibblewindi

Bibblewindi is an existing Santos site which is partially operational. The area of Bibblewindi to be occupied by the tank and other surface infrastructure as part of the proposed activity is a cleared gravel area to the north of the existing water treatment plant (refer Plates 3-11 to 3-12). Water treatment facilities at Bibblewindi have been decommissioned, separate to the proposed activity.

Bibblewindi contains the following operational infrastructure:

- gas flare
- gas transfer piping
- fuel gas conditioning skid and generators
- office and ablutions facility.



Plate 3-1 Leewood – view east along northern boundary



Plate 3-2 Leewood – vegetation in north eastern portion of lot



Plate 3-3 Leewood – view east along southern boundary



Plate 3 4 Leewood – view south east from centre of lot



Plate 3-4 Leewood – dam located in south eastern corner of lot



Plate 3-5 Leewood – dam located in central portion of lot



Plate 3-6 View north along right of way, from a location north of Bohena Creek



Plate 3 8 Typical access track within State Forest



Plate 3 9 Right of way – view south along existing route at the Newell Highway crossing (east side)



Plate 3-7 Location identified for HDD rig at the Newell Highway (west side)



Plate 3-8 Bibblewindi – area identified for pump station, tanks and other surface infrastructure



Plate 3-9 Bibblewindi – access into the Bibblewindi Water Treatment Plant

4.0 EXISTING ENVIRONMENT

4.1 General description

4.1.1 Topography

Leewood is relatively flat, with RLs ranging from 248.78 metres AHD along the eastern boundary (central section), to 244.79 metres AHD along the eastern boundary (northern section). Typical grades across the property are approximately one in 400. Refer Survey Plan (Appendix 4).

Leewood slopes generally towards a drainage feature from the south east to north west. There is also a slight depression in the land surface at the north east of the site along the eastern boundary.

Bibblewindi (excluding those areas occupied by the ponds), being part of a larger developed site, is flat with two relatively small mounds of dirt (up to two metres in height) at the western section. RLs are approximately 279.0 metres AHD across the remainder of the area.

The right of way is relatively flat with a maximum difference in altitude of about 31.7 metres. The right of way generally slopes from south to north with the highest point located at the far southern section and the lowest point located at the far northern section. Detailed elevation data is illustrated on the flowline section diagrams in Appendix 1.

4.1.2 Climate

The Bureau of Meteorology (BoM) weather station considered to be most representative of the subject locality is Narrabri West Post Office. Narrabri Airport AWS is the closest station with recent temperature statistics (Narrabri West Post Office has statistics up to 2002). The local climate is temperate with higher rainfall during the summer months. The average daily maximum temperature is 26.5°C, while the average daily minimum temperature is around 11.7°C (BoM, 2012). Annual rainfall is 578.4 mm and is known to range between 297.4 mm (lowest record) and 1012.1 mm (highest record).

As shown in Table 4-1, based on mean temperature records the warmest month is January and the coolest month is July. October receives the greatest rainfall and April the least.

Table 4-1 Mean climate data

Statistic	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Mean Max Temp (°C)	34.5	33.5	30.8	26.9	22.4	18.4	17.7	20.0	23.9	27.7	30.5	32.0
Mean Min Temp (°C)	20.1	19.9	16.2	12.3	6.9	5.6	3.9	4.9	8.3	12.2	16.4	18.1
Mean Rainfall (mm)	68.0	70.3	27.4	28.5	24.1	53.0	33.9	26.5	37.0	40.5	85.6	85.6

4.1.3 Vegetation

The north eastern portion of Leewood is vegetated. The remainder has been cleared and exists as grassland with a few paddock trees. Leewood is surrounded by State forest to the west, south and east (beyond the Newell Highway).

The right of way occurs across predominantly derived vegetation communities as a result of previous clearing for the existing gas flowline.

Bibblewindi is an existing cleared area of land within the existing Bibblewindi Water Management Facility. It consists of a gravelled surface with no vegetation.

Ecological field surveys were undertaken at Leewood between 30 April and 11 May 2012 and again on 19 September 2012. Field surveys were also undertaken along the right of way between 24 and 25 July 2012. No field investigations of Bibblewindi were necessary as it is a disturbed, gravelled site with no vegetation. The findings of these surveys are contained within the ecological assessment in Appendix 5 and are presented in Figure 4-1 and Figure 4-2. The following sections describe the vegetation communities at Leewood and right of way in further detail.

4.1.3.1 Leewood

Two vegetation communities were observed within Leewood, as discussed below.

(1) Pilliga Box – White Cypress Pine Grassy Open Woodland on Alluvial loams, Darling Riverine Plains and Brigalow Belt South

This tall open woodland is dominated by Pilliga Box (*Eucalyptus pilligaensis*) with other canopy species such as White Cypress Pine (*Callitris glaucophylla*), Narrow-leaved Ironbark (*Eucalyptus crebra*) and Grey Box (*Eucalyptus microcarpa*) occurring throughout. The sub-canopy layer was comprised of Bulloak (*Allocasuarina leuhmannii*) and Deane's wattle (*Acacia deanei*). This community lacked a defined shrub layer. The ground cover consisted mostly of native grasses including Tall Chloris (*Chloris ventricosa*), Bristly Lovegrass (*Eragrostis setifolia*), Purple Lovegrass (*Eragrostis lacunaria*), Hairy Panic (*Panicum effusum*) and Slender Bamboo (*Austrostipa verticillata*). Herbs and forbs in this community were scarce due to ground compaction from stock.

The condition of this community varied throughout the site. The remnant patches of intact Pilliga Box woodland were considered to be in moderate condition with species diversity at a higher level. These remnant patches are located in the north of the site and along the access road to the site. The poor conditioned areas of this woodland are those that now exist as 'paddock' where stock graze and only a few scattered canopy (or paddock) trees remain. In the paddock areas a shrub layer is almost nonexistent and the ground layer is largely a monoculture of only a few grass species.

This community is not commensurate with any Threatened Ecological Communities (TEC) listed under the *Threatened Species Conservation Act 1995* (TSC Act) or *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

(2) Brigalow Woodland

This community is a low woodland with a dense canopy dominated by Brigalow (*Acacia harpophylla*). Occasionally Pilliga Box (*Eucalyptus pilligaensis*) and Belah (*Casuarina cristata*) occur on the edges of this community. The shrub and ground layers were sparse but consisted of species such as *Eremophila* species, *Sclerolaena* species, Small-leaf Bluebush (*Maireana microphylla*), Nardoo (*Marsilea hirsuta*) and Caustic Weed (*Chamaesyce drummondii*).

This community is considered to be in poor-moderate condition. The soil is compacted due to grazing, restricting the growth of understorey and ground layer species. As a result, the fauna guild in which it attracts is limited. The dense array of Brigalow is healthy however its growth appears stunted likely due to poor soil quality.

This community is commensurate with the TEC '*Brigalow within the Brigalow Belt South, Nandewar and Darling Riverine Plains Bioregions'* under the TSC Act and 'Brigalow (*Acacia harpophylla* dominant and co-dominant)' under the EPBC Act. This is discussed further in section 4.3.1.1.

A total of six weed species were also recorded on Leewood. One of these species, Tiger Pear (*Opuntia aurantiaca*), is considered to be a class 4 noxious weed in NSW.

4.1.3.2 Right of way

Little vegetation exists within the right of way due to previous clearing. It predominantly comprises derived vegetation communities as a result of this clearing. Three vegetation communities were observed within the right of way, as discussed below.

(1) Ironbark shrubby woodlands of the Pilliga area, Brigalow Belt South

This community is a shrubby open woodland with an open understorey dominated by one or more of the following: Narrow-leaved Ironbark (*Eucalyptus crebra*), Brown Bloodwood (*Corymbia trachyphloia ssp. amphistomatica*), Dirty Gum (*E. chloroclada*) and White Cypress Pine (*C. glaucophylla*). Small trees and shrubs such as Bulloak (*Allocasuarina luehmannii*), Mudgee Wattle (*Acacia spectabilis*), Deane's Wattle (*Acacia deanei*) and Wedge-leaf Hop-bush (*Dodonaea viscosa*) are often common. The ground layer includes wiregrasses (*Aristida spp*.), Speargrass (*Austrostipa scabra*), Mulga Fern (*Cheilanthes sieberi*), Brown's Lovegrass (*Eragrostis brownii*), Hairy Panic (*Panicum effusum*), Flannel Flower (*Actinotus helianthi*), Pomax (*Pomax umbellata*) and Star Goodenia (*Goodenia rotundifolia*).

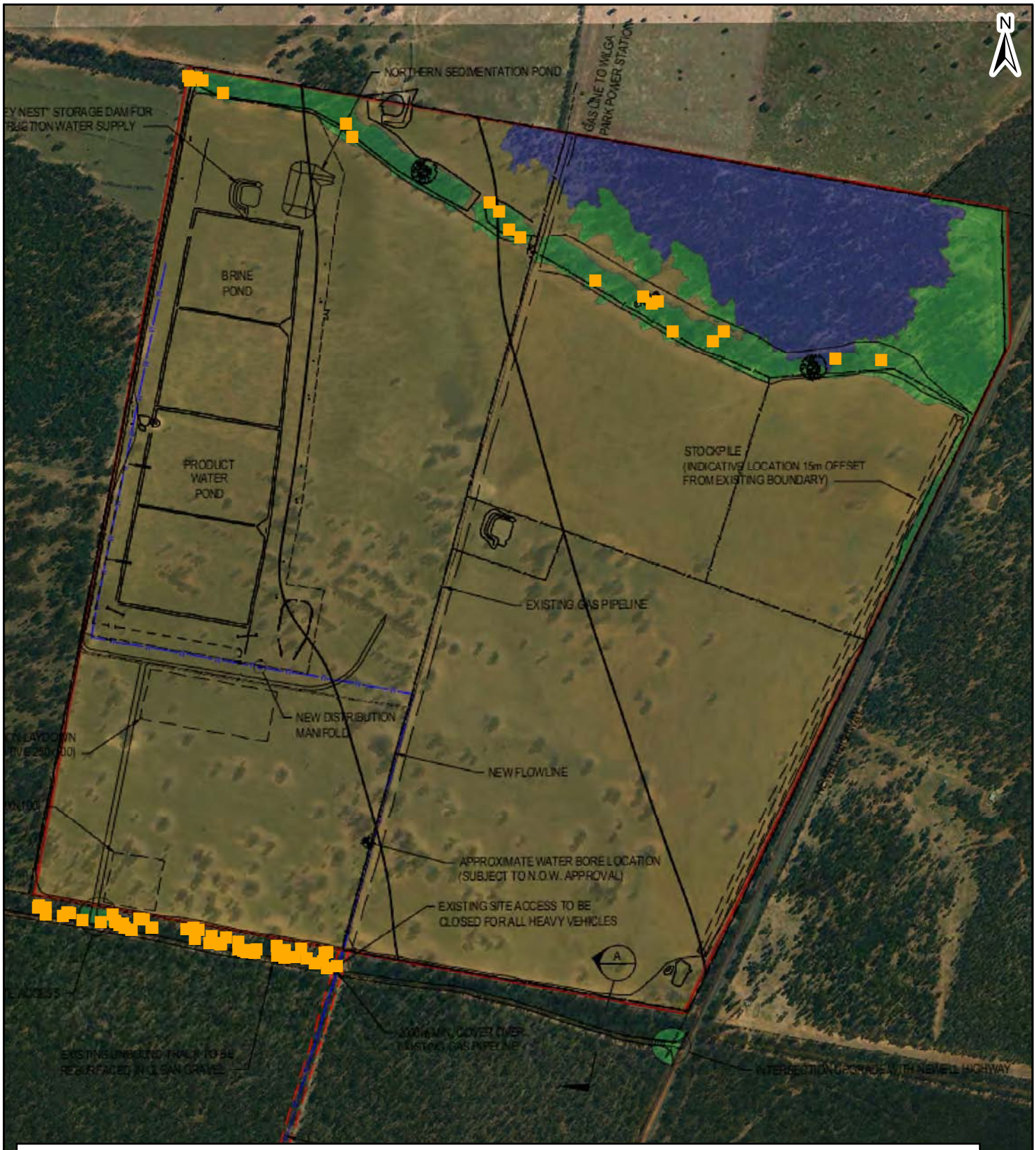
Variants of this community changed in condition from moderate to good condition throughout the right of way. The moderate conditioned sections were found to contain limited resources in the form of logs, termite mounds, and ground debris and also lacked the floral structural diversity required to host an abundant fauna guild. The majority of the variants lacked mature canopy trees, suggesting previous disturbance most likely in the form of clearing. This community is not commensurate with any TEC listed under the TSC or EPBC Acts.

(2) Blakely's Red Gum Riparian Woodland of the Pilliga Outwash, Brigalow Belt

This tall open woodland has a canopy dominated by Blakely's Red Gum (*Eucalyptus blakelyi*) often occurring with Rough-barked Apple (*Angophora floribunda*) and White Cypress Pine (*Callitris glaucophylla*).The shrub layer is sparse but dense occasionally consisting of Common Tea-tree (*Leptospermum polygalifolium*), Narrow-leaved Bottlebrush (*Callistemon linearis*) and Deane's Wattle (*Acacia deanei*). The ground layer often includes segments of bare sand but also contains grass and forbe species such as Blady Grass (*Imperata cylindrica*), *Juncus subsecundus*, Wiregrass (*Aristida ramosa*), Rough Saw-sedge (*Gahnia aspera*) and Mat-rushes (*Lomandra longifolia* and *L. filiformis*). Exotic species such as Cobbler's Pegs (*Bidens pilosa*) and Dandelion (*Taraxacum officinale*) were also recorded in this community.

This community is considered to be in moderate condition due to the presence of a young stand of canopy trees and a lack of floristic structural diversity within the ground and shrub layers.

This community is commensurate with the Critically Endangered Ecological Community '*White Box - Yellow Box - Blakely's Red Gum Grassy Woodlands and Derived Native Grasslands*' (EPBC Act) and '*White Box Yellow Box Blakely's Red Gum Woodland'* (TSC Act). This is discussed further in section 4.3.1.1.



Client: Santos

Compiled by: Glenn Jeffs | Date: 03/10/2012

Approved by: Matt Doherty | Date: 03/10/2012

0 105 210 420 m

Datum: GDA94

RPS

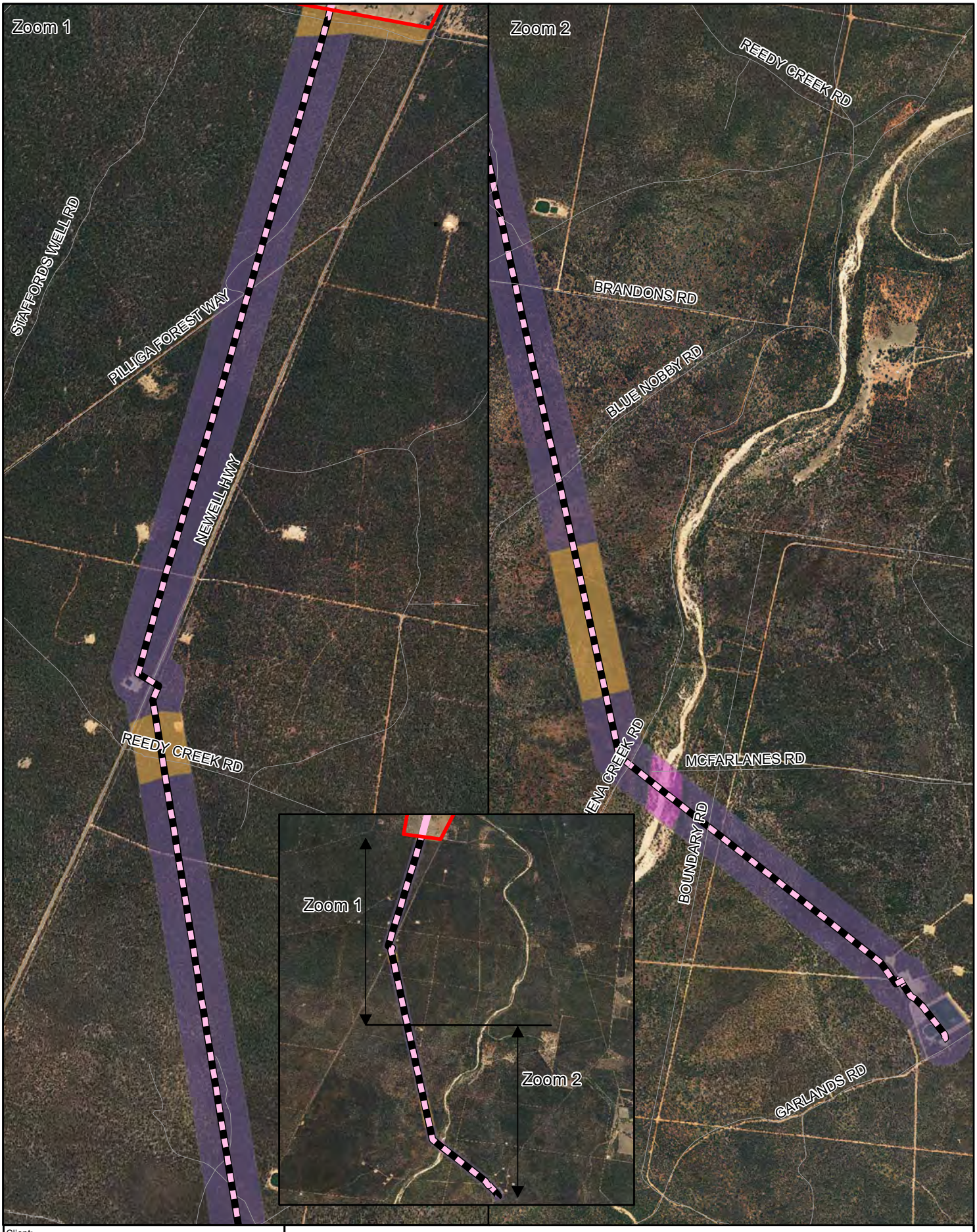
Leewood Vegetation Communities and Habitat trees

Figure 4-1

Project: Leewood - Produced Water and Brine Management Project (Phase 1).

Source:
Bing Maps 2011
Client provided 2012
RPS 2012
LPMA 2007

Tracking number: JN113369-6 03/10/2012 *Path: J:\JOBS\Santos\All Jobs\113369 Truckstop 2\10- Drafting\ArcGIS_map_documents\ref_figures\114765_Figure 4-1.mxd*



Client: Santos	**Right of Way - Vegetation Communities**
Compiled by: Glenn Jeffs — Date: 02/10/2012	
Approved by: Matt Doherty — Date: 02/10/2012	**Figure 4-2** — Project: Leewood - Produced Water and Brine Management Project (Phase 1).

0 330 660 1,320 m

Datum: GDA94

RPS

Source:
Bing Maps 2011
Client provided 2012
RPS 2011

Legend

- Leewood
- Existing Pipeline
- Right of Way
- Local Road
- Blakely's Red Gum riparian woodland of the Pilliga Outwash, Brigalow Belt South Bioregion
- Ironbark shrubby woodlands of the Pilliga area, Brigalow Belt South
- Pilliga Box - Poplar Box- White Cypress Pine grassy open woodland on alluvial loams, Darling Riverine Plains and Brigalow Belt South

(3) Pilliga Box – White Cypress Pine Grassy Open Woodland on Alluvial loams, Darling Riverine Plains and Brigalow Belt South

This tall open woodland is dominated by Pilliga Box (*Eucalyptus pilligaensis*) with other sub-canopy species such as White Cypress Pine (*Callitris glaucophylla*) and Bulloak (*Allocasuarina leuhmannii*) occurring throughout. This community lacked a defined in the shrub layer which when present it was dominated by Deane's wattle (*Acacia deanei),* a Wattle (*Acacia caroleae*) and Narrow-leaved Bottlebrush *(Callistemon linearis)*. The ground cover consisted mostly of native grasses including Purple Wiregrass (*Aristida ramosa*), Bristly Lovegrass (*Eragrostis setifolia*), Purple Lovegrass (*Eragrostis lacunaria*), Hairy Panic (*Panicum effusum*) and Slender Bamboo (*Austrostipa verticillata*).

The condition of this community is considered to be relatively intact and in moderate condition with regards to species diversity and patch health.

This community is not commensurate with any TEC listed under the TSC or EPBC Acts.

A total of eight weed species were recorded along the right of way. One of these species, namely Prickly Pear (*Opuntia stricta*), is considered to be a noxious weed in NSW.

Bohena Creek

Bohena Creek is an ephemeral waterway and at the time of field survey, did not contain any visible or measurable base flows. There are no permanent or temporary pools within the impacted reach with any potential to contain aquatic species.

4.1.4 Soils

A geotechnical investigation of Leewood was undertaken by Golder Associates between 30 July 2012 and 4 August 2012 (Appendix 11). This investigation included the excavation of 39 test pits in the north western portion of the lot in the area where the ponds are proposed to be located. Test pits were excavated with a 24 tonne excavator to a depth of approximately five metres or practical refusal. The results from these investigations are as follows:

- The subsurface profile encountered during investigations generally comprised of a layer of topsoil, a layer of silty clay/silty sandy clay underlain by residual soils of extremely weathered sandstone.
- Groundwater was not encountered in any of the test pits to the excavated depths.
- The topsoil consistency was generally soft and was encountered from the surface to a typical depth of 0.2 metres. The topsoil thickness varied between 0.1 metres and 0.4 metres. The topsoil was generally moist to wet.
- Silty clay/silty sandy clays were encountered below sandy clayey silt throughout the entire investigation area. The materials were encountered at depths between 0.2 metres to about 0.5 metres below the surface and extended to depths of up to 3.7 metres beneath the surface. The sand content in the material gradually increased with depth.
- Silty sand, silty clayey sand and clayey silty sand were encountered beneath the silty clay/silty sandy clay layer as the sand content increased at depths of between 1.6 metres and 3.7 metres below ground surface.
- Practical refusal occurred in a number of test pits at depths between 2.7 metres and 4.9 metres. Where practical refusal was encountered, the depth to refusal was generally found to decrease from the north to the south of site. Practical refusal depths in the area of the proposed product pond (where encountered) generally varied between 2.7 metres and 4.0 metres. It was inferred that refusal occurred on highly weathered sandstone.

Soil surveys were undertaken by Geoff Cunningham Natural Resource Consultants for the Narrabri Coal Seam Gas Utilisation Project, which covered the areas of Bibblewindi and the right of way. The relevant results from these investigations are discussed below.

The surveys identified a mosaic of four Soil Mapping Units (SMUs) within the right of way. These were:

- SMU 1 – Deep Sandy Soils
- SMU 2 – Duplex Soils
- SMU 3 – Gilgai Soils
- SMU 4 – Brigalow and Clay Soils where Brigalow formerly existed

Soils were found to exhibit the following characteristics:

- Most soils contained relatively negligible levels of gravel.
- Soils showed varying levels of dispersibility from slight to very high.
- Many of the subsoils contained moderate to high levels of clay and were considered to be dispersive. On this basis, the erosion potential is likely to be high for all areas of exposed subsoil.
- Soils showed medium linear shrinkage potential.
- Salinity of subsoils ranged from non-saline to moderate saline.
- Some of the lower layers in some SMUs were very alkaline and outside the range acceptable for plant growth, while in others the lowest horizons were relatively acid.

The soils at Bibblewindi and along the right of way were found to be generally stable due to a good cover of litter, groundcovers, shrubs and trees.

A search of the contaminated land record database maintained by the Office of Environment and Heritage (OEH) indicated records of seven contaminated sites within the Narrabri Shire LGA. None of these sites are located near the proposed activity. Contaminants may be present within the soil at Leewood as a result of hydrocarbon spills or use of pesticides associated with its former use for agricultural purposes.

Some contamination at Bibblewindi is known to have occurred in the past as a result of a water release incident at the Bibblewindi Water Management Facility. A soil investigation of the affected area was undertaken by Golder Associates in February 2012 to assess the extent of the impacts from the incident. The investigation found that the average concentration of metals, TPH/TRH, pH, nutrients and salts in samples collected from the affected area were generally greater than (or in some cases equal to) concentrations in background samples. The impacts of the water release were generally found to decrease with depth. Santos is currently in the process of rehabilitating this land, in consultation with DRE.

4.1.5 Land capability and agricultural land suitability

An Agricultural Impact Statement (AIS) has been prepared for the proposed activity (Appendix 6). The AIS focuses on Leewood given the remainder of the project area is located within State forest.

Draft Inherent Soil Fertility and Draft Land and Soil Capability (LSC) mapping prepared by OEH for the Upper Hunter and New England North West Strategic Regional Landuse Areas was reviewed for Leewood as part of the AIS.

Leewood was described as having moderately low inherent soil fertility and was assigned LSC Class 5. Land in LSC Class 5 is described as having severe limitations and is not capable of sustaining high impact land uses except where resources allow for highly specialised land management practices to overcome

limitations (e.g. high value crops). Lower impact land uses (e.g. grazing) can be managed by readily available practices.

The *New England North West Strategic Regional Land Use Plan* (SRLUP) includes Strategic Agricultural Land (SAL) mapping. SAL is highly productive land that has both unique natural resource characteristics as well as socio-economic value. Biophysical SAL is a particular category of SAL which is defined as land with the best quality landforms, soil and water resources which are naturally capable of sustaining high levels of productivity with minimal management practices. Leewood and the broader surrounding areas are not classified as biophysical SAL.

4.1.6 Air

The air quality in the vicinity of the project area is influenced by the common land use practices in the area, including agricultural production and forestry operations and is therefore representative of a rural environment. Fugitive dust and exhaust emissions from vehicles and machinery, particularly on dirt roads, and smoke from bushfires influence the local air quality of the project area.

4.1.7 Geology

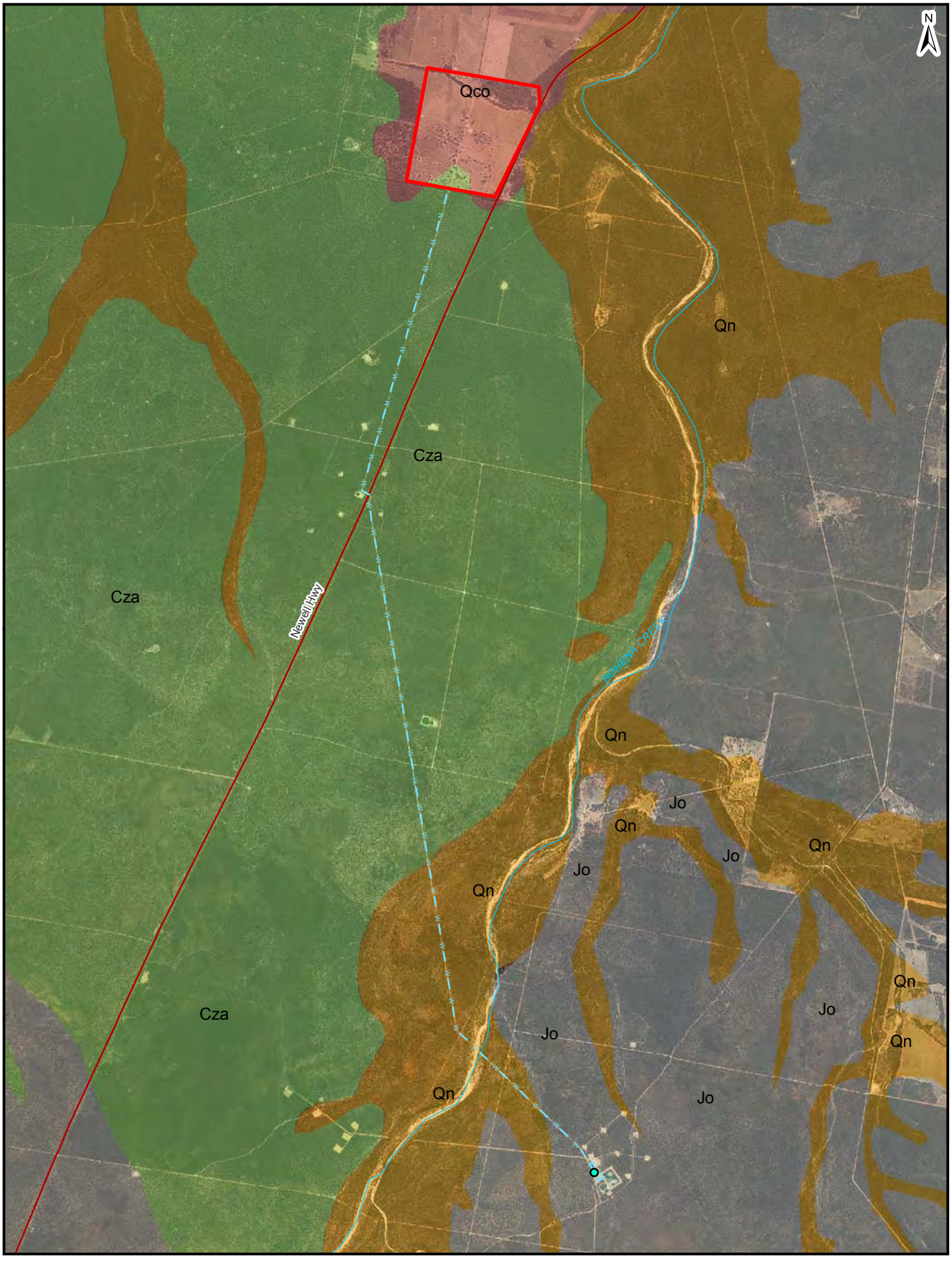
The project area is located in the central portion of the Gunnedah Basin where Jurassic and Cretaceous Surat Basin sediments unconformably overlie Permo Triassic Gunnedah Basin sediments (Figure 4-3). The Gunnedah Basin covers an area of more than 15,000 square kilometres and is defined in structural terms as being bounded to the east by the Hunter Mooki Thrust Fault System and the New England Fold Belt, and to the west by the Lachlan Fold Belt onto which the Gunnedah Basin sediments gradually onlap.

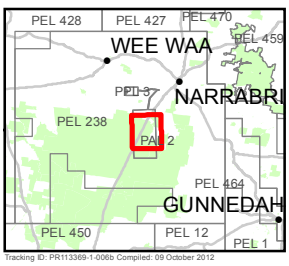
Metavolcanics, meta-sediments and minor ignimbritic volcanics of the Lachlan Fold Belt form much of the basement under the western part of the Gunnedah Basin and the Rocky Glen Ridge. Widespread Late Carboniferous and Early Permian mafic lavas were succeeded by paralic-lacustrine environments with sediments of the Leard and Goonbri Formations deposited. This was followed by low energy fluvial conditions in which the coal measures of the Maules Creek Formation were deposited.

An Early Permian transgression then inundated the area and deposited shallow marine para-conglomerate, sandstone and siltstone of the Porcupine and lower Watermark Formations and culminating in the deposition of the upper Watermark Formation marine claystone.

The Black Jack Formation was deposited in a major delta system with a dominantly northeast sediment source from the New England region. A minor westerly provenance associated with the emergence of the Lachlan Fold Belt is also apparent. The New England provenance of the lower Black Jack Formation resulted in generally quartz lithic and arkosic sandstones with limited reservoir potential. The sandstones were deposited in a lower delta plain/marginal marine environment.

Deposition of the lower Black Jack Formation sediments was followed by an episode when marine conditions affected the Gunnedah Basin, with the deposition of sandstones of poor to fair reservoir quality. Deposition of the western derived quartzose sandstones was followed by very widespread coal swamp conditions depositing the thick Hoskissons Coal seam that is readily correlated across the Basin. The thickness of the Hoskissons Coal ranges from less than one metre in the west to more than 12 metres in the north and to 18 metres in the south-east.





Tracking ID: PR113369-1-006b Compiled: 09 October 2012

N

1 0 1 2

Kilometres

APPROX SCALE 75,000 @ A4

GDA 1994 MGA Zone 55

Disclaimer: While all reasonable care has been taken to ensure the information contained on this map is up to date and accurate, no guarantee is given that the information portrayed is free from error or omission. Please verify the accuracy of all information prior to use.

DATA SOURCES

Base topographic data © Commonwealth of Australia (Geoscience Australia) 2006. Geology digitised from Santos mapping.

LEGEND

Leewood Water Treatment Facility

- Bibblewindi
- Flow Line (Right of Way)
- Leewood
- Highway
- Watercourse

Geology

- Cainozoic - sand plain
- Keelindi beds
- Quaternary - alluvium
- Quaternary - colluvium

RPS

FIGURE 4-3

Geology

Late Permian volcanic activity and tectonism to the east resulted in renewed deposition of more lithic sediments with an easterly provenance and consequently the upper Black Jack Formation has only limited potential for reservoir development. A period of tectonism, uplift and erosion of variable intensity throughout the Basin followed Late Permian deposition. The end of the Permian is marked by a major regional unconformity.

The Digby Formation is marked by a basal conglomerate that has been derived from the New England Fold Belt. This unit thickens towards the east and onlaps onto the older sediments and basement to the west. Reservoir quality is generally poor due to a tight sandstone matrix. Thick near-shore marine shales of the overlying Napperby Formation are considered a potential seal to any hydrocarbons reservoir in the Digby Formation.

Unconformably overlying the Napperby, the Jurassic age Purlawaugh Formation is fluvial dominated, generally consisting of thinly interbedded carbonaceous claystone, siltstone and thin coal seams. There can be abundant carbonaceous fragments with thin beds of flint and clay. Within the Purlawaugh Formation there is development of intra-formational aquitards deposited in meandering river/lacustrine system.

The Pilliga formation conformably overlies the Purlawaugh Formation. The Pilliga Formation is described as medium to very coarse grained, well sorted, angular to subangular quartzose fluvial sandstone. Minor interbedded mudstone, siltstone and fine grained sandstone and coal. The Pilliga Formation is the major aquifer in the northern Gunnedah Basin.

4.1.8 Availability of services

Various existing services are located both below and above ground within or adjacent to the project area. As discussed in section 2.6.3.2, the location, type and depth, or height, of all existing services will be confirmed and marked out in the interests of safety and protection of existing services prior to construction. Impacts to these services are not anticipated as a result of the proposed activity. Services include:

- electrical
- water
- gas
- compressed air
- fibre optic cable (Optus).

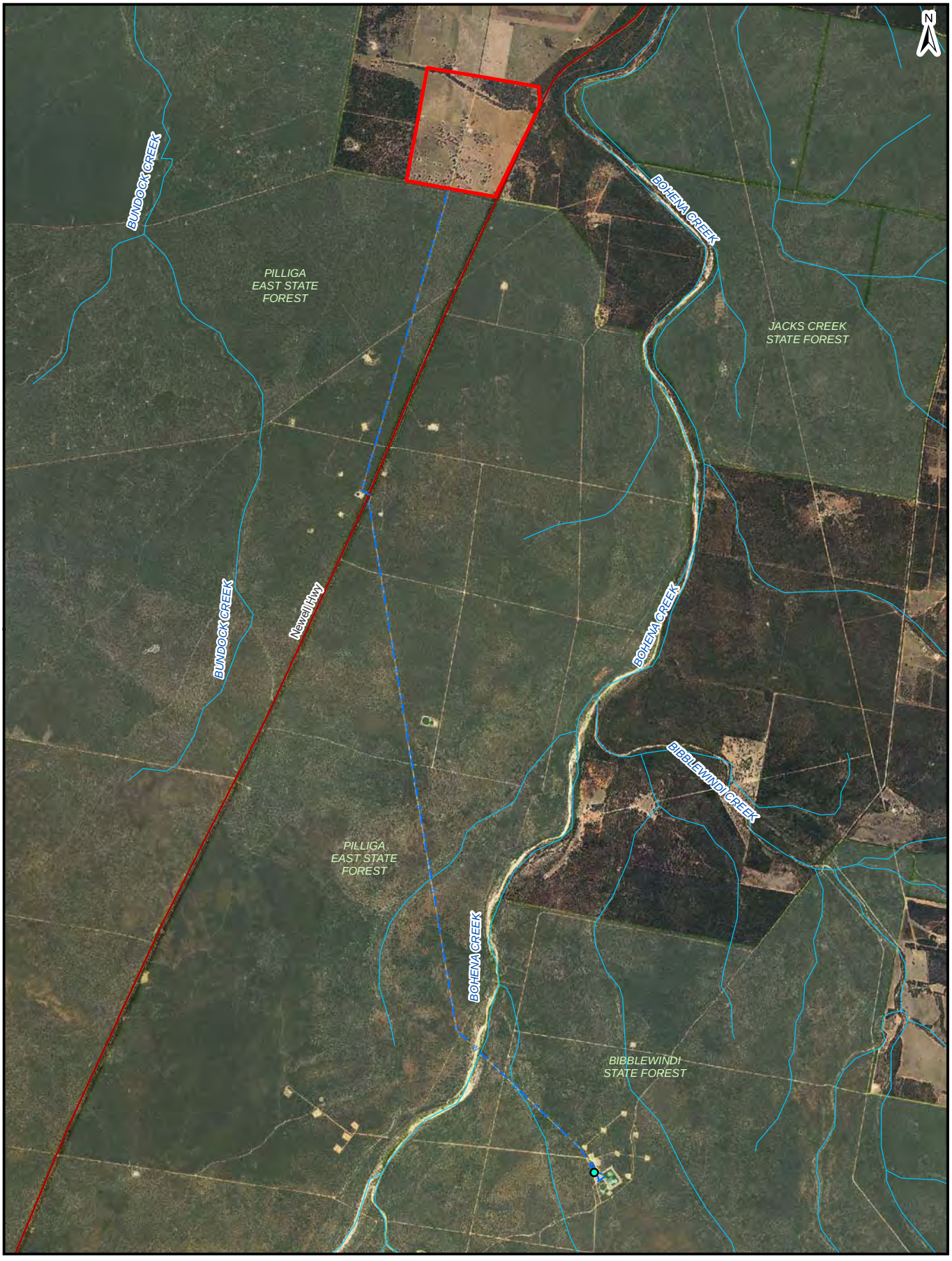
The Optus fibre optic cable runs parallel to the Newell Highway (eastern side) and will need to be crossed by the water flowlines.

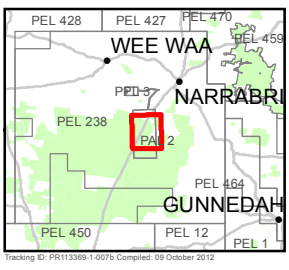
4.2 Description of surface and groundwater sources

4.2.1 Surface water

The project area is located within the Namoi River catchment, which covers an area of approximately 42,000 square kilometres stretching from Woolbrook in the east to Walgett in the west. The catchment is bounded by the Great Dividing Range in the east, the Liverpool Ranges and Warrumbungle Ranges in the south and the Nandewar Ranges and Mount Kaputar to the north. Major tributaries of the Namoi River include Coxs Creek and the Mooki, Peel, Cockburn, Manilla and Macdonald rivers, all of which join the Namoi River upstream of Boggabri (NCMA, 2012).

Figure 4-4 shows the drainage in the vicinity of the project area.





Tracking ID: PR113369-1-007b Compiled: 09 October 2012

N

1 0 1 2

Kilometres

APPROX SCALE 75,000 @ A4

GDA 1994 MGA Zone 55

Disclaimer: While all reasonable care has been taken to ensure the information contained on this map is up to date and accurate, no guarantee is given that the information portrayed is free from error or omission. Please verify the accuracy of all information prior to use.

DATA SOURCES

Base topographic data © Commonwealth of Australia (Geoscience Australia) 2006.

LEGEND

Leewood Water Treatment Facility

Bibblewindi

Flow Line (Right of Way)

Leewood

Highway

Watercourse

State Forest

RPS

FIGURE 4-4

Surface Drainage

The project area is located within the Bohena sub-catchment of the Namoi River catchment. The Bohena sub-catchment covers an area of approximately 830 square kilometres south of Narrabri and is the northern extension of the Borah sub-catchment. The sub-catchment is drained by Bohena, Cowallah and Bibblewindi creeks (NCMA, 2012). Surface water quality within the catchment is influenced by agricultural runoff, spray drift, and vapour transport (NCMA, 2012).

There are no permanent, natural flows within the project area, with Bohena Creek comprising the major drainage feature in the project area. It is ephemeral in nature and flows only when significant rainfall occurs in the catchment.

Mollee Creek is located to the north west of Leewood. A headwater tributary of Mollee Creek traverses Leewood and flows from the southeast to north through the property. Approximately one kilometre upstream (southeast) of Leewood, it crosses the Newell Highway via two 1200 mm by 650 mm box culverts. The tributary is ephemeral and not well defined at the location of the Leewood ponds. Mollee Creek enters the Namoi River more than 30 kilometres downstream of Leewood.

A flood study assessment for Leewood was undertaken by Golder Associates (Appendix 12). It identified those areas of the property affected by both the 50 year annual recurrence interval (ARI) and 100 year ARI (100 year ARI is shown in Figure 4-5). Flow velocities were also modelled and were low at rates between 0.33 and 0.80 metres per second.

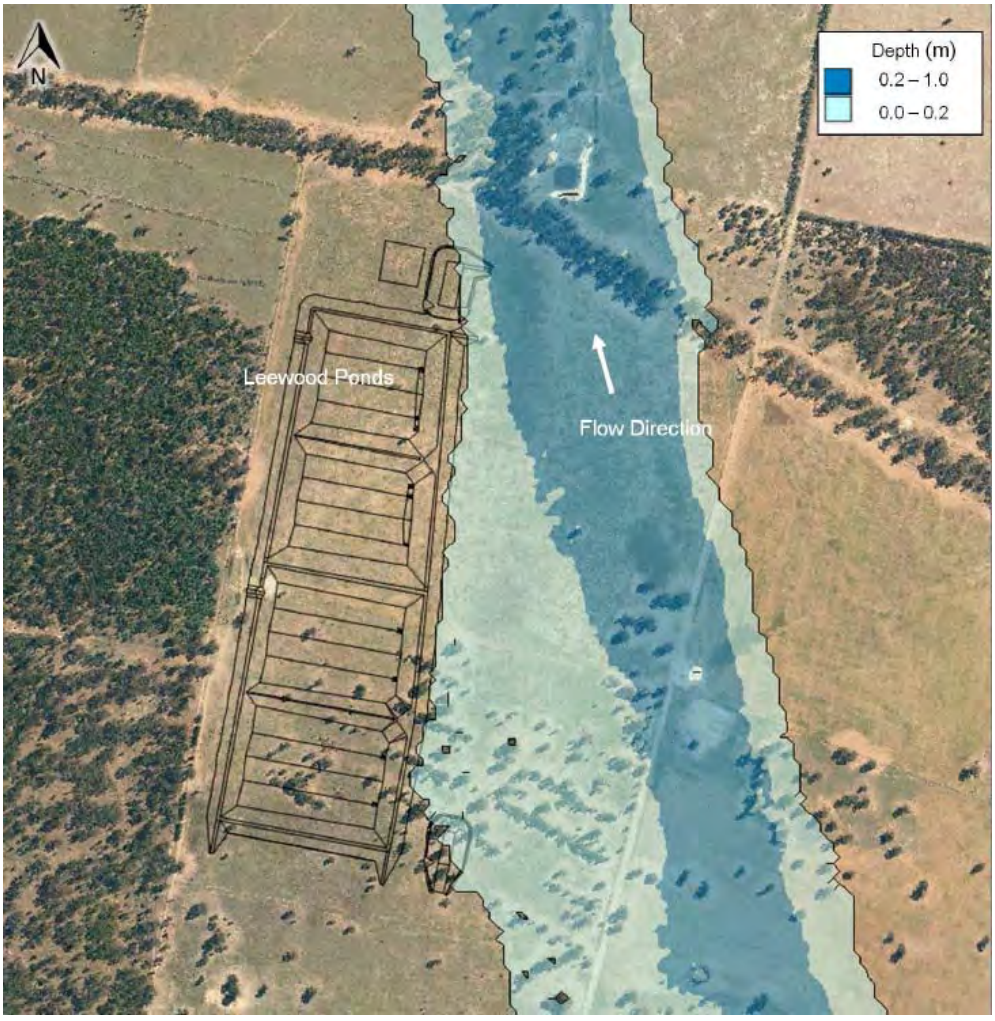


Figure 4-5 100 year ARI flood extent at Leewood (source: Flood Study Assessment, Golder 2012)

4.2.2 Groundwater

Groundwater in the Namoi River catchment supports the irrigation industry and also provides the water supply for many towns and intensive industries. There are a total of 700 license holders in the Namoi River catchment. Groundwater sources include all water contained in the unconsolidated alluvial sediment aquifers associated with the Namoi River and its tributaries (NCMA, 2012).

Three aquifer systems are present beneath the project area; alluvial aquifers, Pilliga Sandstone aquifers and Permian coal seam aquifers.

With the exception of the proposed water bore, only the alluvial aquifers will be impacted by the proposed activity. Geotechnical test pits excavated to a maximum depth of five metres at Leewood did not intercept groundwater.

The alluvial aquifers within the project area are associated with Bohena and Bibblewindi Creeks, with minor thin veneers of alluvium in some tributary creeks. The alluvial sandy soil veneer does not form an aquifer except where Bohena Creek meets the major alluvial aquifer system associated with the deep paleo-channels of the Namoi River.

The alluvium of Bohena Creek and major tributaries consist of clean, medium to coarse quartz sands which are up to about six metres thick. The water table in the alluvium of Bohena Creek varies from surface level following periods of creek flow, to an estimated two metres below surface level during dryer periods.

Groundwater flow is to the north along the creek channel, with discharge eventually to the Namoi River and/or the major alluvial aquifers associated with the river.

4.3 Threatened species, populations and ecological communities

As described in section 4.1.3, ecological field investigations were undertaken at Leewood and along the right of way and an ecological assessment prepared (Appendix 5). No investigations were undertaken at Bibblewindi, as no vegetation is present.

State and federal threatened species searches were carried out for a radius of 10 kilometres from the project area.

An Environment Protection and Biodiversity Conservation (EPBC) Protected Matters Report was generated for Leewood and identified six TECs, seven threatened flora species and 10 threatened fauna species with the potential to occur within a 10 kilometre radius of Leewood.

The same search was undertaken for the right of way and identified six TECs, nine threatened flora species and 15 threatened fauna species with the potential to occur within 10 kilometres of the right of way.

Ten species listed as migratory under the EPBC Act were identified as having the potential to occur in the project area.

A search of the Atlas of NSW Wildlife Database undertaken for Leewood identified six TECs, one threatened flora species and seven threatened fauna species with the potential to occur within a 10 kilometre radius of Leewood.

The same search was undertaken for the right of way on and identified six TECs, six threatened flora species and 24 threatened fauna species with the potential to occur within 10 kilometres of the right of way.

Assessments for likelihood of occurrence for these potentially occurring species were undertaken as part of the ecological assessment. The assessments concluded that many of these species were unlikely to occur within the project area. A number of species were identified as having the potential to occur within the project area and potential for impact was assessed in the ecological assessment.

The field surveys undertaken at Leewood and over the right of way confirmed the presence of a number of these threatened species within the project area. These are discussed further in the following sections.

4.3.1 Leewood

4.3.1.1 Flora

One EPBC Act listed EEC has been confirmed as occurring on Leewood, namely 'Brigalow (*Acacia harpophylla* dominant and co-dominant)'. This community is also commensurate with the TSC Act listed EEC 'Brigalow within the Brigalow Belt South, Nandewar and Darling Riverine Plains Bioregions'. This community is located in the north west corner of property.

Targeted searches did not confirm the presence of any EPBC Act or TSC Act listed threatened flora species within Leewood.

4.3.1.2 Fauna

A total of 53 fauna species were recorded on Leewood including 40 bird, two amphibian, two microchiropteran bat and nine mammal species. No threatened fauna or migratory species listed under the EPBC Act were recorded on Leewood.

One species, the Grey-crowned Babbler, listed as Vulnerable under the TSC Act was recorded multiple times across the site. Nesting sites were also recorded for this species in the vegetation in the north east corner of the property.

No migratory species were identified during the targeted searches.

4.3.2 Right of way

4.3.2.1 Flora

One EPBC Act listed critically endangered ecological community (CEEC) has been confirmed as occurring within the right of way, namely 'White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland'. This is commensurate with the TSC Act listed EEC 'White Box-Yellow Box-Blakely's Red Gum Grassy Woodland'. This community is located at Bohena Creek.

Targeted searches did not confirm the presence of any EPBC Act or TSC Act listed threatened flora species within the right of way.

4.3.2.2 Fauna

The ecological survey for the right of way did not include targeted fauna searches as it does not contain sufficient vegetation to accommodate an abundance of native fauna. During flora surveys, opportunistic sightings of fauna were recorded. A total of 32 birds, five mammals and one reptile were recorded during opportunistic surveys.

No threatened fauna or migratory species listed under the EPBC Act were recorded on the right of way.

Five threatened species listed as Vulnerable under the TSC Act were recorded on site including the Glossy Black-Cockatoo (*Calyptorhynchus lathami*), Diamond Firetail (*Stagonopleura guttata*), Turquoise Parrot (*Neophema pulchella*), Brown Treecreeper (*Climacteris picumnus victoriae*) and Grey-crowned Babbler (*Pomatostomus temporalis temporalis*).

No migratory species were identified during the targeted searches.

4.4 Aboriginal cultural heritage

The types of sites expected to occur within the project area and surrounding region are influenced by a range of factors including the geology, vegetation, landform and the availability of natural resources and shelter. The main types of sites previously recorded in the Narrabri region and which might be expected to occur within the vicinity of the project area are artefact scatters, scarred trees, and open campsites.

A due diligence Aboriginal cultural heritage investigation was carried out for Leewood in accordance with the *Due Diligence Code of Practice for the Protection of Aboriginal Objects in New South Wales 2010* (Appendix 7). As part of this investigation, RPS undertook a desktop review of the environmental and archaeological contexts, including an analysis of the surrounding landscape, a review of prior archaeological investigations, a search of the Aboriginal Heritage Information Management Systems (AHIMS) database maintained by OEH, and a visual inspection of parts of the project area. This included an inspection of Leewood, parts of the flowline route that were not previously disturbed and an along Old Mill Road at the location of the proposed construction entrance to Leewood.

Desktop searches were undertaken for the previously disturbed areas along the right of way and at Bibblewindi. Given that these parts of the project area are on disturbed land (as defined in the *Due Diligence Code of Practice for the Protection of Aboriginal Objects in New South Wales 2010*), a visual inspection was not required under the 2010 Due Diligence Code of Practice (refer section 5.2.6.2).

A search was undertaken of the National Native Title Tribunal (NNTT) registers on 15 October 2012 in accordance with the *ESG2: Environmental Impact Assessment Guidelines*. The search was conducted for the Narrabri LGA (Search Reference: 5153/12sj).

This search identified one native title claimant, being the Gomeroi People. Their claim extends over an area of 111,340 square kilometres and includes the Narrabri LGA. This claim was filed with the NNTT on 20 December 2011 and the notification completed on 15 August 2012. A former claim in 2007 by the Gomeroi Narrabri People was discontinued. Under the *Native Title Act 1993* the valid grant of a freehold estate (other than certain types of Aboriginal and Torres Strait Islander land) on or before 23 December 1996 is known as a 'previous exclusive possession act', meaning that native title has been extinguished over the area.

The findings of these assessments are summarised in the following sections.

4.4.1.1 Leewood

The AHIMS search results indicated that there were no previously recorded Aboriginal heritage sites within one kilometre of Leewood.

The archaeological field survey of Leewood was conducted by RPS over seven days from Monday 30 July 2012 to Sunday 5 August 2012. The field survey excluded the vegetated area in the north east of the site as this will not be impacted by the proposed activity. An additional visual inspection of land along the south western boundary (along Old Mill Road) was undertaken on 19 September 2012. No items of Aboriginal heritage were identified during the investigation.

No other landscape features, such as sand dune systems, ridge lines, cliff faces, caves or rock shelters, which indicate the likely existence of Aboriginal objects, are located in the area of the proposed activity at Leewood.

4.4.1.2 Right of way

AHIMS searches were undertaken along the length of the right of way (Appendix 8) on 26 September 2012 with a buffer of 200 metres around various points.

The basic searches indicated that there are zero (0) Aboriginal sites recorded and zero (0) Aboriginal places declared in, or within, 200 metres of the right of way.

A visual inspection of the flowline route at Bibblewindi (where it is proposed to extend outside the existing right of way) was undertaken on 8 October 2012. A visual inspection of the Bohena Creek crossing was also undertaken on 21 November 2012. Installation of the existing gas flowline did not require the disturbance of the bed of Bohena Creek, as HDD was used to install the flowline. The proposed activity will involve ploughing through the dry creek bed, and while vehicles do currently cross the creek in this location, a precautionary approach was taken to visually inspect the area.

No Aboriginal sites or objects were identified during the visual inspections along the right of way and no historic heritage items or sites were identified. Additionally, no trees exhibiting evidence of cultural modification/scarring were observed and no vegetation with natural heritage significance was identified.

4.4.1.3 Bibblewindi

AHIMS searches were undertaken for Bibblewindi (Appendix 9) on 26 September 2012 with a buffer of 50 meters, 200 metres, and one kilometre respectively. The basic searches indicated that there are zero Aboriginal sites recorded and zero Aboriginal places declared in, or within, one kilometre of Bibblewindi.

4.5 Historic cultural and natural heritage

Searches of the Heritage Branch, OEH State Heritage Inventory with reference to the *Narrabri Local Environmental Plan 1992* were undertaken on 15 October 2012. The searches reveal 14 local heritage items listed in the LEP. A search of the Heritage Branch, OEH State Heritage Inventory on the same day revealed a total of 37 items of local significance in the Narrabri LGA, including the 14 LEP items. Of these 37 local heritage items, no heritage items are in or near to the project area.

Components of the Sydney University Giant Air-shower Recorder (SUGAR) array were identified at Leewood during field investigations. A SUGAR station, comprising two pits are located along the western boundary of Leewood. The pits are not registered on the OEH State Heritage Inventory; nor are they listed on the Narrabri LEP, however have been identified as having heritage significance.

The Narrabri district has been the centre of innovative astronomy research since the early 1960s, when the University of Sydney's School of Physics established the Narrabri Stellar Intensity Interferometer, which was the first astronomical instrument to measure the diameter of a large number of stars. The area is also home to Paul Wild's Radioheliograph at Culgoora and the SUGAR array.

The SUGAR array was established by the University of Sydney's School of Physics in the Pilliga Forest, and operated between 1968 and 1979. The array consisted of 47 stations dotted around the Pilliga Forest, with each station consisting of pairs of large liquid scintillation detectors (pits filled with fluid) separated by 50 metres. The SUGAR project was developed to measure showers resulting from cosmic ray particles of the highest known energy. Each station operated in an autonomous manner with solar power units and received

their timing information via radio receivers (Brownlee et al 1968: 68). At this stage it is unknown how many of these stations remain in situ in the area.

4.6 Environmentally sensitive areas

The project area is not located within an Environmentally Sensitive Area of State Significance, as defined under the *State Environmental Planning Policy (Mining, Petroleum Production and Extractive Industries) 2007* (Mining SEPP) (refer Table 4-2).

Table 4-2 Environmentally sensitive areas

Is the proposed activity located on or within any of the following:	Yes/No
Coastal waters of the State	No
Lands protected under SEPP 14 – Coastal Wetlands?	No
Lands protected under SEPP 26 – Littoral Rainforests?	No
Aquatic reserves dedicated under the *Fisheries Management Act 1994* or a marine park under the *Marine Parks Act 1997*?	No
Wetland areas dedicated under the Ramsar Wetlands Convention?	No
A World Heritage Area declared under the World Heritage Convention?	No
Land identified in an environmental planning instrument as being of high Aboriginal cultural significance?	No
An area reserved or dedicated under the *National Parks and Wildlife Act 1974*?	No
Land, places, buildings or structures listed on the State Heritage Register?	No
Is the proposed activity located within land reserved or dedicated within the meaning of the *Crown Lands Act 1989* for preservation of flora, fauna, geological formations or for other environmental protection purposes?	No
Land identified as being critical habitat under the *Threatened Species Conservation Act 1995* or Part 7A of the *Fisheries Management Act 1994*?	No

5.0 REGULATORY CONTEXT

5.1 Commonwealth legislation

5.1.1 Environmental Protection and Biodiversity Conservation Act

The EPBC Act provides for the protection of certain Matters of National Environmental Significance (MNES) listed under the Act, which include:

- World Heritage Areas
- National Heritage Places
- Ramsar wetlands of international importance
- Commonwealth listed threatened species and ecological communities
- listed migratory species
- Commonwealth marine areas
- Great Barrier Reef Marine Park
- nuclear actions.

Under the EPBC Act, Commonwealth approval is required from the Minister of Sustainability, Environment, Water, Population and Communities (Minister) for any action that will have or is likely to have a significant impact on a MNES, or on the environment of Commonwealth land or on the environment if the action is proposed to be taken by a Commonwealth agency (known as a 'controlled action').

A person proposing to take a controlled action must refer the proposed activity to the Minister for determination. A person proposing to take an action that the person thinks is not a controlled action may refer the proposed activity to the Minister for the Minister's decision whether or not the action is a controlled action.

An EPBC Act Protected Matters Search Report was generated for a 10 kilometre radius surrounding the site to determine whether any MNES will likely be affected the proposed activity. In addition, an Ecological Assessment was prepared to determine whether the proposed activity will be likely to impact on any nationally listed threatened species or ecological communities, or migratory species.

An assessment of the proposed activity against MNES is provided in section 6.7. The proposed activity will be unlikely to have a significant impact on any MNES, or the environment on Commonwealth land and is not proposed to be taken by a Commonwealth agency. Therefore, the proposed activity is unlikely to constitute a controlled action and Santos does not propose to lodge a referral to the Minister.

5.1.2 Native Title Act

The objectives of the *Native Title Act 1993* include:

- Recognises native title rights and sets down basic principles in relation to native title in Australia;
- Provides for the validation of past acts which may be invalid because of the existence of native title;
- Provides for a future regime in which native title rights are protected and conditions imposed on acts affecting native title land and waters;
- Provides a process by which native title rights can be established and compensation determined, and by

which determinations can be made as to whether future grants can be made or acts done over native title land and waters; and

- Provides for a range of other matters, including the establishment of a National Aboriginal and Torres Strait Islander Land Fund.

A search was undertaken of the National Native Title Tribunal (NNTT) registers on 15 October 2012. This search identified one native title claimant, being the Gomeroi People. Their claim extends over an area of 111,340 square kilometres and includes the Narrabri Shire Council area. This claim was filed with the NNTT on 20 December 2011 and the notification completed on 15 August 2012. A former claim in 2007 by the Gomeroi Narrabri People was discontinued. Under the *Native Title Act 1993* the valid grant of a freehold estate (other than certain types of Aboriginal and Torres Strait Islander land) on or before 23 December 1996 is known as a 'previous exclusive possession act', meaning that native title has been extinguished over the area.

The right of way and Bibblewindi components of the project area, being situated wholly within Crown land, can therefore be subject to a native title claim (Section 23B of the *Native Title Act 1993*). Leewood is a freehold estate granted prior to 23 December 1996 and cannot be subject to a native title claim.

Santos has been undertaking discussions with Native Title Services Corporation, which is the native title representative body for NSW. They have also engaged with the Gomeroi Native Title Applicants in preliminary negotiations to a native title agreement.

Santos is hosting a full day detailed technical project briefing and field visit for the Gomeroi Registered Applicants in January to discuss the proposed activity.

5.2 NSW Legislation

5.2.1 Petroleum (Onshore) Act

The *Petroleum (Onshore) Act 1991* (Petroleum Act) regulates the onshore exploration for and production of petroleum. Under the Petroleum Act, petroleum means:

> *(a) any naturally occurring hydrocarbon, whether in a gaseous, liquid or solid state, or*
>
> *(b) any naturally occurring mixture of hydrocarbons, whether in a gaseous, liquid or solid state, or*
>
> *(c) any naturally occurring mixture of one or more hydrocarbons, whether in a gaseous, liquid or solid state, and one or more of the following, that is to say, hydrogen sulphide, nitrogen, helium, carbon dioxide and water,*
>
> *and includes any substance referred to in paragraph (a), (b) or (c) that has been returned to a natural reservoir, but does not include coal or oil shale or any substance prescribed to be a mineral for the purposes of the Mining Act 1992.*

The holder of an assessment lease has the exclusive right to prospect for petroleum and to assess any petroleum deposit on the land comprised in the lease. An assessment lease is designed to allow retention of rights over an area in which a significant petroleum deposit has been identified, if mining the deposit is not commercially viable in the short term but there is a reasonable prospect that it will be in the longer term. The holder is allowed to continue prospecting operations and to recover petroleum in the course of assessing the viability of commercial mining.

The proposed activity will be undertaken in accordance with PAL 2, granted under the Petroleum Act. The conditions of PAL 2 require activities to be undertaken in accordance with an approved Petroleum Operations Plan (POP). The POP for PAL 2 has recently been updated to reflect the proposed activity and other future operations within PAL 2 and has been submitted to DRE for approval.

5.2.2 Environmental Planning & Assessment Act

5.2.2.1 Overview

The EP&A Act regulates development carried out in NSW. The carrying out of development is regulated under either Part 4 or Part 5 of the EP&A Act.

Development is required to be assessed under Part 5 of the EP&A Act if the relevant environmental planning instruments provide that the development does not require consent or is not exempt development, and the development is either carried out by a determining authority or requires the approval of a determining authority.

The *State Environmental Planning Policy (Mining, Petroleum Production and Extractive Industries) 2007* (Mining SEPP) aims 'to provide for the proper management and development of mineral, petroleum and extractive material resources for the social and economic welfare of [NSW]'. Clause 6 of the Mining SEPP provides that development for the purposes of "petroleum exploration" may be carried out without development consent. "Petroleum exploration" includes prospecting and assessment of petroleum under a petroleum exploration licence or a petroleum assessment lease. The proposed activity is being carried out for the purposes of petroleum exploration under PAL 2 and requires approval of the Director-General under the conditions of PAL 2. This has the effect that development consent is not required and the proposed activity is required to be assessed under Part 5 of the EP&A Act.

The *State Environmental Planning Policy (State and Regional Development) 2011* (State and Regional Development SEPP) identifies development which is 'State significant development' for the purposes of Part 4, Section 89C of the EP&A Act. Clause 8 of the State and Regional Development SEPP states that development is declared to be State significant development under Part 4 of the EP&A Act if it is not permissible without development consent under an environmental planning instrument and is specified in Schedule 1 or 2. Development listed in clause 6 of Schedule 1 of the State and Regional Development SEPP includes development for the purposes of "petroleum production", drilling and operating petroleum exploration wells which meet certain criteria and development for the purpose of petroleum related works which are ancillary to another State significant development project, or have a capital investment of more than $30 million.

The proposed activity is not considered State significant development under Part 4 of the EP&A Act because:

- it is for the purposes of "petroleum exploration" under PAL 2, which is defined as development without consent under the Mining SEPP, and
- it is not development listed under Schedule 1 or 2 of the State and Regional Development SEPP, specifically:
  - » it is not petroleum production
  - » it is not the drilling or operation of petroleum exploration wells
  - » it is not petroleum related works that are ancillary to or an extension of another State significant development project, or that have a capital investment value of more than $30 million.

A determining authority, for the purposes of this activity, is defined in Part 5 to include a public authority whose approval is required before an activity may be carried out. DTIRIS (DRE) is a determining authority for the purposes of Part 5 of the EP&A Act for the proposed activity.

5.2.2.2 Determining authorities and the REF

Under Part 5 of the EP&A Act, a determining authority is required to examine and take into account to the fullest extent possible all matters affecting or likely to affect the environment by reason of the proposed activity.

Additionally, clause 228 of the *Environmental Planning and Assessment Regulation 2000* sets out the factors that must be taken into account concerning the impact of an activity on the environment.

The determining authority is required to consider whether the proposed activity is likely to significantly affect the environment or threatened species, populations or ecological communities, or their habitats to determine whether an Environmental Impact Statement (EIS) of Species Impact Statement (SIS) is required. In deciding whether there is likely to be a significant effect on threatened species, populations or ecological communities or their habitats, section 5A of the EP&A Act requires the following factors to be taken into account (the 'seven part' test of significance):

(a) in the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction,

(b) in the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction,

(c) in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:

(i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or

(ii) is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction,

(d) in relation to the habitat of a threatened species, population or ecological community:

(i) the extent to which habitat is likely to be removed or modified as a result of the action proposed, and

(ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and

(iii) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality,

(e) whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly),

(f) whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan,

(g) whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.

This REF has been prepared to assist the determining authority to meet the obligations under the EP&A Act. This REF concludes that the proposed activity is not likely to significantly affect the environment or threatened species, populations or ecological communities or their habitats.

5.2.2.3 Narrabri Local Environmental Plan 1992

While the proposed activity does not require consent under Part 4 of the EP&A Act, consideration has been given to the relevant zone objectives under the Narrabri LEP. The project area is located within land zoned 1(a) General Rural, the objectives of which are to promote the proper management and utilisation of resources by:

- *a) protecting, enhancing and conserving:*
  - *i. agricultural land in a manner which sustains its efficient and effective agricultural production potential,*
  - *ii. soil stability by controlling and locating development in accordance with soil capability,*
  - *iii. forests of existing and potential commercial value for timber production,*
  - *iv. valuable deposits of minerals, coal, petroleum and extractive materials by controlling the location of development for other purposes in order to ensure the efficient extraction of those deposits,*
  - *v. trees and other vegetation in environmentally sensitive areas where the conservation of the vegetation is significant to scenic amenity or natural wildlife habitat or is likely to control land degradation,*
  - *vi. water resources for use in the public interest,*
  - *vii. areas of significance for nature conservation, including areas with rare plants, wetlands and significant habitats, and*
  - *viii. places and buildings of archaeological or heritage significance, including the protection of Aboriginal relics and places,*
- *b) preventing the unjustified development of agricultural land for purposes other than agriculture,*
- *c) preventing residential development of prime crop and pasture land, except where it is ancillary to agriculture or another use permissible in the zone,*
- *d) facilitating farm adjustments,*
- *e) ensuring that any allotment created for an intensive agricultural pursuit is potentially capable of sustaining a range of such purposes or other agricultural purposes,*
- *f) minimising the cost to the community of:*
  - *i. fragmented and isolated development of rural land, and*
  - *ii. providing, extending and maintaining public amenities and services.*

The proposed activity will contribute to promoting efficient extraction of valuable deposits of CSG (which is classified as “petroleum” under the Mining SEPP). The project area’s location outside of the main town centre will minimise potential impacts to the surrounding community. Therefore, the proposed activity is considered to be a suitable activity within zone 1(a) (General Rural).

5.2.2.4 State Environmental Planning Policy No. 44 – Koala Habitat Protection

State Environmental Planning Policy No. 44 – Koala Habitat Protection (SEPP 44) aims 'to encourage the proper conservation and management of areas of natural vegetation that provide habitat for koalas to ensure a permanent free-living population over their present range and reverse the current trend of koala population decline'.

Schedule 1 of SEPP 44 lists LGAs to which SEPP 44 applies and includes the Narrabri LGA. SEPP 44 applies to local councils determining development applications under Part 4 of the EP&A Act. Although SEPP 44 does not apply in relation to the assessment of development under Part 5 of the EP&A Act, it has been considered in the preparation of this REF.

SEPP 44 requires that before granting development consent under Part 4 of the EP&A Act for development on land over one hectare in area, a consent authority must form a view as to whether the land is 'potential' or 'core' koala habitat. Potential koala habitat is defined as:

> *areas of native vegetation where the trees of the types listed in Schedule 2 constitute at least 15% of the total number of trees in the upper or lower strata of the tree component.*

Core koala habitat is defined as:

> *an area of land with a resident population of koalas, evidenced by attributes such as breeding females (that is, females with young) and recent sightings of and historical records of a population.*

Where core koala habitat is found to occur, SEPP 44 requires that a site-specific koala plan of management be prepared.

RPS undertook field surveys across the project area (excluding Bibblewindi) as part of an ecological assessment (Appendix 5). The wooded areas within Leewood were found to contain *Eucalyptus pilligaensis* (Pilliga Box) which is a secondary feed tree species. Both Leewood and the right of way were found to contain *Eucalyptus crebra* (Narrow-leaved Ironbark) which is also a secondary feed tree species. No primary feed trees listed under Schedule 2 of the SEPP 44 were detected in the project area. No Koalas or traces of Koalas such as scats or scratches on tree trunks were observed within the study area during habitat assessments. The closest records of Koalas relative to the study area were within 10 kilometres as recorded on the Atlas of NSW Wildlife Database.

As no Koalas, or signs of Koala occupation were observed in the project area and no primary feed tree species were identified, it has been determined that the project area does not provide 'Core' Koala habitat according to SEPP 44.

5.2.3 Forestry Act

The primary objective of the *Forestry Act 1916* is to provide for the dedication, reservation, control, and use of State forests, timber reserves and Crown lands for forestry and other purposes.

Section 31 of the Act states that an Occupation Permit may be granted for land within a State Forest '*for any purpose approved by the commission and specified in the permit*'. Proposed works within the State Forest will be undertaken in accordance with the existing Occupation Permit held by Santos and administered by Forests NSW.

5.2.4 Water legislation

The *Water Act 1912* (Water Act) and WMA are the key pieces of legislation regulating access and impacts to surface and groundwater resources in NSW. Where a water sharing plan is in place, the WMA governs the issuing of water access licenses (WALs) and water management and activity approvals. There are three water sharing plans in force for the project area, including:

- Water Sharing Plan for the Namoi Unregulated and Alluvial Water Sources
- Water Sharing Plan for the NSW Great Artesian Basin Groundwater Sources
- Water Sharing Plan for the NSW Murray Darling Basin Porous Rock Groundwater Sources.

5.2.4.1 Approvals

Part 3 of Chapter 3 of the WMA deals with approvals required under the WMA. In particular, sections 89, 90 and 91 relate to water use approvals, water management work approvals (including water supply work, drainage work and flood work approvals) and activity approvals (including controlled activity approvals and aquifer interference approvals), respectively.

A water use approval and water supply approval under sections 89 and 90 will be required for the proposed water bore. Applications for these approvals have been lodged with NOW.

A flood work approval is required to construct and use flood work at a specified location. Flood work is defined within to include a work in the vicinity of a river or within a floodplain (as declared under the WM Regulation) that is of such a size or configuration that it is likely to have an effect on the flow of water to or from a river or the distribution or flow of floodwater in times of flood. Clause 13 of Schedule 9 of the WMA Act provides that any land that was designated as a floodplain under Part 8 of the Water Act is taken to be a floodplain for the purposes of the WMA Act. The Namoi River - Narrabri to Wee Waa floodplain, as declared under the Water Act, is located nearby but not within the project area. The proposed activity is considered unlikely to affect the flow of water to or from any river, or the distribution or flow of floodwaters. Therefore, a flood work approval is not required for the proposed activity.

Clause 39 of the WM Regulation provides that activities specified in Part 2 of Schedule 5 of the regulation are exempt from requiring controlled activity approvals under section 91 of the WMA. Part 2 of Schedule 5 includes any activity carried out in accordance with a right in force under the Petroleum Act. Therefore, a controlled activity approval is not required for the proposed activity.

Under section 91 of the WMA, an aquifer interference approval is required to penetrate, interfere or obstruct flows within an aquifer, or take or dispose of waters from an aquifer, however NOW are currently not requiring aquifer interference approvals. Refer to section 5.2.4.3 for a discussion of the Aquifer Interference Policy.

5.2.4.2 Water access licences

Under Part 2 of Chapter 3 of the WMA, it is an offence to take water from a source regulated by the WMA unless in accordance with a water access licence (WAL) or unless an exemption applies. Exemptions for requiring WALs are listed under Part 1 of Schedule 5 of the Water Management (General) Regulation 2011 (WM Regulation) and include:

> *Any person lawfully engaged in prospecting or fossicking for minerals or petroleum under the Mining Act 1992 or the Petroleum (Onshore) Act 1991—in relation to:*

(a) the taking of water required for such prospecting or fossicking pursuant to a lease, licence, mineral claim or environmental assessment permit under the Mining Act 1992 or a petroleum title under the Petroleum (Onshore) Act 1991 (an authority), up to a maximum of 3 megalitres for all such prospecting or fossicking pursuant to each such authority in any water year, and

(b) the taking of up to 3 megalitres of water required for all other such prospecting or fossicking in any water year.

The proposed water bore is expected to lift 30 ML groundwater per year from the Pilliga Sandstone, which is part of the Southern Recharge Groundwater Source described in the Water Sharing Plan for Great Artesian Basin Water Sources 2008. A WAL (an aquifer access licence) will therefore be required for the proposed water bore. NOW is not issuing any new aquifer access licences in the target water source (Great Artesian Basin). Santos currently has a 10 ML licence to abstract shallow groundwater from the Great Artesian Basin groundwater source. As the expected demand for groundwater is forecast to be above this, Santos is currently sourcing additional volumes either by way of short term leasing or purchasing of allocation to cover these short term requirements.

5.2.4.3 Aquifer Interference Policy

Section 97(6) of the WMA states that 'an aquifer interference approval is not to be granted unless the relevant Minister is satisfied that adequate arrangements are in force to ensure that no more than minimal harm will be done to the aquifer, or its dependent ecosystems, as a consequence of its being interfered with in the course of the activities to which the approval relates'.

The *NSW Aquifer Interference Policy* (the Policy) was released in September 2012 to clarify the requirements for obtaining water licences and approvals for aquifer interference activities. The Policy establishes and objectively defines minimal impact considerations for groundwater sources, connected water sources, and their dependent ecosystems, culturally significant sites and water users.

Table 1 of the Policy outlines two levels of minimal impact considerations, which will be considered for aquifer interference activities. For the Great Artesian Basin Southern Recharge water source, the following impact considerations apply:

Condition	Water table	Water pressure	Water quality
1.	Less than or equal to 10% cumulative variation in the water table, allowing for typical climatic "post-water sharing plan" variations, 40m from any (a) high priority groundwater dependent ecosystem, or (b) high priority culturally significant site, listed in the schedule of the relevant water sharing plan. A maximum of a 2m decline cumulatively at any water supply work.	(a) Less than 0.2m cumulative variation in the groundwater pressure, allowing for typical climatic "post-water sharing plan" variations, 40m from any: (i) high priority groundwater dependent ecosystem; or (ii) high priority culturally significant site; listed in the schedule of the relevant water sharing plan. (b) A cumulative pressure level decline of not more than 15m, allowing for typical climatic "post-water sharing plan" variations. (c) The cumulative pressure level decline of no more than 10% of the 2008 pressure level above ground surface at the NSW State border, as agreed between NSW and Qld.	Any change in the groundwater quality should not lower the beneficial use category of the groundwater source beyond 40m from the activity.
2.	If more than 10% cumulative variation in the water table, allowing for typical climatic "post-water sharing plan" variations, 40m from any:	If the predicted pressure head decline is greater than requirement 1.(a). above, then appropriate studies are required to demonstrate to the Minister's satisfaction that the decline will not prevent the long-term	If condition 1 is not met then appropriate studies will need to

Condition	Water table	Water pressure	Water quality
	(a) high priority groundwater dependent ecosystem; or (b) high priority culturally significant site; listed in the schedule of the relevant water sharing plan then appropriate studies (including the hydrogeology, ecological condition and cultural function) will need to demonstrate to the Minister's satisfaction that the variation will not prevent the long-term viability of the dependent ecosystem or culturally significant site. If more than 2m decline cumulatively at any water supply work then make good provisions should apply.	viability of the dependent ecosystem or culturally significant site. Pressure level decline should not (a) cause any flowing bore to cease to flow, (b) be any more than 1m, allowing for typical "post-water sharing plan" variations, at any flowing water supply work unless make good provisions apply, or (c) be any more than 2m, allowing for typical "post-water sharing plan" variations, at any non flowing water supply work unless make good provisions apply.	demonstrate to the Minister's satisfaction that the change in groundwater quality will not prevent the long-term viability of the dependent ecosystem, significant site or affected water supply works.

As previously stated, the proposed water bore is subject to separate approvals from NOW. These applications will demonstrate compliance with the minimal impact considerations for the target water source.

5.2.5 Threatened Species Conservation Act

The TSC Act sets the framework for the listing of threatened species, populations and ecological communities, and key threatening processes in NSW, and the preparation and implementation of recovery plans and threat abatement plans.

The TSC Act also provides the mechanism for applying for and obtaining licences to take actions which could result in harm to a threatened species, population or ecological community, or their habitat, or damage to critical habitat.

Section 5A of the EP&A Act lists seven factors that must be taken into account in determining the significance of a potential impact on 'threatened species, populations or ecological communities (or their habitats)' listed under the TSC Act. The assessment of significance (7-part test) is used to determine whether activities are 'likely' to cause 'a significant impact' on threatened biota and thus whether an SIS is required.

The ecological assessment prepared for the proposed activity identified a number of threatened species and ecological communities as having the potential to occur on the site or surrounds. Two EECs and six threatened fauna species were recorded on, or in close proximity to, the project area. These are discussed in section 4.3. The ecological assessment concluded that the proposed activity is unlikely to have a significant impact on threatened species, populations or ecological communities (or their habitats).

5.2.6 National Parks and Wildlife Act

5.2.6.1 Threatened Species

Part 8A of the *National Parks and Wildlife Act 1974* (NPW Act) regulates the undertaking of activities which may impact on threatened species, populations and ecological communities listed under the TSC Act and their habitats. The NPW Act provides that a person must not harm any animal that is a threatened species, population or ecological community, pick any plant which is part of a threatened species, population or ecological community, damage any critical habitat or damage any habitat of a threatened species, population

or ecological community without a licence being obtained under the NPW Act or TSC Act or unless another exception applies.

The NPW Act provides that these requirements do not apply if the action was essential for the carrying out of an activity in accordance with an approval of a determining authority under Part 5 of the EP&A Act where the determining authority has complied with Part 5.

5.2.6.2 Aboriginal Cultural Heritage

The NPW Act conserves places, objects and features of significance to Aboriginal people.

It is an offence under the NPW Act to:

- harm or desecrate an object that the person knows is an Aboriginal object except in accordance with an Aboriginal heritage impact permit (AHIP)
- harm or desecrate Aboriginal objects and Aboriginal places except in accordance with an Aboriginal heritage impact permit or where the person can show they exercised due diligence to reasonably determine that no Aboriginal object will be harmed.

A cultural heritage assessment of the site was prepared in accordance with the *Due Diligence Code of Practice for the Protection of Aboriginal Objects in New South Wales 2010* (DECCW 2012). The assessment determined that the proposed activity will not impact on any known Aboriginal objects or places. Provided that the mitigation measures identified in section 6.5.2 were carried out, impacts to any unknown Aboriginal objects or places should be avoided. Therefore, an AHIP is not required for the proposed activity.

5.2.7 Noxious Weeds Act

The *Noxious Weeds Act 1993* is a NSW government instrument outlining the definition, declaration, and control of noxious weeds throughout the State. Local government bodies have the responsibility to ensure that the Act is complied with within their boundaries.

For a plant to be declared a Noxious Weed it must be considered to pose a serious threat to humans, agriculture and/or the environment. There must also be consideration given to the feasibility of control and enforcement of those methods.

Landowners or occupiers have obligations under the *Noxious Weeds Act 1993* to control any declared weed on their property. Council is required to conduct inspections of private properties to check compliance with the *Noxious Weeds Act 1993* and Noxious Weed Officers have the authority to issue control notices for any breach.

Under the actions of this Act, a level of control can be applied to reducing the abundance and distribution of exotic weeds within Australia.

Two noxious weeds, Tiger Pear and Prickly Pear, were identified in the project area. Under the provisions of the *Noxious Weeds Act 1993*, these species are classified as Class 4 weeds. This means that the growth and spread of the plant must be controlled according to the measure specified in a management plan published by the local control authority and the plant may not be sold, propagated or knowingly distributed. Management of these species will be undertaken in accordance with the Narrabri Shire Council Management Plan for Prickly Pear (Plan No. PP01/2006, as revised 1 March 2011).

5.2.8 Native Vegetation Act

The *Native Vegetation Act 2003* (NV Act) seeks to encourage revegetation and rehabilitation of land with appropriate native vegetation, provide incentives to landholders to manage native vegetation on their properties, and end broad scale clearing, unless it improves or maintains the environment.

Under section 25(h), the NV Act does not apply to any clearing that is part of an activity carried out in accordance with an approval of a determining authority within the meaning of Part 5 of the EP&A Act if the determining authority has complied with Part 5. Under section 25(m), the NV Act does not apply to any clearing authorised under the Petroleum Act.

5.2.9 Protection of the Environment Operations Act

The primary objective of the POEO Act is to 'protect, restore and enhance the quality of the environment in New South Wales, having regard to the need to maintain ecologically sustainable development'. The POEO Act requires EPLs be obtained for the carrying out of 'scheduled activities' or pollution of waters. The produced water and brine ponds will be located within PAL 2 and it is not expected that an EPL will be required for the proposed activity.

5.2.10 Heritage Act

The main objective of the *Heritage Act 1977* (Heritage Act) is to encourage the conservation of the heritage of New South Wales. The site is not listed on the State Heritage Register under the Heritage Act.

The *Heritage Act 1977 (NSW)* also prevents impacts on 'relics', which are defined as:

> *any deposit, artefact, object or material evidence that:*
>
> *(a) relates to the settlement of the area that comprises New South Wales, not being Aboriginal settlement, and*
>
> *(b) is of State or local heritage significance.*

Under the Heritage Act, it is an offence to disturb or excavate any land knowing or having reasonable cause to suspect that the disturbance or excavation will or is likely to result in a relic being discovered, exposed, moved, damaged or destroyed unless the disturbance or excavation is carried out in accordance with an excavation permit. No items of heritage significance listed under either the Narrabri LEP 1992 or on the NSW State Heritage Register occur on the site. A number of items of local and State heritage significance occur within the Narrabri LGA, however these are not located in close proximity to the site.

Two items of heritage significance were identified at Leewood during the archaeological field surveys. The proposed activity will not impact on any these potential items provided that the mitigation measures identified in section 6.6.2 are carried out.

5.2.11 Dams Safety Act

The NSW Dams Safety Committee (DSC) was constituted by the NSW Government under the *Dams Safety Act 1978* to ensure the safety of dams in NSW.

For new dams, the DSC's initial objective is to ensure that they are designed and constructed according to appropriate engineering standards and safety criteria. Accordingly, owners and designers must provide details of proposed dams for the DSC's consideration at an early stage. After construction, dam safety is monitored by requiring prescribed dam owners to arrange for:

(1) Proper operation and maintenance of their dams using trained personnel.

(2) Regular dam surveillance using trained personnel.

(3) Appropriate dam safety emergency plans to be in place for those dams whose failure could cause loss of non-itinerant life.

(4) Ongoing assessment of dam behaviour on the basis of surveillance information.

(5) Periodic review of their dam's compliance with current DSC requirements.

(6) Review of all dam information and assessments by experienced personnel.

(7) Actions, in response to dam assessments, to ensure that their dams are maintained in a safe condition.

The DSC assigns dams a Consequence Category according to their potential failure consequences. The Consequence Category is used to determine the need to prescribe a dam, the level and frequency of surveillance of a dam to ensure its continuing safety, and the extent and priority for some safety improvement measures.

For all prescribed dams the DSC requires Surveillance Reports after the first substantial filling (or one year after completion, whichever is first), and subsequently at intervals not exceeding five years. In addition, for dams whose configurations and operations may change significantly during their lives (eg ash and mining dams), the DSC requires owners to submit Annual Inspection Reports to provide status updates.

The Leewood ponds are anticipated to fall within the Significant Consequence category and are considered a prescribed structure under the *Dams Safety Act 1978*. The pond designs have been referred to the DSC for approval. The approval of the DSC will be required prior to the commencement of the pond construction.

5.2.12 Roads Act

The *Roads Act 1993* seeks to:

(a) *to set out the rights of members of the public to pass along public roads, and*

(b) *to set out the rights of persons who own land adjoining a public road to have access to the public road, and*

(c) *to establish the procedures for the opening and closing of a public road, and*

(d) *to provide for the classification of roads, and*

(e) *to provide for the declaration of RMS and other public authorities as roads authorities for both classified and unclassified roads, and*

(f) *to confer certain functions (in particular, the function of carrying out road work) on RMS and on other roads authorities, and*

(g) *to provide for the distribution of the functions conferred by this Act between RMS and other roads authorities, and*

(h) *to regulate the carrying out of various activities on public roads.*

Works to the Newell Highway and Old Mill Road intersection and the HDD of the Newell Highway will require approval under section 138 of the *Roads Act 1993*. Consultation with both NSW Roads and Maritime Services (RMS) and Narrabri Shire Council will be undertaken in this regard.

6.0 ENVIRONMENTAL IMPACTS AND MITIGATION

This section of the REF addresses the potential environmental impacts associated with the proposed activity and identifies mitigation measures to ensure any impacts are appropriately managed. Potential impacts have been categorised in accordance with the ESG2 Guidelines. Impact categories include:

- negligible
- low adverse
- medium adverse
- high adverse
- positive.

The following table addresses the specific impact assessment questions posed in Chapter 4 of the ESG2 Guidelines for each type of potential impact. Each of these questions has been discussed in detail in the following sections of the REF. The table responds to each question, identifies where in the REF it is discussed in further detail or why it has not been addressed.

Table 6-1 Compliance with Chapter 4 of the ESG2 Guidelines

Issue	Response/reference
4.1 Physical and chemical impacts	
Is the proposed activity likely to impact on soil quality or land stability?	No. Potential impacts associated with erosion and sedimentation and soil contamination can be adequately addressed with mitigation, including erosion and sediment control and management of topsoil and chemicals. Refer sections 2.6.7 and 6.1.1.
Is the activity likely to affect a waterbody, watercourse or wetland or natural drainage system?	No. The proposed activity will not result in the redirection of flow of any watercourse. It is considered highly unlikely that the proposed activity will result in the pollution of waters. The proposed activity will involve the extraction of approximately 30 ML per year for construction water purposes. This is being assessed by NOW and will comply with the relevant provisions of the WMA, including the Aquifer Interference Policy where relevant. Potential impacts associated with proposed ploughing through Bohena Creek, release of pond water/brine and surface water run-off can be adequately addressed with mitigation. Refer sections 2.6.7, 6.1.2 and 6.1.3.
Is the activity likely to change flood or tidal regimes, or be affected by flooding?	No. Leewood is affected by the 1:100 year flood level. A flood assessment has been undertaken for the proposed activity which has identified that there will be no changes to the downstream flood regime and that the proposed activity would not be impacted by flooding. Refer sections 4.2.1 and 6.1.3 and Appendix 12.
Is the activity likely to affect coastal processes and coastal hazards, including those under projected climate change conditions?	No. The project area is not located within the coastal zone and will not be affected by coastal processes or hazards. This has not been addressed further in the REF.
Does the proposed activity involve the use, storage or transport of hazardous substances or the use or generation of chemicals which may build up residues in the environment?	Yes. Small quantities of diesel and drilling fluids will be stored within the project area and used during the proposed activity. Their use, storage and transport will be appropriately managed to ensure no spills occur, or if they do, they are appropriately remediated.

Issue	Response/reference
	Refer section 6.1.7.
Does the activity involve the generation or disposal of gaseous, liquid or solid wastes or emissions?	Yes. Small quantities of hydrocarbons will be released from the water holding tank at Bibblewindi. These minor levels of hydrocarbons are not expected to affect air quality. While the proposed activity does not involve the generation or disposal of produced water or brine, it does involve their storage and transfer. An EPL is not required for the proposed activity. Refer section 5.2.9 and 6.1.6.
Will the activity involve the emission of dust, odours, noise, vibration, or radiation in the proximity of residential/urban areas or other sensitive locations?	Yes. Construction activities will generate dust, noise and vibration within 750 metres of a residential receiver. The closest residential receiver is located 750 metres to the west of the Leewood ponds, however this residence is only occupied on weekends and during school holidays. The closest permanently occupied residential receiver to the proposed works is approximately 1.5 kilometres to the north. Impacts can be appropriately mitigated. Refer to sections 6.1.4 and 6.1.5.
4.2 Biological impacts	
Is any vegetation to be cleared or modified (including vegetation of conservation significance)?	Yes, however no vegetation of significance will be cleared. The proposed activity will be likely to result in the clearing of approximately 48.2 hectares of disturbed and previously cleared grazing land at Leewood and up to19.2 hectares of predominantly derived vegetation communities and regrowth along the right of way. Refer section 6.2 and Appendix 5.
Is the activity likely to have a significant effect on threatened flora or fauna species, populations, or their habitats, or critical habitat; or an endangered ecological community or its habitat? (aka the threatened species *assessment of significance*)	No. No threatened ecological communities or threatened flora will be impacted by the proposed activity. While a number of threatened fauna species were identified within the project area, the proposed activity will not result in the removal of high quality habitat. Refer sections 6.2 and 6.7 and Appendix 5.
Does the activity constitute or is part of a key threatening process?	No. Refer sections 6.2 and Appendix 5.
Does the activity have the potential to endanger, displace or disturb fauna (including fauna of conservation significance) or create a barrier to their movement?	Yes, fauna may be disturbed or displaced. Removal of some vegetation, including hollow bearing trees will be required as part of the proposed activity. This may impact fauna. However, the quality of habitat to be removed is poor and impacts would be minor. Refer 6.2 and Appendix 5.
Is the activity likely to impact on an ecological community of conservation significance?	No. The proposed activity will not require the removal of any ecological community of conservation significance. Refer sections 6.2 and 6.7 and Appendix 5.
Is the activity likely to cause a threat to the biological diversity or ecological integrity of an ecological community?	No. The proposed activity will predominantly impact previously disturbed land, including grazing land at Leewood and derived communities and regrowth along the right of way. Refer sections 6.2 and 6.7 and Appendix 5.
Is the activity likely to introduce noxious weeds, vermin, feral species or genetically modified organisms into an area?	No. Prickly pear has been identified in the project area. Mitigation has been proposed to ensure it is appropriately managed. Refer sections 6.2 and Appendix 5.

Issue	Response/reference
4.3 Community impacts	
Is the activity likely to affect existing community services or infrastructure?	No. The proposal will result in minor increases of traffic on the local road network. There may be some impact to accommodation availability in Narrabri during construction, however this is not anticipated to be significant. Refer section 6.3.4.
Does the activity affect sites of importance to the local or broader community for their recreational or other values or access to these sites?	No. While part of the proposed activity is within the State forest, which may be used by the public for recreational purposes, the proposed activity is unlikely to significantly affect the overall recreational value of the forest. Refer section 6.3.4.
Is the activity likely to affect economic factors?	Yes. The proposed activity will have positive economic benefits for the local community. Refer section 6.3.5.
Is the activity likely to have an impact on the safety of the community?	No. While there is potential for up to five persons to be affected in the event of a dam failure, this is considered highly unlikely to occur. The probable loss of life in the event of dam failure has been calculated at <0.05. The ponds have been designed and will be continually managed and maintained to ensure that a dam break does not occur. Refer section 6.3.1.
Is the activity likely to cause a bushfire risk?	No. Parts of the project area are expected to exhibit moderate to high bushfire hazard mainly due to the extent of vegetation cover, however it is unlikely that the proposed activity would cause a bushfire risk. Refer section 6.3.1.
Is the activity likely to cause impacts on the visual or scenic landscape?	Yes. Visual impacts associated with the proposed activity will mainly be in relation to the Leewood ponds and those few parts of the flowline visible from the Newell Highway. The topography of the surrounding area and separation distances between sensitive receivers will reduce impacts in this regard. Proposed landscaping measures will reduce impacts from the Newell Highway. Refer section 6.3.3.
4.4 Natural resource impacts	
Is the activity likely to result in the degradation of an area reserved for conservation purposes?	No. There are no areas reserved for conservation that would be affected by the proposed activity. Refer section 6.4.
Is the activity likely to affect the use of, or the community's ability to use, natural resources?	No. The proposed activity will not require significant quantities of natural resources. Water required during construction will be sourced from a proposed water bore, which is subject to licensing and approvals from NOW. Refer section 6.4.
Is the activity likely to involve the use, wastage, destruction or depletion of natural resources including water, fuels, timber, or extractive materials?	No. The proposed activity will require the removal of minor areas of vegetation within the State forest, which will have no impact on forestry operations. The proposed clearing is in accordance with the Occupation Permit entered into with Forests NSW. Refer section 6.4.

Issue	Response/reference
4.5 Aboriginal cultural heritage impacts	
Will the activity disturb the ground surface or any culturally modified trees (e.g. a scar tree)?	Yes, the proposal will disturb the ground surface. The proposed activity involves excavation for pond construction and ploughing for flowline installation. A cultural heritage assessment of the site was prepared in accordance with the *Due Diligence Code of Practice for the Protection of Aboriginal Objects in New South Wales 2010* (DECCW 2012). The assessment determined that the proposed activity will not impact on any known Aboriginal objects or places. Refer section 6.5.
Does the activity affect known Aboriginal objects or Aboriginal places?	No. Refer section 6.5.
Is the activity located in areas where landscape features indicate the presence of Aboriginal objects?	Yes. The proposed activity is located within 200 metres of Bohena Creek. A site inspection of the creek did not identify the presence of any items of Aboriginal heritage significance. Refer section 6.5.
Can harm to objects or disturbance of landscape features be avoided?	Yes. No harm to objects or landscape features is proposed. Refer section 6.5.
Does the proposed activity affect areas subject to native title claims, indigenous land use agreements or joint management?	Yes. The Gomeroi People have filed a claim over an area of 111,340 km² which includes the Narrabri LGA and the project area. Santos has engaged with Native Title Services, which is the native title representative body for NSW, in respect to this matter. Santos has also had preliminary discussions with the Gomeroi Native Title Applicants in the lead up to a native title agreement. Refer sections 5.1.2 and 6.5.
4.6 Historic cultural or natural heritage impacts	
What is the impact on places, buildings, landscapes or moveable historic heritage items?	Nil. Two identified items of European heritage significance have been identified on Leewood. The proposed activity has been designed to avoid impacts to the items. Refer section 6.6.
Is any vegetation of cultural landscape value likely to be affected (e.g. gardens and settings, introduced exotic species, or evidence of broader remnant land uses)?	No. There is no vegetation of cultural landscape value within the project area. No further assessment was required.
4.7 Matters of National Environmental Significance	
Is the proposed activity likely to impact on matters of national environmental significance under the *Environmental Protection and Biodiversity Conservation Act 1999*?	No. The proposed activity will not impact of any MNES. Refer Table 6-5.
4.8 Cumulative Impacts	
Is the proposed activity likely to have any significant cumulative impacts?	Refer section 6.8.

6.1 Physical and chemical impacts

6.1.1 Soil quality and land stability

6.1.1.1 Impacts

The proposed activity will require vegetation clearing and land disturbance for the Leewood ponds, road works, drilling of the water bore at Leewood and land disturbance for the installation of the flowline and facilities at Bibblewindi. These works have the potential to cause soil erosion, loss of topsoil and sedimentation of waterways.

The ploughing technique proposed for the installation of the flowline will minimise land disturbance, however there will still be potential for erosion given the sandy topsoils in the State forest and alluvium in Bohena Creek.

The proposed activity could result in soil contamination as a result of spilled or leaked chemicals (such as drilling fluid additives), fuel or oil. Spills or leaks could occur during handling, use, storage or transit of chemicals, fuels and oils. Spills or leaks may also occur during refuelling or maintenance of plant or equipment.

Soil contamination could also result from a dam failure or overflow scenario. A dam failure event is considered highly unlikely, as discussed in further detail in section 6.3.1. Likewise, a dam overflow event is considered highly unlikely. The water balance model that has informed the design of the ponds has considered major rainfall events and the production rates of existing pilot wells that will feed into the ponds. The ponds are designed with an Environmental Containment Freeboard (ECF) sufficient to provide storage in excess of the 48 hour 1:20,000 ARI event (assumed to be 650.5 mm) or approximately three 48 hour 1:100 year ARI events. The ECF significantly exceeds the requirements of the DSC guidance, which requires the ECF of Significant Consequence Category dams to provide storage for a 1:10 AEP 72 hour event (which at the Leewood site would equate to a rainfall depth of approximately 155 mm). The pond spillways are also designed for a 1:10,000 AEP event, assuming the ponds are full to spillway level when the event occurs. This means that the probability of a pond embankment overtopping is significantly less than 1:10,000 AEP as the ponds are intended to be operated at MOWL, well below the spillway crest elevations.

Well water production monitoring and level tracking of the ponds will be undertaken to manage the quantity of produced water entering the Leewood ponds prior to the construction of additional treatment infrastructure at Leewood (which is not part of the proposed activity). Should any indicators predict an early fill of the ponds prior to the commissioning of the water treatment infrastructure, a turn down of water production rates from high producing pilot wells will be initiated to maintain a safe operational input rate. Should the ponds reach a level that is predicted to be maximal for the near term, pilots will be shut in until the treatment infarstructure is ready.

Other mechanisms to be implemented to ensure that a dam overflow does not occur are discussed further in section 6.3.1.2.

Should the topsoil to be stockpiled at Leewood be stored for an extended period (i.e. greater than 12 months), impacts to the structure, biological activity, chemical properties and organic content may be affected.

Drilling activities will produce drilling mud and drill cuttings. These materials are unlikely to present an erosion hazard as drilling mud and cuttings will be contained in surface tanks or lined pits.

6.1.1.2 Mitigation measures

Mitigation measures outlined in section 6.3.1.2 will ensure the risk of dam failure or overflow and associated impacts to soils are negligible. The following additional measures will be undertaken to ensure impacts to soils are minimised.

- A specific erosion and sediment control plan (ESCP) will be developed and implemented for the proposed activity by the Principal Contractor based on a detailed investigation of site conditions. The ESCP will incorporate (as a minimum) those measures identified in section 2.6.7.
- An investigation of soils will be undertaken prior to commencement of ploughing to determine feasibility of method for length of flowline installation. Traditional trenching will only be used when ploughing is determined unfeasible.
- Topsoil will be stripped and stockpiled (separately to the subsoils) at Leewood for later use on embankment batters. Stockpiles will be managed according to best management practices, including:
  - » Maintaining topsoil stockpiles at a height of no greater than 1.2 metres.
  - » Stabilising stockpiles using a temporary sterile cover crop or other acceptable materials.
- Should the topsoil at Leewood need to be stockpiled for more than 12 months, alternative arrangements will be undertaken to ensure that the physical, biological and chemical integrity of the topsoil is not diminished. This may include use of the topsoil for fill elsewhere on at Leewood.
- Topsoil will be spread onto pond embankments at a minimum depth of 0.3 metres (if sufficient quantities are available) as soon as possible following construction to encourage vegetation growth.
- Topsoil spread onto the embankments will be treated with good quality agricultural lime, applied at a rate of approximately one tonne per hectare.
- Reinstatement of the right of way will occur as soon as possible after ploughing or trenching.
- Ploughing through Bohena Creek will not be undertaken if flows are present. Bohena Creek will not be trenched.
- Bank stabilisation measures will be employed at Bohena Creek during flowline installation and the bank will be reintstated immediately following construction.
- With the exception of the Newell Highway crossing and where the flowline reaches Bibblewindi, flowline installation works are to occur only within the existing right of way. Vegetation removal along these areas of the right of way will only involve slashing of grasses and disturbance associated with ripping and ploughing, or trenching if necessary.
- The additional area required outside the cleared right of way at the Newell Highway crossing is to be kept to a minimum and no greater than 20m x 30m. The additional work area is to be clearly marked and no works are to occur outside this area.
- Where the flowline route extends outside the existing right of way at Bibblewindi, clearing will be kept to the minimum required, with a maximum width of 12 metres.
- Vehicular traffic along the right of way will be kept to a minimum.
- Where trenching is to be undertaken, topsoil will be stockpiled on the one side of the trench. Subsoils removed from the trench will also be placed on the same side and profile inversion avoided during reinstatement.
- Existing and proposed access tracks will be topped with gravel where necessary to reduce the erosion potential during construction. Cleared work areas will also be treated with an appropriate surface material to minimise erosion.
- The quantity of chemicals, fuels and oils stored on site will be minimised, where practicable.

- All chemicals, fuels and oils stored within the project area will be kept in an appropriately secured, bunded storage shed in accordance with the relevant MSDS.
- An MSDS register of all chemicals used or stored in the project area will be maintained.
- Maintenance of vehicles, plant and equipment will occur off site at an appropriately licensed facility unless deemed appropriate to conduct such maintenance on site.
- Refuelling of plant and equipment at Leewood will occur in a designated, bunded area. Refuelling along the right of way will not occur within 40 metres of Bohena Creek.
- A spill kit will be available at all active work sites within the project area during construction and personnel will be trained in its use.
- Any spills or leaks will be contained and cleaned up immediately using the spill kit. Contaminated material (such as contaminated soil or absorbent materials) will be removed from the site for disposal at a licensed waste facility.
- Plant and equipment will be inspected daily to ensure these are properly maintained.
- Upgrades to the Old Mill Road and Newell Highway intersection will include spray seal surfacing for the first 30 metres and rumble strips to remove potential contaminants.
- Monitoring and maintenance of the ponds will occur in accordance with section 2.6.5 to ensure a dam failure or overflow event is avoided. In the unlikely event that a dam failure or overflow did occur, Santos will implement a comprehensive rehabilitation program of all affected areas.

6.1.1.3 Potential impact category

With the implementation of mitigation measures, potential impacts are likely to be low adverse.

6.1.2 Groundwater

6.1.2.1 Impacts

Impacts to groundwater may be associated with the excavation of the ponds, installation of the flowline or drilling the water bore. Groundwater contamination could also occur due to spills of oil, fuels or chemicals if not cleaned up appropriately; or in the unlikely event of dam failure or overflow.

The flowlines are proposed to be buried at a shallow depth of 1000 mm and are unlikely to encounter groundwater. Installation of the adjacent gas flowline (to a depth of approximately 1200 mm) did not encounter groundwater. Groundwater was not detected during the geotechnical investigation at Leewood, which included test pits to a depth of five metres. The proposed HDD crossing of the Newell Highway is considered unlikely to intercept groundwater on the basis that the previous HDD crossing to the same depth and in the same general location did not encounter groundwater.

Shallow groundwater may be intercepted during the ploughing at Bohena Creek.

Potential impacts to groundwater associated with the drilling of the proposed water bore may result from drilling or well installation if not carried out correctly. Potential impacts include:

- creating an artificial connection between water-bearing formations that bypasses aquitards or aquicludes resulting in cross contamination of aquifers
- contamination of the aquifers by drilling fluids or mud if these are lost in the formation
- groundwater drawdown.

6.1.2.2 Mitigation measures

The measures identified in section 6.1.1.2 will also minimise potential impacts to groundwater. Mitigation measures outlined in section 6.3.1.2 will ensure the risk of dam failure or overflow and associated risks to groundwater are negligible. In addition, the following mitigation measures will be implemented to minimise potential impacts on groundwater sources:

- Water Supply Works and Water Use Approvals will be obtained from NOW prior to constructing the proposed water bore.
- Appropriate Aquifer Access Licences will be sourced and transferred to the approved works prior to construction of the bore.
- A driller licensed with the appropriate qualifications under the National Water Drillers Licensing Accreditation will be present to supervise the drilling though the aquifers and as required by regulations only to the limit of their technical capabilities in regards to water well drilling (unless exemptions are obtained).
- Drilling operations and waste management procedures for the water bore will be in accordance with accepted industry practices and in accordance with the processes outlined in this REF.
- No chemicals or lubricants (apart from those used to fuel machinery) will be used in the Bohena Creek crossing. Refuelling of construction vehicles will not be undertaken within 40 metres of Bohena Creek.
- Excessive drilling mud losses at the HDD crossing and water bore will be cured by loss circulation material (cellulose material such as sawdust or other benign naturally occurring substances) to ensure most fluids return to the surface.
- At the completion of drilling (HDD and water bore) all drilling muds and any contaminated cuttings (if present) will be disposed of or recycled at an appropriate licensed facility.
- An overall water monitoring program, inclusive of groundwater (as per section 2.6.5.5 of the REF) will be developed and implemented for the Leewood Ponds during the detailed design process.

6.1.2.3 Potential impact category

The proposed drilling methods will reduce the risk of impacts to groundwater sources. The risk of groundwater contamination due to spills or leaks on site will be reduced through spill containment and clean up procedures.

Given the short duration of the construction activities, the minimal requirement for chemicals and fuels on site and the proposed groundwater monitoring program, a negligible to low adverse impact on groundwater sources is expected; provided the identified mitigation measures are implemented.

6.1.3 Surface water

6.1.3.1 Impacts

The potential impacts on surface water associated with the proposed activity include erosion and sedimentation, surface water contamination due to dam failure/overflow or chemical/fuel release and impacts to flooding downstream of Leewood.

Chemicals will be used during construction of some parts of the proposed activity, including the drilling of the water bore and HDD crossing of the Newell Highway. Fuels will also be used and stored within the project area during construction and operation.

A small encroachment of the pond embankment is proposed within the 100 year ARI affected land. Flood modelling has been undertaken which demonstrates that downstream impacts to flooding are negligible (refer section 4.2.1for further detail).

In the highly unlikely event of dam failure or overflow, waters will drain in a general northerly direction to Mollee Creek, which is part of the Namoi Catchment. This will have negative impacts on the water quality in the catchment.

6.1.3.2 Mitigation measures

Implementation of the mitigation measures identified in section 6.1.1 will ensure impacts in relation to erosion and sedimentation are minimised. Mitigation measures outlined in section 6.3.1.2 will ensure the risk of dam failure or overflow and associated impacts to surface water are negligible. Additional mitigation measures to minimise impacts to surface water include the following.

- Pedestrian and vehicular traffic entering Bohena Creek will be minimised.
- Chemicals and hazardous substances will be used and stored according to regulatory requirements including the *Work Health and Safety Act 2011.*
- Refuelling of machinery will occur within designated areas away from surface water features. No refuelling will be undertaken within 40 metres of Bohena Creek.
- Works within the 100 year ARI affected area will be restricted to construction of a small turkeys nest.
- Regular monitoring, maintenance and reporting of the Leewood ponds will be undertaken in accordance with the DSC requirements and as outlined in section 2.6.5. Any potential integrity issues will be rectified immediately following identification.
- In the unlikely event that a dam failure or overflow did occur, Santos will implement a comprehensive rehabilitation program of all affected areas.
- Drilling mud will be contained in surface tanks which will be regularly inspected and maintained.
- A minimum freeboard of 300 millimetres will be maintained for any tanks or pits containing liquid waste.
- Weather forecasts will be monitored and in the event that prolonged, severe wet weather or flooding was predicted, works will cease and plant, machinery and any chemicals will be secured and bunded.

6.1.3.3 Potential impact category

With the implementation of mitigation measures, potential impacts are likely to be negligible to low adverse.

6.1.4 Air quality and greenhouse gases

6.1.4.1 Impacts

The greatest potential impact to regional air quality associated with the proposed activity will be particulate emissions associated with site preparation and construction of the ponds as well as hydrocarbon release from the water balancing tank. There will also be potential impacts associated with dust generated during clearing, construction of flowlines, maintenance and upgrade of existing access tracks (including Old Mill Road) and drilling of the water bore. Other potential impacts include:

- dust generated during clearing, road upgrades, pond excavation and flowline installation
- exhaust emissions from vehicle movements to and from the site
- exhaust emissions from plant and machinery operations on site
- hydrocarbon release during water transfer at the water balancing tank.

Dust levels generated by the proposed activity will vary depending on weather conditions.

The main air pollutants associated with vehicle, plant and machinery exhaust emissions include fine particulates ($PM_{2.5}$), carbon monoxide, oxides of nitrogen, carbon dioxide and hydrocarbons.

Direct greenhouse gas emissions from the proposed activity include:

- exhaust from plant and machinery
- small quantities of hydrocarbons released during water transfer at the water transfer tank (it is anticipated that approximately 53 kilograms of methane will be discharged for each ML of water discharged into the water balancing tank)
- exhaust emissions from power supply.

Greenhouse gas emissions generated by the proposed activity will not significantly contribute to State or National greenhouse gas emissions given the scale of impacts and short duration of construction works.

6.1.4.2 Mitigation measures

Relevant mitigation measures to control dust are provided in section 6.1.1.2. Additional mitigation measures that will be implemented to minimise impacts on air quality include:

- Areas of disturbance will be limited to the minimum required to carry out the proposed activity safely and efficiently.
- Reinstatement of the right of way will be undertaken as soon as practical following installation.
- Vehicle movements along the right of way will be minimised.
- Dust will be suppressed as required by spraying water on active sources, along access tracks and at Leewood and Bibblewindi during construction.
- Access tracks will be maintained with gravel as required.
- The water balancing tank at Bibblewindi will not be covered to allow for the dispersion of released hydrocarbons.
- Site speed limits will be imposed to minimise dust generated by vehicle movements.
- Vehicles, plant and equipment will be regularly maintained to ensure they are in good operating condition.
- Vehicles, plant and machinery will be turned off when not in use rather than left idling.

6.1.4.3 Potential impact category

Greenhouse gas emissions generated by the proposed activity will not significantly contribute to State or National greenhouse gas emissions given the scale of impacts and short duration of construction works. Dust and other air emissions can easily be managed with the identified mitigation measures. Therefore a negligible to low adverse impact on air quality is expected.

6.1.5 Noise

6.1.5.1 Criteria

Noise generating works associated with the proposed activity will predominantly occur during the construction period (approximately six months) and are therefore not permanent. For this reason, the *Interim Construction Noise Guideline* (ICNG) (DECC, 2009) is considered to be appropriate for consideration of noise impacts.

The ICNG recommends the following noise management levels for construction activities:

Time of day	Noise management level	How to apply
Recommended standard hours: Monday to Friday 7am to 6pm and Saturday 8am to 1pm	Noise affected RBL + 10 dB(A)	The noise affected level represents the point above which there may be a reaction to noise. Where the predicted or measured noise level ($L_{Aeq,\ 15\ minute}$) is greater than the noise affected level, all reasonable and feasible work practices should be applied to meet the noise affected level. All potentially impacted residents should be informed of the nature of works to be carried out, the expected noise levels and duration, as well as contact details.
	Highly noise affected 75 dB(A)	The highly noise affected level represents the point above which there may be strong reaction to noise. Where noise is above this level, the determining authority may require respite periods by restricting the hours that the very noisy activities can occur.
Outside recommended standard hours	Noise affected RBL + 5 dB(A)	A strong justification will typically be required for works outside the recommended standard hours. All feasible and reasonable work practices should be applied to meet the noise affected level. Where all feasible and reasonable practices have been applied and noise is more than 5 dB(A) above the noise affected level, the proponent should negotiate with the affected receiver.

Source: Interim Construction Noise Guideline (DECC 2009)

Noise Monitoring

Attended and unattended noise monitoring was undertaken at various locations surrounding the project area by Aecom in 2011, as part of a project proposed by Eastern Star Gas. Relevant to the proposed activity, noise monitoring was undertaken at a location approximately 1.5 kilometres to the south of Leewood (500 metres east of the Newell Highway) and north of Bibblewindi, approximately 1.2 kilometres north east of the right of way (refer Figure 6-1).

Unattended noise monitoring

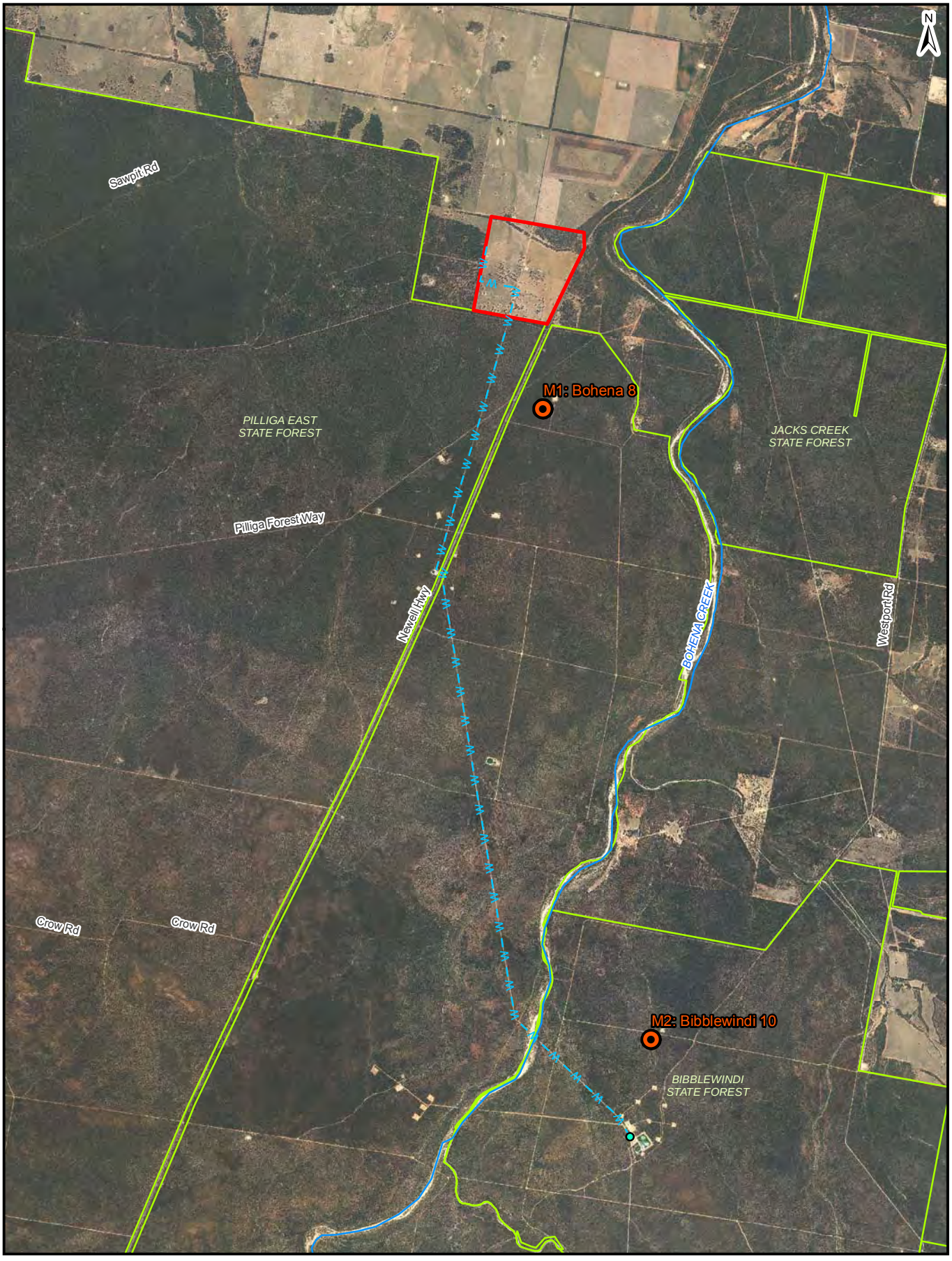
Loggers were used to continuously measure background noise levels between 25 January 2011 and 1 February 2011 at the location closest Leewood and between 25 January 2011 and 29 January 2011 at the location closest the right of way.

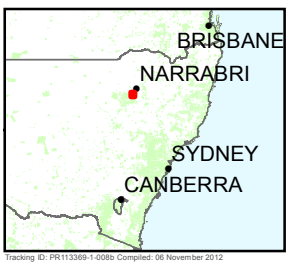
The results of the monitoring are shown in Table 6-2. The Rating Background Level (RBL) is representative of the average minimum background sound level (in the absence of the source under consideration), or simply the background level. The LA_{eq} is essentially the average sound level. It is defined as the steady sound level that contains the same amount of acoustical energy as a given time-varying sound.

Table 6-2 Summary of RBLs and existing LAeq ambient noise levels dB(A) (source: Aecom 2011)

Location	Rating background levels (L_{A90})			Ambient noise levels L_{Aeq}		
	Day[1]	Evening[2]	Night[3]	Day	Evening	Night
Leewood	30	30	30	45	45	43
Right of way	30	30	30	53	56	56

Notes:
1. Day is defined as 7:00 am to 6:00 pm, Monday to Saturday and 8:00 am to 6:00 pm Sundays & Public Holidays.
2. Evening is defined as 6:00 pm to 10:00 pm, Monday to Sunday and Public Holidays.
3. Night is defined as 10:00 pm to 7:00 am, Monday to Saturday and 10:00 pm to 8:00 am Sundays and Public Holidays.





Tracking ID: PR113369-1-008b Compiled: 06 November 2012

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Kilometres

APPROX SCALE 90,000 @ A4

GDA 1994 Zone 55

Disclaimer: While all reasonable care has been taken to ensure the information contained on this map is up to date and accurate, no guarantee is given that the information portrayed is free from error or omission. Please verify the accuracy of all information prior to use.

DATA SOURCES

Base topographic data © Commonwealth of Australia (Geoscience Australia) 2006. Noise monitoring locations AECOM, 2011.

LEGEND

- Noise Monitoring Site
- State Forest / Reserve / Park

Leewood Water Treatment Facility

- Bibblewindi
- W Flow Line (Right of Way)
- Leewood

RPS

FIGURE 6-1

Noise Monitoring Locations

Source: AECOM, 2011

The RBL at both locations was 30 dB(A) during the day, evening and night time periods. This is the minimum RBL considered in NSW under the *NSW Industrial Noise Policy* (INP) (EPA, 2000). The ambient noise levels at the location closest the right of way was higher during the evening and night time periods due to local fauna.

Attended noise monitoring

Attended noise measurements of existing ambient conditions were conducted at the two locations to assist in quantifying the contributing noise sources at the different monitoring locations. Where applicable, seasonal noise contributions (e.g. insects) were filtered out by removing the 4 kHz to 6.3 kHz 1/3 octave bands from the results.

The results of the attended noise measurements are presented in Table 6-3.

Table 6-3 Attended noise measurement results (dB(A) (source: Aecom 2011)

Location	Date/time	Measured sound pressure level			Notes
		L_{Aeq}	L_{A90}[1]	L_{A90}[2]	
Leewood	25/1/2011 12:32	41	33	31	Distant traffic noise, wildlife activity (significant insect noise)
	24/1/2011 21:29	51	49	22	Distant traffic noise, wildlife activity (significant insect and bat noise)
Right of way	25/1/2011 13:14	45	40	35	Wildlife activity (significant insect noise)
	24/1/2011 22:23	60	58	28	Wildlife activity (significant insect and bat noise)

Notes:

1. Includes insect noise.

2. Excludes LA90 levels from 4 kHz to 6.3 kHz (contribution from insects)

During the week, construction will occur within standard construction hours. Construction activities on weekends are proposed to be undertaken outside of the recommended standard construction hours, i.e. between 7am and 8am Saturdays, between 1pm and 6pm Saturdays and on Sundays. This is considered justified given the significant separation distances between the project area and the nearest permanently occupied residence, and also because it will make efficient use of remote machinery and workforce and shorten the overall duration of the proposed activity. Consultation with adjacent land owners and mitigation has been proposed to manage noise appropriately during these times, and are outlined in section 6.1.5.3.

The measured RBLs of 30dB(A) were considered representative of the project area. Based on an assumed RBL of 30 dB(A), the noise affected level for works during standard hours is 40 dB(A) and outside of standard hours is 35 dB(A).

6.1.5.2 Impacts

Noise will be generated during construction of the Leewood ponds (including drilling of the water bore), installation of flowlines, and construction of pumping station and associated infrastructure at Bibblewindi. There will also be noise generated during the upgrade of Old Mill Road. The greatest potential for noise generation will occur during the excavation works at the Leewood ponds.

During operation, noise generation will be minor and occur during operation of diesel generators and other minor infrastructure.

The nearest residence to the proposed ponds is located on the adjoining property to the west of Leewood, approximately 750 metres to the west. Consultation with the land owner has confirmed that this residence is

not permanently occupied and is used every second weekend and during school holidays. The closest permanent residence is located approximately 1.5 kilometres to the north of the proposed ponds. The noise monitoring undertaken close to Leewood (and 500 metres from the Newell Highway) indicates that ambient noise levels in the vicinity of Leewood are likely to be affected by traffic noise from the Newell Highway.

Noise consultants Noise Measurement Services (NMS) carried out noise source modelling of excavation equipment (bulldozer) during construction of the Leewood ponds. Modelling was performed based on a source on the top of the western side of the dam wall, which would have the most impact to the adjacent property to the west.

Noise predictions were undertaken based on the method described in *ISO 9613-2 (1996) Acoustics – Attenuation and sound propagation outdoors Part 2: General Methods of Calculation*, which takes into account meteorological factors. The predicted LA_{eq} sound levels from the bulldozer on top of the five metre high dam wall are illustrated in Table 6-4.

Table 6-4 Predicted noise levels for bulldozer (from western wall)

Distance from source (metres)	Predicted LAeq (dB(A)
100	57.2
200	49.8
300	45.3
400	41.9
500	39.2
1000	30.3
1500	24.5
2000	20.1

This demonstrates that the closest residences (including the residence located approximately 750 metres to the west) are unlikely to be noise affected by excavation (by 1 bulldozer) at the Leewood ponds, both during and outside of standard construction hours. Should more than one excavator be utilised, an increase of 3 dB(A) would be experienced each time the noise source was doubled (i.e. 2 bulldozers at 1000 metres would equate to 33.3 dB(A) and 4 bulldozers would equate to 36.6 dB(A)). The residential property to the west may be slightly noise affected outside of standard construction hours if this was to occur, however the exceedance would be minor. It is noted that a noise level of 45dA(A) is approximately 10dB(A) below normal conversation at one metre. In addition, this modelling applies a conservative approach i.e. flat terrain and no vegetation. The area between the western wall of the ponds and the nearest sensitive receiver to the west, some 750m away, is heavily vegetated, therefore some natural noise attenuation would be achieved. At no point would the residences be highly noise affected (i.e. noise levels exceed 75dBA) at any time).

The closest residences to the right of way are located approximately two kilometres to the east. Ploughing activities to be undertaken along the right of way would not be as noisy as construction of the Leewood ponds. The modelling for these noisier activities presented above demonstrates no impact at a distance of two kilometres. These residences are therefore unlikely to be noise affected by the proposed activity.

There are no recreational facilities located in close proximity to the subject site within the Pilliga State Forest however parts of the State forest may be used for recreational four wheel driving, walking and bird watching.

Noise monitoring will be undertaken at the commencement of construction to confirm the level of noise generated and identify whether proposed mitigation is sufficient. The construction will occur over approximately six months and during this time, ongoing communication will be undertaken with affected landowners to identify any concerns.

There may be some noise disturbance to recreational users of the State forest during the construction period, however these will be temporary and users will be able to utilise other areas of the State forest not affected by noise during this time.

6.1.5.3 Mitigation measures

The following measures will be implemented to minimise noise impacts:

- Construction activities will only be undertaken during the proposed construction hours of 7am to 6pm.
- Community notification will be undertaken prior to commencement of construction.
- Adjacent landowners will be contacted prior to construction and kept informed of construction activities at all times.
- Adjacent landowners will be advised of construction staging and the noisier activities including excavation and drilling and will be given a clear indication of how long noisy activities will take.
- Contact details will be provided to residents in the vicinity of the project area, and a complaints register will be kept.
- Where feasible and reasonable, particularly noisy activities will be undertaken during the middle of the day and not on Sundays.
- Broadband reversing alarms on vehicles should be used in place of tonal alarms wherever feasible.
- Plant and machinery not being used will be turned off.
- Reasonable and alternative work practices which generate less noise will be examined and implemented where feasible and reasonable.
- Heavy vehicle activity that passes through residential areas or the Narrabri town centre will be undertaken during standard construction hours (7:00am-6:00pm, Monday to Friday, 8:00am-1:00pm Saturdays) wherever feasible.
- All plant will be regularly maintained and fitted with manufacturer's standard noise mitigation equipment.
- Noise monitoring will be carried out at the commencement of construction of Leewood ponds to confirm noise levels at the nearest sensitive receivers.
- In the event of a noise complaint, the effectiveness of noise mitigation measures will be assessed and additional feasible and reasonable measures implemented, where necessary. This may include noise monitoring.
- Santos will ensure that any community issues of concern are met with a prompt response.

6.1.5.4 Potential impact category

Potential noise impacts during construction will be temporary and could be managed through the identified mitigation measures. Impacts during operation will be expected to be negligible. Impacts associated with noise are therefore expected to be low adverse.

6.1.6 Waste

6.1.6.1 Impacts

The proposed activity will generate the following waste streams during construction:

- vegetation waste (grass and trees)
- drill cuttings from HDD and drilling of water bore

- drilling fluid
- oil, chemical and fuel containers
- general site waste such as packaging materials and food wastes
- excess pond liner material
- sewage waste.

Waste generated during operation will be generally limited to general site wastes and food wastes.

Potential impacts associated with the generation and disposal of these wastes include:

- leaching of chemicals and other pollutants into groundwater, soils or surface water
- pollution or contamination of land or water due to lack of suitable containment of waste
- littering of the site, surrounding properties or surface waters due to lack of suitable containment of waste
- odours caused by improper storage or treatment of putrescible waste.

6.1.6.2 Mitigation measures

During construction, the following specific measures will be carried out to minimise waste and potential impacts associated with waste generation and disposal:

- A site waste management plan will be implemented by the contractors engaged to undertake the works.
- Appropriate waste receptacles will be provided in the project area including covered rubbish bins for disposal of domestic wastes.
- All wastes will be removed from the project area at the completion of works for recycling or disposal at an appropriately licensed facility.
- The type and volume of all waste removed from the project area will be recorded.
- Portable toilets will be provided on site and will be regularly serviced by a licensed contractor.

Generic measures to be implemented during both construction and operation include:

- A waste management strategy based upon the principles of avoid, reduce, reuse and recycle will be implemented for the project area.
- Management of waste, including its transport, will comply with the POEO Act and POEO (Waste) Regulation.
- Waste materials will be separated, classified and managed in accordance with the *Waste Classification Guidelines Part 1: Classifying Waste* (DECCW 2009).
- All staff and contractors will be made aware of waste management procedures during the site induction and through toolbox talks.
- Chemical, fuel and oil containers will be managed according to the MSDS or manufacturers' directions to avoid potential impacts to the environment or human health.

6.1.6.3 Potential impact category

Potential impacts associated with waste generation and management can be appropriately managed with the identified mitigation measures. A low adverse impact is expected.

6.1.7 Chemicals and hazardous substances management

6.1.7.1 Impact

Chemicals or hazardous substances to be used within the project area include drilling fluids and fuel. The drilling activities at the Newell Highway crossing and the proposed water bore will require the use of chemicals (particularly drill fluid additives). Drilling equipment and other machinery will require other substances such as fuels and oils which will be transported to, and stored in, the project area. These chemicals and fuels could be spilled during transit, storage or use in the project area. Only small quantities of chemicals are anticipated to be required as part of the proposed activity and any impacts associated with a spill will be minor and localised. These impacts have been discussed further in sections 6.1.1, 6.1.2 and 6.1.3.

6.1.7.2 Mitigation measures

The measures identified in section 6.1.1.2 will minimise potential impacts and risks associated with the use of hazardous substances and chemicals. In addition, the following mitigation measures will be implemented:

- Chemicals and potentially hazardous substances will be used and stored according to regulatory requirements including the *Work Health and Safety Act 20011*.
- Any dangerous goods will be transported according to regulatory requirements under the *Dangerous Goods (Road and Rail Transport) Act 2008*.

6.1.7.3 Potential impact category

Potential impacts associated with chemical and hazardous substance use can be appropriately managed with the identified mitigation measures. A negligible to low adverse impact from chemical and hazardous substance use is expected.

6.2 Biological impacts

6.2.1 Impacts

A range of impacts may result from the proposed activity as a result of vegetation removal, topsoil disturbance, excavation and other construction activities. Impacts to fauna may also occur during operation of the Leewood ponds. An ecological assessment has been undertaken for the proposed activity (Appendix 5) which assessed impacts associated with proposed works at Leewood and along the right of way. Bibblewindi forms part of a cleared and gravelled site (operating under an existing approval) and was therefore not surveyed.

6.2.1.1 Leewood

The proposed activity will be likely to result in the clearing of approximately 48.2 hectares of disturbed and previously cleared grazing land at Leewood.

Some additional impacts will be associated with clearing a short access track to Leewood from Old Mill Road and an upgrade to the intersection of Old Mill Road with Newell Highway. These impacts will result in the clearing of approximately 0.8 hectares of Pilliga Box Woodland.

One EEC, the '*Brigalow within the Brigalow Belt South, Nandewar and Darling Riverine Plains Bioregions*' (EPBC Act) commensurate with 'Brigalow (*Acacia harpophylla* dominant and co-dominant)' (TSC Act), was recorded on Leewood. This area will be retained and protected as part of the proposed activity.

One threatened fauna species, the Grey-crowned Babbler (*Pomatostomus temporalis temporalis*), was recorded on Leewood and nesting sites were identified.

Assessment via a seven part test found that the proposed activity is unlikely to significantly impact any potentially occurring species listed under the TSC Act. Assessment under the EPBC Act found that the proposed activity is unlikely to significantly impact on any potentially occurring species listed in the EPBC Act. There are larger areas of more suitable habitat for threatened species nearby (Pilliga State Forest ~ 160,000 hectares) and the proposal will affect a small area of sub-optimal habitat (~ 48.2 hectares of cleared, grazed paddocks with scattered paddock trees and the clearing of approximately 0.8 hectares of Pilliga Box Woodland within the Pilliga State Forest). Therefore, it is considered that the proposed development is not likely to have an adverse effect on the life cycle of any threatened entities (listed under the TSC Act or the EPBC) such that a viable local population or community is likely to be placed at risk of extinction.

The Leewood ponds have the potential to impact upon local fauna during operation. The geomembrane pond liners will be slippery when wet and the slopes of the internal embankment of the pond will be relatively steep. This could prevent animals from exiting the water should they enter the pond enclosure. The ponds may also be used bird species from time to time. The saline composition of the water would be likely to deter birds from drinking the pond water and it is unlikely that the water composition would pose a threat to birds that had only external contact with it. There are no incidences of bird fatalities recorded on Santos' (or ESG's) Incident Management Systems at any other water storage ponds in the Gunnedah Basin.

6.2.1.2 Right of Way

The right of way has been previously cleared and disturbed and will be re-disturbed for an approximate length of 16 kilometres and a maximum width of 12 metres. This equates to a maximum disturbance of 19.2 hectares, which is comprised of derived vegetation communities and regrowth approximately five years old. An additional area of clearing will be required where the flowline route extends outside the existing right of way at Bibblewindi. This will require the clearing of approximately 0.18 hectares of Ironbark Shrubby Woodland.

Five threatened fauna species, namely the Brown Treecreeper, Grey-crowned Babbler, Turquoise Parrot, Glossy Black-Cockatoo and Diamond Firetail, were recorded along the right of way.

Assessment via a seven part test found that the proposed activity is unlikely to significantly impact on any potentially occurring species listed under the TSC Act. Assessment under the EPBC Act found that the proposed activity is unlikely to significantly impact on any potentially occurring species listed on the EPBC Act. There are larger areas of more suitable habitat for threatened entities nearby (Pilliga State Forest ~ 160,000 hectares) and the proposal will affect a small area of sub-optimal habitat (~ 19.2 hectares of existing cleared and disturbed easement and the clearing of approximately 0.18ha of Ironbark Shrubby Woodland within the Pilliga State Forest). Therefore, it is considered that the proposed development is not likely to have an adverse effect on the life cycle of any threatened entities (listed under the TSC Act or the EPBC) such that a viable local population or community is likely to be placed at risk of extinction.

A small section (220 metres x 12 metres) of the previously cleared right of way was found to occur within an area which is likely to be commensurate with the *White Box Yellow Box Blakely's Red Gum Woodland* EEC (TSC Act) and *White Box, Yellow Box, Blakely's Red Gum and Derived Grasslands* CEEC (EPBC Act).

The condition of this area of vegetation was identified as degraded, specifically as the modified 'derived grassland' form of the listed community. The ecological impact of the removal of approximately 0.264 hectares of the derived grassland vegetation has been considered and it is concluded that the proposed activity will not have a significant impact upon the ecological community.

There will also be disturbance of some remnant vegetation where the pipeline crosses the Newell Highway. This will require the clearing of an additional area of approximately 0.07 hectares of a vegetation community which is common in the locality (*Ironbark shrubby woodlands of the Pilliga area, Brigalow Belt South*).

The ecological field surveys found that the proposed activity will be unlikely to have a significant impact on threatened species, populations or ecological communities in the locality providing that the recommended mitigation measures are adopted. The proposed activity does not constitute, and is not part of, a key threatening process under the TSC Act.

6.2.2 Mitigation measures

The site will be rehabilitated in accordance with section 2.6.9 of the REF. Other relevant mitigation measures are contained within section 6.1.1.2. In addition, the following measures will be implemented to further minimise impacts on flora and fauna:

- No clearing will occur within the retained remnant vegetation in the north east of Leewood which contains the EEC Brigalow and known Grey-crowned Babbler nesting sites. Access to this area will be prohibited during the construction phase to maintain the ecological integrity of this habitat. During operation, the existing access track through this vegetation may be utilised by small vehicles, however no additional clearing will occur.
- No additional clearing will occur outside the existing right of way, other than the HDD work area and associated launch and receive pits adjacent to the Newell Highway and where the flowline route extends outside the existing right of way at Bibblewindi.
- Appropriate measures will be employed to ensure that machinery utilised in the project area are free of materials (soils etc.) such that they do not infect vegetation within the project area with *Phytophthora cinnamomi*, or cause the distribution of weed species. Measures will be implemented to ensure that no seeds or plants are removed from the project area.
- Declared Noxious weeds (including Prickly Pear/ Tiger Pear) will be managed in accordance with local and state guidelines.
- Vehicle speeds will be minimised at all times on site to reduce the risk of fauna strike.
- Clearing of large eucalypts and hollowing bearing trees within the location of the proposed new access point off Old Mill Road will be avoided.
- A security fence around the toe of the external embankment will be installed to limit ground dwelling fauna from entering the pond. The fence will be inspected regularly for damage and any repairs carried out to prevent animal access to the ponds.
- An appropriate type of material (such as astro-turf or netting) will be installed at regular intervals along internal batter face of ponds to provide emergency egress for fauna.
- When necessary to remove habitat/hollow bearing trees, an environmental representative or ecologist will be present to ensure that fauna are handled appropriately.
- All disturbed areas outside of the impact footprint will be rehabilitated with endemic native vegetation following construction.

6.2.3 Potential impact category

The proposed activity is unlikely to significantly impact on any species, population or ecological community listed under the TSC Act or EPBC Act. Impacts are expected to be low adverse.

6.3 Community impacts

6.3.1 Public Safety

6.3.1.1 Impacts

Safety implications of the proposed activity include hazards associated with moving vehicles and machinery, construction and operation of infrastructure and plant, use of chemicals, fuels and oils, bushfire, works within the vicinity of the Newell Highway and risk to human life in the unlikely event of dam failure.

The project area is located in, or surrounded by, relatively dense vegetation. Parts of the project area will be expected to exhibit moderate to high bushfire hazard mainly due to the extent of vegetation cover. There is some potential for the proposed activity to contribute to the occurrence of bushfire in the area due to accidental ignition by vehicles, machinery, or smoking/cigarettes.

Authorised and unauthorised access to the Leewood ponds and other operational sites could result in harm to human life.

Works undertaken in close proximity to the Newell Highway will pose a potential risk for construction workers. Impacts and mitigation to address traffic management are discussed in further detail in section 6.3.2 below.

A Dam Failure Impact Assessment prepared by Golder Associates (Appendix 10) has been undertaken to evaluate impacts to people, the environment, livestock and properties downstream in the event of dam failure of the Leewood ponds. The assessment considered dam failure impacts in three scenarios: sunny day, 1:2 year AEP flood day and 1:100 year flood day failure scenarios.

When full, a dam failure at the Leewood ponds would result in a flood wave with a peak discharge of 300 cubic metres per second and would last for approximately two hours. As the flood wave moved downstream, it would attenuate and result in a dambreak affected zone extending up to 19 kilometres downstream of the ponds. Up to twelve homesteads were identified in the vicinity of the affected zone. One homestead would be affected in all three scenarios. One homestead would be affected in the 1:2 AEP and 1:100 AEP scenarios. This equated to a total population at risk (PAR) of five persons, with a probable loss of life (PLL) of less than 1 (0.05).

As previously mentioned, a dam failure is considered highly unlikely. Dam failure is uncommon and only one dam failure of a prescribed dam is known to have occurred in NSW recent times (DSC, 2011). This dam failure did not result in loss of life and there were only minor impacts associated with the failure.

The Leewood ponds have been designed to a higher standard than required in NSW. Slope stability of the pond embankments has been designed with consideration of the Operating Basis Earthquake (OBE) and Maximum Design Earthquake (MDE). Slope stability analyses undertaken by Golder Associates have found that the pond design met or exceeded minimum Factors of Safety in steady state load conditions and during both an OBE and MDE, under a variety of scenarios.

The dam design is being reviewed by the DSC to examine and investigate the location and design of the proposed ponds. During operation of the ponds, the DSC will maintain a role in monitoring the ongoing operation of the ponds. Impacts are considered unlikely if the correct monitoring and reporting procedures are followed, as per the mitigation measures. In the unlikely event of dam failure, the DSEP will be implemented to ensure any persons at risk were safely evacuated.

6.3.1.2 Mitigation measures

The following measures will be undertaken to ensure public safety is maintained.

- Monitoring of the pond construction will be undertaken for the duration of works to ensure integrity of the construction. This will include:
  - » Periodic inspections by a dam engineer or representative.
  - » Full time Level 1 Supervision (in accordance with AS 3798) of earthworks for pond embankment construction. All geotechnical testing required will be undertaken by a NATA accredited testing organisation.
  - » Full time Construction Quality Assurance (CQA) monitoring of the geosynthetics installation will be carried out by a representative of the dam engineer field staff member for all geomembrane lining systems installed in the ponds.
- The perimeter of the ponds will be secured with continuous minimum 1.8 metre high security fence and sign posted at regular intervals to indicate access restrictions prior to commissioning.
- An appropriate material (such as astro-turf or netting) will be provided at regular intervals along internal batter face of the ponds to provide emergency egress for humans. Emergency life rings to be provided at these locations.
- Pond embankments will be constructed at maximum batter of 1V:4H.
- Pond crests will be minimum five metre width with one way access restricted to light vehicles only.
- A 500 mm height safety bund will be provided where access ramps join the embankment crest.
- A continuous one way access track will be provided around the pond perimeter to allow ease of access for maintenance purposes. Safety bollards will be provided where drains or pipework cross beneath the perimeter access track.
- Electronic pond water monitoring devices will be designed and constructed such that requirement for pond entry for maintenance purposes is reduced.
- Pond outlet pontoon structures located over pond water will include steel mesh and guard rails to facilitate safe operational and maintenance access.
- A water operations plan will be developed which set out a guide for the hydraulic operation, monitoring and maintenance of the ponds. As a minimum, the manual will cover those operational, inspections, reporting and monitoring requirements outlined in section 2.6.5. The manual will be prepared prior to first fill of the ponds.
- A Dam Safety Emergency Plan (DSEP) will be prepared and submitted to the DSC prior to operation of the ponds. The DSEP will provide emergency response procedures that should be followed by operations staff responsible for the management of the Leewood ponds. It will be referred to in the event of a release of stored water or brine from the ponds which may present a risk to personnel and or/public and the surrounding environment.
- General site safety protocols, incident management and emergency procedures (including bushfire risk) will be implemented during the construction and operation works.
- A groundwater monitoring program as per section 2.6.5.5 will be implemented at Leewood to provide an ongoing assessment of the effectiveness of the environmental control measures and to limit risk of impact on any shallow aquifers associated with the ponds.
- Construction and operational sites (including Leewood and Bibblewindi) will be fenced and locked after construction hours. The right of way will not be fenced and locked but construction equipment will be left secured.

6.3.1.3 Potential impact category

With the implementation of mitigation measures, potential public safety impacts will be medium adverse.

6.3.2 Traffic

6.3.2.1 Impacts

The proposed activity will generate traffic during the construction period, including staff and construction vehicles. Only minor levels of traffic will be associated with the operation of the proposed activity.

The additional construction traffic may temporarily impact the existing operation of the Newell Highway and State forest roads, including Old Mill Road. Impacts will mainly be in relation to a reduction in speed limits along the Newell Highway during particular periods of construction. Potential safety impacts could also be associated with the proposed intersection upgrade works at the Newell Highway/Old Mill Road intersection.

It is anticipated that intersections on the Newell Highway will continue to operate at existing levels of service. Impacts to heavy vehicle movements along the Newell Highway are considered unlikely.

Construction and personnel vehicles exiting the project area may track sediments and other pollutants onto the Newell Highway.

A transport assessment has been prepared to address traffic impacts and identify appropriate management strategies (Appendix 3).

6.3.2.2 Mitigation measures

The following measures will be carried out to minimise potential impacts associated with traffic generated during construction and operation and potential impacts to the road network:

- Access to and from adjacent properties will be maintained for the duration of construction.
- Construction will only occur during the proposed construction hours (7am to 6pm, seven days per week).
- Parking for staff during construction and operation will be accommodated within the project area.
- Construction traffic will not be permitted to queue or park within Old Mill Road, other State forest roads or the Newell Highway unless to carry out works.
- Heavy construction equipment will be delivered to the project area at the beginning of the construction period and will remain on-site until the project is complete.
- Truck routes during construction will be restricted to the direct route via the Newell Highway to minimise impacts on local roads.
- There will be no transportation of bulk fill on the Newell Highway.
- Oversized vehicles required for transporting earthmoving equipment will be undertaken in accordance with the relevant requirements of Roads and Maritime Services (RMS).
- The site access plan outlined in section 4.8 of the transport assessment (Appendix 3) will be implemented during construction (including the intersection upgrade at the Newell Highway and Old Mill Road) and traffic managed accordingly.
- Prior to the commencement of construction, all required approvals will be sought from RMS and/or Narrabri Council. This will include approval for the intersection design and a road occupancy licence.
- Construction traffic will only access Leewood via Old Mill Road. Operational traffic may use the existing site access directly onto the Newell Highway, or via a new access point along the southern boundary of

Leewood.

6.3.2.3 Potential impact category

With the implementation of mitigation measures, potential traffic impacts will be low adverse.

6.3.3 Amenity

6.3.3.1 Impacts

Amenity impacts associated with the proposed activity will include visual, dust, noise, and traffic impacts.

Visual impacts associated with the proposed activity will mainly be in relation to the Leewood ponds and those few parts of the flowline visible from the Newell Highway.

The visual impact of the Leewood ponds will be most significant from the Newell Highway as this is the most heavily used road in the vicinity of the ponds. While the ponds will also be visible from points along Old Mill Road, this road is a minor road with minimal traffic. Existing vegetation along part of the northern boundary and to the west and south will provide some screening of the ponds from most other locations outside the project area.

Parts of the flowline construction will be visible from the Newell Highway and other State forest roads. In particular, HDD crossing of the Newell Highway will be visible for a short duration.

While Leewood is not highly visible from any residence, it may be visible from agricultural properties in the immediate vicinity. The presence of plant, equipment and stockpiles during construction and operation of the proposed activity will result in visual clutter and may detract from the scenic qualities of the land. It is noted that the visual characteristics of the proposed ponds will be similar to those of a large farm dam. The topography of the surrounding area is relatively flat which will reduce the visibility of the ponds from surrounding areas.

The proposed activity will result in minor increases in traffic along Newell Highway and Old Mill Road throughout construction. These impacts are addressed in section 6.3.2.

The proposed activity may temporarily increase dust and noise levels within the vicinity of the project area, though these will be controlled with the measures outlined in sections 6.1.4 and 6.1.5 respectively.

6.3.3.2 Mitigation measures

Mitigation measures to control dust, noise and traffic impacts are addressed in sections 6.1.4, 6.1.5 and 6.3.2, respectively. Additional measures to manage amenity impacts include:

- Topsoil from pond construction will be stockpiled along the eastern boundary of Leewood to provide visual screening during pond construction.
- A landscaped buffer of minimum 10 metre width will be established along the eastern boundary of Leewood to provide visual screening in the longer term. Species used in the landscaped buffer will comprise local endemic species and be selected in consultation with the Namoi Catchment Management Authority.
- The project area will be kept in a clean and tidy manner during site preparation, construction activities and operation.

6.3.3.3 Potential impact category

With the implementation of mitigation measures, potential amenity impacts will be medium adverse.

6.3.4 Community services, infrastructure and sites of importance

6.3.4.1 Impacts

The works are not likely to affect community services or infrastructure, or sites of importance to the local community. Part of the project area is within the Pilliga State Forest which is accessible to the public. During the construction of the flowline certain parts of the forest may be inaccessible to the public.

There may be some impacts to accommodation availability within Narrabri during construction.

Many of the site preparation, earthworks and field services employed during this project will be sourced from local suppliers, where possible. This will have a positive impact on the local economy through direct and indirect means.

6.3.4.2 Mitigation measures

The following measures will be implemented to minimise impacts on the local community and neighbouring properties:

- The consultation activities outlined in 2.3 will be implemented.
- The landowner and local community will continue to be consulted with leading up to and during the proposed works.
- All community enquiries and complaints will continue to be responded to promptly.
- The community will be promptly informed of any changes to timing or scheduling which will have an adverse impact on them.
- Narrabri Shire Council will be notified prior to commencement of works and liaised with throughout construction.
- Access will be maintained throughout the Pilliga State Forest for the duration of the construction period.
- Access throughout the State forest will be maintained throughout the duration of the construction phase.
- Should the construction extend significantly beyond six months (e.g. due to wet weather), adjacent landholders and Narrabri Shire Council will be informed.

6.3.4.3 Potential impact category

Potential impacts to community services, infrastructure or sites of importance are considered low adverse.

6.3.5 Economic impacts

6.3.5.1 Impacts

The proposed activity will provide economic benefits for Narrabri as well as the broader area through the introduction of a temporary workforce and associated accommodation requirements and purchasing of material supplies.

6.3.5.2 Mitigation measures

The following mitigation measures will be undertaken to ensure positive impacts to the local economy:

- Materials and services will be sourced locally where possible and feasible.

6.3.5.3 Potential impact category

Potential economic impacts are considered positive.

6.4 Natural resource & land use impacts

6.4.1 Impacts

Forestry operations and agriculture are the two key land uses relevant to the project area. Bibblewindi and the right of way are designated Crown Lands (State Forest) under the *Forestry Act 1916*. Leewood is a Santos owned property which is designated Zone 1a (General Rural) under the Narrabri Local Environment Plan 1992. It is not identified as SAL under the SRLUP. Impacts to these land uses as a result of the proposed activity are expected to be minor.

Consultation with Forests NSW occurred during the route selection process of the existing gas flowline. Operations within the State forest associated with this proposed activity will occur within this pre-cleared flow line corridor. Only minor vegetation clearing is likely to occur at the Newell Highway crossing, at two locations along Old Mill Road and for a short section of the flowline route which extends outside the right of way. There is the potential for weeds and pathogens to be spread as a result of the proposed activities.

Leewood is not currently used for agricultural purposes and it is not proposed that it will be during the construction or operational phases of the proposed activity. Notwithstanding, the proposed activity will quarantine land that could otherwise be utilised for cattle grazing. An AIS has been prepared to evaluate the impact of the proposed activity on agricultural resources and production at Leewood and within the surrounding Narrabri LGA (Appendix 6).

The AIS found that cattle grazing on Leewood is not economically viable due to the quality of the existing unimproved pasture and the property size. While the proposed activity will have an impact on potential agricultural production during the construction and operational phases of proposed activity, the impact on production value will be negligible in terms of the gross value of livestock production in the Narrabri LGA. As the right of way and Bibblewindi have no existing productive agricultural value, the proposed activity will not impact on agricultural resources and production within these areas.

The AIS concluded that the proposed development will not have an unreasonable impact on agricultural resources and production at Leewood or within the Narrabri Shire.

6.4.2 Mitigation measures

Implementation of the mitigation measures identified in section 6.1.1 will ensure impacts to soils (and future agricultural potential at Leewood) are minimised. Additional mitigation measures to minimise impacts to land use and natural resources include the following.

- Removal of mature trees in the State forest will only be undertaken at the Old Mill Road intersection and at the identified access point between Old Mill Road and Leewood to facilitate safe turning radiuses for heavy vehicles.
- Forests NSW will be kept informed of activities during construction and operation.
- All works will be undertaken in accordance with the Occupation Permit.

- Works associated with the proposed activity will not impact on agricultural production at any adjacent properties.

6.4.3 Potential impact category

With the implementation of mitigation measures, potential impacts are likely to be low adverse.

6.5 Aboriginal cultural heritage impacts

6.5.1 Impacts

The proposed activity will involve ground disturbance works, including excavation of soil, construction of ponds, installation of the flowlines (involving ploughing and drilling) and the drilling of the water bore.

A due diligence Aboriginal cultural heritage investigation was carried out for Leewood, including its access off Old Mill Road and two parts of the flowline that were not previously disturbed. These included an area adjacent Bibblewindi where the flowline extended outside the existing cleared right of way and the Bohena Creek crossing, which was previously under-bored.

Desktop searches were undertaken for the previously disturbed areas along the right of way and at Bibblewindi. Given that these parts of the project area are on disturbed land (as defined in the *Due Diligence Code of Practice for the Protection of Aboriginal Objects in New South Wales 2010*), a visual inspection was not required under the 2010 Due Diligence Code of Practice (refer section 5.2.6.2).

No Aboriginal objects, sites or culturally modified trees were identified in the AHIMS searches or during archaeological surveys carried out by RPS (Appendix 7). The vegetated area in the north east of Leewood was excluded from the investigation but will not be impacted by the proposed activity.

The Gomeroi People have filed a claim over an area of 111,340 km² which includes the Narrabri LGA and the project area. Santos has engaged with Native Title Services, which is the native title representative body for NSW, in respect to this matter. Santos has also had preliminary discussions with the Gomeroi Native Title Applicants in the lead up to a native title agreement.

6.5.2 Mitigation measures

The following measures will be implemented to reduce potential impacts on Aboriginal heritage:

- Project staff and contractors will be made aware of their statutory obligations for heritage under the NPW Act and the Heritage Act, through the site induction and toolbox talks.
- The work area will be clearly demarcated on site to ensure that plant and vehicles keep within the approved area of disturbance. No works will be undertaken in the vegetated area in the north east corner of the site.
- If any previously unidentified Aboriginal site/s are identified during works, then works in the immediate area will cease, the area will be cordoned off and the OEH Enviroline 131 555 will be contacted. A suitably qualified archaeologist will be contacted so that the site can be assessed and managed.
- In the event that skeletal remains are uncovered, work must cease immediately in that area and the proponent, Santos must contact the NSW Police Coroner to determine if the material is of Aboriginal origin. If determined to be Aboriginal, the OEH Enviroline 131 555 and relevant Aboriginal stakeholders must be contacted to determine an action plan for the management of the skeletal remains prior to works re-commencing.

6.5.3 Potential impact category

Provided the identified mitigation measures are carried out, potential impacts on Aboriginal cultural heritage will be negligible.

6.6 European cultural heritage impacts

6.6.1 Impacts

The proposed activity will involve ground disturbance works, including excavation of soil, construction of ponds, installation of the flowline (involving ploughing and drilling), and the drilling of the water bore.

No European cultural heritage sites are listed as occurring within close proximity to the project area and no relics or items of potential European cultural heritage significance were identified within Leewood during the archaeological field survey. There is some potential for relics or other items of European heritage value to be uncovered during clearing and excavation works.

Two items of heritage significance (a SUGAR station comprising two SUGAR pits) have been identified on the western boundary of Leewood. The pits are not registered on the OEH State Heritage Inventory; nor are they listed on the Narrabri LEP, however have been identified as having heritage significance (refer section 4.5). The proposed activity has been located to avoid these items.

No vegetation of cultural landscape value is likely to be affected.

6.6.2 Mitigation measures

The following measures will be implemented to reduce potential impacts on European heritage:

- The proposed works should avoid the SUGAR pits. The SUGAR pits will be flagged and a temporary barrier erected around them prior to commencement of works. No works will occur within this zone.
- A plan showing the location of the potential heritage items and the exclusion zone will be retained on site and all on-site personnel advised accordingly.
- The barriers will be removed at the completion of construction.
- If impact on the historic heritage items cannot be avoided by the proposed activity further investigation under the *Heritage Act 1977* including the preparation of a Statement of Heritage Impact will be required.
- If any previously unidentified potential European cultural heritage material is identified during works, then works in the immediate area will cease, the area will be cordoned off and the OEH Heritage Branch will be contacted. A suitably qualified archaeologist will be contacted so that the site can be assessed and managed.

6.6.3 Potential impact category

Provided the identified mitigation measures are carried out, potential impacts on European cultural heritage will be low adverse.

6.7 Matters of National Environmental Significance

The proposed activity will not impact of any MNES as detailed in Table 6-5.

Table 6-5 Matters of National Environmental Significance

MNES	Overview
World Heritage Properties	The proposed activity is not located in or within close proximity to a World Heritage area.
National Heritage Places	The proposed activity is not located in or within close proximity to a National Heritage Place.
Wetlands protected by international treaty (the RAMSAR convention)	The proposed activity is not located within a RAMSAR listed wetland area.
Nationally listed threatened species and ecological communities:	A number of threatened species listed under the EPBC Act have been recorded within a 10 kilometre radius of both Leewood and the right of way. None of the species listed were recorded during the field surveys. The likelihood of occurrence and potential impact of the abovementioned species is assessed in the Ecological Assessment and is discussed in section 4.3. It is considered unlikely that the proposed activity will have a significant impact on any of the species. One threatened ecological community listed under the EPBC Act was recorded on Leewood and one on the right of way. These ecological communities were assessed in the Ecological Assessment. It is considered unlikely that the proposed activity will have a significant impact on any of the species.
Migratory species	Five migratory bird species listed under the EPBC Act were identified having the potential to occur within the project area. None of these species were identified during the field surveys. Impacts to these species are considered unlikely.
Commonwealth marine areas	The proposed activity will not impact any Commonwealth marine areas.
Great Barrier Reef Marine Park	The proposed activity will not impact the Great Barrier Reef Marine Park.
All nuclear actions	The proposed activity does not involve a nuclear activity.

6.8 Cumulative impacts

Cumulative impacts associated with the proposed activity have been considered in terms of operational and construction impacts.

The proposed activity will essentially replace existing infrastructure at Bibblewindi. Water treatment infrastructure is also planned to be constructed at Leewood, subject to further approvals and environmental impact assessment. Once operational, these two activities would together facilitate ongoing CSG exploration within PAL 2 and PEL 238 and would therefore contribute to cumulative impacts associated with Santos' broader exploration program in the Gunnedah Basin.

Long term, cumulative impacts may be associated with the visual impact of the proposed activity. Cumulative visual impacts will not occur within the immediate locality, but could be associated with CSG and mining infrastructure across the broader region. The visual impact of the Leewood ponds will be appropriately mitigated through the proposed measures identified in this REF.

Cumulative impacts associated with construction will be temporary and minor. The construction program is expected to last approximately six months. During this time, additional CSG exploration activities are likely to be occurring within the vicinity, including the drilling of exploration core holes, work over activities and other decommissioning and rehabilitation works at the Bibblewindi Water Management Facility. Some of these activities will be in proximity to the project area (predominantly within the State forest) however none will be in close proximity to Leewood and the adjacent landowners.

The potential cumulative impacts during construction will predominantly be in relation to traffic, dust and air quality and noise impacts. Most of these impacts will be localised and therefore unlikely to result in

cumulative impacts across the broader area. Cumulative impacts associated with construction traffic on the Newell Highway and other State forest roads will be likely to be minor due to the short term construction period. Impacts will be appropriately managed with the mitigation measures identified in the REF.

Overall cumulative impacts associated with the proposed activity will be land disturbance and vegetation removal, land use impacts, community and economic impacts. Other CSG, mining and agricultural activities in the region will be occurring during the operational life of the proposed activity which could lead to cumulative impacts.

Vegetation to be removed does not comprise any significant vegetation. The majority of vegetation to be removed is grazing pasture of low habitat value at Leewood. Only very small areas of clearing will be required within the State forest to enable safe vehicular access to the project area. The proposed activity will therefore not contribute to cumulative impacts to significant vegetation removal.

The proposed activity will result in land disturbance of an area that has previously not been developed, except for grazing purposes. As a result of the proposed activity, an agricultural property of approximately 246 hectares will not be available for agricultural purposes. This is a small parcel of land that has been identified as non-viable for grazing purposes due to its size and pasture quality. In the context of other proposed CSG activities in the area, these are generally temporary activities that do not require long term use of agricultural land. Proposed coal mining activities may result in cumulative impacts in terms of land disturbance and agricultural impacts, however these will be addressed through the provisions of the SLURP and specific AISs prepared for these activities.

The proposed activity and other coal mining and CSG activities will stimulate the local and regional economies, however may result in pressure on labour resources, accommodation, road infrastructure and telecommunications. Santos is committed to working with local governments to ensure that these issues are addressed appropriately.

6.8.1 Mitigation measures

Santos will work with Narrabri Shire Council to ensure issues relating to increased pressure on labour resources, temporary and permanent accommodation, road infrastructure and telecommunications are addressed appropriately at a strategic level.

7.0 Summary of impacts

The potential impacts associated with the proposed activity are summarised in Table 7-1.

Table 7-1 Summary of impacts

Aspect	Potential impacts	Potential impact category (with mitigation measures)
Soil quality and land stability	▪ soil erosion and loss of topsoil or spoil ▪ land contamination in event of a leak , spill or dam failure ▪ reduction in quality of stockpiled topsoil	Low adverse
Groundwater	▪ groundwater contamination in event of a dam failure ▪ groundwater contamination due to mixing of aquifers, loss of drilling mud into the formation or inappropriate management of spills	Negligible to low adverse
Surface water	▪ sedimentation of surface waters due to increased erosion ▪ contamination of surface waters in event of a leak, spill or dam failure ▪ pollution/contamination of surface waters in event of flooding and inundation of the site	Negligible to low adverse
Air quality and greenhouse gases	▪ generation of dust and other particulates ▪ generation of greenhouse gas emissions	Negligible to low adverse
Noise	▪ generation of noise, particularly during construction	Low adverse
Waste	▪ generation and disposal of various wastes ▪ contamination of groundwater, soils or surface water from waste ▪ litter due to lack of suitable waste containment odours from improper storage or treatment of putrescible waste	Low adverse
Hazardous substance and chemical use	▪ land, water or air pollution, or fire, from improper use of hazardous substances or chemicals	Negligible to low adverse
Flora and fauna	▪ removal of approximately 48.2 hectares of non-significant vegetation at Leewood and up to 19.38 hectares along the right of way/flowline route ▪ temporary disruption to breeding cycle, roosting, sheltering and foraging behaviour of fauna species ▪ fauna injury or death in ponds	Low adverse
Public safety	▪ potential to impact up to five persons in event of dam failure ▪ hazards if persons were to fall in to pond ▪ safety implications for staff working in close proximity to traffic on Newell Highway ▪ introduction of other hazards, such as moving vehicles, plant and machinery, and chemicals, fuels and oils with potential safety implications ▪ bushfire risk	Medium adverse
Traffic	▪ increase in traffic on Newell Highway and State forest roads ▪ tracking of sediment onto Newell Highway	Low adverse
Amenity	▪ visual impact of ponds from Newell Highway and surrounding properties ▪ temporary reduced amenity for adjacent landowners from noise and dust	Medium adverse

Aspect	Potential impacts	Potential impact category (with mitigation measures)
	▪ minor traffic increases on Newell Highway and State forest roads	
Community services, infrastructure and sites of importance	▪ pressure on temporary accommodation in Narrabri area ▪ temporary inaccessibility of parts of State forest during construction.	Low adverse
Economic issues	▪ economic benefits to Narrabri and broader area	Positive
Natural resources and land use impacts	▪ impacts to forestry operations ▪ removal of approximately 246 hectares of land available for livestock grazing ▪ impacts on agricultural resources including soil, surface water and groundwater ▪ spread of weeds or pathogens	Low adverse
Aboriginal cultural heritage	▪ disturbance of unknown Aboriginal objects	Negligible
European cultural heritage impacts	▪ disturbance of potential heritage items identified at Leewood (astronomy pits) ▪ disturbance of other unknown European heritage items	Low adverse

7.1 Clause 228 Guidelines

Clause 228 of the *Environmental Planning and Assessment Regulation 2000* outlines a number of factors that must be taken into consideration in assessing an activity under Part 5 of the EP&A Act. An assessment of the clause 228 factors is provided in Table 7-2.

Table 7-2 Clause 228 factors

Factor	Impact
Any environmental impact on a community	Minor long term. The proposed activity will have long term, localised visual impacts however these are not considered significant. Other environmental impacts will be short term and localised. There are no residential properties within one kilometre of the project area. The nearest permanently occupied residential dwelling is located approximately 1.5 kilometres north of the site. The proposed activity will generate additional traffic (mainly during construction) but this will be unlikely to significantly impact the local road network. Impacts associated with the proposed activity will be virtually imperceptible to the wider community.
Any transformation of a locality	Minor long term. There will be a localised visual impact in the immediate vicinity of Leewood. This impact will be managed through implementation of visual screening and landscaping.
Any environmental impact on the ecosystems of the locality.	Negligible. The proposed activity will require the removal of up to approximately 49 hectares of non-significant vegetation at Leewood and 19.27 hectares of non-significant vegetation on the right of way. Removal of quality habitat will be minimal.
Any reduction of the aesthetic, recreational, scientific or other environmental quality or value of a locality	Minor long term. The proposed activity will reduce the aesthetic values of Leewood from the immediate vicinity. Landscaping and visual screening will ensure no significant impacts on the scenic qualities of the landscape.
Any effect on a locality, place or building having	Nil. No locality, place or building having aesthetic, anthropological, archaeological,

Factor	Impact
aesthetic, anthropological, archaeological, architectural, cultural, historical, scientific or social significance or other special value for present or future generations	architectural, cultural, historical, scientific or social significance or other special value for present or future generations occur within or near the site.
Any impact on the habitat of protected fauna (within the meaning of the National Parks and Wildlife Act 1974)	Negligible. The project area provides marginal foraging and nesting habitat for a range of protected fauna species within the meaning of the NPW Act. There are larger areas of more suitable habitat for threatened species nearby (Pilliga State Forest, approximately 160,000 hectares) and the proposed activity will affect a small area of sub-optimal habitat. Impacts will be negligible.
Any endangering of any species of animal, plant or other form of life, whether living on land, in water or in the air	Nil. The proposed activity will not endanger any species of animal, plant or other form of life, whether living on land, in water or in the air.
Any long-term effects on the environment	Minor long term. The proposed activity will result in the construction and long term operation of CSG related infrastructure. The Leewood ponds have a 25 year design life and will have visual impacts during this time. Mitigation measures will minimise the level of these impacts.
Any degradation of the quality of the environment	Minor short term. There is potential for minor short term environmental degradation as a result of air and noise emissions during the works.
Any risk to the safety of the environment	Minor long term. There is a low risk of dam failure, which will have impacts to surface water, soils, groundwater and vegetation downstream of Leewood. The proposed activity could also result in short term potential risks to the safety of the environment due to incidents and spills.
Any reduction in the range of beneficial uses of the environment	Nil. The proposed activity will not result in any reduction in the range of beneficial uses of the environment.
Any pollution of the environment	Minor long term. There is a low risk of dam failure, which could result in pollution of the environment downstream of Leewood. The proposed activity could also result in short term potential risk of pollution of the environment due to incidents and spills or as a result of air or noise emissions.
Any environmental problems associated with the disposal of waste	Nil. Any contaminated drill cuttings and drill mud/fluids will be disposed of at an appropriate licensed facility. All other wastes generated by the proposed activity will be collected, classified and removed from site for recycling, disposal or disposal at a licensed waste facility if required. Given the short term nature of the construction, only minor quantities of waste will be produced.
Any increased demands on resources (natural or otherwise) that are, or are likely to become, in short supply	Minor short term. Resources required for the proposed activity are not in limited supply in the area. No imported fill will be required for pond construction. Water from the proposed water bore will need to be licensed through an existing WAL.

8.0 CONCLUSION

This REF has been prepared to assess the potential environmental impacts of produced water and brine management ponds at a property known as "Leewood", near Narrarbi NSW, together with associated infrastructure within PAL 2 (the proposed activity). The proposed activity is permissible without development consent and requires assessment and determination under Part 5 of the *Environmental Planning and Assessment Act 1979* (EP&A Act). The REF addresses the requirements of section 111 of the EP&A Act, clause 228 of the *Environmental Planning and Assessment Regulation 2000* and the *ESG2: Environmental Impact Assessment Guidelines* (DTIRIS 2012).

The primary purpose of the proposed activity is to enable produced water and brine to be transferred from the existing Bibblewindi Water Management Facility located in the Pilliga State Forest, to the new Leewood ponds, which are located outside the Pilliga State Forest. The transfer of produced water and brine to Leewood will allow Santos to locate the produced water and brine storage ponds outside of the Pilliga, thereby reducing the risk of adverse environmental impact on the forest environment from the water storage activities.

The proposed activity may also facilitate, subject to further approvals, additional water treatment infrastructure replacing the existing Bibblewindi Water Management Facility to be located outside of the Pilliga State Forest near the ponds and the rehabilitation of the existing ponds within the Pilliga. The produced water and brine ponds are designed to be used with future water treatment infrastructure.

A range of potential impacts to the environment and community may be associated with the proposed activity. These have been considered in detail in the REF. The proposed activity has been located and designed to avoid significant environmental and heritage constraints and to reduce impacts to the surrounding community. On balance, the proposed activity will have a low adverse impact on the environment and community.

The proposed activity is not likely to significantly affect the environment or any threatened species, populations or ecological communities, their habitats or critical habitat and does not require preparation of an environmental impact statement or species impact statement.

9.0 STATEMENT OF COMMITMENTS

Table 9-1 provides a statement of commitments for the proposed activity.

Table 9-1 Statement of Commitments

Item	Commitment
Activity type and location	▪ The proposed activity will be carried out at Leewood, within the existing right of way between Leewood and Bibblewindi and at Bibblewindi, as described in section 2 of the REF. The proposed activity will generally include: - A produced water flow line and return flow line of approximately 16 kilometres in length, linking the proposed brine pond at Leewood to the existing Bibblewindi Pond 3 in the Pilliga State Forest. These flow lines are to be located within the previously cleared right of way associated with the existing gas flow line which links Wilga Park Power Station with the Bibblewindi Water Management Site. - Additional piping to connect existing water gathering systems terminating at Bibblewindi to new infrastructure. - One five ML produced water tank with associated pumping station and power supply, to be located adjacent the existing Bibblewindi 3 Pond. - One 300 ML produced water pond at Leewood. - One 300 ML brine pond at Leewood. - A produced water distribution manifold and associated piping at Leewood, to allow water distribution into produced water and brine storage ponds. - Associated construction compound, road and intersection upgrades, site offices and car parking areas at Leewood. - Following construction, transfer and storage of produced water and brine currently stored at the Bibblewindi Water Management Facility and produced water from existing pilots in PEL 238 and PAL 2 to the Leewood ponds.
Hours of operation	▪ Hours of operation (including construction) will be 7am till 6pm, seven days a week.
Activity duration	▪ Approximately six months construction and operation for the duration of Santos' CSG exploration activities in PAL 2 and PEL 238.
Proposed commencement date	▪ Works will commence in the first quarter of 2013.
Maximum area of disturbance	▪ Approximately 48.2 hectares at Leewood and 19.38 hectares along the right of way.
Rehabilitation commitments and timeframes	▪ The project area will be rehabilitated to its pre-operational condition (or better) once operational activities have ceased. ▪ A detailed rehabilitation strategy for the project area will be developed at the end of the life of the proposed activity.
Community consultation and complaint management	▪ Community consultation and complaint management will be undertaken in accordance with section 2.3 of the REF.
Soil quality and land stability	▪ A specific erosion and sediment control plan (ESCP) will be developed and implemented for the proposed activity by the Principal Contractor based on a detailed investigation of site conditions. The ESCP will incorporate (as a minimum) those measures identified in section 2.6.7. ▪ An investigation of soils will be undertaken prior to commencement of ploughing to determine feasibility of method for length of flowline installation. Traditional trenching will only be used when ploughing is determined unfeasible. ▪ Topsoil will be stripped and stockpiled (separately to the subsoils) at Leewood for later use on embankment batters. Stockpiles will be managed according to best management practices, including: - Maintaining topsoil stockpiles at a height of no greater than 1.2 metres.

Item	Commitment
	- Stabilising stockpiles using a temporary sterile cover crop or other acceptable materials. ▪ Should the topsoil at Leewood need to be stockpiled for more than 12 months, alternative arrangements will be undertaken to ensure that the physical, biological and chemical integrity of the topsoil is not diminished. This may include use of the topsoil for fill elsewhere on at Leewood. ▪ Topsoil will be spread onto pond embankments at a minimum depth of 0.3 metres (if sufficient quantities are available) as soon as possible following construction to encourage vegetation growth. ▪ Topsoil spread onto the embankments will be treated with good quality agricultural lime, applied at a rate of approximately one tonne per hectare. ▪ Reinstatement of the right of way will occur as soon as possible after ploughing or trenching. ▪ Ploughing through Bohena Creek will not be undertaken if flows are present. Bohena Creek will not be trenched. ▪ Bank stabilisation measures will be employed at Bohena Creek during flowline installation and the bank will be reintstated immediately following construction. ▪ With the exception of the Newell Highway crossing and where the flowline reaches Bibblewindi, flowline installation works are to occur only within the existing right of way. Vegetation removal along these areas of the right of way will only involve slashing of grasses and disturbance associated with ripping and ploughing, or trenching if necessary. ▪ The additional area required outside the cleared right of way at the Newell Highway crossing is to be kept to a minimum and no greater than 20m x 30m. The additional work area is to be clearly marked and no works are to occur outside this area. ▪ Where the flowline route extends outside the existing right of way at Bibblewindi, clearing will be kept to the minimum required, with a maximum width of 12 metres. ▪ Vehicular traffic along the right of way will be kept to a minimum. ▪ Where trenching is to be undertaken, topsoil will be stockpiled on the one side of the trench. Subsoils removed from the trench will also be placed on the same side and profile inversion avoided during reinstatement. ▪ Existing and proposed access tracks will be topped with gravel where necessary to reduce the erosion potential during construction. Cleared work areas will also be treated with an appropriate surface material to minimise erosion. ▪ The quantity of chemicals, fuels and oils stored on site will be minimised, where practicable. ▪ All chemicals, fuels and oils stored within the project area will be kept in an appropriately secured, bunded storage shed in accordance with the relevant MSDS. ▪ An MSDS register of all chemicals used or stored in the project area will be maintained. ▪ Maintenance of vehicles, plant and equipment will occur off site at an appropriately licensed facility unless deemed appropriate to conduct such maintenance on site. ▪ Refuelling of plant and equipment at Leewood will occur in a designated, bunded area. Refuelling along the right of way will not occur within 40 metres of Bohena Creek. ▪ A spill kit will be available at all active work sites within the project area during construction and personnel will be trained in its use. ▪ Any spills or leaks will be contained and cleaned up immediately using the spill kit. Contaminated material (such as contaminated soil or absorbent materials) will be removed from the site for disposal at a licensed waste facility. ▪ Plant and equipment will be inspected daily to ensure these are properly maintained. ▪ Upgrades to the Old Mill Road and Newell Highway intersection will include spray seal surfacing for the first 30 metres and rumble strips to remove potential contaminants. ▪ Monitoring and maintenance of the ponds will occur in accordance with section 2.6.5 to ensure a dam failure or overflow event is avoided. In the unlikely event that a dam failure or overflow did occur, Santos will implement a comprehensive rehabilitation program of all affected areas.
Groundwater	▪ Water Supply Works and Water Use Approvals will be obtained from NOW prior to constructing the proposed water bore. ▪ Appropriate Aquifer Access Licences will be sourced and transferred to the approved works prior to construction of the bore.

Item	Commitment
	▪ A driller licensed with the appropriate qualifications under the National Water Drillers Licensing Accreditation will be present to supervise the drilling though the aquifers and as required by regulations only to the limit of their technical capabilities in regards to water well drilling (unless exemptions are obtained). ▪ Drilling operations and waste management procedures for the water bore will be in accordance with accepted industry practices and in accordance with the processes outlined in this REF. ▪ No chemicals or lubricants (apart from those used to fuel machinery) will be used in the Bohena Creek crossing. Refuelling of construction vehicles will not be undertaken within 40 metres of Bohena Creek. ▪ Excessive drilling mud losses at the HDD crossing and water bore will be cured by loss circulation material (cellulose material such as sawdust or other benign naturally occurring substances) to ensure most fluids return to the surface. ▪ At the completion of drilling (HDD and water bore) all drilling muds and contaminated cuttings will be disposed of at an appropriate licensed facility. ▪ An overall water monitoring program, inclusive of groundwater (as per section 2.6.5.5 of the REF) will be developed and implemented for the Leewood Ponds during the detailed design process.
Surface water	▪ Pedestrian and vehicular traffic entering Bohena Creek will be minimised. ▪ Chemicals and hazardous substances will be used and stored according to regulatory requirements including the *Work Health and Safety Act 2011.* ▪ Refuelling of machinery will occur within designated areas away from surface water features. No refuelling will be undertaken within 40 metres of Bohena Creek. ▪ Works within the 100 year ARI affected area will be restricted to construction of a small turkeys nest. ▪ Regular monitoring, maintenance and reporting of the Leewood ponds will be undertaken in accordance with the DSC requirements and as outlined in section 2.6.5. Any potential integrity issues will be rectified immediately following identification. ▪ In the unlikely event that a dam failure or overflow did occur, Santos will implement a comprehensive rehabilitation program of all affected areas. ▪ Drilling mud will will contained in surface tanks which will be regularly inspected and maintained. ▪ A minimum freeboard of 300 millimetres will be maintained for any tanks or pits containing liquid waste. ▪ Weather forecasts will be monitored and in the event that prolonged, severe wet weather or flooding is predicted, works will cease and plant, machinery and any chemicals will be secured and bunded.
Air quality and greenhouse gases	▪ Areas of disturbance will be limited to the minimum required to carry out the proposed activity safely and efficiently. ▪ Reinstatement of the right of way will be undertaken as soon as practical following installation. ▪ Vehicle movements along the right of way will be minimised. ▪ Dust will be suppressed as required by spraying water on active sources, along access tracks and at Leewood and Bibblewindi during construction. ▪ Access tracks will be maintained with gravel as required. ▪ The water balancing tank at Bibblewindi will not be covered to allow for the dispersion of released hydrocarbons. ▪ Site speed limits will be imposed to minimise dust generated by vehicle movements. ▪ Vehicles, plant and equipment will be regularly maintained to ensure they are in good operating condition. ▪ Vehicles, plant and machinery will be turned off when not in use rather than left idling.
Noise	▪ Construction activities will only be undertaken during the proposed construction hours of 7am to 6pm. ▪ Community notification will be undertaken prior to commencement of construction.

Item	Commitment
	▪ Adjacent landowners will be contacted prior to construction and kept informed of construction activities at all times. ▪ Adjacent landowners will be advised of construction staging and the noisier activities including excavation and drilling and will be given a clear indication of how long noisy activities will take. ▪ Contact details will be provided to residents in the vicinity of the project area, and a complaints register will be kept. ▪ Where feasible and reasonable, particularly noisy activities will be undertaken during the middle of the day and not on Sundays. ▪ Broadband reversing alarms on vehicles should be used in place of tonal alarms wherever feasible. ▪ Plant and machinery not being used will be turned off. ▪ Reasonable and alternative work practices which generate less noise will be examined and implemented where feasible and reasonable. ▪ Heavy vehicle activity that passes through residential areas or the Narrabri town centre will be undertaken during standard construction hours (7:00am-6:00pm, Monday to Friday, 8:00am-1:00pm Saturdays) wherever feasible. ▪ All plant will be regularly maintained and fitted with manufacturer's standard noise mitigation equipment. ▪ Noise monitoring will be carried out at the commencement of construction of Leewood ponds to confirm noise levels at the nearest sensitive receivers. ▪ In the event of a noise complaint, the effectiveness of noise mitigation measures will be assessed and additional feasible and reasonable measures implemented, where necessary. This may include noise monitoring. ▪ Santos will ensure that any community issues of concern are met with a prompt response.
Waste	Construction: ▪ A site waste management plan will be implemented by the contractors engaged to undertake the works. ▪ Appropriate waste receptacles will be provided in the project area including covered rubbish bins for disposal of domestic wastes. ▪ All wastes will be removed from the project area at the completion of works for recycling or disposal at an appropriately licensed facility. ▪ The type and volume of all waste removed from the project area will be recorded. ▪ Portable toilets will be provided on site and will be regularly serviced by a licensed contractor. Construction and operation: ▪ A waste management strategy based upon the principles of avoid, reduce, reuse and recycle will be implemented for the project area. ▪ Management of waste, including its transport, will comply with the POEO Act and POEO (Waste) Regulation. ▪ Waste materials will be separated, classified and managed in accordance with the *Waste Classification Guidelines Part 1: Classifying Waste* (DECCW 2009). ▪ All staff and contractors will be made aware of waste management procedures during the site induction and through toolbox talks. ▪ Chemical, fuel and oil containers will be managed according to the MSDS or manufacturers' directions to avoid potential impacts to the environment or human health.
Hazardous substance and chemical use	▪ Chemicals and hazardous substances will be used and stored according to regulatory requirements including the *Occupational Health and Safety Act 2000*. ▪ Any dangerous goods will be transported according to regulatory requirements under the *Dangerous Goods (Road and Rail Transport) Act 2008*.
Biological impacts	▪ No clearing will occur within the retained remnant vegetation in the north east of Leewood which contain the EEC Brigalow and known Grey-crowned Babbler nesting sites. Access to this area will be prohibited during the construction phase to maintain the ecological integrity of this habitat. During operation, the existing access track through this vegetation may be

Item	Commitment
	utilised by small vehicles, however no additional clearing will occur. ▪ No additional clearing will occur outside the existing ROW, other than the HDD work area and associated launch and receive pits adjacent to the Newell Highway and where the flowline route extends outside the existing right of way at Bibblewindi. ▪ Appropriate measures will be employed to ensure that machinery utilised in the project area are free of materials (soils etc.) such that they do not infect vegetation within the project area with *Phytophthora cinnamomi*, or cause the distribution of weed species. No seeds or plants will be removed from the project area. ▪ Declared Noxious weeds (including Prickly Pear/ Tiger Pear) will be managed in accordance with local and state guidelines. ▪ Vehicle speeds will be minimised at all times on site to reduce the risk of fauna strike. ▪ Clearing of large eucalypts and hollowing bearing trees within the location of the proposed new access point off Old Mill Road will be avoided. ▪ A security fence around the toe of the external embankment will be installed to limit ground dwelling fauna from entering the pond. The fence will be inspected regularly for damage and any repairs carried out to prevent animal access to the ponds. ▪ An appropriate type of material (such as astro-turf or netting) will be installed at regular intervals along internal batter face of ponds to provide emergency egress for fauna. ▪ When necessary to remove habitat/hollow bearing trees, an environmental representative or ecologist will be present to ensure that fauna are handled appropriately. ▪ All disturbed areas outside of the impact footprint will be rehabilitated with endemic native vegetation following construction.
Public Safety	▪ Monitoring of the pond construction will be undertaken for the duration of works to ensure integrity of the construction. This will include: - Periodic inspections by a dam engineer or representative. - Full time Level 1 Supervision (in accordance with AS 3798) of earthworks for pond embankment construction. All geotechnical testing required will be undertaken by a NATA accredited testing organisation. - Full time Construction Quality Assurance (CQA) monitoring of the geosynthetics installation will be carried out by a representative of the dam engineer field staff member for all geomembrane lining systems installed in the ponds. ▪ The perimeter of the ponds will be secured with continuous minimum 1.8 metre high security fence and sign posted at regular intervals to indicate access restrictions prior to commissioning. ▪ An appropriate material (such as astro-turf or netting) will be provided at regular intervals along internal batter face of the ponds to provide emergency egress for humans. Emergency life rings to be provided at these locations. ▪ Pond embankments will be constructed at maximum batter of 1V:4H. ▪ Pond crests will be minimum five metre width with one way access restricted to light vehicles only. ▪ A 500 mm height safety bund will be provided where access ramps join the embankment crest. ▪ A continuous one way access track will be provided around the pond perimeter to allow ease of access for maintenance purposes. Safety bollards will be provided where drains or pipework cross beneath the perimeter access track. ▪ Electronic pond water monitoring devices will be designed and constructed such that requirement for pond entry for maintenance purposes is reduced. ▪ Pond outlet pontoon structures located over pond water will include steel mesh and guard rails to facilitate safe operational and maintenance access. ▪ A water operations plan will be developed which set out a guide for the hydraulic operation, monitoring and maintenance of the ponds. As a minimum, the manual will cover those operational, inspections, reporting and monitoring requirements outlined in section 2.6.5. The manual will be prepared prior to first fill of the ponds. ▪ A Dam Safety Emergency Plan (DSEP) will be prepared and submitted to the DSC prior to operation of the ponds. The DSEP will provide emergency response procedures that should be followed by operations staff responsible for the management of the Leewood ponds. It will

Item	Commitment
	be referred to in the event of a release of stored water or brine from the ponds which may present a risk to personnel and or/public and the surrounding environment. ▪ General site safety protocols, incident management and emergency procedures (including bushfire risk) will be implemented during the construction and operation works. ▪ A groundwater monitoring program as per section 2.6.5.5 will be implemented at Leewood to provide an ongoing assessment of the effectiveness of the environmental control measures and to limit risk of impact on any shallow aquifers associated with the ponds. ▪ Construction and operational sites (including Leewood and Bibblewindi) will be fenced and locked after construction hours. The right of way will not be fenced and locked but construction equipment will be left secured.
Traffic	▪ Access to and from adjacent properties will be maintained for the duration of construction. ▪ Construction will only occur during the proposed construction hours (7am to 6pm, seven days per week). ▪ Parking for staff during construction and operation will be accommodated within the project area. ▪ Construction traffic will not be permitted to queue or park within Old Mill Road, other State forest roads or the Newell Highway unless to carry out works. ▪ Heavy construction equipment will be delivered to the project area at the beginning of the construction period and will remain on-site until the project is complete. ▪ Truck routes during construction will be restricted to the direct route via the Newell Highway to minimise impacts on local roads. ▪ There will be no transportation of bulk fill on the Newell Highway. ▪ Oversized vehicles required for transporting earthmoving equipment will be undertaken in accordance with the relevant requirements of Roads and Maritime Services (RMS). ▪ The site access plan outlined in section 4.8 of the transport assessment (Appendix 3) will be implemented during construction (including the intersection upgrade at the Newell Highway and Old Mill Road) and traffic managed accordingly. ▪ Prior to the commencement of construction, all required approvals will be sought from RMS and/or Narrabri Council. This will include approval for the intersection design and a road occupancy licence. ▪ Construction traffic will only access Leewood via Old Mill Road. Operational traffic may use the existing site access directly onto the Newell Highway, or via a new access point along the southern boundary of Leewood.
Amenity	▪ Topsoil from pond construction will be stockpiled along the eastern boundary of Leewood to provide visual screening during pond construction. ▪ A landscaped buffer of minimum 10 metre width will be established along the eastern boundary of Leewood to provide visual screening in the longer term. Species used in the landscaped buffer will comprise local endemic species and be selected in consultation with the Namoi Catchment Management Authority. ▪ The project area will be kept in a clean and tidy manner during site preparation, construction activities and operation.
Community services, infrastructure and sites of importance	▪ The consultation activities outlined in 2.3 will be implemented. ▪ The landowner and local community will continue to be consulted with leading up to and during the proposed works. ▪ All community enquiries and complaints will continue to be responded to promptly. ▪ The community will be promptly informed of any changes to timing or scheduling which will have an adverse impact on them. ▪ Narrabri Shire Council will be notified prior to commencement of works and liaised with throughout construction. ▪ Access will be maintained throughout the Pilliga State Forest for the duration of the construction period. ▪ Access throughout the State forest will be maintained throughout the duration of the construction phase. ▪ Should the construction extend significantly beyond six months, (e.g. due to wet weather) adjacent landholders and Narrabri Shire Council will be informed.

Item	Commitment
Economic issues	▪ Materials and services will be sourced locally where possible and feasible.
Natural resources	▪ ˜ Removal of mature trees in the State forest will only be undertaken at the Old Mill Road intersection, at the identified access point between Old Mill Road and Leewood to facilitate safe turning radiuses for heavy vehicles and along the flowline route at Bibblewindi. ▪ Forests NSW will be kept informed of activities during construction and operation. ▪ All works will be undertaken in accordance with the Occupation Permit. ▪ Works associated with the proposed activity will not impact on agricultural production at any adjacent properties.
Aboriginal cultural heritage	▪ Project staff and contractors will be made aware of their statutory obligations for heritage under the NPW Act and the Heritage Act, through the site induction and toolbox talks. ▪ The work area will be clearly demarcated on site to ensure that plant and vehicles keep within the approved area of disturbance. No works will be undertaken in the vegetated area in the north east corner of the site. ▪ If any previously unidentified Aboriginal site/s are identified during works, then works in the immediate area will cease, the area will be cordoned off and the OEH Enviroline 131 555 will be contacted. A suitably qualified archaeologist will be contacted so that the site can be assessed and managed. ▪ In the event that skeletal remains are uncovered, work must cease immediately in that area and the proponent, Santos must contact the NSW Police Coroner to determine if the material is of Aboriginal origin. If determined to be Aboriginal, the OEH Enviroline 131 555 and relevant Aboriginal stakeholders must be contacted to determine an action plan for the management of the skeletal remains prior to works re-commencing.
European cultural heritage	▪ The proposed works should avoid the SUGAR pits. The SUGAR pits will be flagged and a temporary barrier erected around them prior to commencement of works. No works will occur within this zone. ▪ A plan showing the location of the potential heritage items and the exclusion zone will be retained on site and all on-site personnel advised accordingly. ▪ The barriers will be removed at the completion of construction. ▪ If impact on the historic heritage items cannot be avoided by the proposed activity further investigation under the *Heritage Act 1977* including the preparation of a Statement of Heritage Impact will be required. ▪ If any previously unidentified potential European cultural heritage material is identified during works, then works in the immediate area will cease, the area will be cordoned off and the OEH Heritage Branch will be contacted. A suitably qualified archaeologist will be contacted so that the site can be assessed and managed.
Cumulative	▪ Santos will work with Narrabri Shire Council to ensure issues relating to increased pressure on labour resources, temporary and permanent accommodation, road infrastructure and telecommunications are addressed appropriately at a strategic level.

GLOSSARY

Term	Meaning
Airlift surging	Also known as airlift pumping, this is a combination method for developing rock wells, where air is injected into the borehole so that water is lifted from the top of the well casing.
Annulus	The space between the wellbore and surrounding pipe.
Casing	A pipe placed in a well to prevent the wall of the hole from caving in and to prevent movement of fluids from one formation to another.
Cementing	The application of a liquid slurry of cement and water to various points inside and outside the casing.
Completion	Final preparations to ready a well for production.
Consequence category	Category assigned to a dam according to the seriousness, and magnitude, of the adverse consequences affecting the community's interests, including environmental effects, which could be expected to result from that dam's failure. In assigning such consequence categories, no account is taken of the likelihood of dam failure.
Core hole	The hole made for the core sample, which is obtained by drilling with special drills into a substance (e.g. sediment or rock) with a hollow steel tube called a core drill.
Drill cuttings	Broken pieces of rock formed by the bit duing drilling.
Drill fluid/mud	Circulating fluid that can lift cuttings from the wellbore to the surface and to cool down the drill bit.
Final (total) depth	The depth at which a well is drilled.
Flowline	A pipeline which conveys fluid or gas from once location to another.
Fuel gas conditioning skid	A machine that delivers clean and treated natural gas to gas turbines, gas engines, and other equipment which needs clean fuel.
Fusion bonding	A process that protects steel pipes from corrosion, where a fusion-bond epoxy powder is melted at a high heat and becomes a solid coating once applied to steel surfaces by chemical cross-linking.
Gathering system	Large systems of pipelines that gather water and gas, typically associated with CSG projects.
Horizontal directional drilling	A low impact construction technique that involves drilling short distances below ground surface to install linear infrastructure, thereby avoid impacts to the ground surface.
Pilot well	A well that is drilled as a small scale production trial with associated water and gas handling facilities.
Potholing	A method for exposing utilities to confirm location, identity, size, number of services and depth. Involves the use of high pressure water or compressed air to break up the ground.
Produced water	Also known as CSG water or wastewater, this is the water that is pumped out of coal seams in order to release CSG.
Pump skid	An integrated package mounted on a common base plate, which generally includes a mixture of tanks, piping, high or low pressure pumps or compressors, instrumentation, and other operational hardware.
Right of way	The access road along the surface of buried linear infrastructure.
Rumble strip	A raised or corrugated section of roadway which assists in the removal of loose sediments from vehicles.
Screen jetting	This is a combination method for developing rock wells, where a jetting tool, activated by either air or water, forces out high-pressure fluid and develops the formation.
Spillway	Structure designed to permit discharges from a dam or pond.
Spillway flood capacity	The capacity that a dam or (e.g. pond) can reach before a spill or flooding will occur.
Supervisory control and	A computer controlled system that monitors and controls industrial processes.

Term	Meaning
data acquisition (SCADA) system	
Surface casing	A drilled and cemented pipe used to provide blow-out protection, to seal off water/hydrocarbon sands and prevent the loss of circulation. Also used to seal off water sands, weak formations and/or lost circulation zones. In some cases surface and intermediate casing requirements are provided by the same string.
Wellhead	The system of spools, valves and associated adapters that provide pressure control for production.

ABBREVIATIONS

Term/abbreviation	Meaning
AEP	Annual Exceedance Probability
AHD	Australian Height Datum
AHIMS	Aboriginal Heritage Information Management System
AIS	Agricultural Impact Statement
ARI	Average Recurrence Interval
BoM	Bureau of Meteorology
CAT	cable avoidance tools
CEEC	Critically endangered ecological community
CSG	Coal seam gas
DERM	Department of Environment and Resource Management (QLD)
DRE	Division of Resources and Energy (under DTIRIS)
DSA	Design storage allowance
DSC	Dam Safety Committee
DSEP	Dam Safety Emergency Plan
DTIRIS	Department of Investment, Trade, Regional Infrastructure and Services
EP&A Act	*Environmental Planning and Assessment Act 1979*
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999*
EEC	Endangered ecological community
ESCP	Erosion and sediment control plan
FGCS	Fuel gas conditioning skid
HDD	Horizontal directional drilling
HDPE	High Density Polyethylene
LEP	Local Environmental Plan
LGA	Local government area
LSC	Land and Soil Capability
ML	Megalitres
MNES	Matter of National Environmental Significance
MOWL	Maximum Operating Water Level
MSDS	Materials Safety Data Sheets
NPW Act	*National Parks and Wildlife Act 1994*
NV Act	*Native Vegetation Act 2003*
NOW	NSW Office of Water
OEH	Office of Environment and Heritage
PAR	Population at risk
PAL	Petroleum Assessment Lease
PEL	Petroleum Exploration Licence
POEO Act	*Protection of the Environment Operations Act 1997*
PPL	Probable loss of life

Term/abbreviation	Meaning
REF	Review of Environmental Factors
RL	Reduced level
SAL	Strategic agricultural land
SCADA	Supervisory control and data acquisition
SEPP	State Environmental Planning Policy
SMS	Safety management system
SMU	Soil mapping units
SRLUP	Strategic Regional Land Use Policy
TEC	Threatened ecological community
TSC Act	*Threatened Species Conservation Act 1995*
WMA	*Water Management Act 2000*

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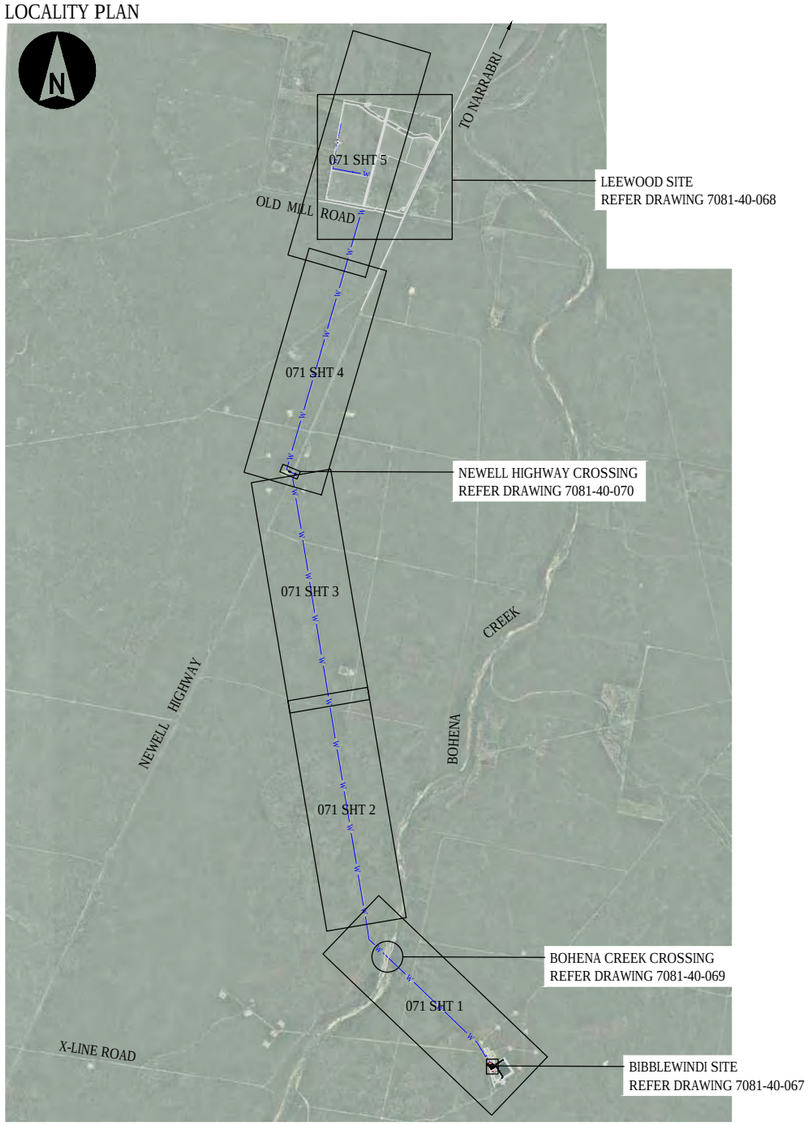
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Appendix 1

Design drawings (Flowline and Bibblewindi)

AREA 7081 - LEEWOOD WATER TREATMENT FACILITY

LOCALITY PLAN



DRAWING INDEX

DRAWING NUMBER	DRAWING TITLE
7081-40-066	PROJECT KEY PLAN
7081-40-067	BIBBLEWINDI PLOT PLAN: GENERAL ARRANGEMENT
7081-40-068	LEEWOOD PLOT PLAN: GENERAL ARRANGEMENT & SECTIONS
7081-40-069	BOHENA CREEK CROSSING PLAN AND TYPICAL DETAILS
7081-40-070	NEWELL HIGHWAY CROSSING PLAN AND TYPICAL DETAILS
7081-40-071 SHT 1	FLOWLINE PLAN AND LONGITUDINAL SECTION: SHEET 1 OF 5
7081-40-071 SHT 2	FLOWLINE PLAN AND LONGITUDINAL SECTION: SHEET 2 OF 5
7081-40-071 SHT 3	FLOWLINE PLAN AND LONGITUDINAL SECTION: SHEET 3 OF 5
7081-40-071 SHT 4	FLOWLINE PLAN AND LONGITUDINAL SECTION: SHEET 4 OF 5
7081-40-071 SHT 5	FLOWLINE PLAN AND LONGITUDINAL SECTION: SHEET 5 OF 5
7081-40-072	BIBBLEWINDI PLOT PLAN: TYPICAL SECTIONS

LEGEND

- WATER FLOWLINE
- PROPOSED FENCELINE
- EXISTING ELECTRICAL CABLE
- EXISTING ELECTRICAL CABLE TO BE ABANDONED
- EXISTING GAS PIPELINE
- EXISTING TELECOMMUNICATIONS LINE

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A	07/09/12	MD	DT	AM				ISSUED FOR INTERNAL REVIEW

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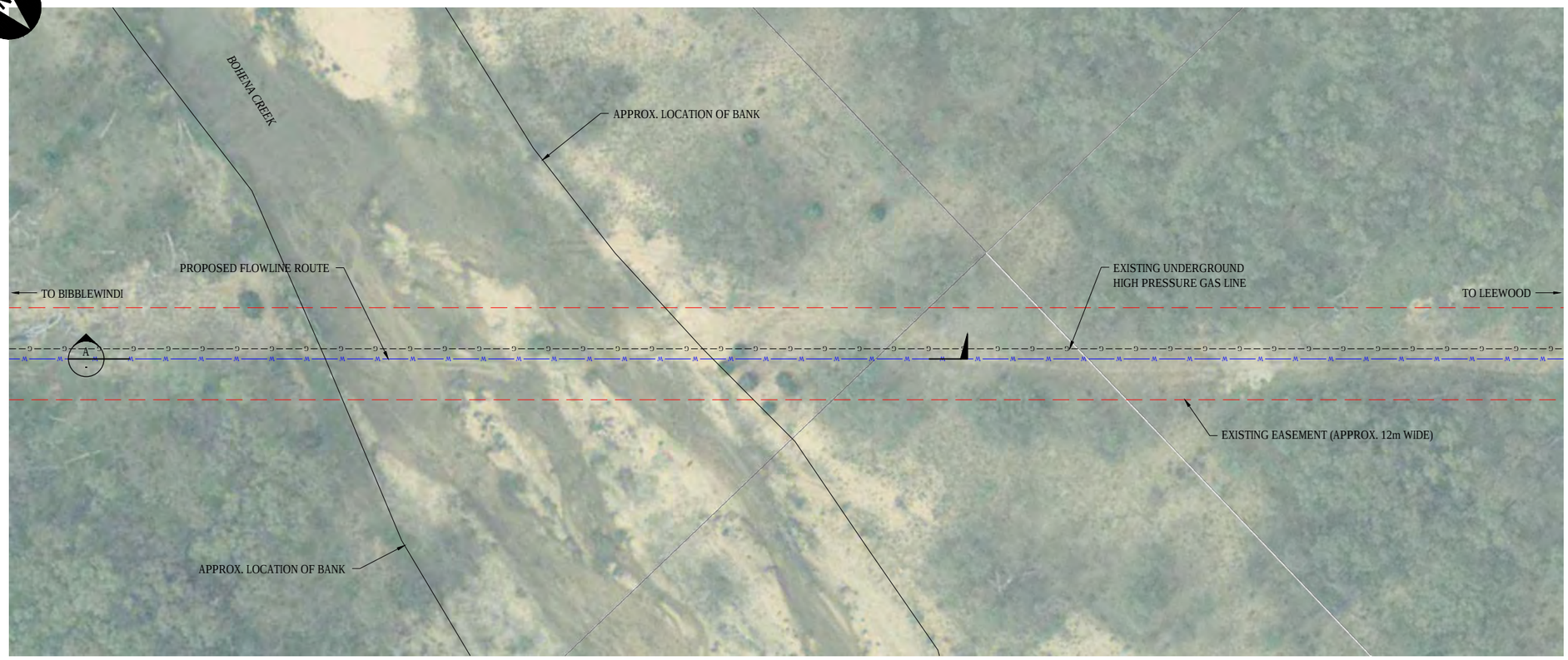
AREA 7081 - LEEWOOD WATER TREATMENT FACILITY
BIBBLEWINDI WATER TRANSFER FACILITIES
PROJECT KEY PLAN

Santos

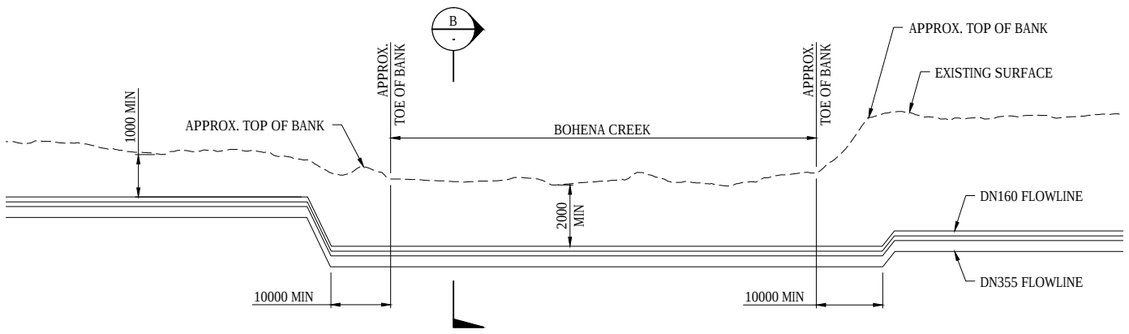
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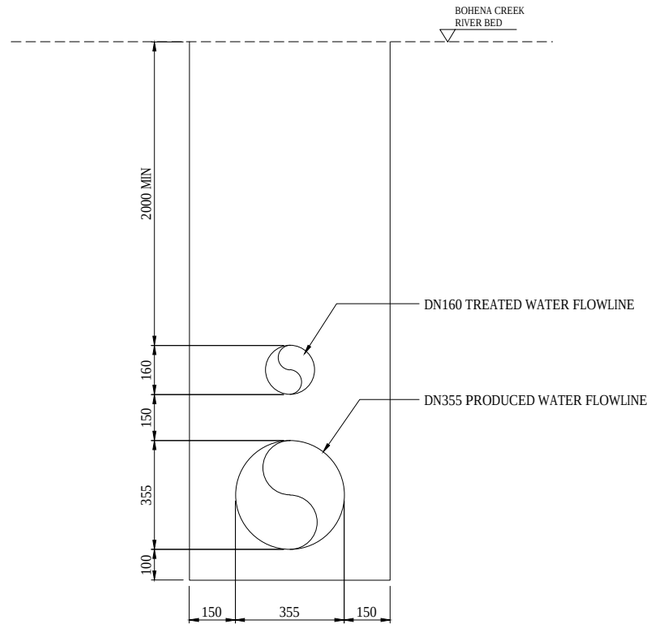


PLAN
SCALE 1:500



SECTION A
1:500(H), 1:50(V)

NOTE: EXISTING GAS MAIN NOT SHOWN FOR CLARITY



TYPICAL BOHENA CREEK CROSSING

SECTION B
SCALE 1:10

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SCALE 1:10
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SCALE 1:50
5 0 10 20m
SCALE 1:500

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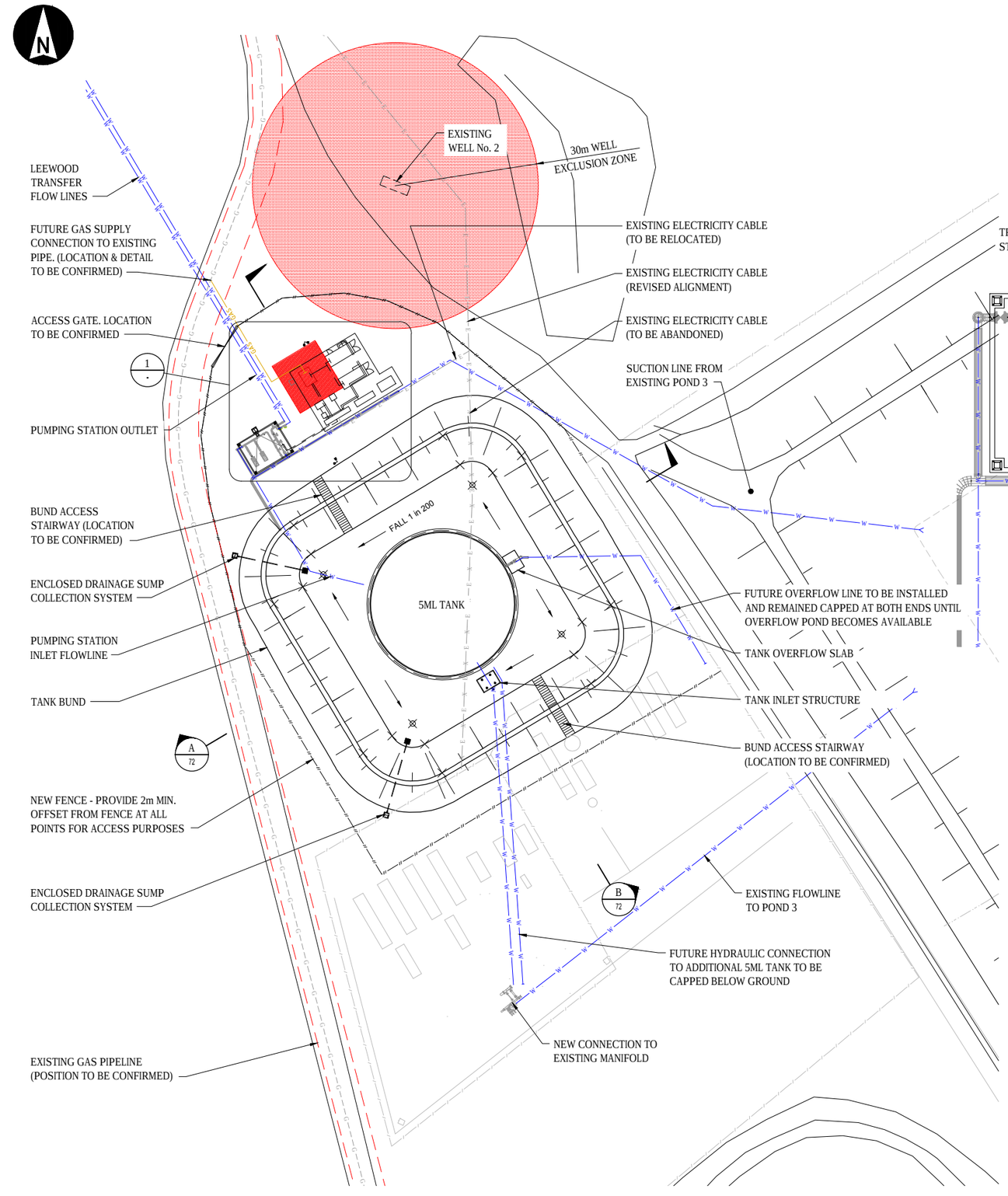
AREA 7081 - LEEWOOD WATER TREATMENT FACILITY
BIBBLEWINDI WATER TRANSFER FACILITIES
BOHENA CREEK CROSSING PLAN
AND TYPICAL DETAILS

Santos

DRAWING No. 7081-40-069

REV C

CADFILE No. -



DETAIL 1 / - SCALE 1:100

NOTE: CABLE ROUTES NOT SHOWN

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SCALE 1:500 (5 0 10 20m)

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AREA 7081 - LEEWOOD WATER TREATMENT FACILITY
BIBBLEWINDI WATER TRANSFER FACILITIES
BIBBLEWINDI PLOT PLAN
GENERAL ARRANGEMENT AND SECTIONS

Santos

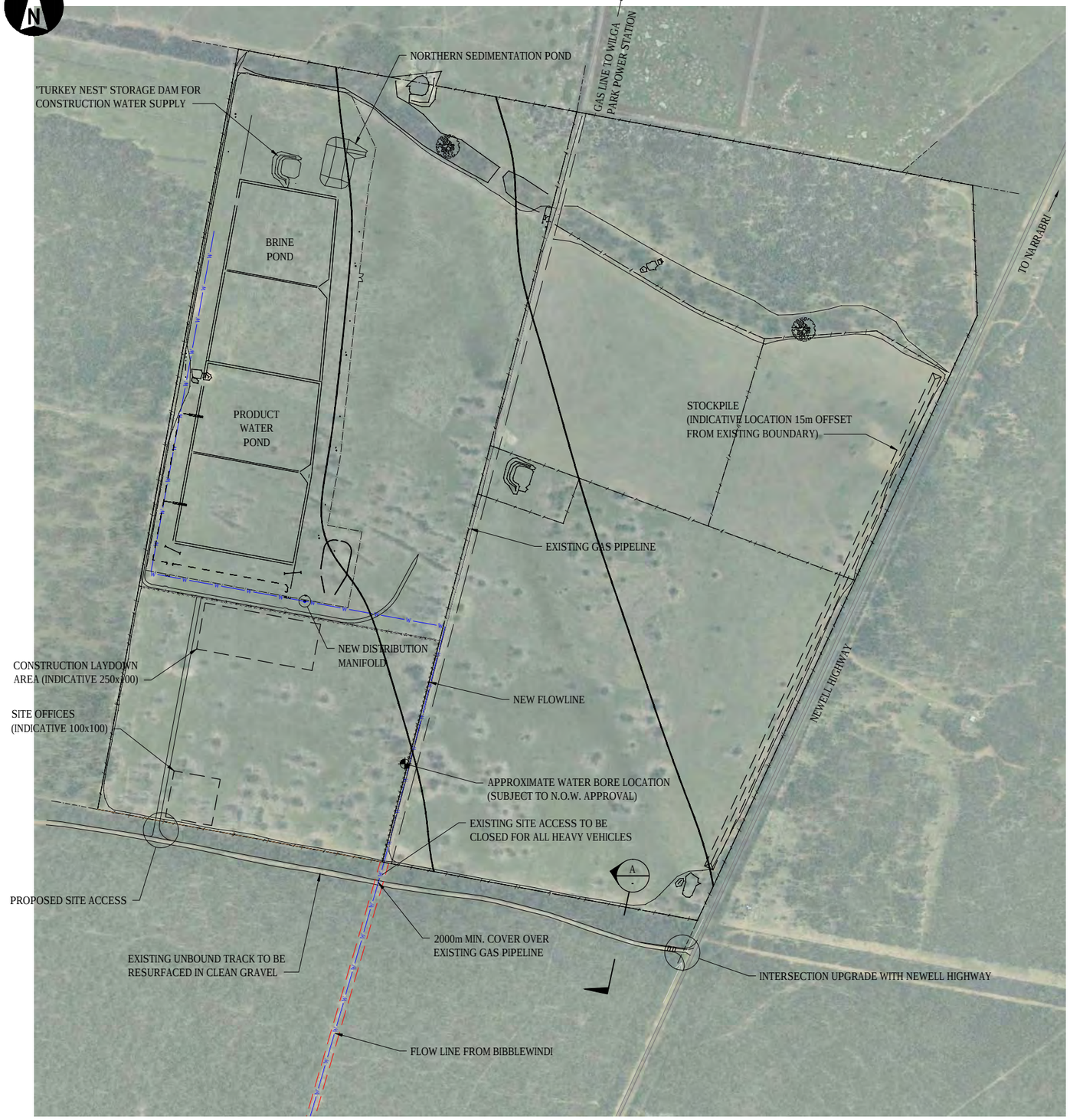
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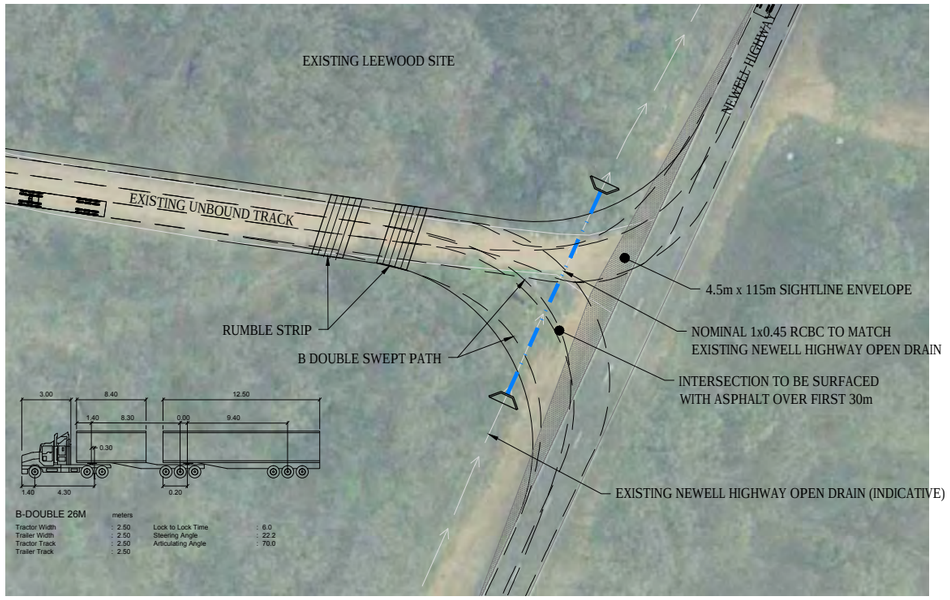
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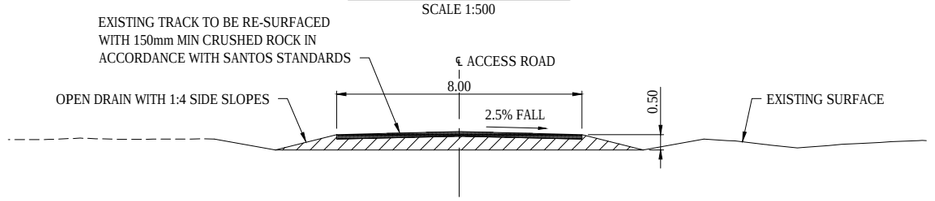
LAYOUT PLAN
SCALE 1:5000



INTERSECTION UPGRADE WITH NEWELL HIGHWAY
SCALE 1:500



PROPOSED SITE ACCESS
SCALE 1:500



TYPICAL ACCESS ROAD UPGRADE

SECTION A
SCALE 1:100

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SCALE 1:500
50 0 100 200m
SCALE 1:5000

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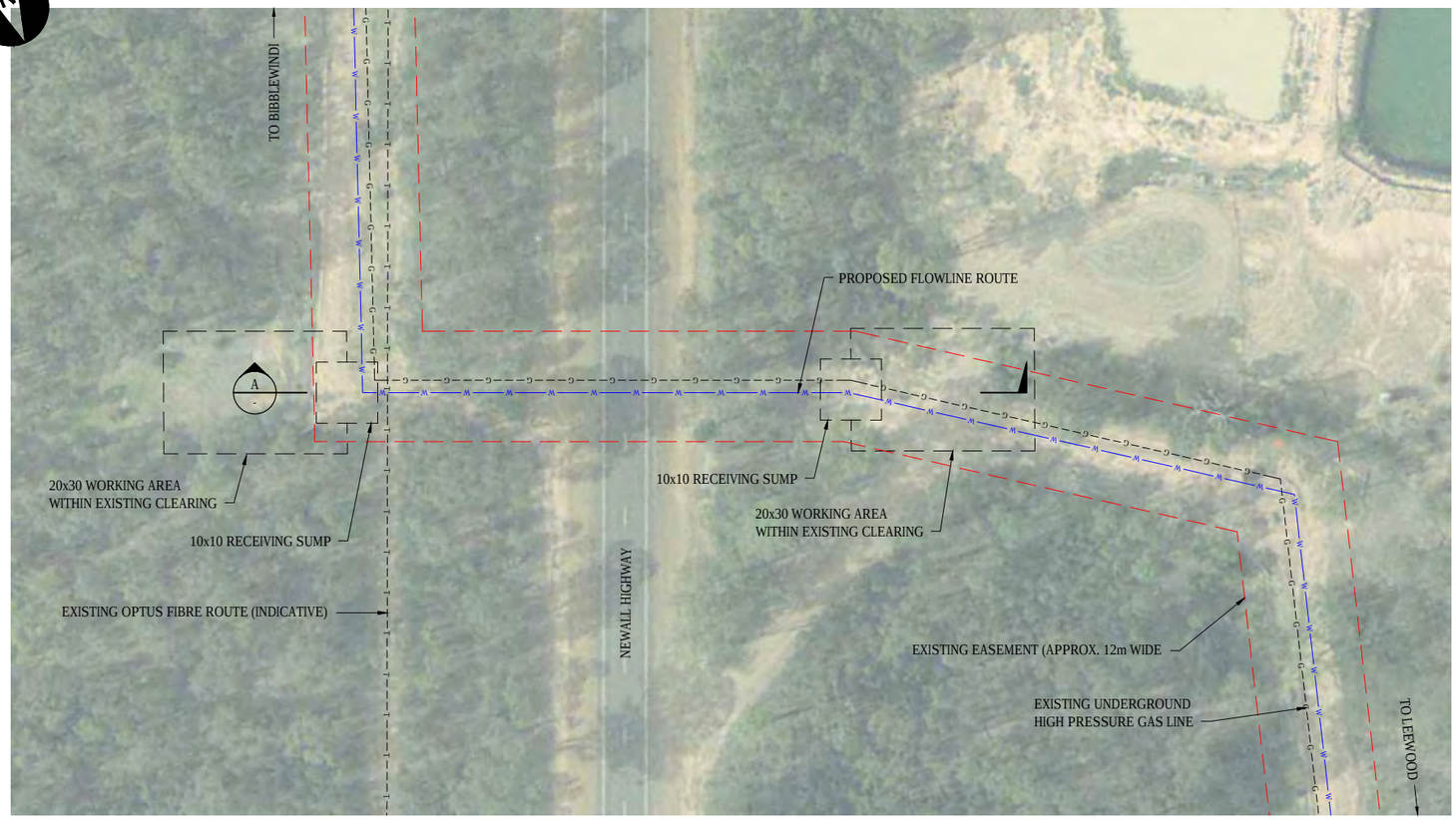
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LEEWOOD PLOT PLAN
GENERAL ARRANGEMENT AND SECTIONS

Santos

DRAWING No. 7081-40-068

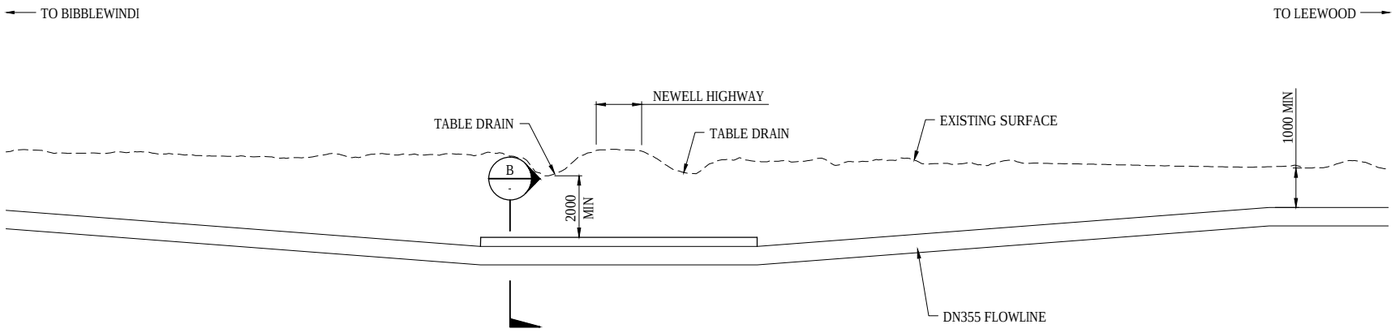
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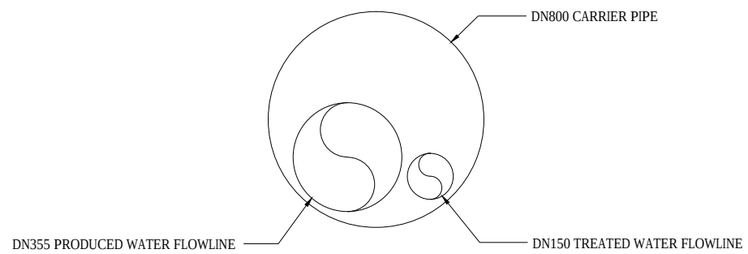
PLAN
SCALE 1:500

NOTE:
FINAL LOCATION OF RECEIVING SUMPS AND WORKING AREAS TO BE DETERMINED IN CONSULTATION WITH HDD CONTRACTOR. LOCATIONS SHOWN ARE INDICATIVE



SECTION A - 1:500(H), 1:50(V)

NOTE: EXISTING GAS MAIN AND FUTURE RETURN FLOWLINE NOT SHOWN FOR CLARITY



SECTION B - SCALE 1:10

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5 0 10 20m — SCALE 1:500

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AREA 7081 - LEEWOOD WATER TREATMENT FACILITY
BIBBLEWINDI WATER TRANSFER FACILITIES
NEWELL HIGHWAY CROSSING PLAN
AND TYPICAL DETAILS

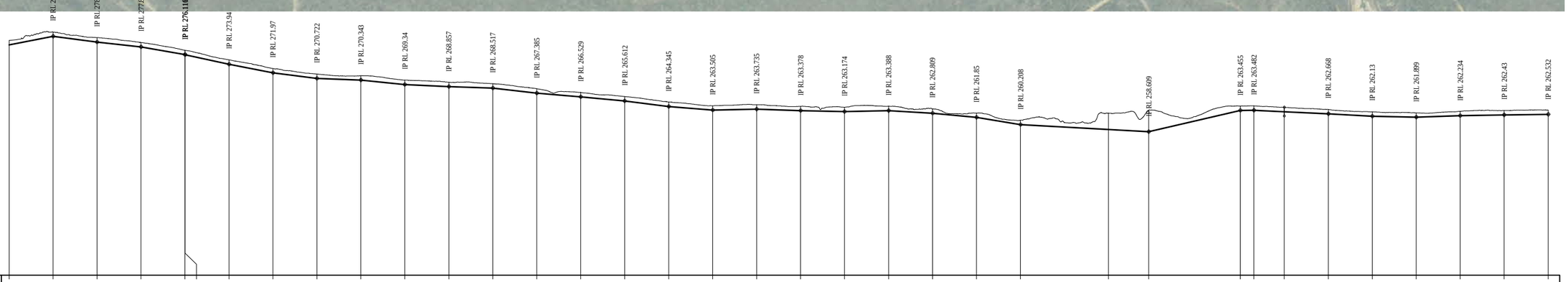
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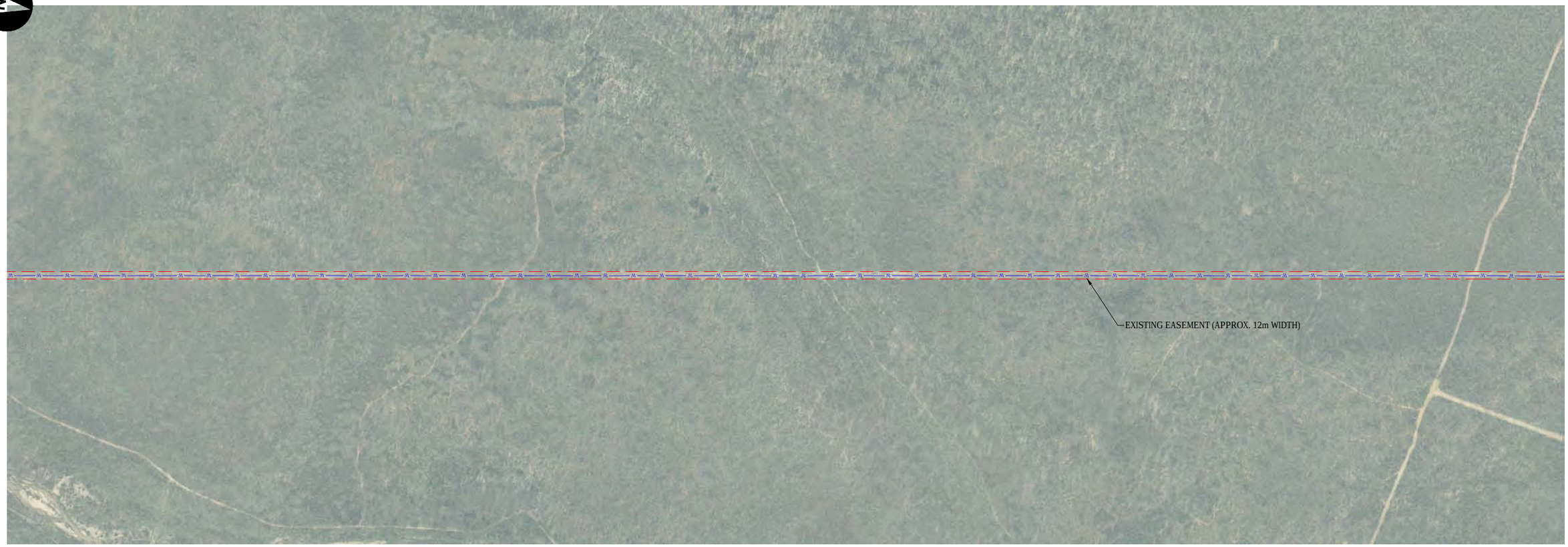
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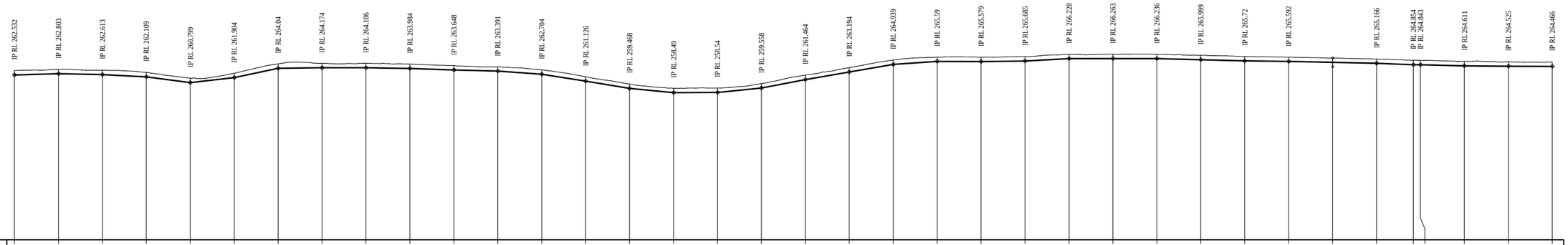




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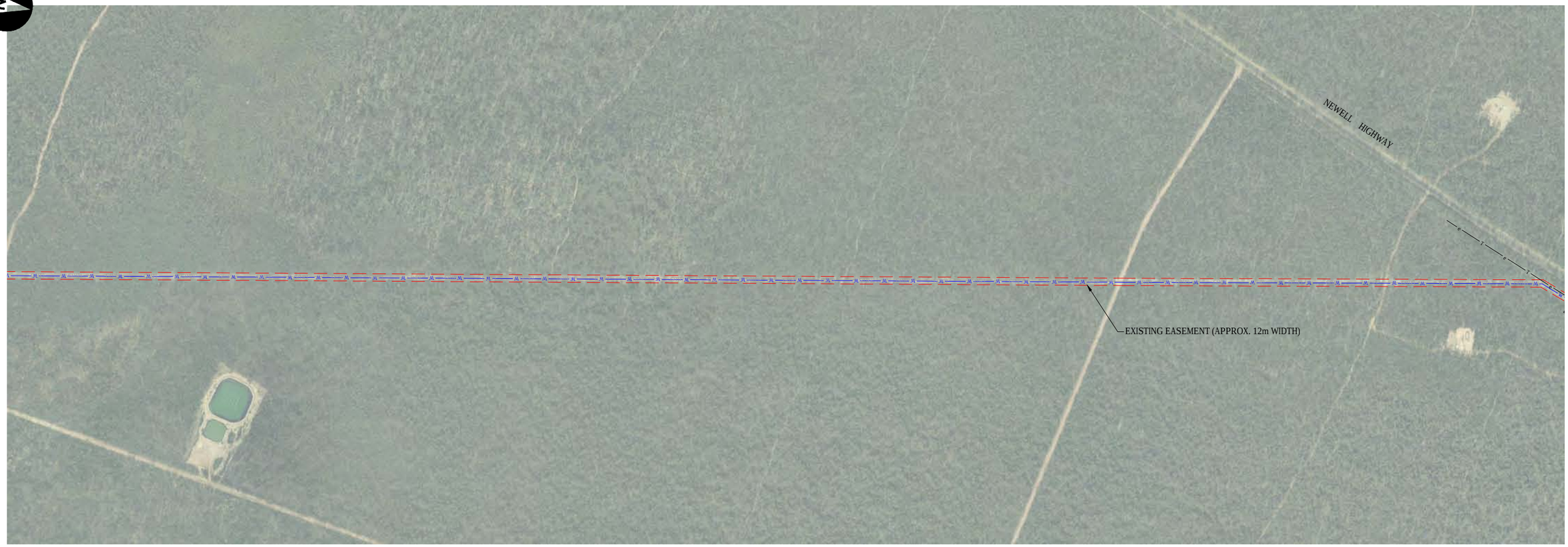
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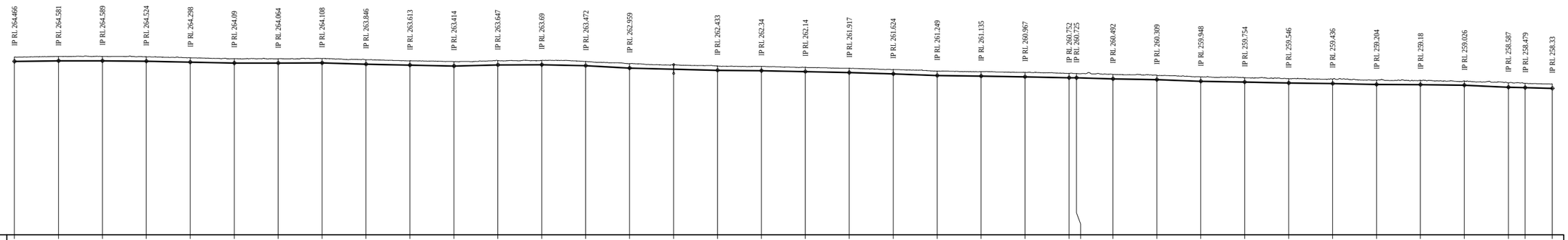




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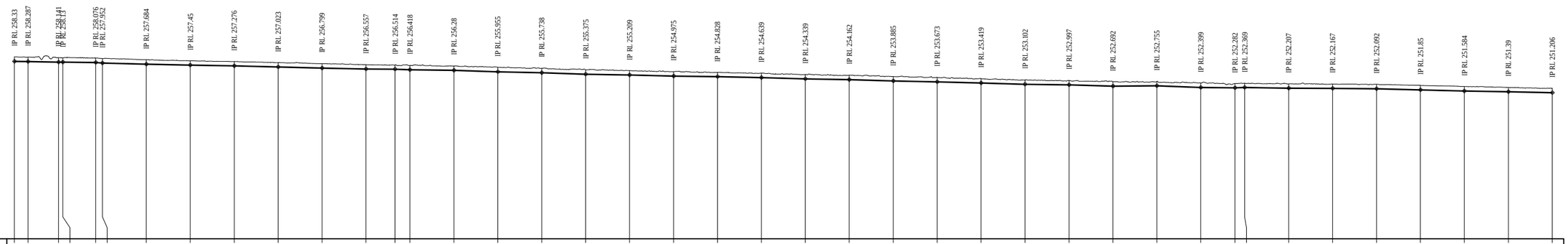




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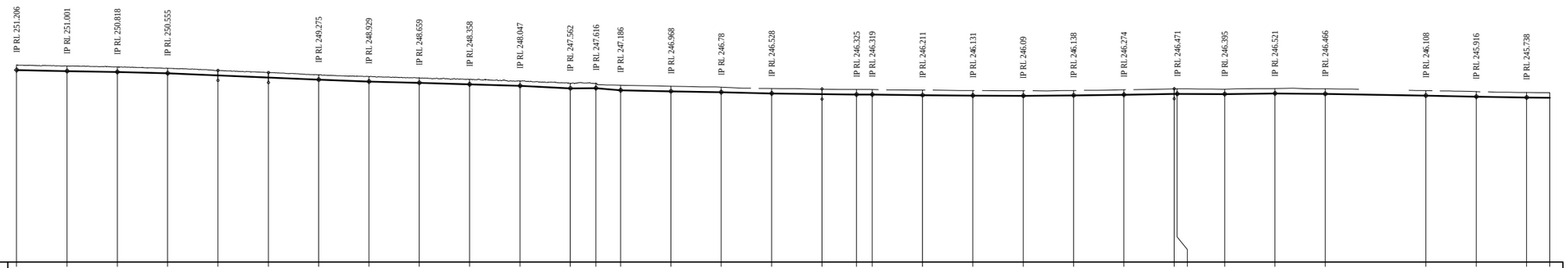




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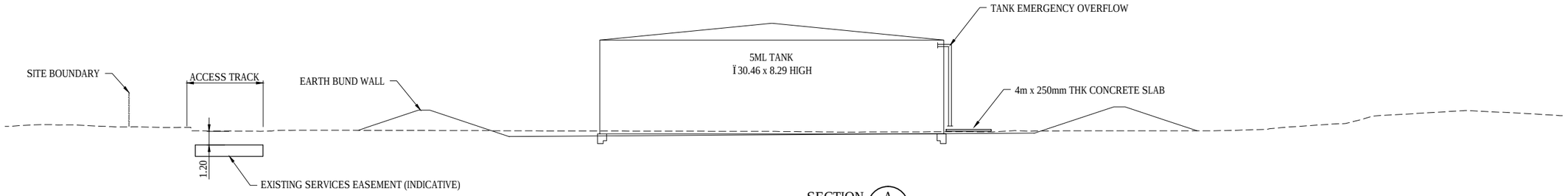
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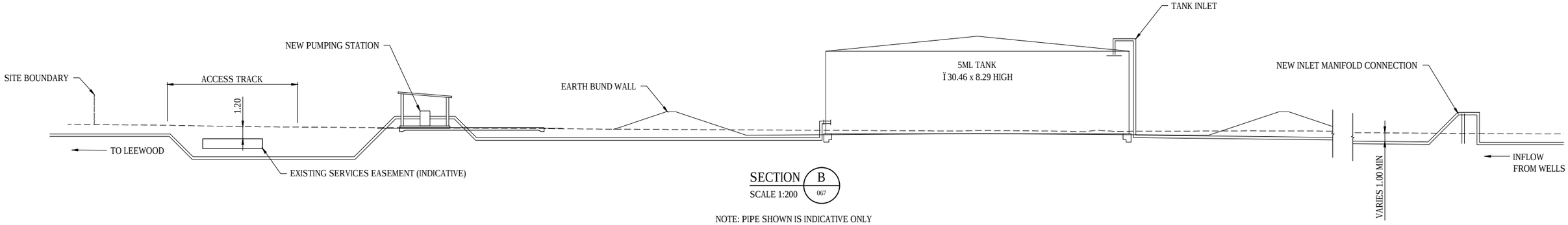
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| | | |



SECTION A
SCALE 1:200 067

NOTE: PIPE SHOWN IS INDICATIVE ONLY



SECTION B
SCALE 1:200 067

NOTE: PIPE SHOWN IS INDICATIVE ONLY

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A.B.N. 80 007 550 923

AREA 7081 - LEEWOOD WATER TREATMENT FACILITY
BIBBLEWINDI WATER TRANSFER FACILITIES
BIBBLEWINDI PLOT PLAN
TYPICAL SECTIONS

Santos

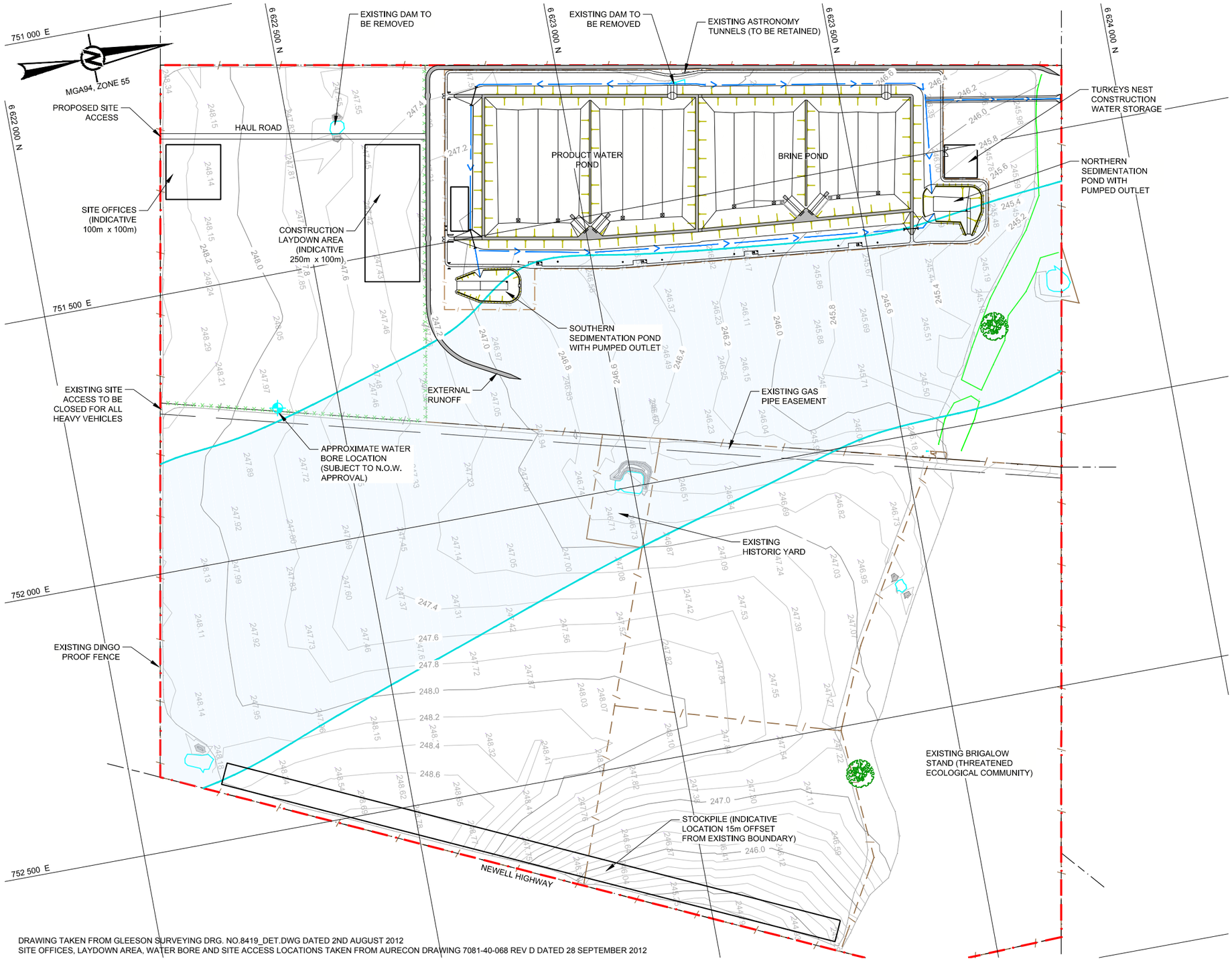
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REV C

CADFILE No. -

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Appendix 2

Design drawings (Leewood ponds)



NOTES:

1. THESE NOTES APPLY TO ALL PROJECT DRAWINGS IN THE SET UNLESS NOTED OTHERWISE AND SHALL BE READ IN CONJUNCTION WITH THE SPECIFICATION.
2. ALL LEVELS ARE IN METRES TO AUSTRALIAN HEIGHT DATUM (AHD).
3. ALL CO-ORDINATES ARE IN METRES TO MAP GRID AUSTRALIA (MGA).
4. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS NOTED OTHERWISE.
5. DIMENSIONS AND LOCATION OF EXISTING STRUCTURES SHALL BE CONFIRMED ON SITE BY THE CONTRACTOR PRIOR TO COMMENCEMENT OF WORKS.
6. LOCATION AND DEPTH OF ALL SERVICES TO BE VERIFIED BY THE CONTRACTOR PRIOR TO COMMENCEMENT OF WORKS.
7. DIMENSIONS SHALL NOT BE SCALED OFF DRAWINGS.

LEGEND

- EXISTING CONTOURS AT 0.2m INTERVALS
- EXISTING FENCE
- SITE BOUNDARY (INFERRED)
- EXISTING FENCE TO BE REMOVED
- 50 YEAR (AEP = 0.02) FLOOD INUNDATION EXTENTS
- EXISTING DAM
- INDICATIVE LOCATION OF POSSIBLE SCARRED TREES

DRAWING TAKEN FROM GLEESON SURVEYING DRG. NO.8419_DET.DWG DATED 2ND AUGUST 2012
SITE OFFICES, LAYDOWN AREA, WATER BORE AND SITE ACCESS LOCATIONS TAKEN FROM AURECON DRAWING 7081-40-068 REV D DATED 28 SEPTEMBER 2012

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0 150 300 450m
1:7,500

REVISION	DESCRIPTION	DRAWN	DRAWN CHECK	DESIGN	DESIGN CHECK	AUTHORISED	DATE
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A	PRELIMINARY ISSUE	DAT	PDM	DRW			27.09.12

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LEAD PROJECT DRAFTER	PROJECT MANAGER	SCALE	SHEET SIZE
DAT	DRW	AS SHOWN	A3

CLIENT: SANTOS LTD
PROJECT: LEEWOOD PONDS
DRAWING TITLE: SITE PLAN

PROJECT No	DOC No	DOC TYPE	DRAWING No	REVISION
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Xref: GAP_LOGO-A3.dwg; 127615025-XREF-NATURAL SURFACE AUGUST 2012.dwg;

MGA94, ZONE 55

6 622 800 N
6 623 000 N
6 623 200 N
6 623 400 N
6 623 600 N
6 623 800 N
751 200 E
751 400 E
751 600 E
751 800 E
752 000 E
6 622 600 N

DIVERSION BUND
EXISTING SITE FENCE
EXISTING DAM TO BE REMOVED
PROPOSED OVERFLOW FOR SPILLWAY DISCHARGE
ACCESS RAMP
PROPOSED SPILLWAY
NORTHERN SEDIMENTATION POND WITH PUMPED OUTLET
PRODUCT WATER POND
BRINE POND
TRANSFER STATION
ACCESS RAMP
ACCESS RAMP
4m WIDE ACCESS TRACK
SOUTHERN SEDIMENTATION POND WITH PUMPED OUTLET
1 IN 50 YEAR FLOOD EXTENTS
EXISTING VEGETATION
1 IN 50 YEAR FLOOD EXTENTS
A
D010

LEGEND

- EXISTING CONTOURS AT 0.2m INTERVALS
- EXISTING FENCE
- SITE BOUNDARY
- CHAINWIRE SECURITY FENCE
- EMBANKMENT TOE DRAIN
- INLET PIPE EASEMENT
- OUTLET PIPE EASEMENT
- 50 YEAR (AEP = 0.02) FLOOD INUNDATION EXTENTS
- EXISTING DAM
- DIVERSION BUND
- PROPOSED GROUNDWATER MONITORING BORES

OVERALL POND CONCEPT	
DAM STRIPPING AREA (m²)	231,550
DAM FOOTPRINT AREA (m²)	231,550
TOTAL FILL VOLUME (m³) [B]	243,235
CUT VOLUME COMMENCING AT ESTIMATED STRIPPING SURFACE (m³) [A] *	292,010
CUT TO FILL RATIO [%] [A]/[B]	1.20

* BASED UPON 200mm TOP SOIL STRIPPING DEPTH

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PRELIMINARY

0 80 160 240m
1:4,000

DRAWING TAKEN FROM GLEESON SURVEYING DRG. NO.8419_DET.DWG DATED 2ND AUGUST 2012
SITE OFFICES, LAYDOWN AREA, WATER BORE AND SITE ACCESS LOCATIONS TAKEN FROM AURECON DRAWING 7081-40-068 REV D DATED 28 SEPTEMBER 2012

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A	PRELIMINARY ISSUE	DAT	PDM	DRW			27.09.12

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LEAD PROJECT DRAFTER	PROJECT MANAGER	SCALE	SHEET SIZE
DAT	DRW	AS SHOWN	A3

CLIENT: SANTOS LTD
PROJECT: LEEWOOD PONDS
DRAWING TITLE: GENERAL ARRANGEMENT PLAN

PROJECT No	DOC No	DOC TYPE	DRAWING No	REVISION
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MGA94, ZONE 55

6 622 800 N
6 622 900 N
6 623 000 N
6 623 100 N
6 623 200 N
6 622 700 N

751 200 E
751 300 E
751 400 E
751 500 E
751 600 E

DIVERSION BUND
EXISTING SITE FENCE
B
FIG 7
EXISTING ASTRONOMY TUNNELS (TO BE RETAINED)
DIVERSION BUND VEHICLE CROSSING
PROPOSED MANIFOLD UNIT
POND INLET PIPE
ACCESS RAMP
POND INLET STRUCTURE
TRANSFER STATION
TO CONNECT TO R.O. PLANT PIPELINES
CULVERT FOR PIPELINE CROSSING
DIVERSION BUND VEHICLE CROSSING
CULVERT FOR PIPELINE CROSSING
ACCESS RAMP
SEEPAGE PIPE CLEANOUT POINT
RISING MAIN
UNDERLINER SUMP
FLOATING PONTOON STRUCTURE
GANTRY WALKWAY
UNDERLINER EXTRACTION STATION
SEDIMENTATION POND
PUMPED OUTLET
SPILLWAY
INLET PIPE TO CONNECT TO TRANSFER PIPELINE
4m WIDE ACCESS TRACK
REFER FIGURE 4

4H:1V
1.00%
0.40%
VALLEY
RIDGE

LEGEND
- ACCESS TRACK
- CHAINWIRE SECURITY FENCE
- EXISTING FENCE
- EMBANKMENT TOE DRAIN
- NATURAL GROUND CONTOURS (0.2m INTERVALS)
- INLET PIPE EASEMENT
- OUTLET PIPE EASEMENT

0 40 80 120m
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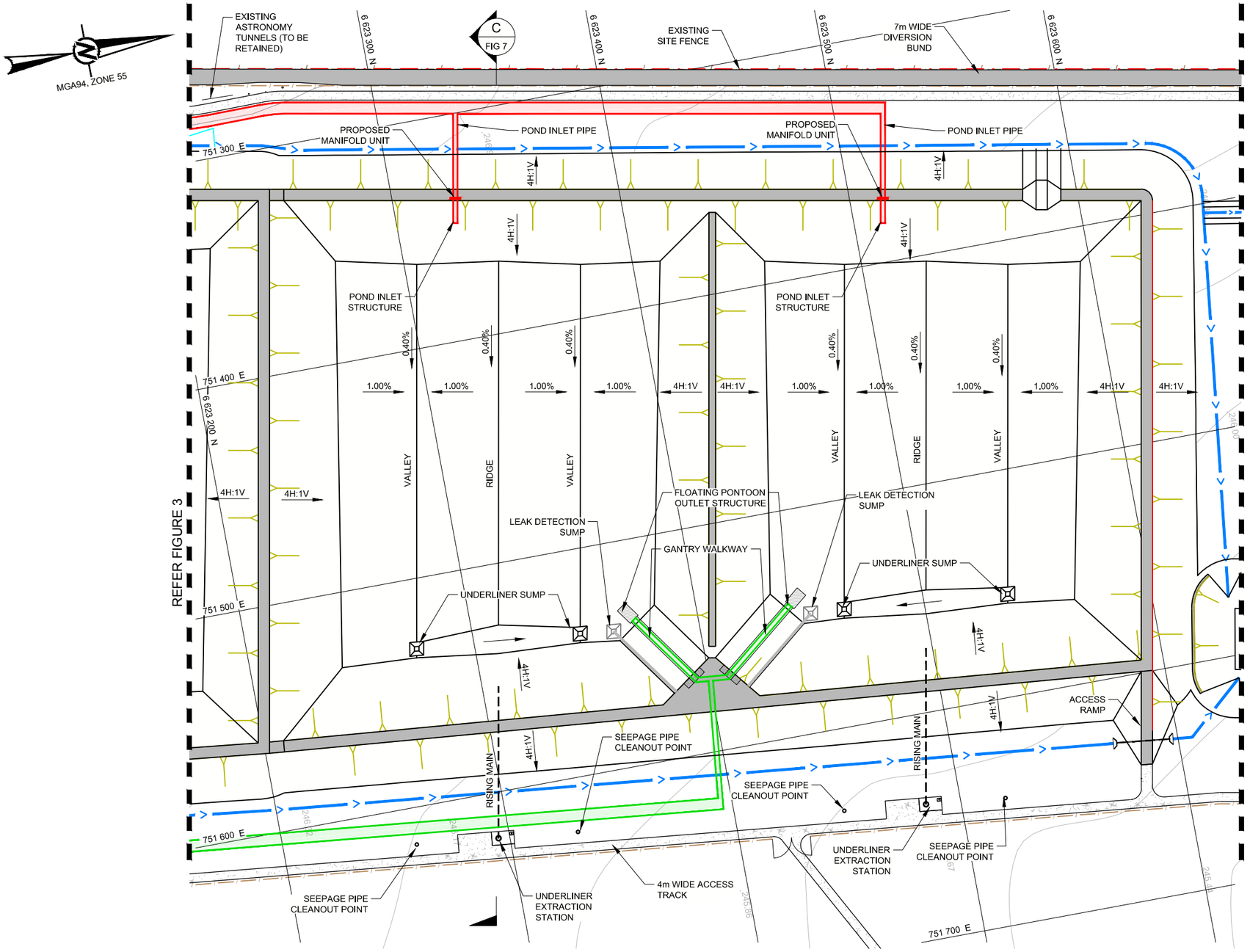
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CLIENT	SANTOS LTD	PROJECT	LEEWOOD PONDS
DRAWN BY	DAT	DATE	17.08.12
CHECKED BY	FWG	DATE	12.09.12
DRAWING TITLE	CONCEPTUAL PRODUCT WATER POND LAYOUT PLAN		
SCALE	AS SHOWN	SHEET SIZE	A3
PROJECT No	127615025	DOC No	011
DOC TYPE	M	FIGURE No	003
REVISION	1		FIGURE 3

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LEGEND

- ACCESS TRACK
- CHAINWIRE SECURITY FENCE
- EXISTING FENCE
- EMBANKMENT TOE DRAIN
- NATURAL GROUND CONTOURS (0.2m INTERVALS)
- INLET PIPE EASEMENT
- OUTLET PIPE EASEMENT

0 40 80 120m

1:2,000

DRAWING TAKEN FROM GLEESON SURVEYING DRG. NO.8419_DET.DWG DATED 2ND AUGUST 2012

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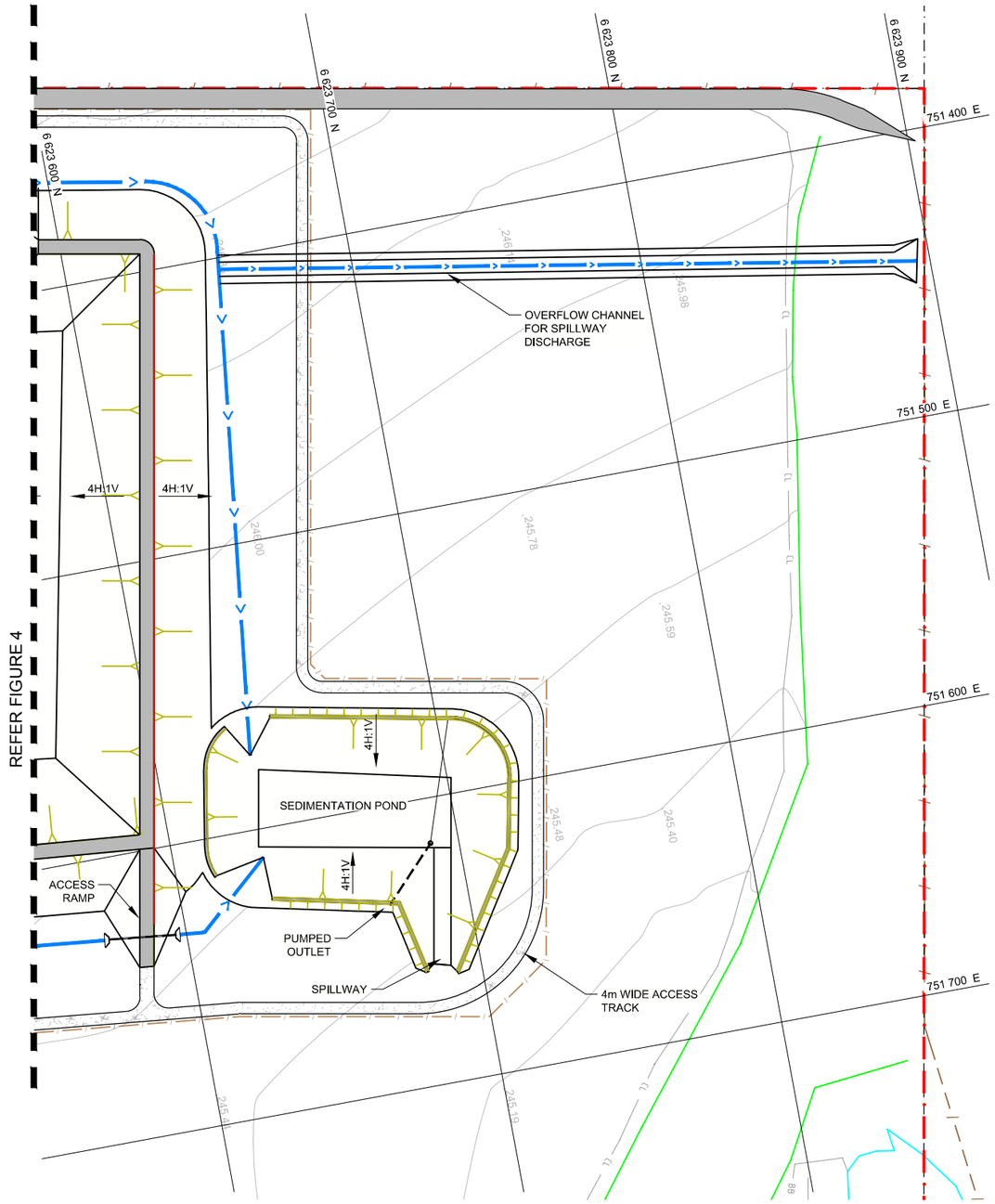
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DRAWING TITLE	CONCEPTUAL BRINE POND LAYOUT PLAN		
CHECKED BY	FWG	DATE	12.09.12
SCALE	AS SHOWN	SHEET SIZE	A3

PROJECT No	DOC No	DOC TYPE	FIGURE No	REVISION	
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MGA94, ZONE 55



LEGEND

- ACCESS TRACK
- CHAINWIRE SECURITY FENCE
- EXISTING FENCE
- EMBANKMENT TOE DRAIN
- NATURAL GROUND CONTOURS (0.2m INTERVALS)

0 40 80 120m

1:2,000

DRAWING TAKEN FROM GLEESON SURVEYING DRG. NO.8419_DET.DWG DATED 2ND AUGUST 2012

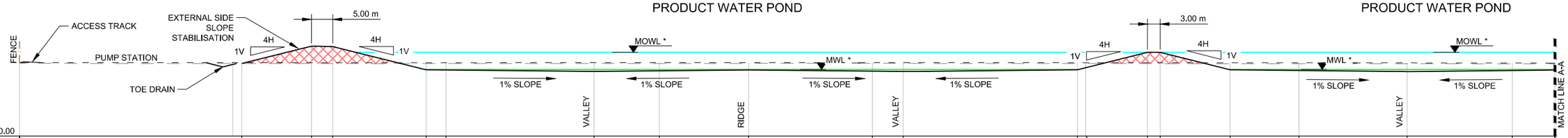
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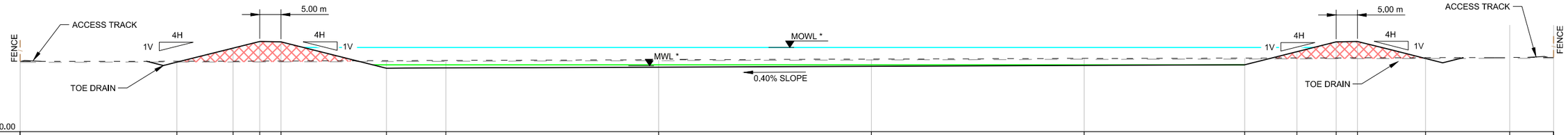
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CHECKED BY: FWG	DATE: 12.09.12		
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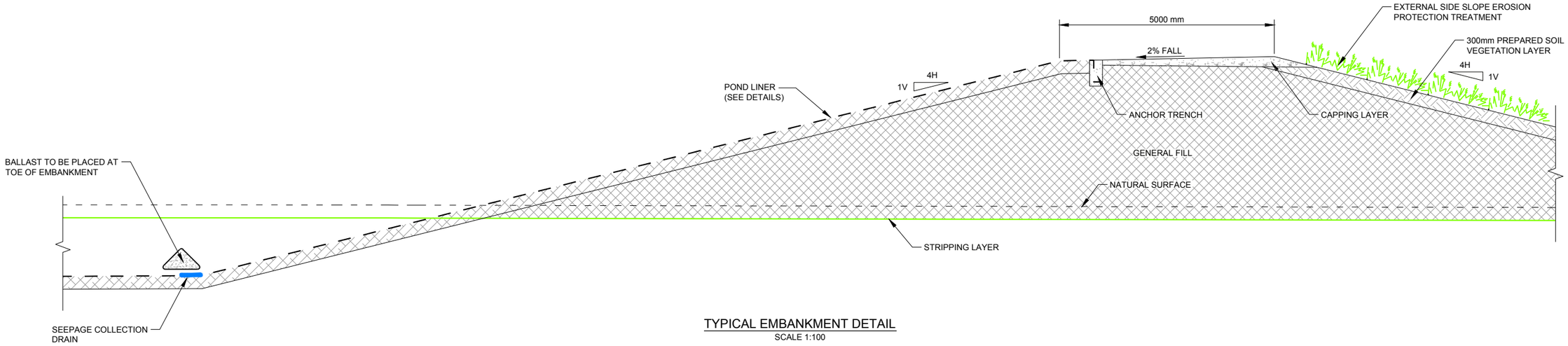


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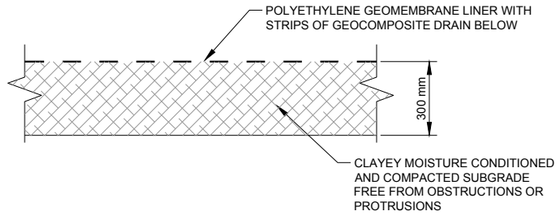

FENCE
ACCESS TRACK
5.00 m
4H
1V
4H
1V
TOE DRAIN
MOWL *
MWL *
0.40% SLOPE
1V
4H
4H
1V
5.00 m
ACCESS TRACK
FENCE

| | | |

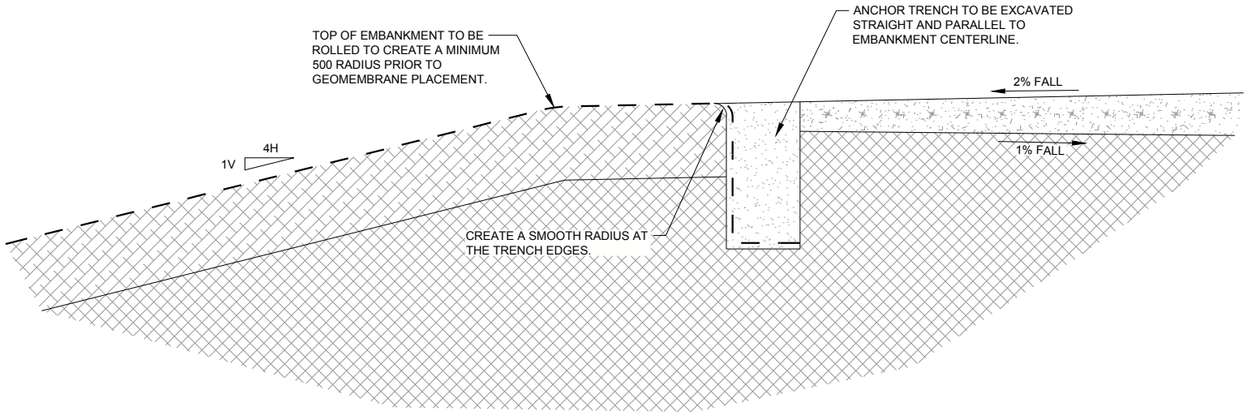
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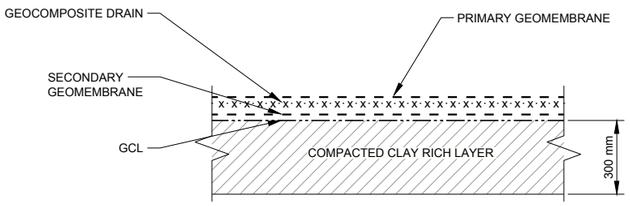
TYPICAL EMBANKMENT DETAIL
SCALE 1:100



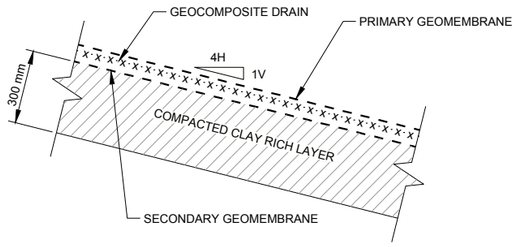
PRODUCT WATER POND LINER
SCALE 1:25



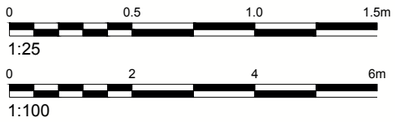
TYPICAL ANCHOR TRENCH DETAIL
SCALE 1:25



BRINE POND LINER - FLOOR
SCALE 1:25



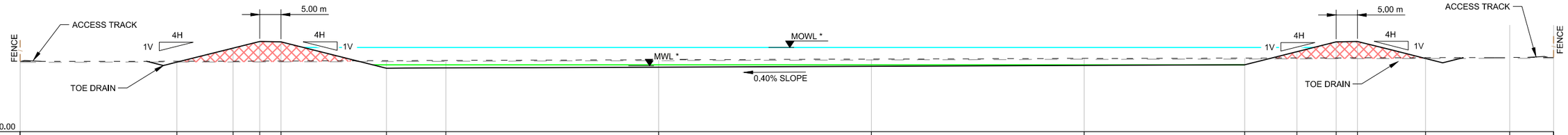
BRINE POND LINER - SLOPE
SCALE 1:25



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CHECKED BY: FWG	DATE: 12.09.12							
SCALE: AS SHOWN	SHEET SIZE: A3	PROJECT No: 127615025	DOC No: 011	DOC TYPE: M	FIGURE No: 008	REVISION: 1	FIGURE 8	

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Xref: GAP_LOGO-A3.dwg;


FENCE
ACCESS TRACK
5.00 m
4H
1V
4H
1V
TOE DRAIN
MOWL *
MWL *
0.40% SLOPE
1V
4H
4H
1V
5.00 m
ACCESS TRACK
FENCE

| | | |

Appendix 3

Transport Assessment



Leewood Project
Newell Highway, Narrabri
Transport Assessment

transportation planning, design and delivery

13S1042000 26/11/12

GTAconsultants

Leewood Project

Newell Highway, Narrabri

Transport Assessment

Issue: D 26/11/12

Client: RPS Group
Reference: 13S1042000
GTA Consultants Office: NSW

Quality Record

Issue	Date	Description	Prepared By	Checked By	Approved By
A	28/09/12	Final	Cameron Ward	Rhys Hazell	
B	08/10/12	Additional information and updates incorporated	Cameron Ward	Rhys Hazell	
C	05/11/12	Additional information and updates incorporated	Cameron Ward	Rhys Hazell	
D	26/11/12	Additional information and updates incorporated	Cameron Ward	Rhys Hazell	

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1. Introduction

1.1 Background

GTA Consultants was commissioned by RPS Group in August 2012 to prepare a transport assessment to determine the impact of construction works associated with the construction and operation of produced water and brine ponds and other infrastructure (the proposal), located adjacent to the Newell Highway approximately 24km south of Narrabri, NSW.

The proposal involves the construction of one 300ML brine pond and one 300ML produced water pond (collectively referred to as the Leewood Ponds) on a Santos owned property known as 'Leewood'. It also involves the construction of two water flow lines from Leewood to the existing Bibblewindi Lifted Water Management Plant, located approximately 15km south of Leewood in the Pilliga State Forest. Additional surface infrastructure, including a water distribution manifold, pumping station, power supply and a water holding tank also form part of the proposal.

The two flow lines are to be installed within an existing corridor currently containing a gas transfer flow line and will pass under the Newell Highway approximately 4.5km south of the Leewood site. At the crossing, an 800mm carrier pipe will be bored under the road in a two-stage process.

Works at the Bibblewindi site will involve the construction of a water holding tank and surrounding earth bund, together with electrical/ instrumentation and communications infrastructure to facilitate the pipeline and Leewood site operation.

Santos is proposing to construct additional water treatment infrastructure, including a reverse osmosis plant, brine concentrator and brine crystalliser at Leewood in the future. The construction and operation of this additional water treatment infrastructure will be subject to further approvals and environmental impact assessment and does not form part of the proposal.

1.2 Purpose of this Report

This report sets out an assessment of the anticipated transport implications of the project, as they relate to the construction and operation, including consideration of the following:

i existing traffic conditions surrounding the site
ii construction staging associated traffic management
iii construction vehicle requirements
iv truck routes to and from each site
v site accesses during operation
vi the transport impact of the construction works and site operation on the surrounding road network
vii road upgrade works.

As significant construction works and operational activities have previously occurred at the Bibblewindi site, the existing conditions assessment focusses on the Leewood site only, however the Newell Highway traffic characteristics are relevant to both sites.

1.3 References

In preparing this Transport Assessment, reference has been made to the following:

- an inspection of the site and its surrounds on 19 September 2012
- Leewood Brine and Water Management Project Concept Design Report, Revision B, Aurecon, 20 September 2012
- Procedures for use in the Preparation of a Traffic Management Plan (TMP), Roads and Maritime Services (RMS), December 2001 (Version 2.0)
- Traffic Control at Work Sites manual, RMS, June 2010
- Australian Standard, Manual of Uniform Traffic Control Devices – Part 3: Traffic Control for Works on Roads, AS1742.3:2009
- traffic surveys undertaken by Narrabri Shire Council as referenced in the context of this report
- plans for the proposed development prepared by Santos, Drawing Number 7081-40-068, Revision A, dated 07 September 2012
- other documents and data as referenced in this report.

2. Leewood Site Existing Conditions

The Leewood site is located adjacent to the Newell Highway approximately 24km south of Narrabri and covers an area of approximately 246 hectares. It has frontages to the Newell Highway along the eastern boundary and Old Mill Road (also known as Dog Proof Fence Road) along the southern boundary.

The surrounding properties predominantly include rural land used primarily for farming purposes with Pilliga East State Forest located immediately to the south.

The location of the subject site and its surrounding environs is shown in Figure 2.1.

Figure 2.1: Subject Site and Its Environs



Basemap source: Google Maps

2.1 Road Network

The road network within the vicinity of the subject site is shown in Figure 2.2 together with further descriptions of the key roads in the immediate vicinity.

Figure 2.2: Road Network



Source: NSW Land and Property Management Authority

2.1.1 Adjoining Roads

Newell Highway

Newell Highway is a classified State Road and is a major north-south inland transport corridor linking NSW with Victoria and Queensland. Adjacent to the site, it is a two-way, sealed rural highway configured with a 2-lane, 7 metre wide carriageway, with approximately 0.5m sealed shoulder. On-site observations indicate that the current pavement condition is good in the vicinity of Old Mill Road with no major defects.

It is understood that the posted speed limit has recently been increased from 100km/h to 110km/h.

Newell Highway is shown in Figure 2.3 and carries approximately 1,900 vehicles per day[1].

Old Mill Road

Old Mill Road (also known as Dog Proof Fence Road) is an unsealed forestry road travelling in an east-west direction for approximately 35 km along the northern boundary of Pilliga East State Forest. It is understood to be managed and maintained by Forests NSW, however on-site observations indicate that maintenance is infrequent and there is no posted speed limit. Old Mill Road connects with the Newell Highway at a priority controlled T-intersection.

Old Mill Road is shown in Figure 2.4.

1 Based on the tube counts undertaken by Narrabri Shire Council in September to November 2011

Figure 2.3: Newell Highway (looking north)



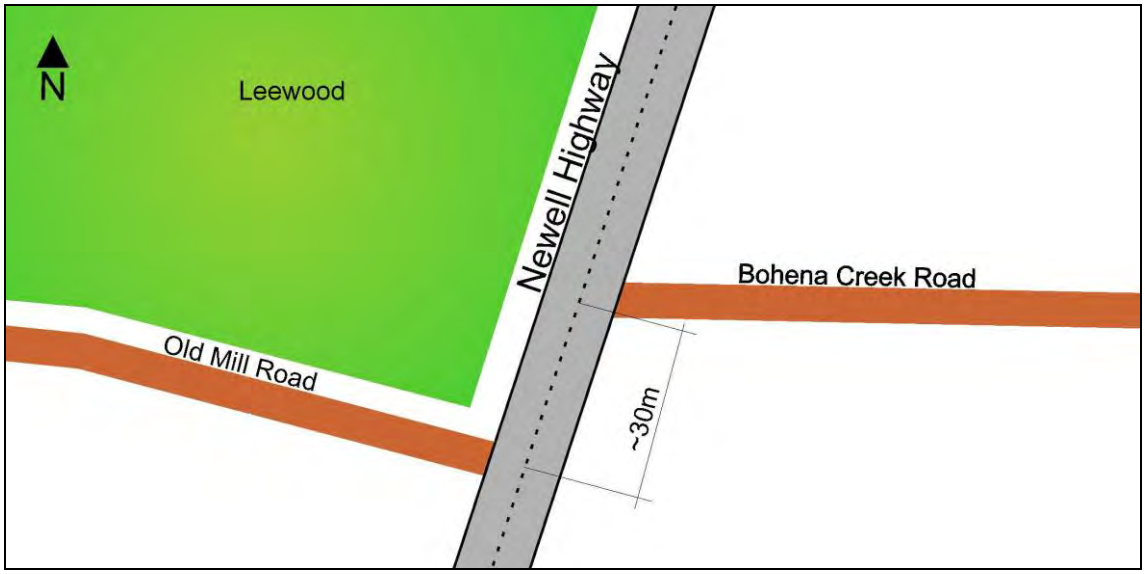
Figure 2.4: Old Mill Road



Bohena Creek Road

It is noted that Old Mill Road continues in an east-west direction east of the Newell Highway. This section of the road is also commonly referred to as Bohena Creek Road and meets the Newell Highway at a priority controlled T-intersection, approximately 30m north of the intersection described above. The existing layout of these intersecting roads is illustrated in Figure 2.5.

Figure 2.5: Existing Intersection Layout



2.2 Traffic Volumes

Narrabri Shire Council has provided GTA Consultants with recent traffic volume data for the Newell Highway. The tube count data was collected between September 2011 and November 2011, approximately 20km south of Narrabri. This location is approximately 6km north of Old Mill Road. The data results are summarised in Figure 2.6 and Figure 2.7 with the following key data gathered:

- Average Daily Traffic: 1,860 vehicles
- proportion heavy vehicles: 48.1%
- 7 day average peak hour: 134
- highest average peak hour: 156.

Full survey data is provided in Appendix A. No existing traffic volume information is available for Old Mill Road, however site observations indicate that the typical volumes would be less than 10 vehicles per day.

Figure 2.6: Newell Highway – 24 Hour Traffic Profile

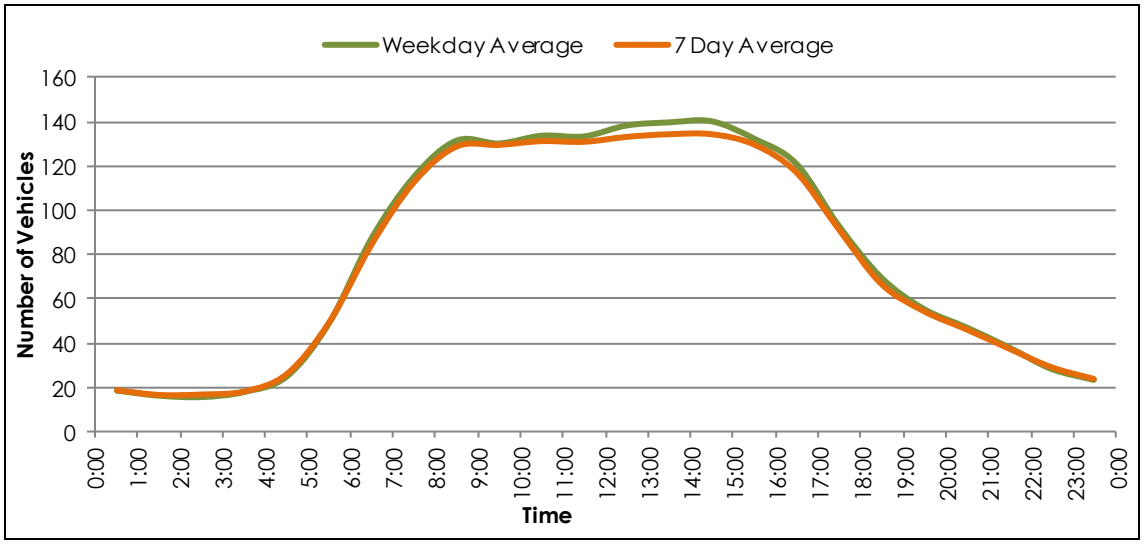
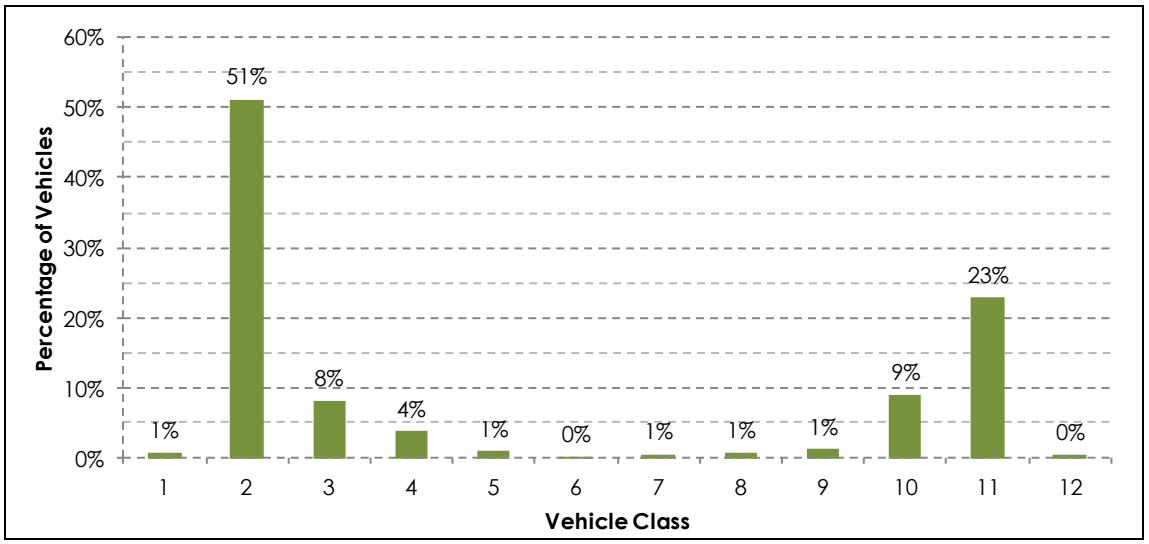


Figure 2.7 illustrates that the Newell Highway carries a high percentage of heavy vehicles, in particular B-doubles (class 10) and Double Road Trains (Class 11). These two classes account for 32 percent of traffic along the Newell Highway with light vehicles (cars, motorbikes, etc) accounting for 51 percent.

Figure 2.7: Newell Highway – Percentage of Vehicle Type



3. Proposed Project Works

The primary purpose of the proposed activity is to enable produced water and brine to be transferred from the existing Bibblewindi Water Management Facility located in the Pilliga State Forest, to the new Leewood ponds, which are located outside the Pilliga State Forest.

The proposal will enable a number of existing (and approved) pilot wells, which have been switched off, to be returned to service. Produced water from these wells would be directed to the Leewood Ponds.

The scope of work is summarised as follows:

- A produced water flow line and return flow line of approximately 16km in length, linking the proposed brine pond at Leewood to the existing Bibblewindi 3 brine pond in Pilliga State Forest. These flow lines are to be located within the previously cleared right of way associated with the existing gas flow line which links Wilga Park Power Station with the Bibblewindi Water Management Site.
- Additional piping to connect existing water gathering systems terminating at Bibblewindi to new infrastructure.
- One 5ML produced water tank with associated pumping station and power supply, to be located adjacent the existing Bibblewindi 3 Pond.
- Construction of an earth bund around the produced water tank at Bibblewindi.
- One 300ML produced water pond and one 300ML brine pond at Leewood.
- A produced water distribution manifold and associated piping at Leewood, to allow water distribution into produced water and brine storage ponds.
- Additional facilities including a site office, storage facilities, lay-down areas and car parking.

A plan of the proposed works at Leewood and Bibblewindi is presented in Appendix B of this report.

The construction works are scheduled to be carried out in stages with works planned to commence in mid February 2013 (subject to approvals) and continue through to the end of August 2013.

4. Construction Traffic Management

Construction Traffic Management considerations for the duration of the construction works have been developed on the basis of the following which are described in more detail below.

- overall principles of construction traffic management
- staging schedule
- hours of operation
- construction traffic volumes
- truck routes
- traffic and parking affects
- road upgrades
- site access plan.

4.1 Overall Principles of Construction Traffic Management

The overall principles of traffic management during the construction activity include:

- maintain access to/ from adjacent properties
- restrict construction vehicle movements to designated routes to/ from the site via the Newell Highway
- manage and control construction vehicle activity in the vicinity of the site
- construction activity to be carried out in accordance the approved hours of works as determined by the relevant authorities.

4.2 Staging Schedule

Construction works are anticipated to commence in mid February 2013 with a planned completion by the end of August 2013, a period of approximately 5-6 months. It is understood that construction would be undertaken through the following stages, however they may be undertaken concurrently, or closely staged where possible.

Table 4.1: Works Staging Schedule

Stage	Leewood	Bibblewindi
Stage 1	site establishment and mobilisation	site establishment and mobilisation
Stage 2	upgrade works on Old Mill Road and intersection works at the Newell Highway (12 days)	transfer station and earth bund construction
Stage 3	Leewood Ponds construction	electrical and instrumentation works (40 days)
Stage 4	flow line installation (less than 40 days)	communication equipment installation (30 days)
Stage 5	demobilisation	demobilisation

It should be noted that access for the Leewood flow line installation (Stage 4) is anticipated to be via several locations along the 15 km alignment over the duration of the project. Construction traffic associated with these works would access the site via Old Mill Road for a brief period, when the works are within the Leewood site or in close proximity.

4.3 Hours of Operation

The hours of construction work will be determined by the appointed construction contractor. It is anticipated that construction hours would be 7:00am to 6:00pm, 7 days per week.

Given the rural nature of the project site locations, this is not expected to negatively impact the surrounding area. However, any associated heavy vehicle activity that passes through residential areas (including Narrabri town centre) should be confined to typical construction hours (7:00am-6:00pm, Monday to Friday, 8:00am-1:00pm Saturdays).

The contractor will be responsible for instructing and controlling all subcontractors with respect to the hours of work. Any work outside the approved construction hours would be subject to specific prior approval by the relevant authorities.

4.4 Construction Staff Traffic

The number of staff required on-site would vary between each works stage and is anticipated to peak at less than 45 staff at Leewood and 12 at Bibblewindi. This would be at a time where there may be some overlap of works associated with Stage 2 to Stage 4. Staff access arrangements would be further developed by the construction contractor; however for assessment purposes, 3 options have been considered.

4.4.1 Private Vehicles

Construction vehicle activity would be greatest should staff predominantly travel to/ from the site via private vehicles. Should this be the case, on-site designated staff parking would be provided for use during each shift. It is anticipated that the average vehicle occupancy under this arrangement would be in the order of 1.2-1.5 persons per vehicle.

4.4.2 Company Car Pool

A system where company 4WD site vehicles are made available for use by staff during each shift for travel to/ from the site as part of a broader car pool scheme remains an option and would reduce construction vehicle activity. It is anticipated that the average vehicle occupancy under this arrangement would be 3 persons per vehicle.

4.4.3 Shuttle Bus (Leewood only)

A shuttle bus service operating between Narrabri and the site at start and end of each shift would further reduce construction vehicle activity. The shuttle bus would pick-up in the morning at pre-determined locations within Narrabri Town Centre, including dedicated worker accommodation near Narrabri, and drop-off staff at the Leewood site. An afternoon shuttle bus service would provide for the return journey. Should a shuttle bus service be implemented, limited designated on-site parking (and manoeuvring area) should be provided for use by the shuttle bus and senior staff.

4.4.4 Staff Traffic Volumes

Given the above, the approximate staff required for each works stage and the corresponding vehicle trips are outlined in Table 4.2.

Table 4.2: Estimated Staff Vehicle Volumes (by Option)

Stage	Number of Staff Required		Estimated Number of Vehicle Trips per Day (by option)				
	Leewood	Bibblewindi	Private Vehicles		Company Car Pool		Shuttle Bus
			Leewood	Bibblewindi	Leewood	Bibblewindi	Leewood
Stage 1	5	5	8	8	6	6	N/A[2]
Stage 2	5[1]	12	0	16	0	8	0
Stage 3	30	9	40	12	20	6	4 + 4 bus
Stage 4	15	6	20	8	10	4	4 + 4 bus
Stage 5	5	5	8	8	6	6	N/A[2]

[1] stage 2 staff would commute to the site daily in small works vehicles, thus have been accounted for as construction traffic
[2] a shuttle bus service would not be required during stage 1 and stage 5 given low staff numbers
Stage 1 and stage 5 construction vehicle volumes have been estimated and based on anticipated low staff numbers during machinery delivery/removal
Bibblewindi assumed to not require the use of a shuttle bus during any stage

Parking for staff of an appropriate size, as discussed above, would be accommodated on- site during each construction period. This area would be located adjacent to the site access and marked/ signposted appropriately.

4.5 Construction Traffic Volumes

Construction traffic volumes associated with the excavation and construction would generally incorporate truck-and-dog combinations, 19m articulated vehicles and light vehicles (ute or similar). Anticipated construction vehicle volumes per stage are outlined in Table 4.3 with key assumptions detailed as follows:

- All heavy construction vehicles and equipment would be delivered during the beginning of the period they are required, and collected at the end of the same period; at these times the delivery and collection of equipment would have an impact on the external road network. Between these times equipment and vehicles would be left onsite and would not have any impact on the external road network.
- Large plant and equipment may require low loaders up to 25m in length.
- Deliveries of construction materials and equipment would occur regularly throughout a typical working day (10-11 hours), therefore deliveries of construction equipment and vehicles have been distributed evenly throughout the day.
- One tanker of fuel would be delivered to the site approximately 3 times per week during construction. All other fuel tanker movements would be within the project area and would not impact the external road network.
- One vehicle would generate two vehicle movements (in and out).
- Construction materials required for construction would be delivered continuously throughout the construction period as opposed to all deliveries at the start of the construction period.
- Deliveries of construction materials would occur regularly throughout a typical working day (10-11 hours), therefore vehicles delivering construction materials have been distributed evenly throughout the day.
- Some construction materials may initially be transported to Santos' Narrabri Operations Centre, with deliveries to the site as required.

- All bulk fill/ spoil required for and generated by the Leewood ponds construction and Bibblewindi earth bund construction would be managed within the site, with no external bulk haulage.
- Water required during the construction is anticipated to generate two external truck movements per day.
- Pipe sections for the flow lines would be delivered at multiple locations between Leewood and Bibblewindi and would average three deliveries a day.
- Any oversize vehicles required for transporting earth moving equipment to site would be further addressed through specific permits from RMS.

Table 4.3: Construction Traffic Volumes

Stage	Number of Construction Vehicle Trips per Day		Vehicle Type/Activity
	Leewood	Bibblewindi	
Stage 1	10[3]	8	• delivery of earth moving machinery to site, including scrapers/ graders/ compactors, bulldozer (by 19-25m articulated low loader) • delivery of HDD drill rig and plough for flow line • Leewood – delivery of crushed rock or gravel to surface internal roads, lay-down area and car park area (truck-and-dog combination) • delivery of site equipment/ generators/ sheds/ portable toilets (various vehicles as appropriate)
Stage 2	30[4]	8	• delivery of earth moving machinery to site, including scrapers/ graders/ compactors, bulldozer (by 19-25m articulated low loader) • Leewood – delivery of crushed rock or gravel to Leewood (truck-and-dog combination), delivery of material for earthworks, laying of asphalt • delivery of diesel fuel
Stage 3	8[3]	2	• delivery of diesel fuel • Leewood – delivery of generators/ pond lining material/ pumps/ pontoons/ telemetry
Stage 4	8[4]	2	• delivery of 12m sections of piping (19m articulated truck) • delivery and removal of pipe handling equipment and machinery (19m articulated truck) • delivery of diesel fuel
Stage 5	6[3]	8	• removal of temporary construction facilities • removal of earth moving machinery from site, including scrapers/ graders/ compactors bulldozer (19-25m articulated low loader)

[3] Stage 1, 3, 5 construction vehicle volumes have been estimated and based on anticipated machinery delivery/removal requirements

[4] Estimated construction traffic volumes for stage 2 and stage 4 obtained from Aurecon Memorandum, Leewood Water and Brine – Vehicle Types and Trips, 18 September 2012

Each stage of works may involve multiple project components with an overlap of vehicles arriving and departing each site. As a result, it is estimated that peak truck volumes of up to 30 trips per day for Leewood would occur during Stage 2 where delivery of crushed rock is required for track upgrading. Peak truck volumes of up to 8 trips per day would occur during Bibblewindi Stage 1 and Stage 2 works.

The intersections with the Newell Highway in the vicinity of each site would continue to operate at existing levels of service during the overall construction period. However, the intersection of the Newell Highway and Old Mill Road is proposed to be upgraded due to increased truck turning movements. These upgrade works are discussed in Section 6.

With respect to the Bibblewindi site, the intersection of the Newell Highway and X-Line Road will not require upgrading as construction works and operations have been ongoing at this site. It is understood that an intersection upgrade, similar to that proposed at Old Mill Road, was previously undertaken at X-Line Road.

4.6 Newell Highway Under-Boring Works

The existing gas flow line corridor crosses the Newell Highway between the Bibblewindi and Leewood sites. Horizontal directional drilling will be used to install the new flow line across the Newell Highway. This activity should be completed in under a week. The drilling rig is likely to be transported to and from site by either semi-trailer or rigid flatbed truck. The rig will remain on site for the duration of the operation and is anticipated to require approximately 10 staff. The contractor undertaking these works should prepare a specific Traffic Management Plan for these works, identifying the required works area, site access, parking and the necessary traffic control (depending on the required proximity to the Newell Highway travel lanes).

4.7 Truck Routes

All heavy vehicles would be accommodated within each site throughout the construction period. Construction traffic would not be permitted to queue or park within Old Mill Road (or X-Line Road) or along the Newell Highway unless to carry out works.

It is anticipated that the majority of truck arrivals and departures would be from the north, to/ from Narrabri with minor interstate deliveries expected to approach/ depart via the south. All truck movements would be restricted to the direct route via the Newell Highway with the aim of minimising the impact of construction traffic on local forestry roads. Truck drivers will be advised of the designated truck routes to/ from the site.

4.8 Traffic Effects

4.8.1 Emergency Vehicles and Heavy Vehicles

No special provisions are required or proposed for emergency vehicles. Construction activity is also not expected to impact on existing heavy vehicle movements in the vicinity of the site.

4.8.2 Existing and Future Developments

It is understood that there are currently no proposed developments within the Old Mill Road local area that would be adversely impacted by the construction works.

4.8.3 Traffic Movements in Adjoining Council Areas

No adverse affects are expected from the movement of heavy vehicles through adjacent council areas.

4.9 Site Access Plan

The Leewood site access plan for the Newell Highway at Old Mill Road during the proposed construction works is detailed below with an overview signage plan provided in Appendix C. The plan

presents the principles of traffic management, directional signage and is subject to WorkCover requirements and final design.

Detailed information for work site operations is contained in the RMS Traffic Control at Work Sites manual. The control of traffic at work sites must be undertaken with reference to WorkCover requirements and the contractors own Occupational Health and Safety manuals.

There are two distinct stages of traffic management that would be required along the Newell Highway, as follows:

- during the overall construction period
- during the Newell Highway/ Old Mill Road intersection upgrade.

General Requirements

RMS standard Traffic Control Plan (TCP) 195 would be installed on the Newell Highway on approach to Old Mill Road during the construction of the Leewood ponds (Stage 3) and the flow line installation (Stage 4). These signs would be placed a distance of 110 metres apart with no speed reduction anticipated due to the combined low Newell Highway traffic volumes and low truck turning volumes.

At times where the delivery and removal of large earth moving equipment necessitates slow movements via Old Mill Road at the Newell Highway, traffic control (standard TCP 77) and road works speed limits (standard TCP 57) are to be in place. During the first week of this stage of works, truck exit manoeuvres should be monitored by on-site personnel and the need to provide a reduced speed limit of 80km/h considered.

Directional signage in the form of static and/ or Variable Message Signs (VMS) would also be placed on the Newell Highway at Old Mill Road to provide additional signage for truck drivers and workers accessing the site, as well as informing other road users.

It is noted that works associated with the Bibblewindi site will also require the use of works signage for the duration of the construction works where trucks are arriving and departing the site. These would be comparable to that as detailed above for the Leewood site.

Newell Highway/ Old Mill Road Upgrade

Construction works associated with the upgrading of the intersection of Newell Highway and Old Mill Road (Stage 2) would require workers to be near the edge of the carriageway. In addition to RMS standard TCPs (TCP 42 and TCP 195), it is recommended that following road works speed zones be implemented:

- if the clearance between the edge of traffic lane and works is less than 1.2 metres a speed limit of 40km/h though the works area is to be implemented
- if the clearance between the edge of traffic lane and works is between 1.2 and 3 metres a speed limit of 60km/h though the works area is to be implemented.

In addition, it would be recommended that a transition speed limit of 80km/h be installed in advance to allow heavy vehicles additional warning to slow down. Road works speed zones are to be implemented according to the Traffic Control at Work Sites manual (RMS, 2010), with particular reference to Section 8 and standard TCP 57.

The standard RMS TCPs referred to above have been included in Appendix D.

4.10 Road Works Approvals

4.10.1 RMS Design Approval

Before construction commences on the upgraded intersection of the Newell Highway and Old Mill Road, approval for the intersection design will need to be obtained from RMS. Santos would be required to enter into a Works Authorisation Deed (WAD) with RMS which will require the preparation of detailed design plans by a suitably qualified consultant, road safety audit and preparation of a traffic management plan and traffic control plans for the works. As part of this process, relevant design verification and approvals are to be sought.

4.10.2 Road Occupancy Licence

A road occupancy licence would be required to be obtained from the NSW Transport Management Centre for works that have the potential to affect traffic flow along Newell Highway, this includes works on the intersection of Newell Highway and Old Mill Road and the under-boring of Newell Highway for the flow line. A road occupancy licence allows a contractor the use of a specified road space at approved times, provided contain conditions are met.

4.10.3 Newell Highway Under-Boring Works

It is anticipated that design approval would be required for the horizontal directional drilling and flow line installation under the Newell Highway, due to the potential impacts on the road pavement and verge areas. A Road Occupancy Licence would also be required as per the above, as these works would be undertaken within the road reserve.

5. Operational Traffic Management

5.1 Overview

A small on-site staff presence is anticipated during the operational phase of the Leewood site. The Bibblewindi site is anticipated to operate with a similar number of staff to previous operations once works are complete, when the site is able to resume operations.

Although the Leewood site would generate the majority of traffic activity during the construction stages as discussed in Section 3, traffic would also be generated during the operational stages and generally as a result of the following:

- staff travelling to and from the site at the start and end of the daytime shift
- deliveries, maintenance activities and visitors.

5.2 Operational Traffic

The Leewood sites operational workforce would function on a typical daytime shift basis and staff would typically travel to and from Leewood by car. The operational workforce is expected to be generally less than five staff, increasing at times of visitors and site meetings etc. The occupancy of vehicles carrying staff to and from work at comparable mine sites is typically 1.2 staff per vehicle, and it is assumed that the staff travel characteristics of Leewood would be similar. The shift times are assumed to be between 7:00am and 5:00pm weekdays with administration personnel comprising the vast majority of site personnel. Operational deliveries and visitors would be minor and assumed to be less than five vehicles per week.

The workforce would be primarily drawn from the local area around Narrabri and the distribution of Leewood operational staff is assumed to be similar to that during the construction stages.

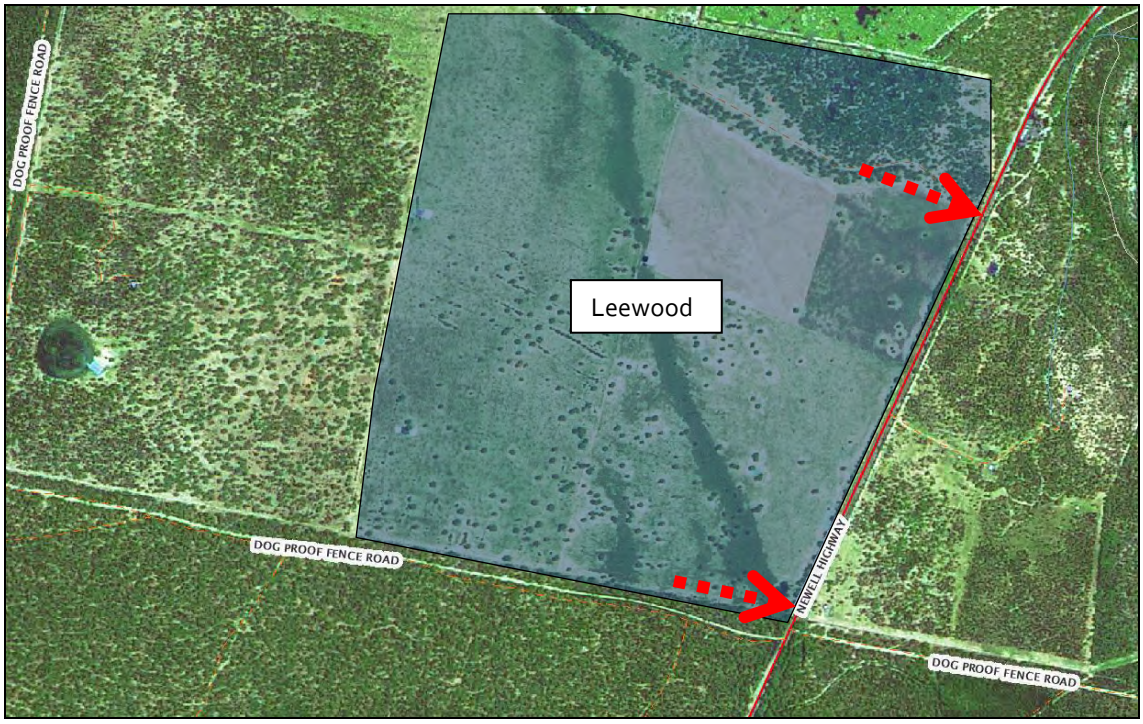
As such, the operational traffic impact of the Leewood site would be minimal with up to five vehicles arriving during each of the weekday AM and PM peak hours. These anticipated traffic volumes would present a negligible impact to the operation of the Newell Highway at the site access.

5.3 Operational Site Access

Access to the Leewood site during site operations would be via a new access driveway adjacent to the southern boundary of the site or through the re-instatement of an existing access in the northern section of the site. These accesses would be primarily for use by light vehicles, with occasional heavy vehicle access to be retained via Old Mill Road. The above access points are shown graphically in Figure 5.1.

Suitable sight lines are available at both these locations (with trimming of adjacent vegetation) in order to permit safe site access.

Figure 5.1: Operational Site Access Points



Source: NSW Land and Property Management Authority

6. Road Upgrades

6.1 Newell Highway/ Old Mill Road

6.1.1 Upgrade Requirements

As the proposal would increase turning movement volumes at the intersection of Newell Highway and Old Mill Road, an assessment of possible upgrade treatments was undertaken in accordance with Austroads Guidelines. The Austroads *Guide to Road Design Part 4A: Unsignalised and Signalised Intersections* (Part 4A) outline standard intersection treatments and warrants for rural roads. The three basic road turn treatments are as follows:

- Basic Turn Treatments (BA)
- Auxiliary Lane Treatments (AU)
- Channelised Turn Treatment (CH).

Auxiliary Lane Treatments and Channelised Turn Treatments are also possible with reduced turning lane lengths; these are classified as AU(S) and CH(S) respectively. Auxiliary right turn lane treatments are common place on regional NSW highways, including the Newell Highway. In 2011 RMS discontinued the installation of Auxiliary right turn lane treatments and now requires the installation of a short channelised right turn treatment. A short channelised turn treatment increases the protection for right turning vehicles and without the road widening requirements of a full length turn bay.

Warrants for each turn treatment are based on the measured safety performance of each treatment and a cost benefit ratio whereby the benefits of providing a higher level treatment are made equal to a proportion of the additional construction costs. The warrants are based on a ratio of through traffic volumes and turning vehicle volumes. No consideration is provided between the appropriate turn treatment and the percentage of heavy vehicles using the road.

The maximum anticipated turning movements during construction is likely to occur during Stage 3 at approximately 48 vehicle trips per day, assuming all workers travel to site via private vehicles. Of these trips, 21 would be expected to arrive/ depart during the peak hours. This, with consideration for the peak hour traffic volumes along the Newell Highway as discussed in Section 2, would require a Basic Turn Treatment for the right turn into Old Mill Road from the Newell Highway (i.e. no formal turning facility).

Left turn from Old Mill Road

There are no prescribed warrants for left turns from minor roads into major roads however the treatments remain the same. Due to the anticipated low turning volumes to/ from Old Mill Road via the Newell Highway, it would not be considered appropriate to provide an intersection treatment in excess of a Basic Turn Treatment.

6.1.2 Proposed Upgrades

The intersection of the Newell Highway and Old Mill Road is proposed to be upgraded to accommodate turning movements of vehicles up to 25m B-double trucks. Plans of the proposed upgrades is included in Appendix B and detailed as follows:

- minor earthworks trimming to provide a consistent grade at the intersection
- drainage amendments to prevent surface flow on to the Newell Highway
- spray seal surfacing of the first 30 metres of Old Mill Road to a maintain constant grade and minimise soil tracked onto the Newell highway by departing vehicles
- installation of rumble strips to remove potential contaminants from vehicles leaving Old Mill Road.

6.1.3 Sight Distances

On-site observations indicate that existing sight distances along the Newell Highway at Old Mill Road are in excess of 200 metres. It is also considered that the clearing of roadside vegetation/ grasses would further improve the sight distances and visibility of the intersection. Photos looking north and south along the Newell Highway from Old Mill Road are shown in Figure 6.1 and Figure 6.2.

Figure 6.1: Newell Highway (looking north)



Figure 6.2: Newell Highway (looking south)



6.2 Old Mill Road

Old Mill Road is to be upgraded to a suitable quality to facilitate the increased truck volumes during both the construction of the Leewood ponds and the flow line installation and the life span of the project. The existing unsealed road would be resurfaced with clean gravel from the Newell Highway to the site access driveway and would include the formation of a new access between Old Mill Road and the site, requiring limited tree clearing as well as earth and drainage works.

6.3 Road Maintenance

Basic wash-down facilities would be provided on-site to clean vehicles prior to leaving site, reducing the likelihood of site or other materials/ contaminants being tracked onto the Newell Highway.

It is anticipated that the surface condition of Old Mill Road and site access tracks will be monitored by the contractor and repaired as needed to maintain all-weather access to the site. This would be undertaken in consultation with Forests NSW.

A 20,000 litre water truck or similar would be present on-site for the duration of construction works, and would provide appropriate dust control and track stabilisation.

7. Conclusion

Based on the analysis and discussions presented within this report, the following conclusions are made:

i The Leewood and Bibblewindi proposed construction works are scheduled to be carried out over 5 stages, with works planned to commence in mid February 2013 (subject to approvals) and continue through to late August 2013, a period of approximately 5-6 months.

ii Up to 45 staff and 12 staff are anticipated to be on-site at Leewood and Bibblewindi respectively during peak construction activity (where stages may overlap) with vehicle volumes dependent on the adopted staff transport options.

iii Up to 60 vehicle trips per day and 20 vehicle trips per day are expected at Leewood and Bibblewindi respectively, where Stage 3 and Stage 4 works may overlap and assuming the use of private vehicles. This would be reduced 30 and 10 vehicle trips under a company car pool scenario.

iv The Leewood site is expected to generate up to 30 truck trips per day during peak construction activity throughout the Stage 2 works.

v Bibblewindi is expected to generate up to 8 truck trips per day over a number of stages where the majority of works will not require the heavy movement of trucks.

vi Under-boring of the Newell Highway is required where the existing gas flow line corridor crosses the Newell Highway between the Bibblewindi and Leewood sites. Specific design and traffic management approvals would be required for these works.

vii The operational workforce at each site is expected to be generally less than 5 staff with deliveries and visitors anticipated to be minor at less than 5 vehicles per week.

viii The existing layout of the intersection of the Newell Highway with Old Mill Road is suitable for the proposed traffic volumes.

ix The intersection of the Newell Highway with Old Mill Road would continue to operate at existing levels of service during the overall construction period however upgrades are proposed due to increased truck turning movements. This would include:

- minor earthworks trimming to provide a consistent grade at the intersection
- drainage amendments to prevent surface flow on to the Newell Highway
- spray seal surfacing of the first 30 metres of Old Mill Road to a maintain constant grade and minimise soil tracked onto the Newell highway by departing vehicles
- installation of rumble strips to remove potential contaminants from vehicles leaving Old Mill Road.

x Old Mill Road would be upgraded and resurfaced to a suitable quality with clean gravel in order to facilitate the increased truck volumes during all construction stages.

xi No intersection works or upgrade works are anticipated for the Bibblewindi site via X-Line Road.

xii Suitable traffic management has been proposed for each stage of construction at each site to safely accommodate construction vehicle movements and maintain existing safety levels for other road users.

Appendix A

Survey Data

MetroCount Traffic Executive
Class Speed Matrix

ClassMatrix-180 -- English (ENA)

Datasets:

Site: **[SH17] 200m north of SR59**
Direction: 3 - South bound, A hit first., **Lane:** 0
Survey Duration: 9:07 Thursday, 20 October 2011 => 20:36 Monday, 21 November 2011
File: G:\Eng\Design\MetroCount v315\User\Data\SH17\2011\SH1710Dec2011.EC0 (Plus)
Identifier: CG48BDKS MC56-L5 [MC55] (c)Microcom 19Oct04
Algorithm: Factory default
Data type: Axle sensors - Paired (Class/Speed/Count)

Site: **[SH17] 200m north of SR59**
Direction: 3 - South bound, A hit first., **Lane:** 0
Survey Duration: 13:04 Thursday, 29 September 2011 => 13:04 Thursday, 29 September 2011
File: G:\Eng\Design\MetroCount v315\User\Data\SH17\2011\SH1729Sep2011.EC0 (Plus)
Identifier: CG48BDKS MC56-L5 [MC55] (c)Microcom 19Oct04
Algorithm: Factory default
Data type: Axle sensors - Paired (Class/Speed/Count)

Site: **[SH17] 200m north of SR59**
Direction: 3 - South bound, A hit first., **Lane:** 0
Survey Duration: 13:32 Wednesday, 5 October 2011 => 9:03 Thursday, 20 October 2011
File: G:\Eng\Design\MetroCount v315\User\Data\SH17\2011\SH1720Oct2011.EC0 (Plus)
Identifier: CG48BDKS MC56-L5 [MC55] (c)Microcom 19Oct04
Algorithm: Factory default
Data type: Axle sensors - Paired (Class/Speed/Count)

Site: **[SH17] 200m north of SR59**
Direction: 3 - South bound, A hit first., **Lane:** 0
Survey Duration: 13:06 Thursday, 29 September 2011 => 13:30 Wednesday, 5 October 2011
File: G:\Eng\Design\MetroCount v315\User\Data\SH17\2011\SH1705Oct2011.EC0 (Plus)
Identifier: CG48BDKS MC56-L5 [MC55] (c)Microcom 19Oct04
Algorithm: Factory default
Data type: Axle sensors - Paired (Class/Speed/Count)

Profile:

Filter time: **13:04 Thursday, 29 September 2011 => 20:36 Monday, 21 November 2011**
Included classes: 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12
Speed range: 10 - 160 km/h.
Direction: North, East, South, West (bound)
Separation: All - (Headway)
Name: Factory default profile

Scheme: Vehicle classification (ARX)
Units: Metric (meter, kilometer, m/s, km/h, kg, tonne)
In profile: Vehicles = 99331 / 99402 (99.93%)

Class Speed Matrix

ClassMatrix-180
Site: SH17.0S SH17.0S SH17.0S SH17.0S
Description: **Multiple sites - See Header sheet for site descriptions.**
Filter time: **13:04 Thursday, 29 September 2011 => 20:36 Monday, 21 November 2011**
Scheme: Vehicle classification (ARX)
Filter: Cls(1 2 3 4 5 6 7 8 9 10 11 12) Dir(NESW) Sp(10,160) Headway(>0)

Speed (km/h)	Class 1	2	3	4	5	6	7	8	9	10	11	12	Speed Totals	
10 - 20	.	1	.	.	.	.	.	.	.	.	.	.	**1**	**0.0%**
20 - 30	.	21	1	.	2	.	.	.	2	1	.	.	**27**	**0.0%**
30 - 40	1	19	1	4	1	.	.	.	1	2	4	.	**33**	**0.0%**
40 - 50	1	14	4	6	2	1	.	2	1	1	2	.	**34**	**0.0%**
50 - 60	1	40	12	27	2	.	.	2	.	5	3	1	**93**	**0.1%**
60 - 70	1	220	36	63	5	.	2	6	.	7	8	2	**350**	**0.4%**
70 - 80	4	717	256	173	17	7	11	16	10	32	50	16	**1309**	**1.3%**
80 - 90	24	2385	1610	427	58	13	53	126	50	218	386	62	**5412**	**5.4%**
90 - 100	130	10248	2971	1468	585	116	218	450	885	5779	13879	261	**36990**	**37.2%**
100 - 110	312	25357	2585	1199	240	47	192	178	217	2917	8246	108	**41598**	**41.9%**
110 - 120	262	10323	629	357	13	14	58	13	4	39	129	11	**11852**	**11.9%**
120 - 130	54	1131	43	42	.	5	5	.	.	6	8	7	**1301**	**1.3%**
130 - 140	13	230	6	9	1	2	.	1	.	.	1	.	**263**	**0.3%**
140 - 150	.	45	2	3	.	1	.	.	.	.	.	.	**51**	**0.1%**
150 - 160	.	17	.	.	.	.	.	.	.	.	.	.	**17**	**0.0%**
	803	**50768**	**8156**	**3778**	**926**	**206**	**539**	**794**	**1170**	**9007**	**22716**	**468**	**99331**	
Class Totals	**0.8%**	**51.1%**	**8.2%**	**3.8%**	**0.9%**	**0.2%**	**0.5%**	**0.8%**	**1.2%**	**9.1%**	**22.9%**	**0.5%**		

MetroCount Traffic Executive
Weekly Vehicle Counts (Virtual Week)

VirtWeeklyVehicle-178 -- English (ENA)

Datasets:

Site:	**[SH17] 200m north of SR59**
Direction:	3 - South bound, A hit first., **Lane:** 0
Survey Duration:	9:07 Thursday, 20 October 2011 => 20:36 Monday, 21 November 2011
File:	G:\Eng\Design\MetroCount v315\User\Data\SH17\2011\SH1710Dec2011.EC0 (Plus)
Identifier:	CG48BDKS MC56-L5 [MC55] (c)Microcom 19Oct04
Algorithm:	Factory default
Data type:	Axle sensors - Paired (Class/Speed/Count)

Site:	**[SH17] 200m north of SR59**
Direction:	3 - South bound, A hit first., **Lane:** 0
Survey Duration:	13:04 Thursday, 29 September 2011 => 13:04 Thursday, 29 September 2011
File:	G:\Eng\Design\MetroCount v315\User\Data\SH17\2011\SH1729Sep2011.EC0 (Plus)
Identifier:	CG48BDKS MC56-L5 [MC55] (c)Microcom 19Oct04
Algorithm:	Factory default
Data type:	Axle sensors - Paired (Class/Speed/Count)

Site:	**[SH17] 200m north of SR59**
Direction:	3 - South bound, A hit first., **Lane:** 0
Survey Duration:	13:32 Wednesday, 5 October 2011 => 9:03 Thursday, 20 October 2011
File:	G:\Eng\Design\MetroCount v315\User\Data\SH17\2011\SH1720Oct2011.EC0 (Plus)
Identifier:	CG48BDKS MC56-L5 [MC55] (c)Microcom 19Oct04
Algorithm:	Factory default
Data type:	Axle sensors - Paired (Class/Speed/Count)

Site:	**[SH17] 200m north of SR59**
Direction:	3 - South bound, A hit first., **Lane:** 0
Survey Duration:	13:06 Thursday, 29 September 2011 => 13:30 Wednesday, 5 October 2011
File:	G:\Eng\Design\MetroCount v315\User\Data\SH17\2011\SH1705Oct2011.EC0 (Plus)
Identifier:	CG48BDKS MC56-L5 [MC55] (c)Microcom 19Oct04
Algorithm:	Factory default
Data type:	Axle sensors - Paired (Class/Speed/Count)

Profile:

Filter time:	**13:04 Thursday, 29 September 2011 => 20:36 Monday, 21 November 2011**
Included classes:	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12
Speed range:	10 - 160 km/h.
Direction:	North, East, South, West (bound)
Separation:	All - (Headway)
Name:	Factory default profile
Scheme:	Vehicle classification (ARX)
Units:	Metric (meter, kilometer, m/s, km/h, kg, tonne)
In profile:	Vehicles = 99331 / 99402 (99.93%)

Weekly Vehicle Counts (Virtual Week)

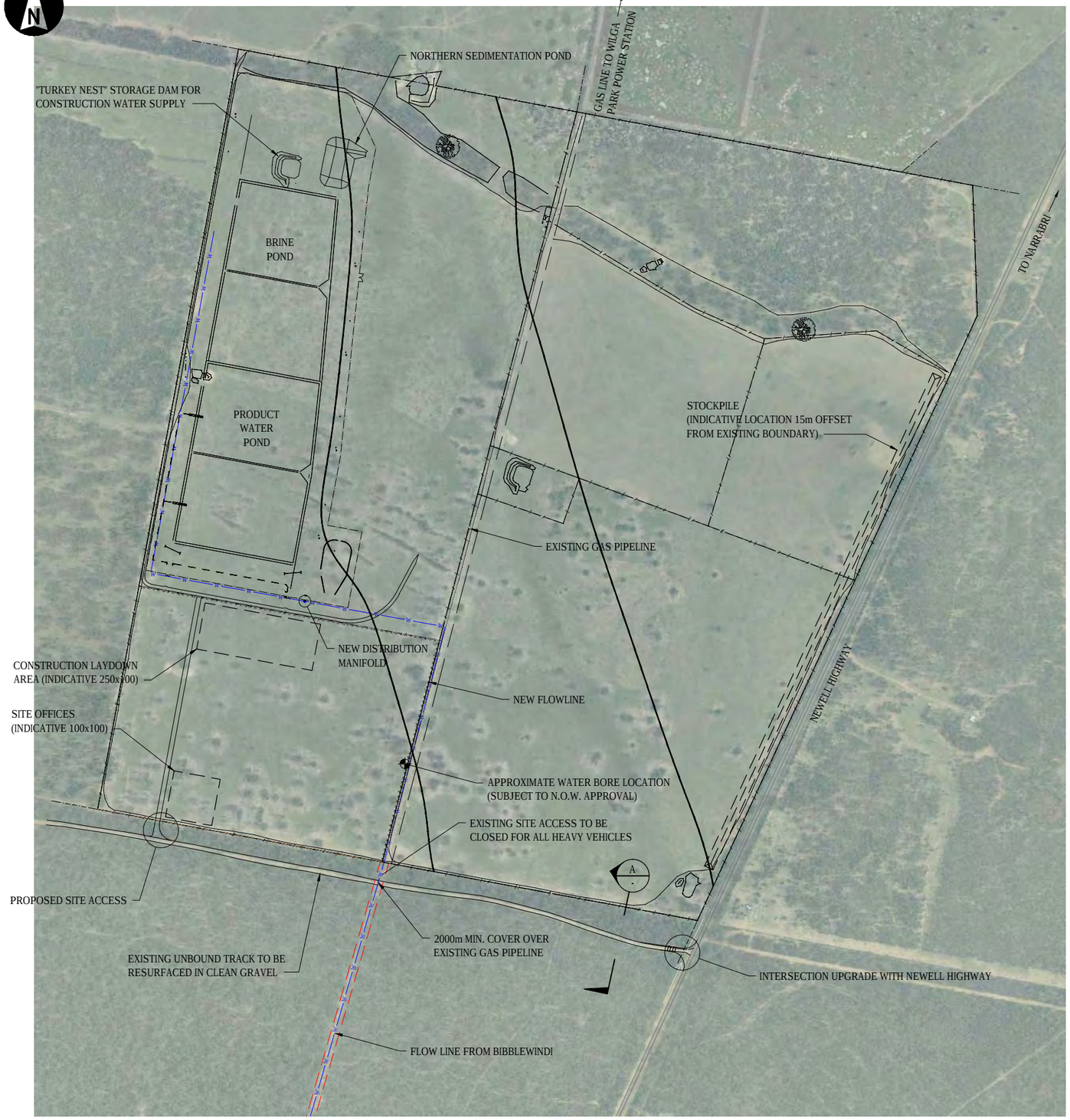
VirtWeeklyVehicle-178
Site: SH17.0S SH17.0S SH17.0S SH17.0S
Description: **Multiple sites - See Header sheet for site descriptions.**
Filter time: **13:04 Thursday, 29 September 2011 => 20:36 Monday, 21 November 2011**
Scheme: Vehicle classification (ARX)
Filter: Cls(1 2 3 4 5 6 7 8 9 10 11 12) Dir(NESW) Sp(10,160) Headway(>0)

	Mon	Tue	Wed	Thu	Fri	Sat	Sun	Averages 1 - 5	Averages 1 - 7
Hour									
0000-0100	17.4	11.3	21.9	19.3	23.6	17.5	20.6	18.8	18.9
0100-0200	11.9	8.3	20.3	21.7	20.6	15.3	19.3	16.5	16.8
0200-0300	11.0	8.1	20.9	17.0	22.1	18.0	21.0	15.9	17.0
0300-0400	15.0	11.7	19.0	21.7	23.3	17.6	19.9	18.2	18.4
0400-0500	18.3	20.6	30.3	29.0	28.3	30.9	26.6	25.2	26.2
0500-0600	36.5	40.3	59.7	58.9	53.0	51.0	48.4	49.4	49.5
0600-0700	68.8	73.7	100.6	97.0	98.9	83.6	71.9	87.6	84.6
0700-0800	88.6	108.0	135.7	119.4	126.9	115.3	97.8	115.3	112.6
0800-0900	125.6	112.6	**151.6<**	124.9	142.0	**130.3<**	113.1	131.5	128.5
0900-1000	118.1	117.3	136.0	**132.6<**	146.4	129.4	124.8	130.2	129.2
1000-1100	**128.1<**	121.4	139.9	127.9	**149.8<**	121.0	**128.1<**	**133.7<**	**130.9<**
1100-1200	124.0	**132.0<**	140.6	124.3	145.6	125.9	122.3	133.4	130.6
1200-1300	134.3	120.7	**148.6<**	136.3	150.4	**124.8<**	115.3	138.3	132.8
1300-1400	**146.4<**	122.7	143.6	**138.8<**	145.3	119.1	122.0	139.7	**134.0<**
1400-1500	138.9	**129.6<**	141.6	134.3	**155.6<**	120.8	117.6	**140.2<**	134.0
1500-1600	125.0	124.9	139.4	133.5	139.4	122.4	**122.0<**	132.4	129.4
1600-1700	99.1	117.9	128.6	122.8	137.1	114.1	99.4	121.0	116.8
1700-1800	69.5	92.9	98.9	95.4	109.1	90.3	83.9	93.0	91.2
1800-1900	55.0	68.0	78.0	72.6	75.5	63.4	55.9	69.7	66.7
1900-2000	43.1	57.7	54.3	57.0	66.1	51.9	50.8	55.6	54.4
2000-2100	30.4	47.7	52.0	56.8	50.3	47.1	40.8	47.3	46.3
2100-2200	28.4	40.0	35.7	45.4	40.5	34.6	37.9	38.3	37.7
2200-2300	20.6	33.1	24.9	33.5	29.9	26.6	35.3	28.6	29.3
2300-2400	14.4	24.9	27.7	28.4	22.3	23.8	25.9	23.6	24.0
Totals									
0700-1900	1352.6	1367.9	1582.3	1462.5	1623.0	1376.5	1302.0	1478.2	1436.7
0600-2200	1523.3	1587.0	1824.9	1718.7	1878.8	1593.8	1503.3	1707.0	1659.6
0600-0000	1558.3	1645.0	1877.4	1780.5	1930.9	1644.1	1564.4	1759.2	1712.9
0000-0000	1668.3	1745.3	2049.4	1948.1	2101.8	1794.4	1720.1	1903.1	1859.6
AM Peak	1000	1100	0800	0900	1000	0800	1000		
	128.1	132.0	151.6	132.6	149.8	130.3	128.1		
PM Peak	1300	1400	1200	1300	1400	1200	1500		
	146.4	129.6	148.6	138.8	155.6	124.8	122.0		

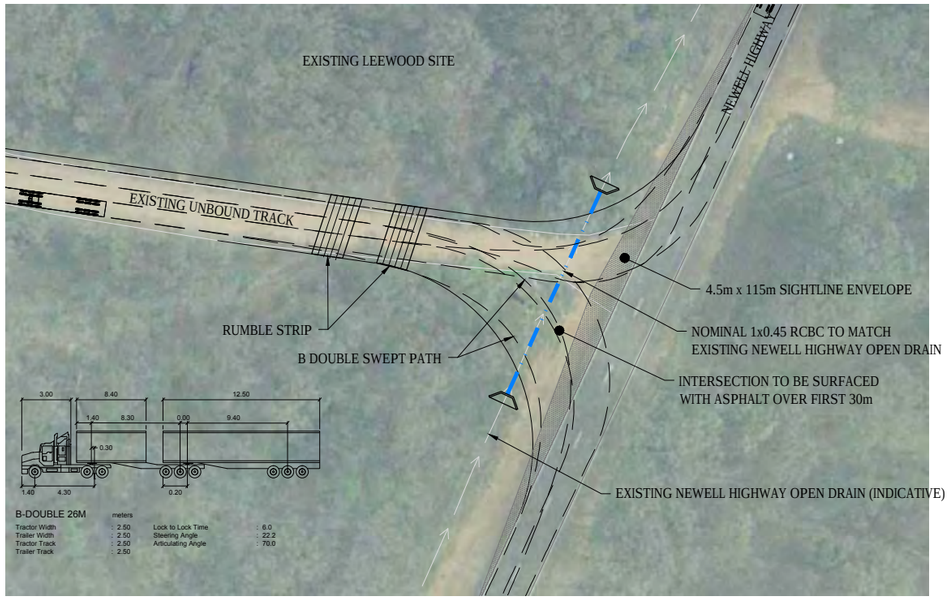
*** - No data.**

Appendix B

Project Site Plans



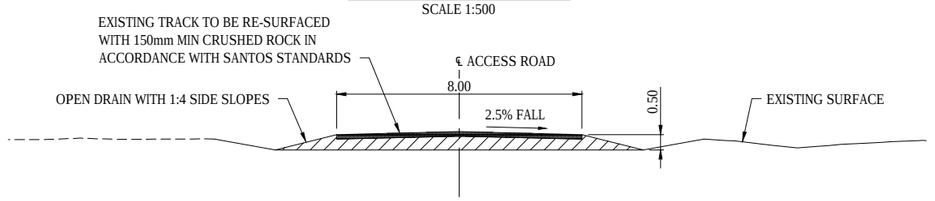
LAYOUT PLAN
SCALE 1:5000



INTERSECTION UPGRADE WITH NEWELL HIGHWAY
SCALE 1:500



PROPOSED SITE ACCESS
SCALE 1:500



TYPICAL ACCESS ROAD UPGRADE

SECTION A
SCALE 1:100

aurecon
Project No. 231947
Aurecon Australia Pty Ltd ABN 54 005 139 873
Level 14, 32 Turbot Street
Brisbane 4000 Australia
Telephone: +61 7 3173 8000
Facsimile: +61 7 3173 8001
Email: brisbane@aurecongroup.com

A person using Aurecon drawings and other data accepts the risk of:
1. Using the drawings and other data in electronic form without requesting and checking them for accuracy against the original hard copy versions.
2. Using the drawings or other data for any purpose not agreed to in writing by Aurecon.
Wherever a discrepancy in the contract documents is found and unless directed otherwise by the Principal/Engineer, the contractor shall adopt, at their own cost the greater quantum, class of finish, grade, or specification where applicable.

5 0 10 20m
SCALE 1:500
50 0 100 200m
SCALE 1:5000

No	DATE	DRN	CHKD	ENG	Q.A.	PROJ	ACC	DESCRIPTION
D	28/09/12	MD	DT	AM				UPDATED FROM SANTOS COMMENTS
C	21/09/12	MD	DT	AM				FINAL ISSUE
B	14/09/12	MD	DT	AM				REF ISSUE
A	07/09/12	MD	DT	AM				ISSUED FOR INTERNAL REVIEW

REVISIONS

DRG No.	SUBJECT

REFERENCE DRAWINGS

DRN:	MWD
DATE:	07/09/12
SCALE:	NTS
CHKD:	DGT
ENG:	AMCC
Q.A.:	
PROJ:	
ACC:	
A.B.N. 80 007 550 923	

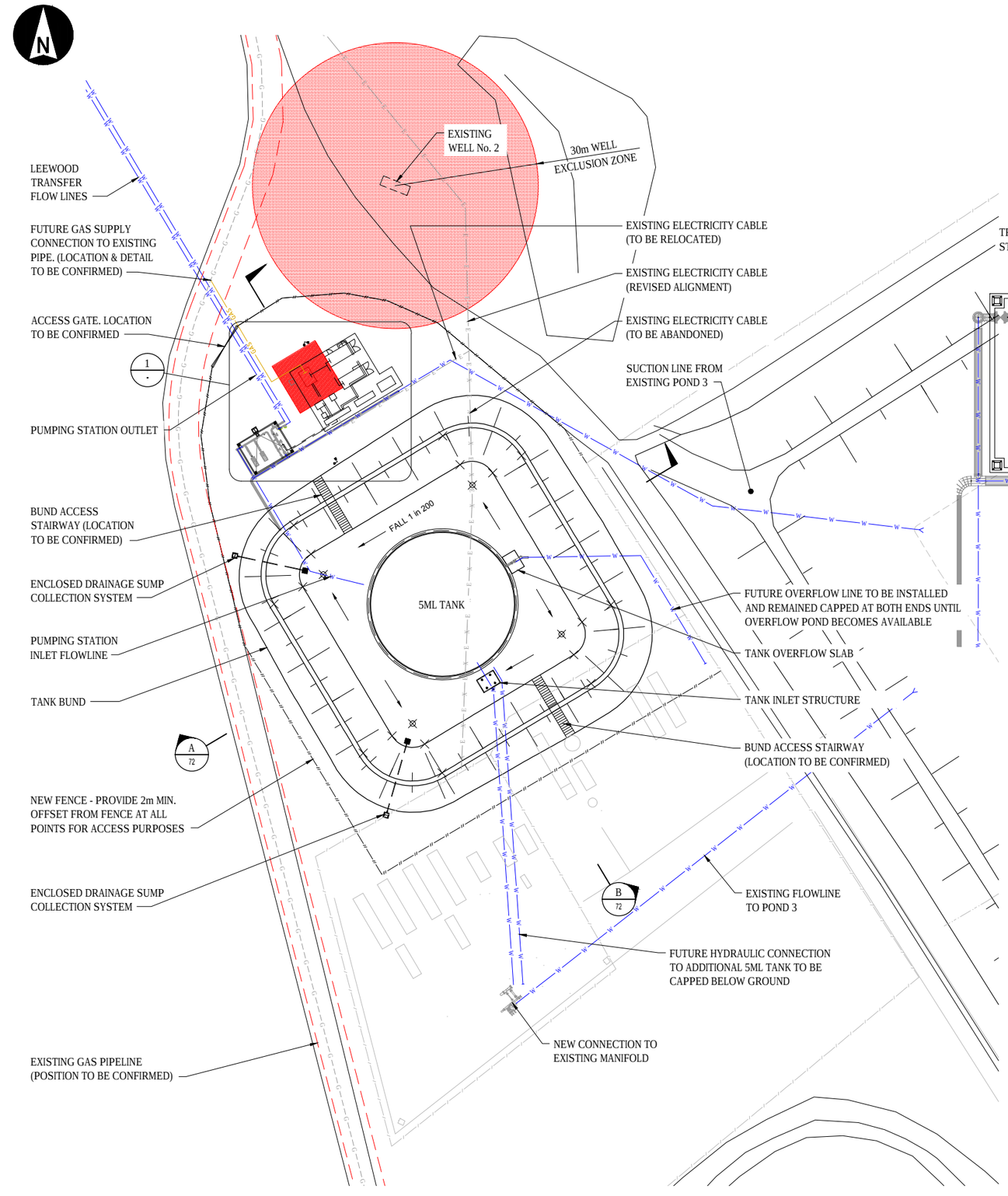
AREA 7081 - LEEWOOD WATER TREATMENT FACILITY
BIBBLEWINDI WATER TRANSFER FACILITIES
LEEWOOD PLOT PLAN
GENERAL ARRANGEMENT AND SECTIONS

Santos

DRAWING No. 7081-40-068

REV D

CADFILE No. -



DETAIL 1 / - SCALE 1:100

NOTE: CABLE ROUTES NOT SHOWN

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Project No. 231947
Aurecon Australia Pty Ltd ABN 54 005 139 873
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Brisbane 4000 Australia
Telephone: +61 7 3173 8000
Facsimile: +61 7 3173 8001
Email: brisbane@aurecongroup.com

A person using Aurecon drawings and other data accepts the risk of:
1. Using the drawings and other data in electronic form without requesting and checking them for accuracy against the original hard copy versions;
2. Using the drawings or other data for any purpose not agreed to in writing by Aurecon.
Wherever a discrepancy in the contract documents is found and unless directed otherwise by the Principal/Engineer, the contractor shall adopt, at their own cost the greater quantum, class of finish, grade, or specification where applicable.

SCALE 1:100 (1 0 2 4m)
SCALE 1:500 (5 0 10 20m)

No	DATE	DRN	CHKD	ENG	Q.A.	PROJ	ACC	DESCRIPTION
F	31/10/12	MD	DT	AM				BUND LAYOUT UPDATED
E	05/10/12	MD	DT	AM				BUND LAYOUT AMENDED
D	21/09/12	MD	DT	AM				FINAL ISSUE
C	17/09/12	MD	DT	AM				RE-ISSUED FOR INTERNAL REVIEW
B	14/09/12	MD	DT	AM				REF ISSUE
A	07/09/12	MD	DT	AM				ISSUED FOR INTERNAL REVIEW

REVISIONS

DRG No.	SUBJECT

REFERENCE DRAWINGS

DRN:	MWD
DATE:	07/09/12
SCALE:	NTS
CHKD:	DGT
ENG:	AMCC
Q.A.:	
PROJ:	
ACC:	
A.B.N. 80 007 550 923	

AREA 7081 - LEEWOOD WATER TREATMENT FACILITY
BIBBLEWINDI WATER TRANSFER FACILITIES
BIBBLEWINDI PLOT PLAN
GENERAL ARRANGEMENT AND SECTIONS

Santos

DRAWING No. 7081-40-067

REV F

CADFILE No. -

AUTOCAD

PLEASE REPLACE TEXT WITH ABBREVIATED DRAWING TITLE : A1SHEET

Appendix C

Leewood Site Access Plan

NOTE:
TEMPORARY VARIABLE MESSAGE SIGNS (VMS) MAY ALSO BE LOCATED ON THE NEWELL HIGHWAY, APPROXIMATELY 250m FROM OLD MILL ROAD TO PROVIDE ADDITIONAL WARNING/ SAFETY DURING CONSTRUCTION ACTIVITY.

PROPOSED SITE ACCESS FROM OLD MILL ROAD

LEEWOOD

SITE

VMS LOCATION

OLD MILL ROAD

NEWELL HIGHWAY

Dog Fence Rd

Bohena Creek Rd

Newell Hwy

110

R1-2A GIVE WAY

W5-205 TRUCKS TURNING

W8-207(R) 220 m ON RIGHT

W5-22

W8-207(L) 220 m ON LEFT

OLD MILL ROAD

OLD MILL ROAD

N

PRELIMINARY PLAN

FOR DISCUSSION PURPOSES
ONLY SUBJECT TO CHANGE
WITHOUT NOTIFICATION

GTAconsultants
www.gta.com.au

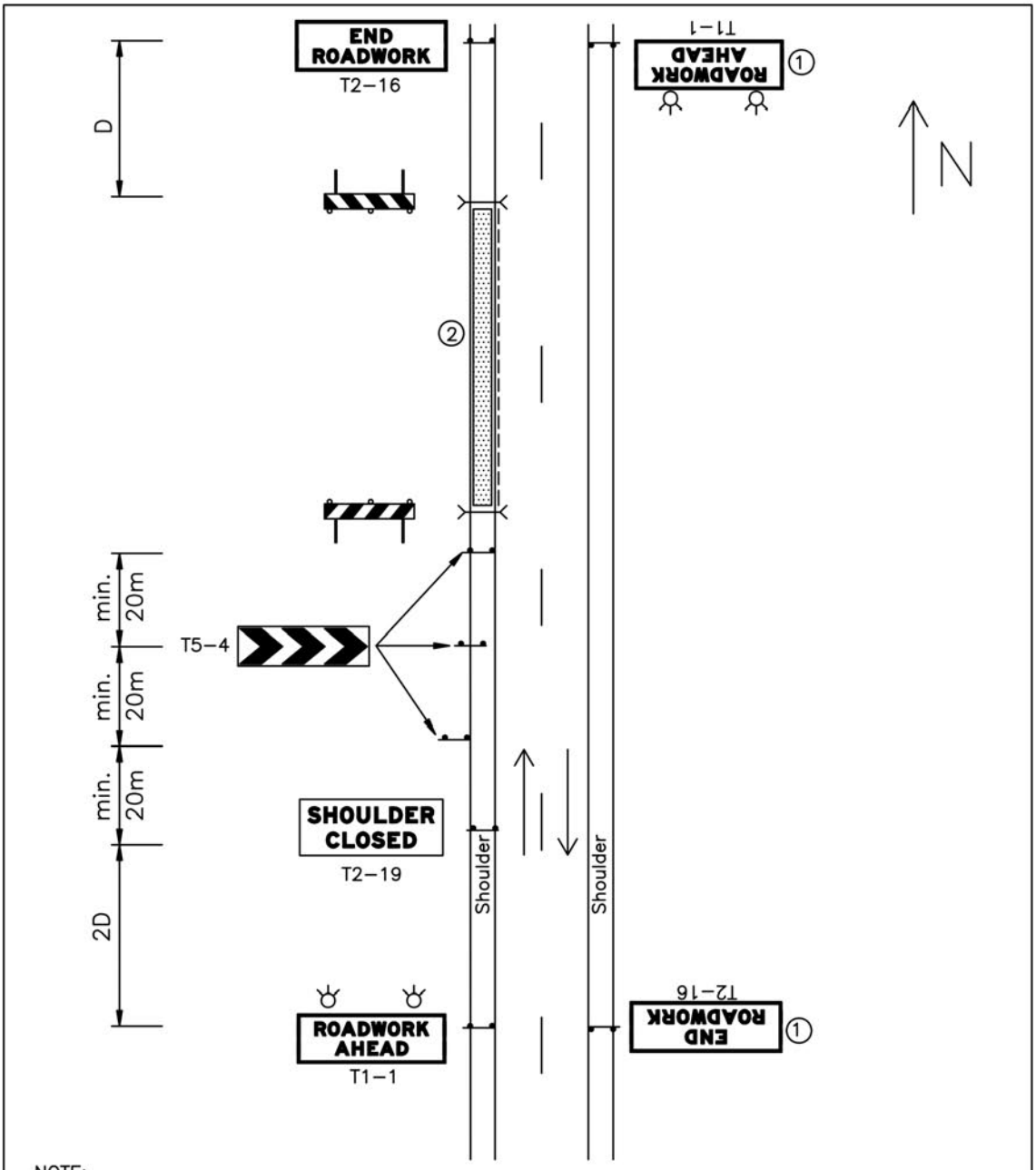
LEEWOOD PROJECT
NEWELL HIGHWAY
SITE ACCESS PLAN

24 SEPTEMBER '12
NOT TO SCALE
13S1042000-01-01-P1

PLOTTED BY : Cameron Ward ON 24/09/2012 AT 7:40:29 PM

Appendix D

Standard Traffic Control Plans

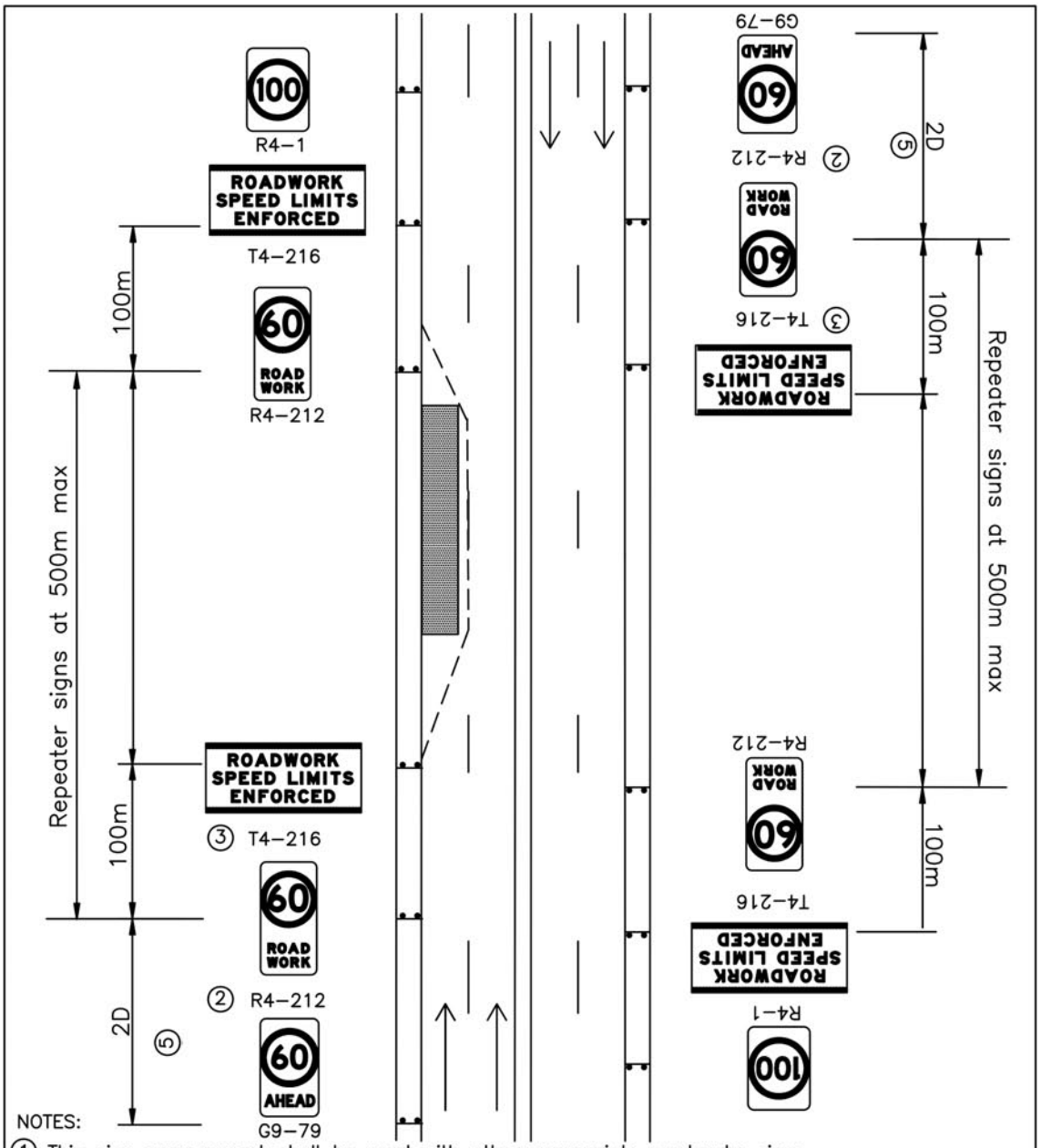


NOTE:
(1) Southbound T1–1 and T2–16 signs should be omitted on a one way carriageway.
(2) At night or when work has stopped, barriers may be erected along the work site at right angles to the traffic flow.

LONG TERM WORK
ALL ROADS
SHOULDER CLOSED

T000042

TCP 42



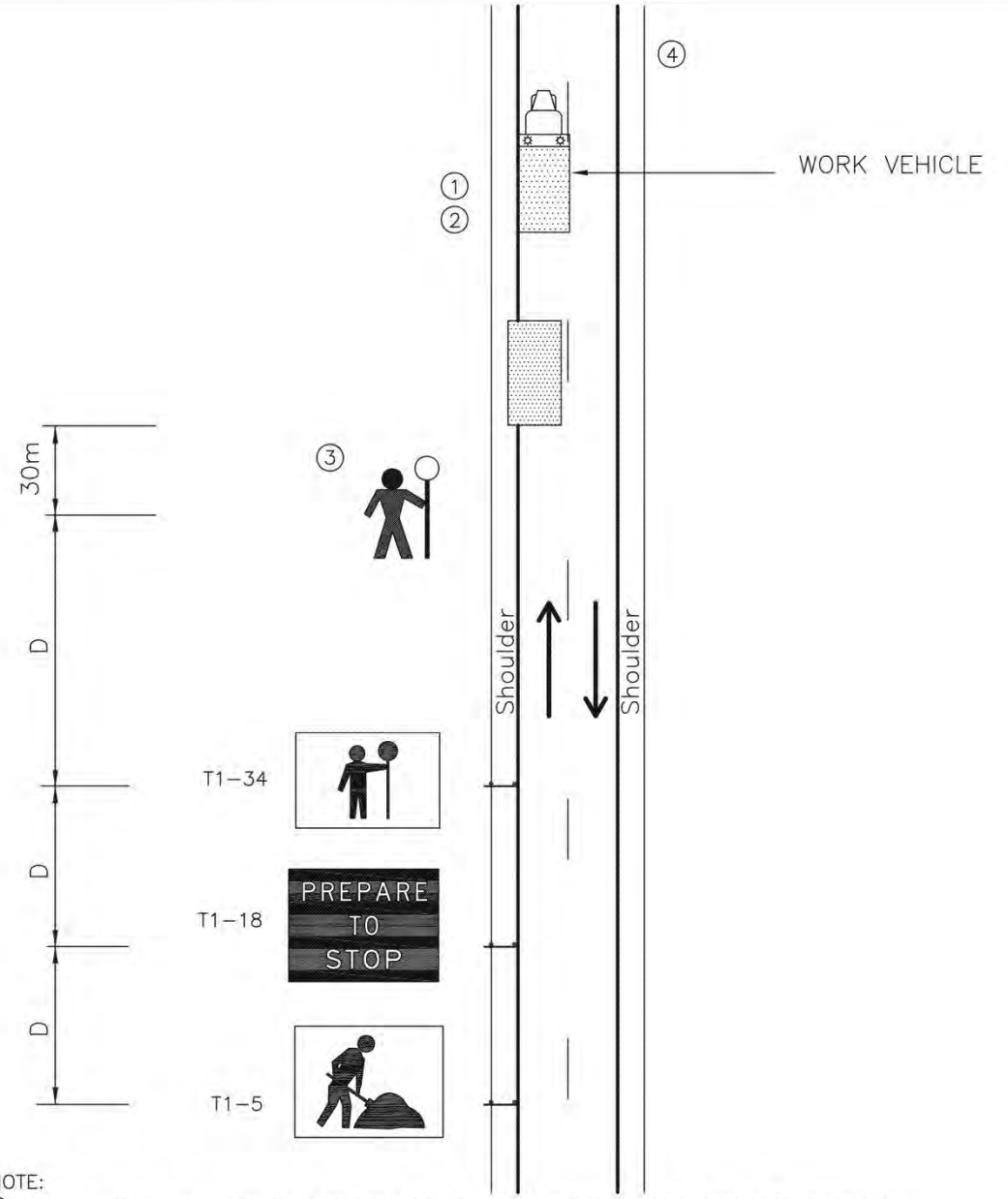
NOTES:

① This sign arrangement shall be used with other appropriate roadworks signs.
② The value of speed limits displayed shall match the speed zone approval.
③ ROADWORKS SPEED ZONES ENFORCED signs are required for works in excess fo 4 weeks or where speed zone compliance is a problem.
④ See Section 8.2 ***Roadwork (temporary) speed zones.***
⑤ The value of D shall be determined at the time of TCP selection/design and shown on the TCP.

ROADWORK SPEED LIMITS

T000057

TCP 57



NOTE:

① While setting up, park Work Vehicle on the shoulder and allow traffic to proceed.

② During work, park Work Vehicle in lane in front of the work to protect personnel from traffic in opposite direction.

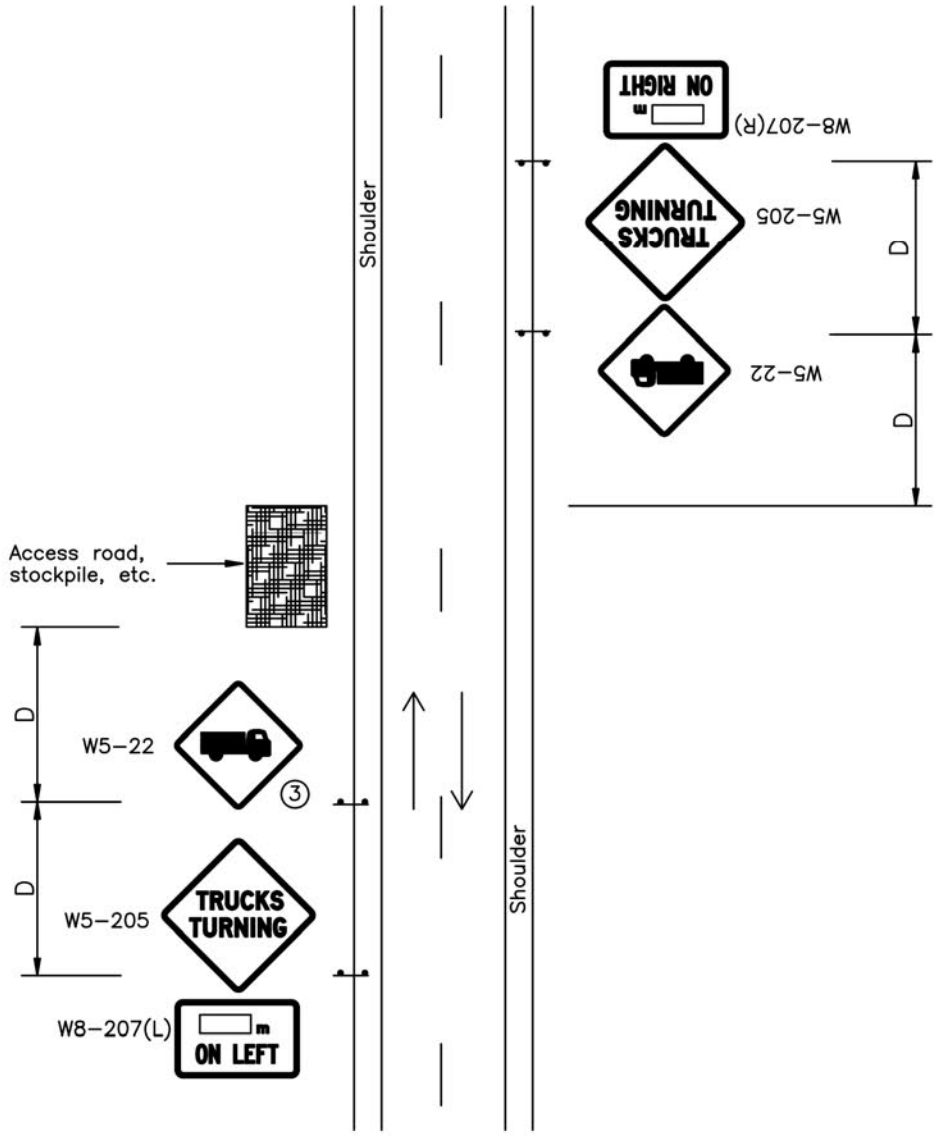
③ Traffic Controller to stop traffic for duration of work and then direct traffic through work area, once it has been cleared of personnel and the Work Vehicle.

④ Signs may be necessary facing the other direction of traffic.

SHORT TERM WORK (UP TO FIVE MINUTES)
2 LANE / 2 WAY (ADT ⩾ 3,000)
MINOR MANUAL WORK

T000077

TCP 77



NOTE:

① For use where roadside is generally undeveloped, ADT is more than 1,500 vehicles per day, sight distance is restricted and there are more than 20 truck movements per shift.

② See ***Traffic control at work sites,*** Section 7.7, ***Signs for depots, stockpiles, quarries, gravel pits etc.***

③ For short term works use T2–25.

ACCESS TO DEPOT, STOCKPILE, QUARRY, GRAVEL PIT ETC.
ALL ROADS
LONG TERM USE

T000195

TCP 195

Melbourne

A 87 High Street South
PO Box 684
KEW VIC 3101
P +613 9851 9600
F +613 9851 9610
E melbourne@gta.com.au

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F +612 8448 1810
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F +618 8334 3610
E adelaide@gta.com.au

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FORTITUDE VALLEY QLD 4006
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F +617 3113 5010
E brisbane@gta.com.au

Gold Coast

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1 Corporate Court
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P +617 5510 4800
F +617 5510 4814
E goldcoast@gta.com.au

www.gta.com.au

GTAconsultants

Appendix 4

Surveys

Gleeson Surveying

Registered Surveyors

1 Bowen Street, P.O. Box 1,
Narrabri N.S.W. 2390.
Phone: 02-67922720 Facs.: 02-67923660
E-mail: gleesurv@bigpond.net.au

"LEEWOOD"

LOT 1 DP771141

Client: SANTOS LIMITED

File Name:	*Sheets:*	*Ref. No.:*
8419_DET.dwg	1 OF 2	8419

Drawing Description:

DETAIL SURVEY

Issue	Date	Revision Type	Dr. By	Ch. By
A	02-08-12	Original Issue	L.B.	R.G.

Datum: AHD

Orientation: MGA

Registered Surveyor

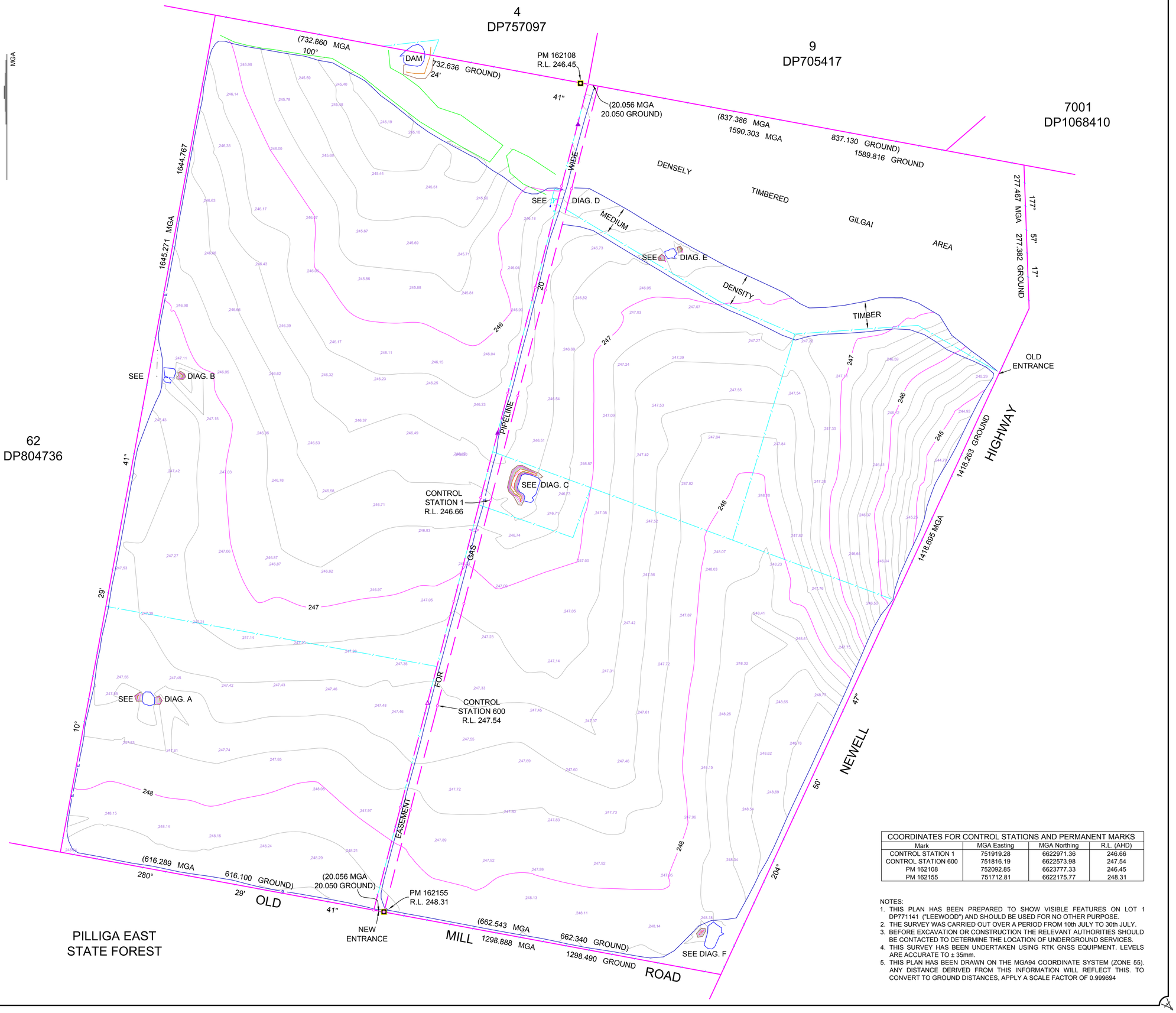
Ross Gleeson

Date : .....

Scale: 1 : 3,500 @ A1

Legend:

- BOUNDARY
- EASEMENT, PEG
- FENCE, POST
- TREE LINE
- EDGE OF DAM
- TOP OF BATTER
- BOTTOM OF BATTER
- CENTRELINE OF TRACK
- 247 CONTOUR MAJOR (1m)
- CONTOUR MINOR (0.2m)
- 246.87 NATURAL SURFACE LEVEL
- SANTOS GAS PIPELINE SIGN



COORDINATES FOR CONTROL STATIONS AND PERMANENT MARKS			
Mark	MGA Easting	MGA Northing	R.L. (AHD)
CONTROL STATION 1	751919.28	6622971.36	246.66
CONTROL STATION 600	751816.19	6622573.98	247.54
PM 162108	752092.85	6623777.33	246.45
PM 162155	751712.81	6622175.77	248.31

NOTES:

1. THIS PLAN HAS BEEN PREPARED TO SHOW VISIBLE FEATURES ON LOT 1 DP771141 ("LEEWOOD") AND SHOULD BE USED FOR NO OTHER PURPOSE.
2. THE SURVEY WAS CARRIED OUT OVER A PERIOD FROM 10th JULY TO 30th JULY.
3. BEFORE EXCAVATION OR CONSTRUCTION THE RELEVANT AUTHORITIES SHOULD BE CONTACTED TO DETERMINE THE LOCATION OF UNDERGROUND SERVICES.
4. THIS SURVEY HAS BEEN UNDERTAKEN USING RTK GNSS EQUIPMENT. LEVELS ARE ACCURATE TO ± 35mm.
5. THIS PLAN HAS BEEN DRAWN ON THE MGA94 COORDINATE SYSTEM (ZONE 55). ANY DISTANCE DERIVED FROM THIS INFORMATION WILL REFLECT THIS. TO CONVERT TO GROUND DISTANCES, APPLY A SCALE FACTOR OF 0.999694

Gleeson Surveying

Registered Surveyors

1 Bowen Street, P.O. Box 1,
Narrabri N.S.W. 2390.
Phone: 02-67922720 Facs.: 02-67923660
E-mail: gleesurv@bigpond.net.au

"LEEWOOD"

LOT 1 DP771141

Client: SANTOS LIMITED

File Name:	*Sheets:*	*Ref. No.:*
8419_DET.dwg	2 OF 2	8419

Drawing Description:

DETAIL SURVEY

Issue	*Date*	*Revision Type*	*Dr. By*	*Ch. By*
A	02-08-12	Original Issue	L.B.	R.G.

Datum: AHD

Orientation: MGA

Registered Surveyor

Ross Gleeson

Date : .....

Scale: SEE PLAN @ A1

Legend:

- BOUNDARY
- EASEMENT, PEG
- FENCE, POST
- TREE LINE
- EDGE OF DAM
- TOP OF BATTER
- BOTTOM OF BATTER
- CENTRELINE OF TRACK
- CONTOUR MAJOR (1m)
- CONTOUR MINOR (0.2m)
- NATURAL SURFACE LEVEL
- SANTOS GAS PIPELINE SIGN

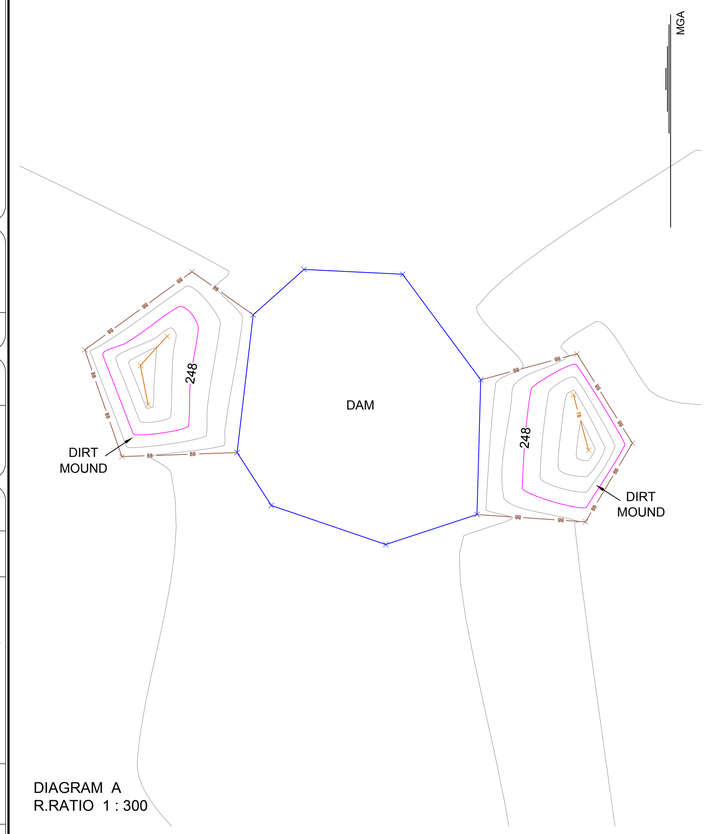


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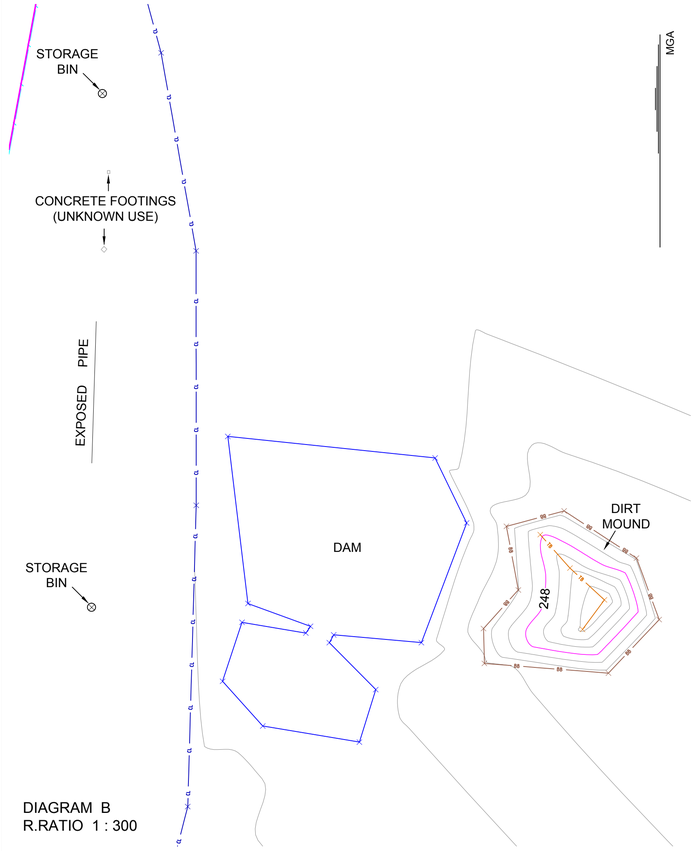


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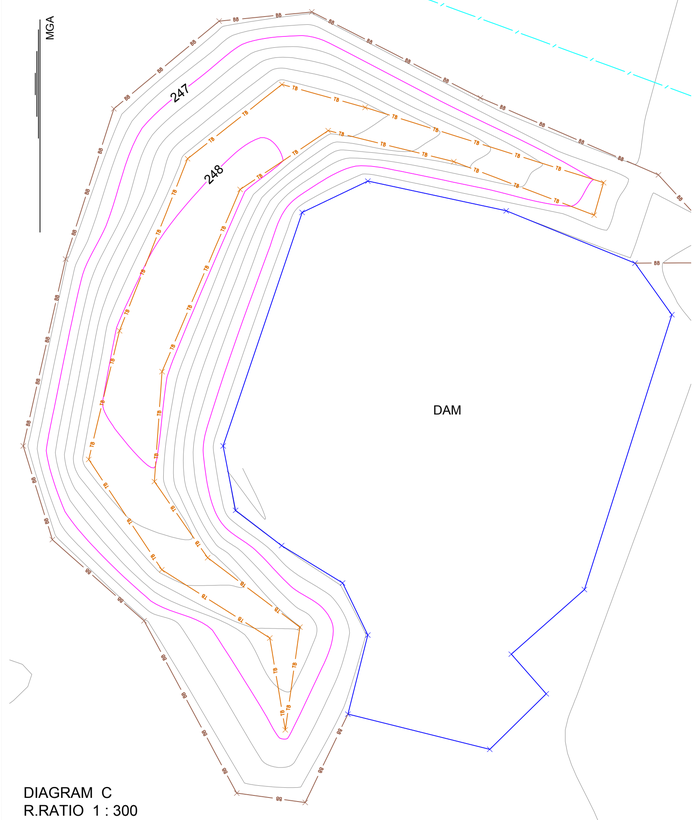


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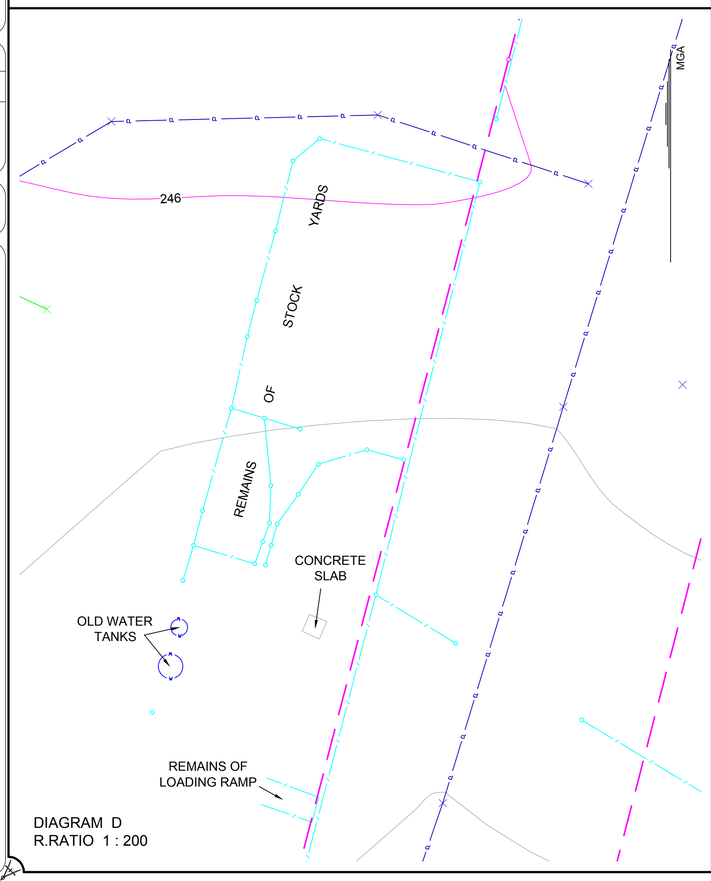


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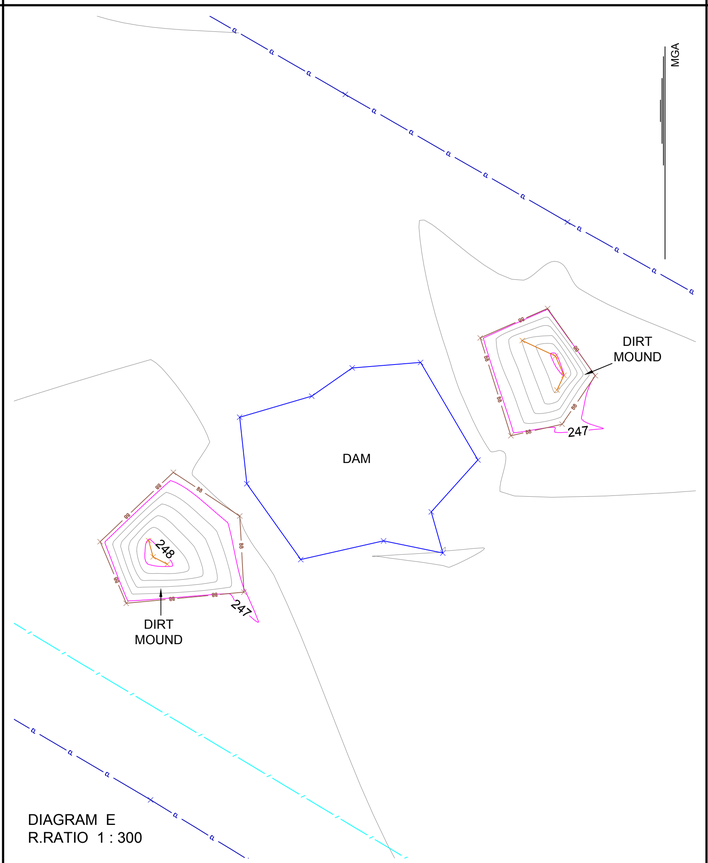


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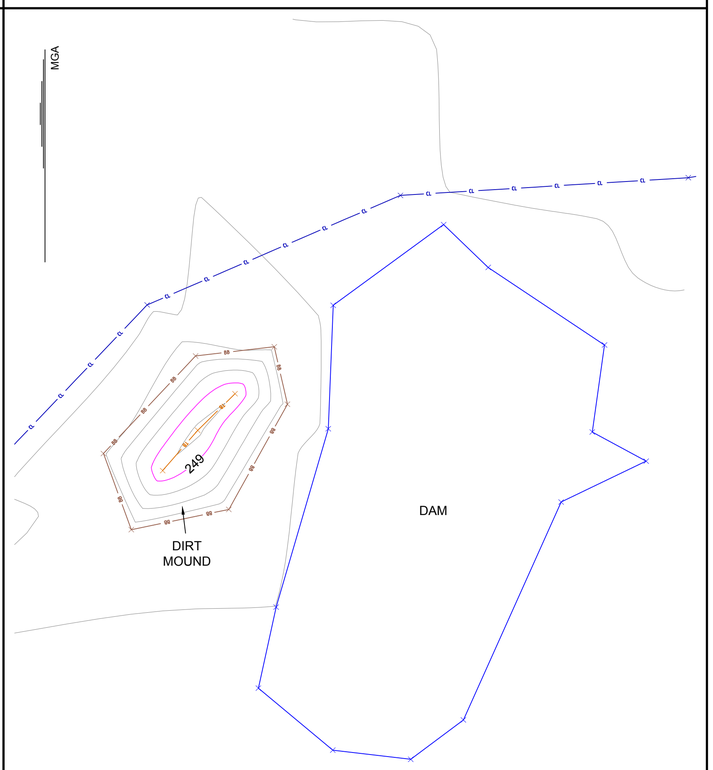
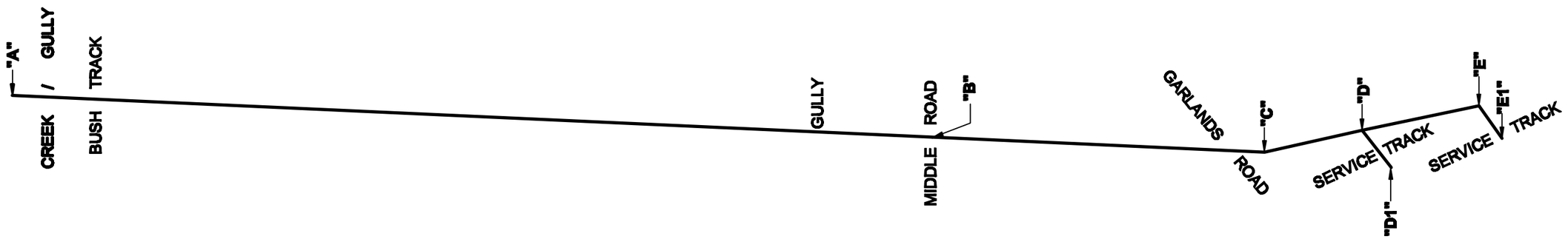


DIAGRAM F
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M. G. A.



CO-ORDINATES OF STATIONS			
Stations	MGA Easting	MGA Northing	R.L.
A	753652.28	6605037.35	279.15
B	753746.28	6607061.35	277.42
C	753777.28	6607793.35	277.34
D	753729.28	6608008.35	278.13
D1	753811.28	6608072.35	278.65
E	753675.28	6608265.35	280.78
E1	753747.28	6608316.35	279.91

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PROPOSED GAS PIPELINE ROUTE
BIBBLEWINDI TO WILGA PARK

Client: EASTERN STAR GAS

File Name: 7815B.dwg
Sheets: 2 OF 24
Ref. No.: 7815
Plan Issue: A

Job Description: PLAN OF CENTRE LINE A TO E

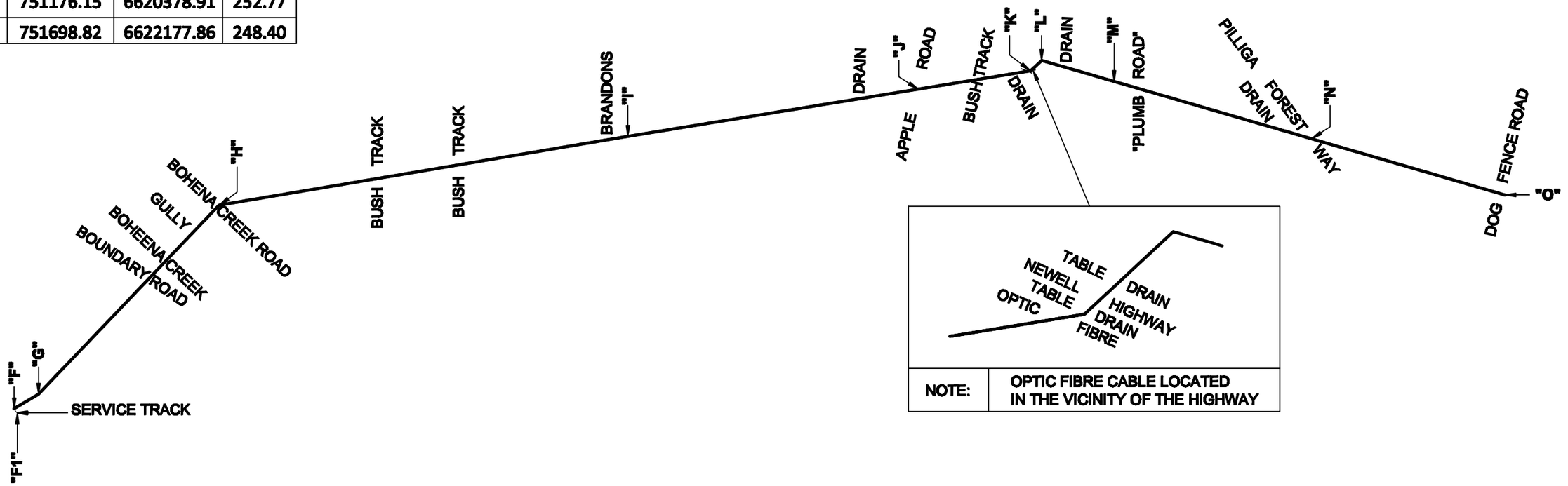
Issue	Date	Revision Type	Dr. By	Ch. By
A	[illegible]	Original Issue	M.C.	R.G.

Scale: 1:10000@A3
Datum: A.H.D
Orientation: M.G.A
Registered Surveyor .....
Date : .....
Drawn: M.C.
Checked: R.G.

M. G. A.

CO-ORDINATES OF STATIONS

Stations	MGA Easting	MGA Northing	R.L.
F	753687.28	6608317.35	280.55
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I	751153.28	6614023.35	265.67
J	750715.28	6616721.35	261.78
K	750543.28	6617766.35	259.39
L	750447.19	6617869.61	259.14
M	750642.85	6618543.19	257.41
N	751176.15	6620378.91	252.77
O	751698.82	6622177.86	248.40



NOTE:	OPTIC FIBRE CABLE LOCATED IN THE VICINITY OF THE HIGHWAY

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PROPOSED GAS PIPELINE ROUTE
BIBBLEWINDI TO WILGA PARK

Client: EASTERN STAR GAS

File Name: 7815B.dwg
Sheets: 10 OF 24
Ref. No.: 7815
Plan Issue: A
Job Description: PLAN OF CENTRE LINE F TO O

Issue	Date	Revision Type	Dr. By	Ch. By
A	22/10/2020	Original Issue	M.C.	R.G.

Scale: 1:40000@A3
Datum: A.H.D
Orientation: M.G.A
Registered Surveyor .....
Date : .....
Drawn: M.C.
Checked: R.G.

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BIBBLEWINDI PONDS AREA

Client: EASTERN STAR GAS

File Name:	Sheets:	Ref. No.:
8230v2.dwg	1 OF 2	8230
	Plan Issue: A	

Job Description: DETAIL SURVEY OF PONDS AREA

Issue	Date	Revision Type	Dr. By	Ch. By
B	11-11-11	Additional Detail	B.W.	R.G.
A	24-11-10	Original Issue	L.B.	R.G.

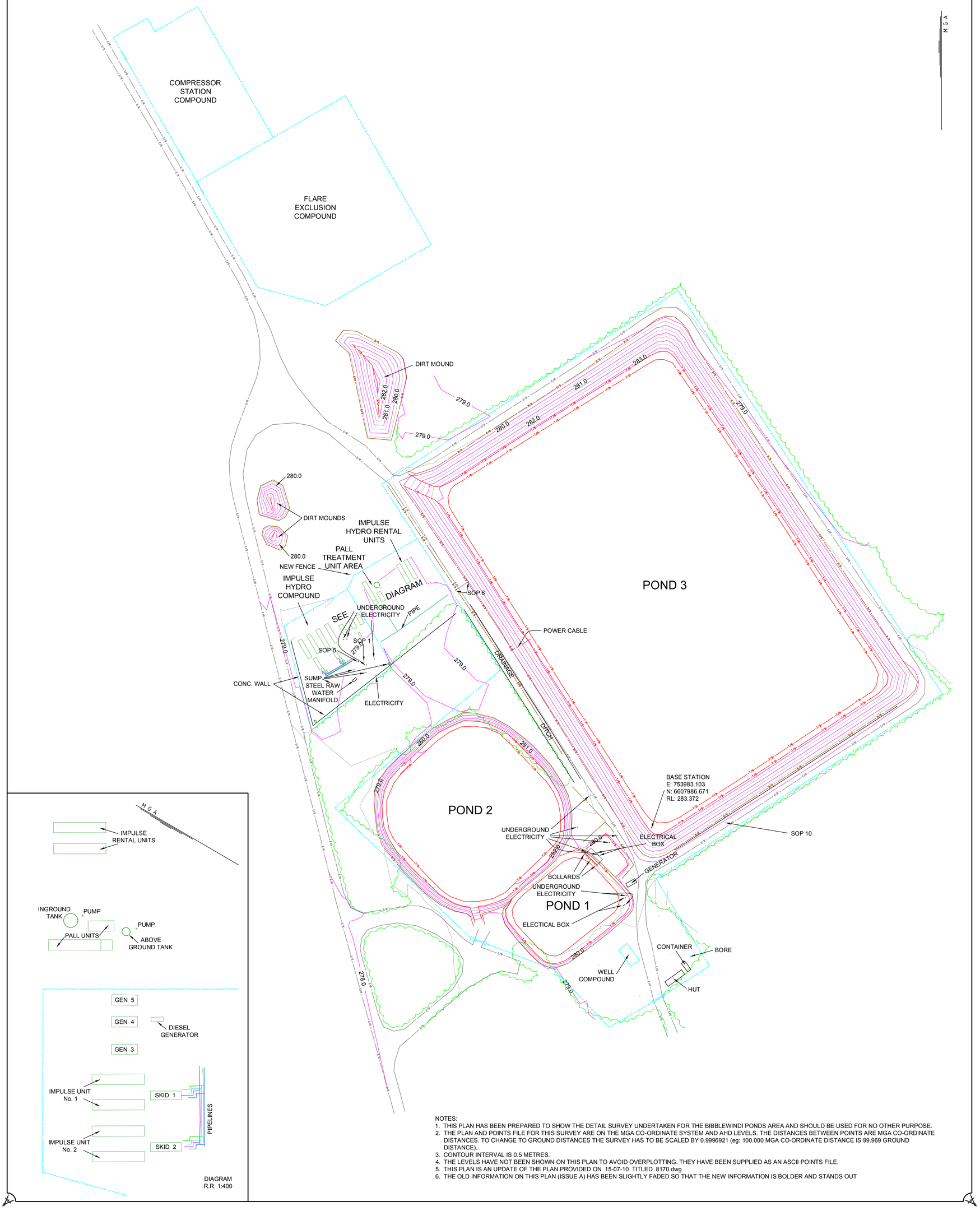
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Datum: AHD
Orientation: MGA

Registered Surveyor .....
Date :

Drawn: LB
Checked: RG

LEGEND
- TOP OF BATTER
- BOTTOM OF BATTER
- MINOR CONTOUR
- MAJOR CONTOUR
- FENCE, GATE
- DRAIN
- EDGE OF ROAD
- APPROXIMATE EDGE OF TREE LINE
- APPRXIMATE LOCATION OF TREE



NOTES:
1. THIS PLAN HAS BEEN PREPARED TO SHOW THE DETAIL SURVEY UNDERTAKEN FOR THE BIBBLEWINDI PONDS AREA AND SHOULD BE USED FOR NO OTHER PURPOSE.
2. THE PLAN AND POINTS FILE FOR THIS SURVEY ARE ON THE MGA CO-ORDINATE SYSTEM AND AHD LEVELS. THE DISTANCES BETWEEN POINTS ARE MGA CO-ORDINATE DISTANCES. TO CHANGE TO GROUND DISTANCES THE SURVEY HAS TO BE SCALED BY 0.9996921 (eg: 100.000 MGA CO-ORDINATE DISTANCE IS 99.969 GROUND DISTANCE).
3. CONTOUR INTERVAL IS 0.5 METRES.
4. THE LEVELS HAVE NOT BEEN SHOWN ON THIS PLAN TO AVOID OVERPLOTTING. THEY HAVE BEEN SUPPLIED AS AN ASCII POINTS FILE.
5. THIS PLAN IS AN UPDATE OF THE PLAN PROVIDED ON 15-07-10 TITLED 8170.dwg
6. THE OLD INFORMATION ON THIS PLAN (ISSUE A) HAS BEEN SLIGHTLY FADED SO THAT THE NEW INFORMATION IS BOLDER AND STANDS OUT

Appendix 5

Ecological Assessment

Leewood – Produced Water & Brine Management Ponds

Ecological Assessment

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Client Manager: Matt Doherty
Report Number: PR113369-6
Version / Date: Final / November 2012

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Document Status

Version	Purpose of Document	Orig	Review	Review Date
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Final	Final for Submission	AB	MD	7-11-2012

Approval for Issue

Name	Signature	Date
Matt Doherty		7-11-2012

Summary

Introduction

RPS Australia East Pty Ltd (RPS) was engaged by Santos to undertake a Flora and Fauna Assessment on a Santos owned property (known as 'Leewood'), access track and connecting 16km flow line Right of Way (ROW) near the Newell Highway, Narrabri, NSW (the study area). This assessment covers the Leewood Produced Water and Brine Management Ponds project. It outlines the occurrence, or likely occurrence, of any threatened species, populations or ecological communities listed in the *Threatened Species Conservation Act 1995* (TSC Act) and threatened entities listed under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). The report recognises the relevant requirements of the *Environmental Planning and Assessment Act 1979* (EP&A Act) as amended by the *Environmental Planning and Assessment Amendment Act 1997*.

Previous Studies

Previous ecological studies conducted in or near the study area have suggested that that there are 14 vegetation types in the study area, six of which correspond with Endangered Ecological Communities (EEC) as listed within the TSC Act. They have also suggested that there is at least three threatened flora and 16 fauna species potentially present on site.

Vegetation

Ground truthing of the site confirmed previous mapping and delineated four native vegetation communities identified as occurring on the study area, two of which are commensurate with EECs listed under EPBC Act and TSC Act. Vegetation communities were mapped in accordance with Namoi CMA Vegetation Mapping and include:

- Pilliga Box – Poplar Box – White Cypress Pine Grassy Open Woodland on Alluvial loams, Darling Riverine Plains and Brigalow Belt South;
- Brigalow woodland;
- Ironbark Shrubby Woodland of the Pilliga Area, Brigalow Belt South; and
- Blakely's Red Gum Riparian Woodland of the Pilliga outwash, Brigalow Belt.

No threatened flora species under the TSC Act and EPBC Act were recorded within the study area during RPS surveys.

Habitat

Habitats within the site were found to vary between poor and moderate condition. The majority of the study area has been cleared. The impact area within the Leewood section of the study area contains only a few paddock trees, providing limited resources for most fauna species. In areas of denser vegetation throughout the study area, logs, tree hollows and vegetation diversity does increase to a moderate level, offering a higher amount of resources for terrestrial and arboreal fauna species to utilise. The vegetation surrounding parts of the 16km ROW provides more suitable and resourceful habitat for a variety of fauna species.

Fauna

A total of 71 fauna species were recorded across the study area including 10 mammals, 2 positively identified michrochiropteran bats, 56 birds, 1 reptile and 2 amphibians. Among these, five threatened fauna

species listed under the TSC Act were recorded, namely the Grey-crowned Babbler, Glossy Black-Cockatoo, Brown Treecreeper, Diamond Firetail and Turquoise Parrot.

Conclusions

Leewood

One threatened fauna species, namely the Grey-crowned Babbler (*Pomatostomus temporalis temporalis*), was recorded within Leewood. Assessment via a seven part test found that the proposal was unlikely to significantly impact on any potentially occurring species listed under the TSC Act. Assessment under the EPBC Act found that the proposal was unlikely to significantly impact on any potentially occurring species listed under the EPBC Act.

One EEC, namely the '*Brigalow within the Brigalow Belt South, Nandewar and Darling Riverine Plains Bioregions*' (EPBC Act) commensurate with 'Brigalow (*Acacia harpophylla* dominant and co-dominant)' (TSC Act), was recorded on Leewood. As discussed in **Appendix 6** and **Appendix 7,** there are larger areas of more suitable habitat for threatened entities nearby (Pilliga State Forest ~ 160,000ha) and the proposal will affect a small area of sub-optimal habitat (~ 48.2ha of cleared, grazed paddocks with scattered paddock trees and the clearing of approximately 0.8ha of Pilliga Box Woodland within the Pilliga State Forest). Therefore, it is considered that the proposed development is not likely to have an adverse effect on the life cycle of any threatened entities (listed under the TSC Act or the EPBC Act) such that a viable local population or community is likely to be placed at risk of extinction.

Right of Way

Five threatened fauna species, namely the Brown Treecreeper, Grey-crowned Babbler, Turquoise Parrot, Glossy Black-Cockatoo and Diamond Firetail, were recorded along the ROW easement. Assessment via a seven part test found that the proposal was unlikely to significantly impact on any potentially occurring species listed under the TSC Act. Assessment under the EPBC Act found that the proposal was unlikely to significantly impact on any potentially occurring species listed on the EPBC Act.

One threatened ecological community (TEC), specifically "*White Box, Yellow Box, Blakely's Red Gum Woodland and derived Grasslands*" (EPBC Act) commensurate with "*White Box, Yellow Box, Blakely's Red Gum Woodland*" (TSC Act) was recorded along the ROW.

The potential direct and indirect impacts that may be associated with the current proposals are considered to be minimal and temporary in nature. A range of mitigation and management measures have been identified, to minimise potential indirect ecological impacts.

As discussed in **Appendix 9** and **Appendix 10**, there are larger areas of more suitable habitat for threatened entities nearby (Pilliga State Forest ~ 160,000ha) and the proposal will affect a small area of sub-optimal habitat (~ 19.2ha of existing cleared and disturbed easement and the clearing of approximately 0.18ha of Ironbark Shrubby Woodland within the Pilliga State Forest). Therefore, it is considered that the proposed development is not likely to have an adverse effect on the life cycle of any threatened entities (listed under the TSC Act or the EPBC) such that a viable local population or community is likely to be placed at risk of extinction.

In conclusion, the proposal has been assessed as being unlikely to significantly impact on any species, population or ecological community listed under the TSC Act or EPBC Act during the construction and operation phases of the project.

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Appendix 9 EPBC Act - Assessment of Significance - ROW
Appendix 10 Seven Part Test - ROW

1.0 Introduction

Santos is investigating opportunities for activities associated with Coal Seam Gas (CSG) exploration in the Gunnedah Basin. RPS was engaged to undertake an ecological pre-clearance assessment of a Santos owned property and associated 16km Right of Way (ROW) of which 16km of the ROW is located within NSW State Forests Estate (2.7km within the Bibblewindi State Forest and 12.8km Pilliga East State Forest) near Narrabri, NSW. This report aims to identify ecological constraints, potential impacts and mitigation measures associated with the development of a Water and Brine Management facility.

1.1 Site Particulars

1.1.1 Regional Location

The study area is located within PEL 238 approximately 24km south west of the township of Narrabri, NSW (**Figure 1**).

1.1.2 Study Area

The study area is comprised of three separate components (**Figure 2**):

(1) "Leewood" (including an access track), a property located along the Newell Highway, approximately 24 km south west of Narrabri (hereafter referred to as Leewood);

(2) A 16km Right of Way (ROW) approximately 12 metres wide, previously cleared, which accommodates an existing gas flow line through the Pilliga State Forest, connecting Leewood to the Bibblewindi Lifted Water Management Plant (hereafter referred to as the ROW); and

(3) Part of the existing Bibblewindi Lifted Water Management Plant, located approximately 15km south of Leewood in the Pilliga State Forest (hereafter referred to herein as Bibblewindi). Note: this site is currently operating under existing approvals and therefore, is not assessed further within this report.

Leewood is approximately 246ha in size and was previously utilised to hold stock (cattle) under private ownership, however, it now exists as vacant land under Santos ownership. The north eastern portion of the site is vegetated whilst the remainder has been cleared and exists as grassland with a few paddock trees. Leewood is surrounded by State Forests to the west, south and east (beyond the Newell Highway). This site also requires an access track which is made up of predominantly an existing road referred to as Dog Proof Fence Road (also known as Old Mill Road) which requires upgrading and a small area of new access road (approximately 0.8ha) is to be constructed as part of the proposal.

The ROW covers approximately 19.2ha across predominantly derived vegetation communities as a result of previous clearing for the existing pipeline. Approximately 16km of the ROW is located within state forests (2.7km within the Bibblewindi State Forest and 12.8km Pilliga East State Forest), where it bisects Bohena Creek and the Newell Highway before entering Leewood.

1.1.3 Topography

The study area is flat terrain on predominantly sandy and alluvial soils with moderate to low fertility.

1.2 Proposed Activity

Santos is proposing to construct and produced water and brine management ponds at Leewood together with associated infrastructure within Petroleum Assessment Lease 2 (PAL 2) (the proposed activity).

The proposed activity involves the construction of one 300 ML brine pond and one 300 ML produced water pond (collectively referred to as the Leewood ponds) at Leewood. It also involves the construction of two water flow lines from Leewood to the existing Bibblewindi Water Management Facility, located approximately 15 kilometres to the south of Leewood in the Pilliga State Forest. Additional surface infrastructure, including a water distribution manifold, pumping station, power supply and water holding tank, also form part of the proposed activity.

1.3 Objectives

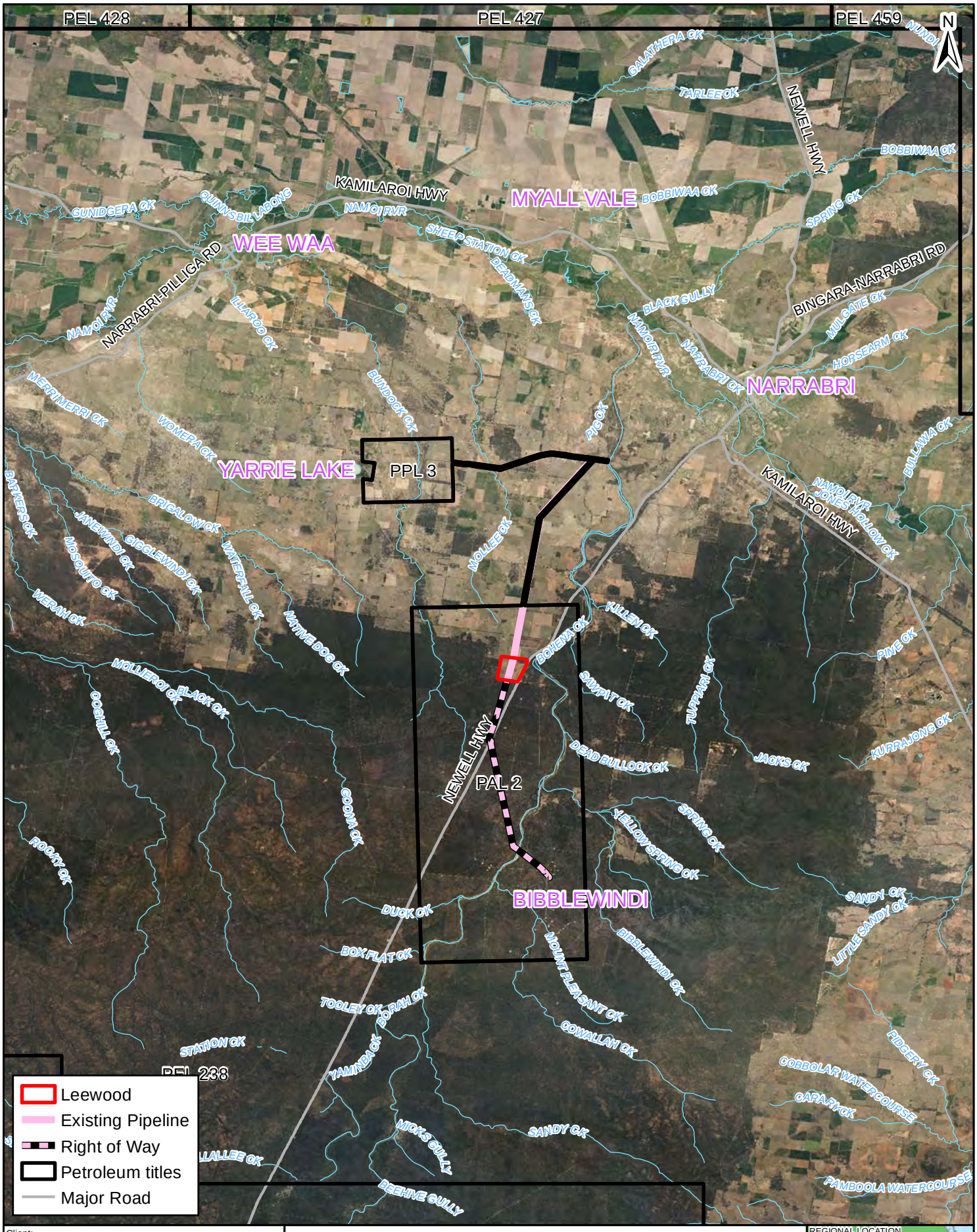
The objectives of this assessment were to undertake an ecological assessment of the proposed study area to identify ecological constraints associated with the proposal, and recommend appropriate mitigation and management measures to reduce potential ecological impacts. Leewood and the ROW areas were surveyed individually at different times of the year. The specific scope of the assessment was to:

- Conduct a background review of relevant environmental databases and mapping;
- Verify the vegetation communities and ecosystems occurring on the study area;
- Identify threatened species and habitat values of the study area;
- Identify significant weed species;
- Identify constraints associated with the ecological features of the study area in a legislative context; and
- Recommend appropriate mitigation measures to minimise potential ecological impacts.

Two separate desktop assessments were conducted prior to on site ecological survey methodologies for the Leewood and ROW field investigations. The assessments detailed the findings of the background review and ecological surveys. Additionally, Commonwealth, state and local legislation relevant to the proposal have been addressed in this assessment.

1.4 Licensing and Certification

- NSW National Parks and Wildlife Service Scientific Investigation Licence S100536 (Valid 31 December 2012);
- Animal Research Authority (Trim File No: 01/1142) issued by NSW Agriculture (Valid 12 March 2013);
- Animal Care and Ethics Committee Certificate of Approval (Trim File No: 01/1142) issued by NSW Agriculture (Valid 12 March 2013); and
- Certificate of Accreditation of a Corporation as an Animal Research Establishment (Trim File No: 01/1522 & Ref No: AW2001/014) issued by NSW Agriculture (Valid 22 May 2014).



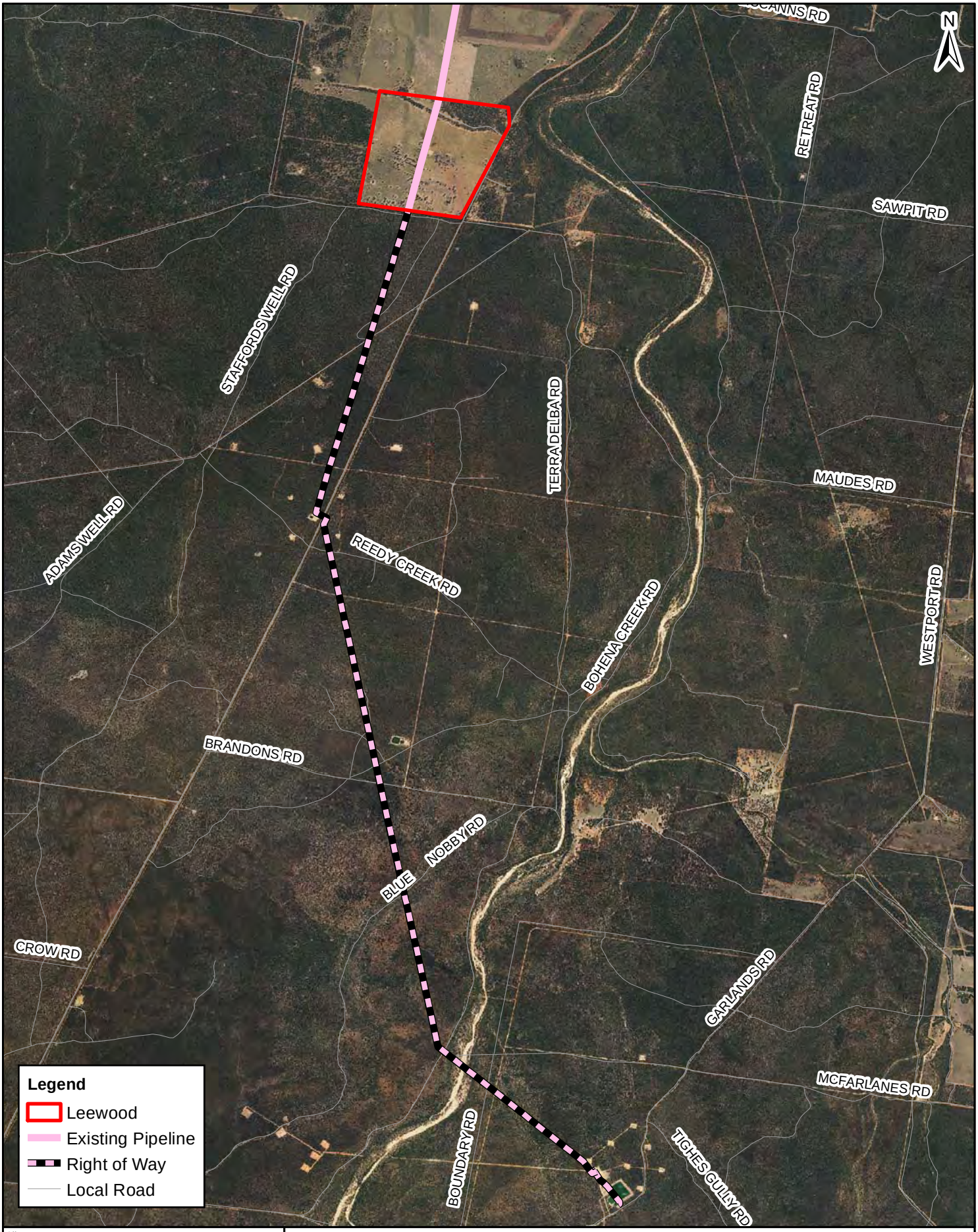
Client: Santos	**Regional Location**	REGIONAL LOCATION
Compiled by: Glenn Jeffs — Date: 02/10/2012	**Figure 1**	Project: Leewood - Produced Water and Brine Management Project (Phase 1).
Approved by: Matt Doherty — Date: 02/10/2012	Bing Maps 2011 RPS 2012 Client Provided 2012 LPMA 2007 MinView 2012	QLD, BALLINA, NARRABRI, NSW, NEWCASTLE, SYDNEY

0 3.5 7 14 km

Datum: GDA94

RPS

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Client: Santos	**Study Area**
Compiled by: Glenn Jeffs — Date: 02/10/2012	
Approved by: Matt Doherty — Date: 02/10/2012	**Figure 2** — Project: Leewood - Produced Water and Brine Management Project (Phase 1).

0 700 1,400 2,800 m

Datum: GDA94

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Bing Maps 2011
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RPS 2012
LPMA 2007

Tracking number: JN113369-6 03/10/2012 *Path: J:\JOBS\Santos\All Jobs\113369 Truckstop 2\10- Drafting\ArcGIS_map_documents\113369-6_Figure2_study area_A4P_20120809.mxd*

2.0 Legislative Context

2.1 Environmental Protection and Biodiversity Conservation Act 1999

The *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) provides that a person proposing to take an action that the person thinks may be a "controlled action" must refer the proposal to the Minister for Sustainability, Environment, Water, Population and Communities (Minister). A "controlled action" is an action that:

- Will have or is likely to have a significant impact on
- World heritage properties
- National heritage places
- Wetlands of international importance
- Great Barrier Reef Marine Parks
- Commonwealth marine areas
- Commonwealth listed threatened species
- Commonwealth listed threatened ecological communities
- Commonwealth listed migratory species
- Is undertaken by the Commonwealth and will have or is likely to have a significant impact on the environment;
- Is undertaken by any person on Commonwealth land and will have or is likely to have a significant impact on the environment; or
- Is a nuclear action.

These are referred to as "matters of national environmental significance" (MNES). The EPBC Act sets out the process for identifying and listing the MNES including listed threatened species and listed migratory species.

If the Minister decides that the proposed action is a controlled action, then the approval of the Minister is required under the EPBC Act.

A person proposing to take an action that the person thinks is not a controlled action may refer the proposal to the Minister for the Minister's decision whether or not the action is a controlled action.

2.2 NSW State Legislation

2.2.1 Environmental Planning and Assessment Act 1979

The EP&A Act regulates development carried out in New South Wales. The carrying out of development is regulated under either Part 4 or Part 5 of the EP&A Act.

Development is required to be assessed under Part 5 of the EP&A Act if the relevant environmental planning instruments provide that the development does not require consent or is not exempt development and the development is either carried out by a determining authority or requires the approval of a determining authority.

The objectives of the *Environmental Planning and Assessment Act 1979* include:

(a) To encourage:

(i) the proper management, development and conservation of natural and artificial resources, including agricultural land, natural areas, forests, minerals, water, cities, towns and villages for the purpose of promoting the social and economic welfare of the community and a better environment,

(ii) the promotion and co-ordination of the orderly and economic use and development of land,

(iii) the protection, provision and co-ordination of communication and utility services,

(iv) the provision of land for public purposes,

(v) the provision and co-ordination of community services and facilities, and

(vi) the protection of the environment, including the protection and conservation of native animals and plants, including threatened species, populations and ecological communities, and their habitats, and

(vii) ecologically sustainable development, and

(viii) the provision and maintenance of affordable housing, and

(b) To promote the sharing of the responsibility for environmental planning between the different levels of government in the State, and

(c) To provide increased opportunity for public involvement and participation in environmental planning and assessment.

Determining Authorities and the REF

Under Part 5 of the EP&A Act, a determining authority is required to examine and take into account to the fullest extent possible all matters affecting or likely to affect the environment by reason of the proposed activity.

Additionally, clause 228 of the *Environmental Planning and Assessment Regulation 2000* (NSW) sets out the factors that must be taken into account concerning the impact of an activity on the environment.

The determining authorities are required to consider whether the proposed activity is likely to significantly affect the environment or threatened species, populations or ecological communities, or their habitats to determine whether an EIS or SIS is required. In deciding whether there is likely to be a significant effect on threatened species, populations or ecological communities or their habitats, section 5A of the EP&A Act requires the following factors to be taken into account (the "seven part" test of significance):

- in the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction,
- in the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction,
- in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:
- is likely to have an adverse effect on the extent of the ecological community such that its local occurrence

is likely to be placed at risk of extinction, or

- is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction,
- in relation to the habitat of a threatened species, population or ecological community:
- the extent to which habitat is likely to be removed or modified as a result of the action proposed, and
- whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and
- the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality,
- whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly),
- whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan,
- whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.

The REF and EA have been prepared to assist the determining authorities in meeting their obligations under the EP&A Act.

SEPP No. 44 – Koala Habitat Protection

State Environmental Planning Policy No. 44 – Koala Habitat Protection (SEPP 44) aims "to encourage the proper conservation and management of areas of natural vegetation that provide habitat for koalas to ensure a permanent free-living population over their present range and reverse the current trend of koala population decline".

Schedule 1 of SEPP 44, which lists the LGAs to which SEPP 44 applies, includes the Narrabri LGA. SEPP 44 applies to local councils determining development applications under Part 4 of the EP&A Act. Although SEPP 44 does not apply in relation to the assessment of development under Part 5 of the EP&A Act, it has been considered in the preparation of this REF.

SEPP 44 requires that before granting development consent under Part 4 of the EP&A Act for development on land over 1 hectare in area, a consent authority must form a view as to whether the land is "potential"' and "core" koala habitat. Potential koala habitat is defined as:

- areas of native vegetation where the trees of the types listed in Schedule 2 constitute at least 15% of the total number of trees in the upper or lower strata of the tree component.

Core koala habitat is defined as:

- an area of land with a resident population of koalas, evidenced by attributes such as breeding females (that is, females with young) and recent sightings of and historical records of a population.

Where core koala habitat is found to occur, SEPP 44 requires that a koala plan of management be prepared for the site.

2.2.2 Threatened Species Conservation Act 1995

The objectives of the *Threatened Species Conservation Act 1995* (NSW) (TSC Act) include:

- To conserve biological diversity and promote ecologically sustainable development;
- Prevent the extinction and promote the recovery of threatened species, populations and ecological communities;
- To protect the critical habitat of those threatened species, populations and ecological communities that are endangered; and
- To ensure that the impact of any action affecting threatened species, populations and ecological preventing the extinction and promoting the recovery of threatened species, populations and ecological communities is properly assessed.

The TSC Act provides the procedure for the listing of threatened species, populations and ecological communities and key threatening processes in New South Wales and the preparation and implementation of recovery plans and threat abatement plans.

The TSC Act also provides the mechanism for applying for and obtaining licences to take actions which will or is likely to result in harm to any animal that is a threatened species, population or ecological community, the picking of any plant which is part of a threatened species, population or ecological community, damage to critical habitat or damage to habitat of a threatened species, population or ecological community where such actions require a license to be obtained.

Key Threatening Processes

A key threatening process (KTP) is defined under the TSC Act as 'a process that threatens, or that may threaten, the survival or evolutionary development of a species, population or ecological community. Threatening processes that adversely affect threatened species, populations or ecological communities, or possibly cause others that are not currently threatened; to become threatened may be eligible for listing as a KTP.

2.2.3 National Parks and Wildlife Act 1974

Part 8A of the *National Parks and Wildlife Act 1974* (NPW Act) regulates the undertaking of activities which may impact on threatened species, populations and ecological communities listed under the TSC Act and their habitats. The NPW Act provides that a person must not harm any animal that is a threatened species, population or ecological community, pick any plant which is part of a threatened species, population or ecological community, damage any critical habitat or damage any habitat of a threatened species, population or ecological community without a licence being obtained under the NPW Act or TSC Act or unless another exception applies.

The NPW Act provides that these requirements do not apply if the action was essential for the carrying out of an activity in accordance with an approval of a determining authority under Part 5 of the EP&A Act where the determining authority has complied with Part 5.

The objectives of the *National Parks and Wildlife Act 1974* include:

(a) The conservation of nature, including, but not limited to, the conservation of:

  (i) habitat, ecosystems and ecosystem processes, and

  (ii) biological diversity at the community, species and genetic levels, and

(iii) landforms of significance, including geological features and processes, and

(iv) landscapes and natural features of significance including wilderness and wild rivers,

(b) The conservation of objects, places or features (including biological diversity) of cultural value within the landscape, including, but not limited to:

(i) places, objects and features of significance to Aboriginal people, and

(ii) places of social value to the people of New South Wales, and

(iii) places of historic, architectural or scientific significance,

(c) Fostering public appreciation, understanding and enjoyment of nature and cultural heritage and their conservation,

(d) Providing for the management of land reserved under this Act in accordance with the management principles applicable for each type of reservation.

2.2.4 Noxious Weeds Act 1993

The *Noxious Weeds Act 1993* (NW Act) is a NSW government instrument outlining the definition, declaration, and control of noxious weeds throughout the State. Local government bodies have the responsibility to ensure that the Act is complied with within their boundaries.

For a plant to be declared a Noxious Weed it must be considered to pose a serious threat to humans, agriculture and/or the environment. There must also be consideration given to the feasibility of control and enforcement of those methods. Plants are declared noxious by order of the Minister for Agriculture.

Landowners or occupiers have obligations under the NW Act to control any declared weed on their property. Council is required to conduct inspections of private properties to check compliance with the NW Act and Noxious Weed Officers have the authority to issue control notices for any breach.

The objects of the *Noxious Weed Act 1993* include:

- To reduce the negative impact of weeds on the economy, community and environment of this State by establishing control mechanisms to:
- prevent the establishment in this State of significant new weeds, and
- prevent, eliminate or restrict the spread in this State of particular significant weeds, and
- (iii) effectively manage widespread significant weeds in this State,
- To provide for the monitoring of and reporting on the effectiveness of the management of weeds in this State.

Under the actions of this Act, a level of control can be applied to reducing the abundance and distribution of exotic weeds within Australia.

2.2.5 Native Vegetation Act 2003

The Native Vegetation Act (NV Act) act provides an outline to the sustainable management and conservation of Australia's native vegetation.

The objectives of the *Native Vegetation Act 2003* include:

- To provide for, encourage and promote the management of native vegetation on a regional basis in the social, economic and environmental interests of the State, and

- To prevent broadscale clearing unless it improves or maintains environmental outcomes, and
- To protect native vegetation of high conservation value having regard to its contribution to such matters as water quality, biodiversity, or the prevention of salinity or land degradation, and
- To improve the condition of existing native vegetation, particularly where it has high conservation value, and
- To encourage the revegetation of land, and the rehabilitation of land, with appropriate native vegetation, in accordance with the principles of ecologically sustainable development.

The NV Act provides three categories of native vegetation including regrowth, protected regrowth and remnant vegetation with clear definitions.

The NV Act provides greater flexibility and incentives for landholders to manage native vegetation sustainably. The Act gives effect to the Government's commitment to ending broad scale clearing unless it improves or maintains environmental outcomes.

Under section 25, the NV Act does not apply to any clearing that is part of an activity carried out by a determining authority within the meaning of Part 5 of the EP&A Act where the determining authority has complied with Part 5. Additionally the NV Act does not apply to any clearing authorised under the *Petroleum (Onshore) Act 1991 (NSW).*

3.0 Methods

3.1 Desktop Assessment

Desktop assessments were undertaken to determine potential and previously recorded threatened species within a 10km radius' of Leewood and the ROW. The Atlas of NSW Wildlife Database was utilised to assess species listed under the TSC Act and a Protected Matters Search was used to assess any species listed under the EPBC Act. The following databases and maps were reviewed:

- EPBC Protected Matters Search Tool for an area extending 10km from the study area (SEWPaC, 2012) (**Appendix 1**);
- Review of threatened fauna and flora records contained in the Bionet (OEH) database of threatened wildlife for an area extending 10km from the site;
- National Vegetation Information Systems mapping; and
- Aerial photography.

3.2 Field Assessment

3.2.1 Leewood

A variety of field survey techniques were employed over the course of a two week period from 30th April 2012 to 11th May 2012 for this assessment to record the suite of flora species and fauna guilds across the site. Commonwealth, State and Local Government policies and guidelines underpin the project survey methodology.

An additional field assessment for the access track took place on the 19th of September 2012.

3.2.2 Right of Way

Comprehensive flora surveys and opportunistic fauna surveys were conducted over two days on 24th - 25th July 2012 and 8th October 2012 along the ROW. Vegetation communities were delineated through flora transects and quadrats. Targeted searches for potentially occurring threatened flora were also conducted along the ROW. Opportunistic fauna surveys were conducted during the survey period targeting threatened species that have been known to occur or are considered as having potential to occur in the area.

3.3 Flora Survey

3.3.1 Vegetation Mapping

Flora surveys and vegetation mapping were carried out within Leewood and the ROW using the following methods:

- Aerial Photograph Interpretation (API) to map the community(s) extent into definable map units;
- Confirmation of the community type(s) present (dominant species) via the undertaking of a flora survey and identification;
- Review of the Namoi CMA Vegetation Geodatabase (Namoi CMA, 2010); and
- Map the type and general extent of the communities present into definable map units where appropriate.

3.3.2 Quadrat Flora Surveys

Six flora quadrat surveys were carried out across Leewood, with an emphasis on potentially significant species. Each quadrat was an area of 20m x 20m and was covered by two ecologists to record as many species as possible within that area.

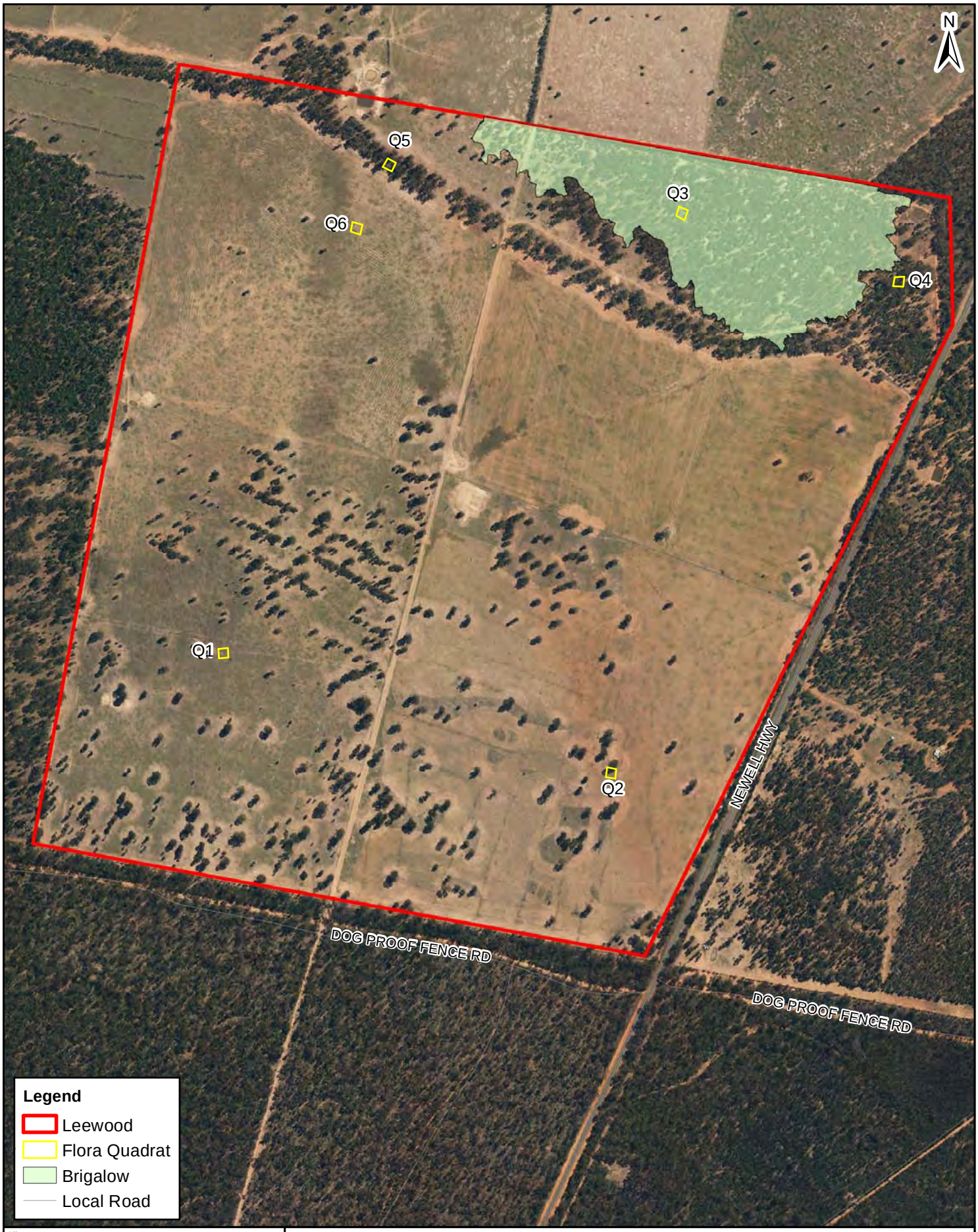
Four flora quadrat surveys were carried out across the ROW with an emphasis on ecologically important vegetation communities and areas that may require further clearing adjacent to the easement for machinery storage. Each quadrat was an area of 30m x 30m and was covered by two ecologists to record as many species as possible within that area.

The quadrat methodologies provided an understanding of the following:

- Vegetation communities within the study area;
- Identify the vegetation community boundaries;
- Record flora species present; and
- Determine the potential distribution of threatened species.

All species recorded were identified as far as practicable to species and subspecies (where relevant) level. Although it is unrealistic to expect to identify all species from the site, during this survey when a plant could not be identified accurately within the field, a voucher sample was collected, together with notes on habitat, form and height, labelled and identified according to nomenclature in Harden (1992–2002). Opportunistic sightings of taxa were also collected if they were not found in any of the sampled sites. At a minimum, all dominant species were identified in all stratums to ensure that an informed delineation resulted.

Figure 3 and **Figure 4** show the locations of Leewood and ROW flora surveys respectively.



Client: Santos

Leewood Flora Survey Effort

Compiled by: Glenn Jeffs | Date: 03/10/2012

Approved by: Matt Doherty | Date: 03/10/2012

Figure 3

Project: Leewood - Produced Water and Brine Management Project (Phase 1).

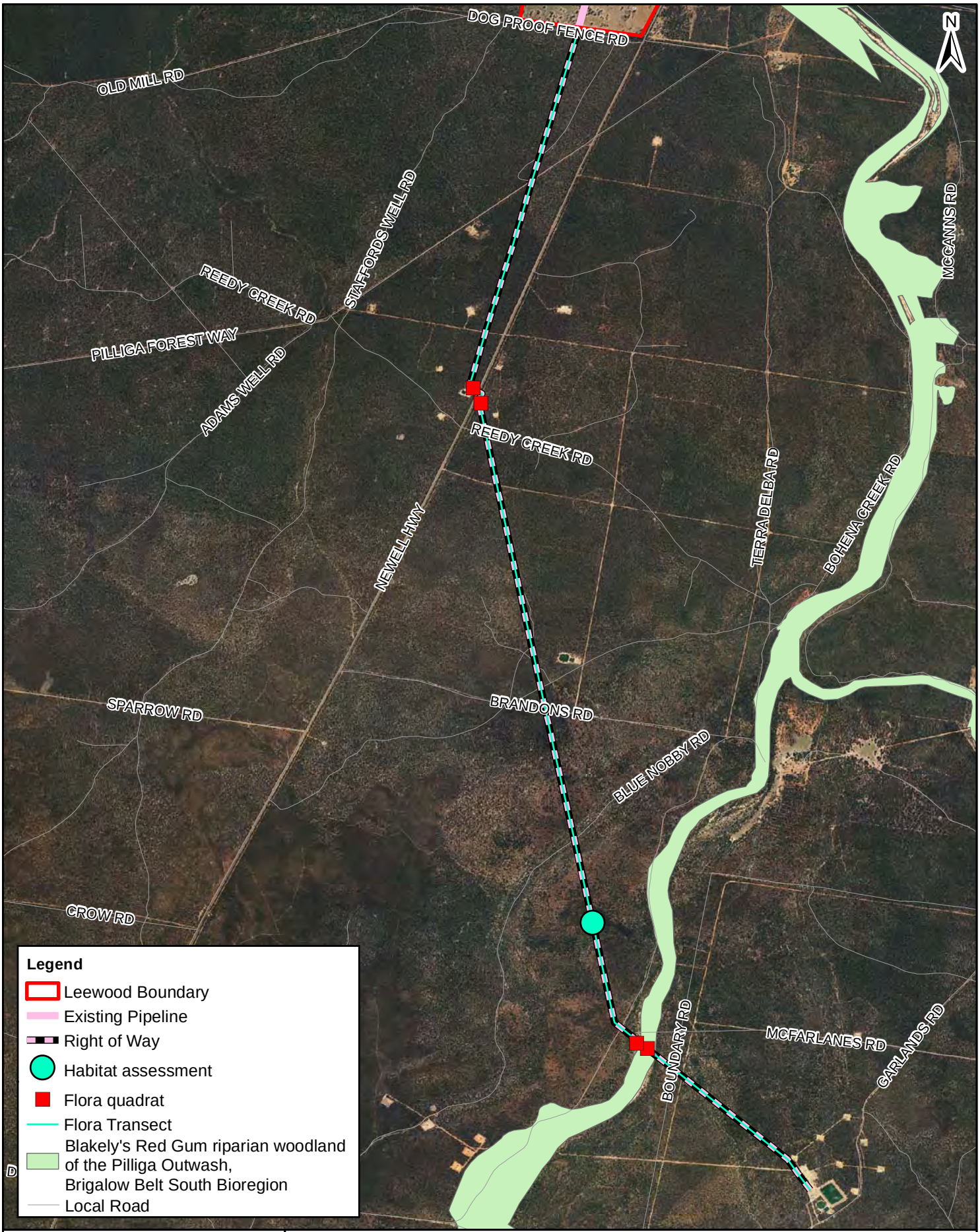
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Source:
Bing Maps 2011
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Client: Santos

Compiled by: Glenn Jeffs Date: 03/10/2012

Approved by: Matt Doherty Date: 03/10/2012

0 600 1,200 2,400 m

Datum: GDA94

RPS

Right of Way Flora Survey Effort

Figure 4

Project: Leewood - Produced Water and Brine Management Project (Phase 1).

Source:
Bing Maps 2011
Client provided 2012
RPS 2012
LPMA 2007

Tracking number: JN113369-6 03/10/2012 *Path: J:\JOBS\Santos\All Jobs\113369 Truckstop 2\10- Drafting\ArcGIS_map_documents\113369-6_Figure4_17km_pipeline_Flora_survey_effort_V2_A4P_20120809.mxd*

3.4 Habitat Assessment

Assessments of the relative value of the habitat present within Leewood (including the site access) and the ROW were undertaken. Assessments also considered the potential value of the study areas (and surrounds) for all major guilds of native flora and fauna.

The assessments were based on the specific habitat requirements of each threatened fauna species in regards to home range, feeding, roosting, breeding, movement patterns and corridor requirements. Consideration was given to contributing factors including topography, soil, light and hydrology for threatened flora and assemblages.

3.5 Fauna Survey

The fauna survey methodology initially consisted of the production of an expected fauna species list for both areas and an assessment of the potential use of the study areas by threatened fauna species (as listed under the TSC Act and EPBC Act) identified from the vicinity of the study area. This was achieved by undertaking literature and database reviews followed by confirmation through field surveys.

Figure 5 outlines the areas surveyed during the fauna survey effort for Leewood. As the fauna survey effort for the ROW was opportunistic and diurnal only this has not been depicted in a figure.

3.5.1 Avifauna

The presence of avifauna within the study area was assessed via opportunistic observations during all days of fieldwork. Birds were identified by direct observation or by recognition of calls or distinctive features such as nests, feathers and owl regurgitation pellets etc.

Daily diurnal bird surveys were conducted for 20 minutes each morning at each trapping location for that week. Birds were identified in the same fashion as listed above.

At Leewood nocturnal surveys, during spotlighting, attempted to identify roosting diurnal birds in a similar fashion to methods employed during diurnal surveys. Spotlighting was undertaken as described in **Section 3.5.7** and targeted nocturnal avifauna species such as owls.

A single stag watch was also conducted at Leewood on a hollow bearing tree to target nocturnal birds that could be residing in or utilising hollows.

3.5.2 Arboreal Mammal Trapping

Arboreal trapping was carried out on Leewood only. Arboreal trapping was undertaken using six Elliott B size traps per trapping transect set for four nights. Traps were mounted on brackets set at approximately 2 m height on trees with a DBH greater than 30 cm. Traps were baited with a rolled oats, peanut butter and honey mixture and the tree trunks were sprayed liberally with a brown sugar and water mix each day in the late afternoon. Traps were checked early each morning. The location of each trap line is shown on **Figure 5**.

Arboreal traps targeted arboreal mammals such as the threatened Squirrel Glider (*Petaurus norfolcensis*) which has been previously recorded from the surrounding area. A total of four trapping transects were undertaken, resulting in 96 arboreal trap nights within the site.

3.5.3 Terrestrial Mammal Trapping

Terrestrial trapping was carried out on Leewood only. Terrestrial trapping was undertaken using 25 Elliott A, 25 Elliott B and six cage traps set per trapping transect for four nights. Elliott traps were baited with a mixture of rolled oats, peanut butter and honey. Cage traps were baited with chicken necks or chicken thighs. Traps were checked early each morning, with any captures identified and released at point of capture. Traps were re-baited where necessary. The location of each trap line is shown in **Figure 5**.

Terrestrial traps targeted small terrestrial mammals such as dasyurids (eg. Antechinus and Dunnarts) and rodents (e.g. rats and mice). A total of four trapping transects were undertaken within the site, resulting in 400 Elliott A trap nights, 400 Elliott B trap nights and 96 cage trap nights within the site.

3.5.4 Hair Funnels

Hair Funnel surveys were carried out on Leewood only. Surveys were undertaken using 20 Faunatech Hair Funnels and wafers over four nights at each site. These were baited with rolled oats, peanut butter and honey. At each site 10 arboreal and 10 terrestrial were set. The location of each trap line is shown on **Figure 5**.

Hair funnels targeted small-medium mammals such as dasyurids (eg. Antechinus and Dunnarts), rodents (e.g. rats and mice), gliders and bandicoots. A total of four trapping transects were undertaken within the site, resulting in 160 arboreal trap nights and 160 terrestrial trap nights.

3.5.5 Herpetofauna

Herpetofauna (frog and reptile) searches were carried out across the study area targeting areas of appropriate habitat. Suitable habitat was limited however where there were areas of rock assemblages, logs and/or leaf litter that could have been suitable for reptile presence, these areas were searched.

3.5.6 Micro-chiropteran Bats

Micro-chiropteran Bat surveys were carried out on Leewood only. Microbat echolocation calls were recorded using one Anabat II Detector and CF ZCAIM unit (at each site) set to remotely record for the entire night (6pm to 6am). Each survey site had four consecutive entire nights of sampling, with emphasis placed on those areas deemed likely to provide potential foraging and flyway sites for microbats. The location of each microbat call survey site is shown in **Figure 5**.

Bat call analysis was undertaken by Anna McConville of who is experienced in the analysis of bat echolocation calls. Each call sequence ('pass') was assigned to one of three categories, according to the confidence with which an identification could be made, being:

- Definite - Pass identified to species level and could not be confused with another species;
- Probable - Pass identified to species level and there is a low chance of confusion with another species; or
- Possible - Pass identified to species level but short duration or poor quality of the pass increases the chance of confusion with another species;

Appendix 2 shows the Anabat report with all results.

A total of four consecutive nights of bat call recording at each of the four trapping sites was undertaken within the Leewood site during surveys.

3.5.7 Spotlighting and Call Playback

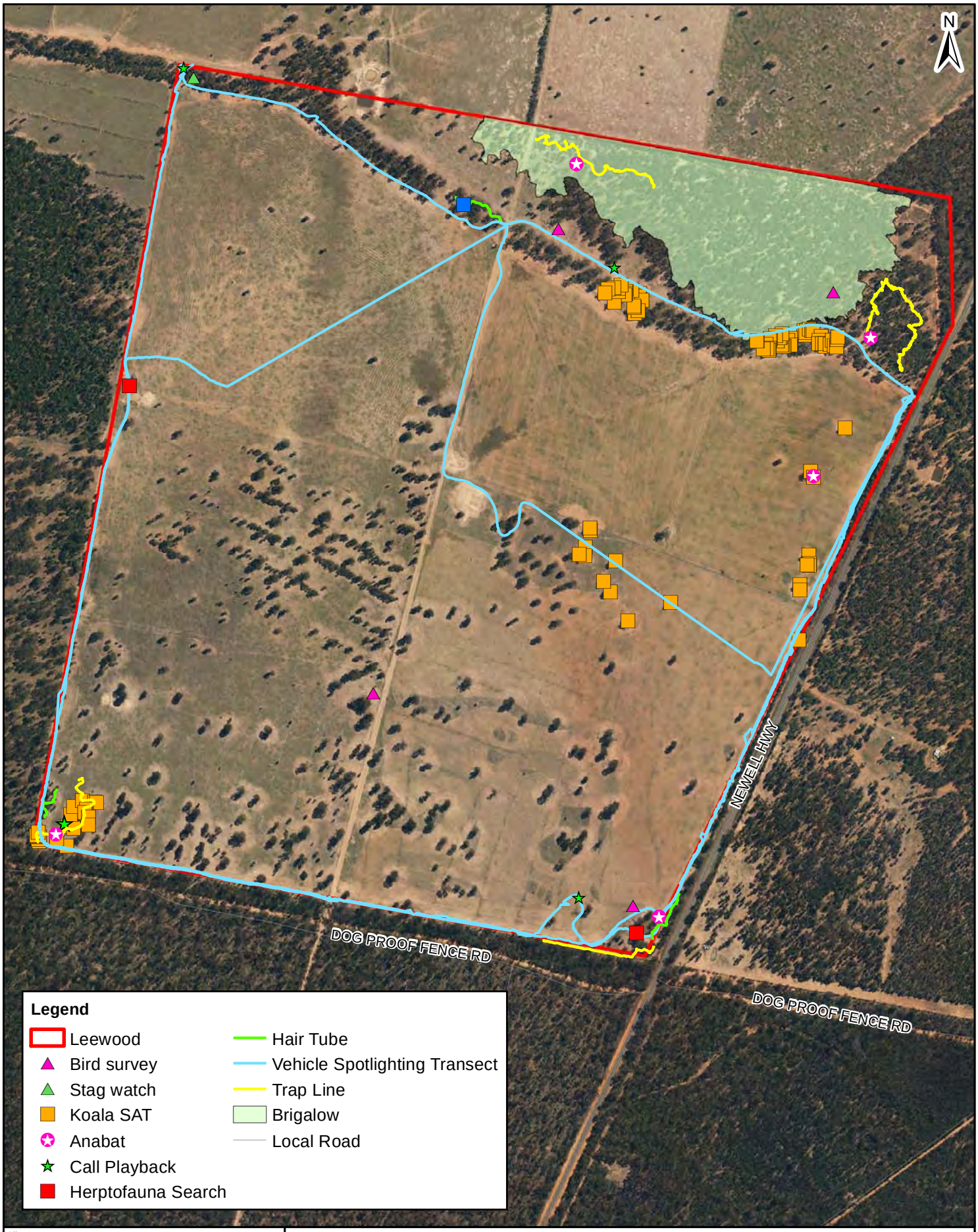
Spotlighting surveys were carried out on Leewood only. Spotlighting was undertaken via the use of a 75-Watt hand-held spotlight and head torch whilst driving over the site. A total of 16 person hours of spotlighting was conducted over 4 nights.

3.5.8 Nocturnal Call Playback

Call Playback surveys were carried out on Leewood only. Pre-recorded calls of Owl, Koala and Glider species with the potential to occur within the site were broadcast during the surveys in an effort to elicit vocal responses or to attract the species to the playback site. The calls were broadcast through an amplification system (loud hailer) designed to project the sound for at least 1km under still night conditions.

As described by Kavanagh and Peake (1993) and Debus (1995), the call of each species was broadcast for at least five minutes, followed by five minutes of listening, and stationary spotlighting. Following the final broadcast and listening, the area was spotlighted on foot. Species targeted included the Barking Owl (*N. connivens*), Powerful Owl (*Ninox strenua*), Masked Owl (*T. novaehollandiae*) and Koala (*Phascolarctus cinerius*). A total of four nights of call playback was undertaken within the site. The location of the call playback sites are shown in **Figure 5**.

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Client: Santos

Compiled by: Glenn Jeffs | Date: 03/10/2012

Approved by: Matt Doherty | Date: 03/10/2012

0 105 210 420 m

Datum: GDA94

RPS

Leewood Fauna Survey Effort

Figure 5

Project: Leewood - Produced Water and Brine Management Project (Phase 1).

Source:
Bing Maps 2011
Client provided 2012
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LPMA 2007

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3.5.9 Koala Assessments

Standard SEPP 44 Assessments of listed Koala feed trees were conducted in combination with identification of the species presence through other means such as identification of scats, scratches, and individuals or their vocalisations. A total of 100 secondary feed trees were assessed on Leewood using the Spot Assessment Technique (SAT) whereas secondary feed trees were observed randomly along the ROW.

3.5.10 Secondary Indications and Incidental Observations

Opportunistic sightings of secondary indications (scratches, scats, diggings, tracks etc.) of resident fauna were noted on Leewood and the ROW. Such indicators included:

- Distinctive scats left by mammals. Any scats unable to be positively identified in the field were collected for further analysis, and scats of predator species containing fur / bones were sent for analysis if appropriate;
- Scratch marks made by various types of arboreal animals;
- Nests made by various guilds of birds;
- Scats and / or scratches consistent with Koalas;
- Tracks left by animals in sand;
- Carcasses and bones;
- Feeding scars on Eucalyptus trees made by Gliders; and
- Whitewash, regurgitation pellets and prey remains from Owls.

Any other incidental observations of fauna were recorded during all phases of fieldwork.

3.6 Survey Limitations

It should be noted that the detectability of flora and fauna and the ability to accurately identify plants to species level may vary greatly with the time of year, prevailing climatic conditions and the presence of reproductive material (e.g. flowers, fruit, and seed capsules). Consequently, the survey conducted for the study area should not be regarded as conclusive evidence that certain protected species do not occur within the study area; however every effort has been made to detect these species in habitats that were considered suitable. Specifically, native grass species can be difficult to identify due to seasonality.

In response to the abovementioned limitations the precautionary approach has been adopted; as such ‘assumed presence’ of known and expected threatened species, populations and ecological communities has been made where relevant to ensure a holistic assessment.

4.0 Flora Results

4.1 Leewood Flora Results

Two vegetation communities were observed within Leewood, including:

- Pilliga Box – White Cypress Pine Grassy Open Woodland on Alluvial loams, Darling Riverine Plains and Brigalow Belt South; and
- Brigalow Woodland.

A description of these communities is provided below, while the location and extent is outlined in **Figure 6**. A detailed flora species list for Leewood is included in **Appendix 3**.

No threatened flora species were recorded on site during field surveys.

4.1.1 Vegetation Communities

Pilliga Box – White Cypress Pine Grassy Open Woodland on Alluvial loams, Darling Riverine Plains and Brigalow Belt South

Description This tall open woodland is dominated by Pilliga Box (*Eucalyptus pilligaensis*) with other canopy species such as White Cypress Pine (*Callitris glaucophylla*), Narrow-leaved Ironbark (*Eucalyptus crebra*) and Grey Box (*Eucalyptus microcarpa*) occurring throughout. The sub-canopy layer was comprised of Bulloak (*Allocasuarina leuhmannii*) and Deane's wattle (*Acacia deanei*). This community lacked a defined shrub layer. The ground cover consisted mostly of native grasses including Tall Chloris (*Chloris ventricosa*), Bristly Lovegrass (*Eragrostis setifolia*), Purple Lovegrass (*Eragrostis lacunaria*), Hairy Panic (*Panicum effusum*) and Slender Bamboo (*Austrostipa verticillata*). Herbs and forbs in this community were scarce due to ground compaction from stock (**Plate 1**).

Condition The condition of this community varied throughout the site. The remnant patches of intact Pilliga Box woodland is considered to be in moderate condition with species diversity at a higher level. These remnant patches are located in the north of the site and along the access road to the site (refer to Figure 6). The poor conditioned areas of this woodland are those that now exist as 'paddock' where stock graze and only a few scattered canopy (or paddock) trees remain. In the paddock areas a shrub layer is almost nonexistent and the ground layer is largely a monoculture of only a few grass species.

Classification This community is not commensurate with any Threatened Ecological Communities (TEC) listed under the TSC or EPBC Acts. Due to the low abundance of Grey Box (*E. microcarpa*) observed in this community, the EEC "*Grey Box (Eucalyptus microcarpa) Grassy Woodlands and Derived Native Grasslands of South-eastern Australia*" (EPBC) commensurate with "Inland Grey Box Woodland in the Riverina, NSW South Western Slopes, Cobar Peneplain, Nandewar and Brigalow Belt South Bioregions" (TSC) was ruled out as occurring on site as this requires a dominant canopy cover of *E. microcarpa*.

It was also determined that this community is not commensurate with the EEC "Native Vegetation on Cracking Clay Soils of the Liverpool Plains" (TSC) commensurate with "Natural grasslands on basalt and fine-textured alluvial plains of northern New South Wales and southern Queensland" (EPBC Act) due to the soil determination. The soil is required to be 'basalt or quaternary alluvial' or 'black earth' cracking clay soils according to the EPBC Act and TSC Act determinations respectively however the soil that persists on site is described as a Brown Cracking Clay (Charman and Murphy 1991). The TSC Act does not specify which cracking clay soil must be present, mentioning only that they "include soils referred to as Black Earth" (NSW Scientific Committee 2011). As the soil on site is classified as a Brown Cracking Clay, it is therefore assumed

not to be commensurate with the TSC listed community. In addition to this geological information the vegetation found to be growing in this substrate was not found to be commensurate with the final determinations for either vegetation community.



Plate 1 Pilliga Box –White Cypress Pine Grassy Open Woodland on Alluvial loams, Darling Riverine Plains and Brigalow Belt South

Brigalow Woodland

Description This community is a low woodland with a dense canopy dominated by Brigalow (*Acacia harpophylla*). Occasionally Pilliga Box (*Eucalyptus pilligaensis*) and Belah (*Casuarina cristata*) occur on the edges of this community. The shrub and ground layers were sparse but consisted of species such as *Eremophila* species, *Sclerolaena* species, Small-leaf Bluebush (*Maireana microphylla*), Nardoo (*Marsilea hirsuta*) and Caustic Weed (*Chamaesyce drummondii*) (**Plate 2**).

Condition This community is considered to be in poor-moderate condition. The soil is compacted due to cattle, restricting the growth of understorey and ground layer species. As a result, the fauna guild in which it attracts is limited. The dense array of Brigalow is healthy however its growth appears stunted likely due to poor soil quality.

Classification This community is commensurate with the Threatened Ecological Community '*Brigalow within the Brigalow Belt South, Nandewar and Darling Riverine Plains Bioregions'* under the TSC Act and 'Brigalow (*Acacia harpophylla* dominant and co-dominant)' under the EPBC Act.



Plate 2 Brigalow Woodland

4.1.2 Threatened Ecological Communities

4.1.2.1 EPBC Act

Six Threatened Ecological Communities listed under the EPBC Act were identified as potentially occurring within the locality of Leewood as part of the EPBC Protected Matters Search Tool, including:

- Brigalow (*Acacia harpophylla* dominant and co-dominant);
- Coolibah - Black Box Woodlands of the Darling Riverine Plains and the Brigalow Belt South Bioregions;
- Grey Box (*Eucalyptus microcarpa*) Grassy Woodlands and Derived Native Grasslands of South-eastern Australia;
- Natural grasslands on basalt and fine-textured alluvial plains of northern New South Wales and southern Queensland;
- Weeping Myall Woodlands; and
- White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland.

An assessment for likelihood of occurrence was conducted, and is included in **Appendix 5**. One EPBC Act listed EEC has been confirmed as occurring within Leewood, namely 'Brigalow (*Acacia harpophylla* dominant and co-dominant)'.

4.1.2.2 TSC Act

The six EPBC listed communities above, all are commensurate with communities listed under the TSC Act with the potential to occur in the Namoi CMA Sub-region and therefore have the potential to occur. These include:

- Brigalow within the Brigalow Belt South, Nandewar and Darling Riverine Plains Bioregions;
- Coolibah - Black Box Woodlands of the Darling Riverine Plains and the Brigalow Belt South Bioregions;
- Inland Grey Box Woodland in the Riverina, NSW South Western Slopes, Cobar Peneplain, Nandewar and Brigalow Belt South Bioregions;
- Native Vegetation on Cracking Clay Soils of the Liverpool Plains;
- Myall Woodland in the Darling Riverine Plains, Brigalow Belt South, Cobar Peneplain, Murray-Darling Depression, Riverina and NSW South western Slopes bioregions; and
- White Box-Yellow Box-Blakely's Red Gum Grassy Woodland.

An assessment for likelihood of occurrence was conducted, and is included in **Appendix 5**. One TSC Act listed EEC has been confirmed as occurring within Leewood, namely 'Brigalow within the Brigalow Belt South, Nandewar and Darling Riverine Plains Bioregions'.

4.1.3 Threatened Flora Species

4.1.3.1 EPBC Act

An EPBC Protected Matters Report was generated on the 12th April 2012 via a search of the EPBC Protected Matters Search Tool. The EPBC Protected Matters Report identified 7 threatened flora species (**Table 1**) with potential to occur within a 10km radius of the study area.

Table 1 Potentially occurring threatened flora species (Protected Matters Search, Leewood).

Scientific Name	Common Name	Status EPBC Act
Bertya opponens		V
Cadellia pentastylis	Ooline	V
Lepidium aschersonii	Spiny Pepper-cress	V
Philotheca ericifolia		V
Pterostylis cobarensis	Cobar Greenhood Orchid	V
Rulingia procumbens		V
Tylophora linearis		E

Status:
E = Endangered
V = Vulnerable

Targeted searches did not confirm the presence of any threatened flora species within Leewood. Notably searches were conducted out of season for several of these species. An assessment of likelihood of occurrence was completed for this species and is included in **Appendix 5.**

4.1.3.2 TSC Act

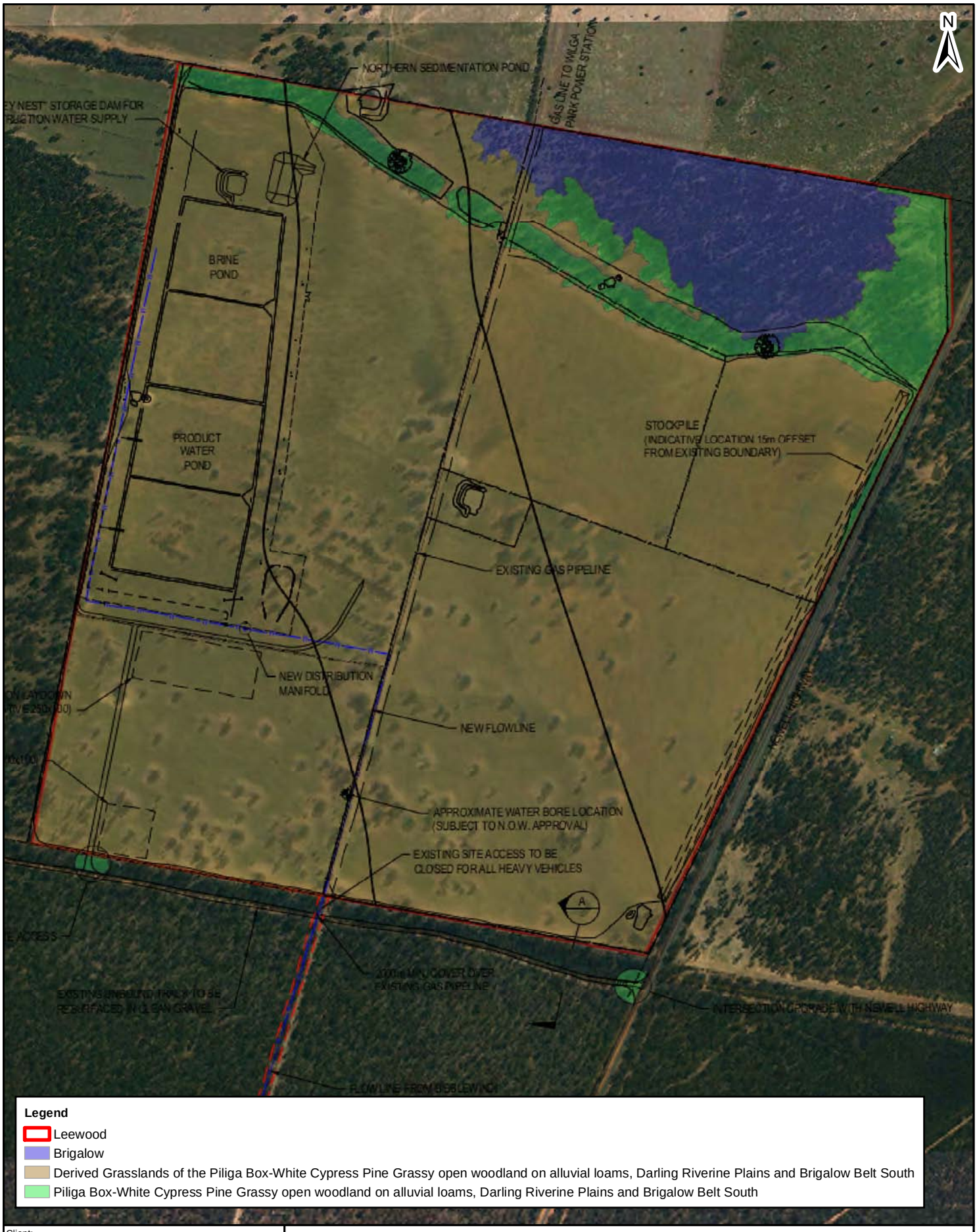
The Atlas of NSW Wildlife Database was accessed on the 12th April 2012 resulting in a total of one threatened species having been recorded within 10km of Leewood. This Vulnerable species is a cryptic greenhood orchid, namely *Pterostylis cobarensis*.

This species flowers from September to November and was therefore not targeted during field surveys. An assessment of likelihood of occurrence was completed for this species and is included in **Appendix 5.**

4.1.4 Weeds

A total of six weed species were recorded on Leewood. One of these species, specifically Tiger Pear (*Opuntia aurantiaca*), is considered to be a noxious weed in NSW (DPI 2012). Under the provisions of the *Noxious Weeds Act* 1993, Prickly Pears (except *Opuntia ficus-indica*) are classified as Class 4 weeds. This means that the growth and spread of the plant must be controlled according to the measure specified in a management plan published by the local control authority and the plant may not be sold, propagated or knowingly distributed.

The remaining species are grasses or herbs that are not considered noxious in NSW.



Client: Santos

Compiled by: Glenn Jeffs | Date: 03/10/2012

Approved by: Matt Doherty | Date: 03/10/2012

0 105 210 420 m

Datum: GDA94

RPS

Leewood Vegetation Communities

Figure 6

Project: Leewood - Produced Water and Brine Management Project (Phase 1).

Source:
Bing Maps 2011
Client provided 2012
RPS 2012
LPMA 2007

Tracking number: JN113369-6 03/10/2012 *Path: J:\JOBS\Santos\All Jobs\113369 Truckstop 2\10- Drafting\ArcGIS_map_documents\113369-6_Figure6_Leewood_vegetation communities_A4P_20121003.mxd*

4.2 Right of Way Flora Results

Three vegetation communities were observed within the ROW area, including:

- Ironbark shrubby woodlands of the Pilliga area, Brigalow Belt South;
- Blakely's Red Gum Riparian Woodland of the Pilliga Outwash, Brigalow Belt ; and
- Pilliga Box – White Cypress Pine Grassy Open Woodland on Alluvial loams, Darling Riverine Plains and Brigalow Belt South.

A description of these communities is provided below, while the location and extent is outlined in **Figure 7**. A detailed flora species list for the ROW is included in **Appendix 3**.

4.2.1 Vegetation Communities

Ironbark shrubby woodlands of the Pilliga area, Brigalow Belt South

Description This community is a shrubby open woodland with an open understorey dominated by one or more of the following: Narrow-leaved Ironbark (*Eucalyptus crebra*), Brown Bloodwood (*Corymbia trachyphloia ssp. amphistomatica*), Dirty Gum (*E. chloroclada*) and White Cypress Pine (*C. glaucophylla*). Small trees and shrubs such as Bulloak (*Allocasuarina luehmannii*), Mudgee Wattle (*Acacia spectabilis*), Deane's Wattle (*Acacia deanei*) and Wedge-leaf Hop-bush (*Dodonaea viscosa*) are often common. The ground layer includes wiregrasses (*Aristida spp*.), Speargrass (*Austrostipa scabra*), Mulga Fern (*Cheilanthes sieberi*), Brown's Lovegrass (*Eragrostis brownii*), Hairy Panic (*Panicum effusum*), Flannel Flower (*Actinotus helianthi*), Pomax (*Pomax umbellata*) and Star Goodenia (*Goodenia rotundifolia*) (refer to **Plate 3**).

Condition Variants of this community changed in condition from moderate to good condition throughout. The moderate conditioned sections were found to contain limited resources in the form of logs, termite mounds, and ground debris and also lacked the floral structural diversity required to host an abundant fauna guild. The majority of the variants lacked mature canopy trees, suggesting previous disturbance most likely in the form of clearing. Feral animal species that compact the ground and reduce soil quality were also recorded throughout this community.

Classification This community is not commensurate with any Threatened Ecological Communities (TEC) listed under the TSC or EPBC Acts.



Plate 3 Ironbark shrubby woodlands of the Pilliga area, Brigalow Belt South

Blakely's Red Gum Riparian Woodland of the Pilliga Outwash, Brigalow Belt

Description This tall open woodland has a canopy dominated by Blakely's Red Gum (*Eucalyptus blakelyi*) often occurring with Rough-barked Apple (*Angophora floribunda*) and White Cypress Pine (*Callitris glaucophylla*).The shrub layer is sparse but dense occasionally consisting of Common Tea-tree (*Leptospermum polygalifolium*), Narrow-leaved Bottlebrush (*Callistemon linearis*) and Deane's Wattle (*Acacia deanei*). The ground layer often includes segments of bare sand but also contains grass and forbe species such as Blady Grass (*Imperata cylindrica*), *Juncus subsecundus*, Wiregrass (*Aristida ramosa*), Rough Saw-sedge (*Gahnia aspera*) and Mat-rushes (*Lomandra longifolia* and *L. filiformis*). Exotic species such as Cobbler's Pegs (*Bidens pilosa*) and Dandelion (*Taraxacum officinale*) were also recorded in this community (Refer to **Plate 4**).

Condition This community was considered to be in moderate condition due to the young stand of canopy trees and lack of floristic structural diversity within the ground and shrub layers.

Classification This community is commensurate with the Critically Endangered Ecological Community '*White Box - Yellow Box - Blakely's Red Gum Grassy Woodlands and Derived Native Grasslands*' (EPBC Act) and '*White Box Yellow Box Blakely's Red Gum Woodland'* (TSC Act).



Plate 4 Blakely's Red Gum Riparian Woodland of the Pilliga Outwash, Brigalow Belt

Pilliga Box – White Cypress Pine Grassy Open Woodland on Alluvial loams, Darling Riverine Plains and Brigalow Belt South

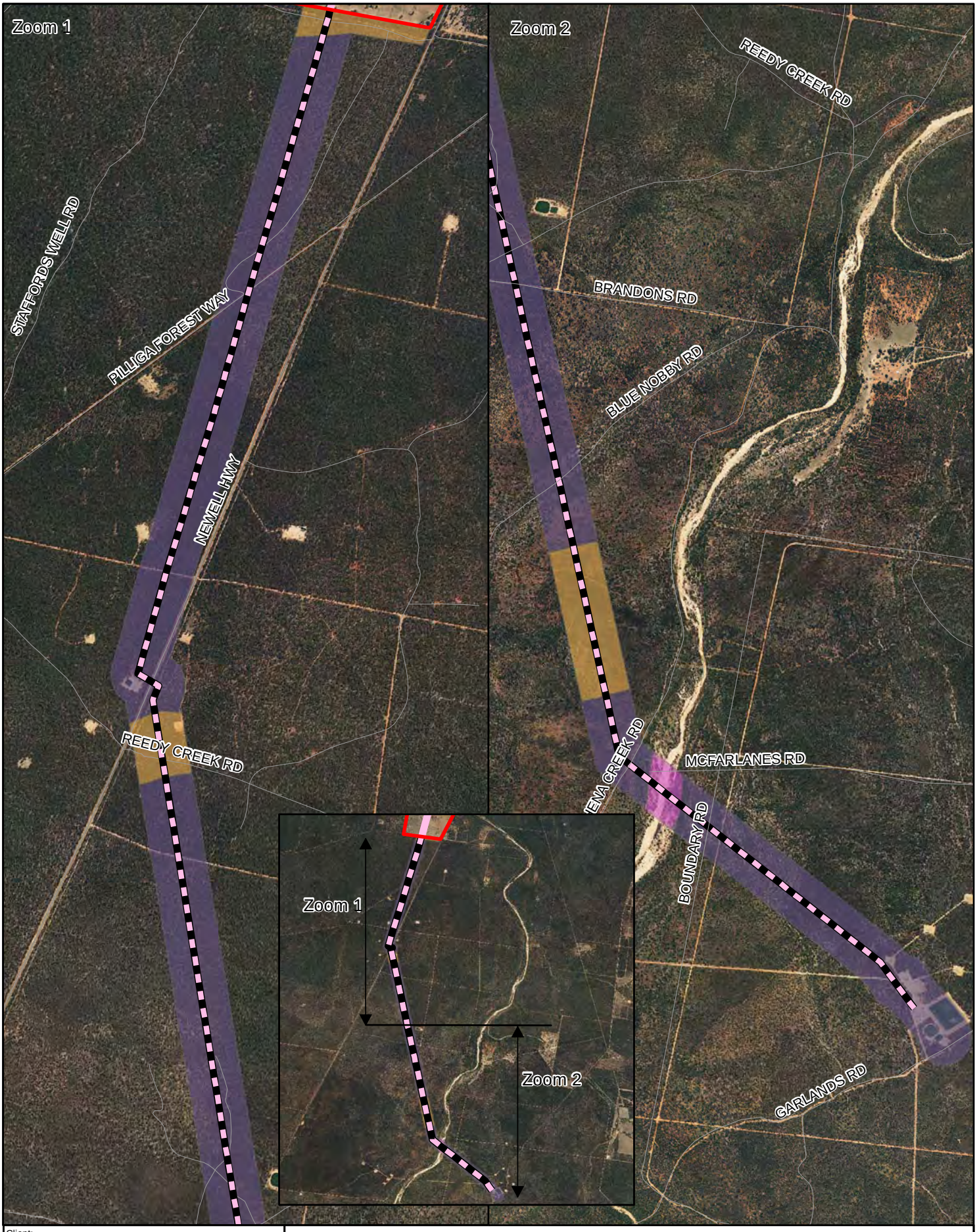
Description This tall open woodland is dominated by Pilliga Box (*Eucalyptus pilligaensis*) with other sub-canopy species such as White Cypress Pine (*Callitris glaucophylla*) and Bulloak (*Allocasuarina leuhmannii*) occurring throughout. This community lacked a defined in the shrub layer which when present it was dominated by Deane's wattle (*Acacia deanei),* a Wattle (*Acacia caroleae*) and Narrow-leaved Bottlebrush *(Callistemon linearis)*. The ground cover consisted mostly of native grasses including Purple Wiregrass (*Aristida ramosa*), Bristly Lovegrass (*Eragrostis setifolia*), Purple Lovegrass (*Eragrostis lacunaria*), Hairy Panic (*Panicum effusum*) and Slender Bamboo (*Austrostipa verticillata*) (**Plate 5**).

Condition The condition of this community was considered to be relatively intact and in moderate condition with regards to species diversity and patch health.

Classification This community is not commensurate with any Threatened Ecological Communities (TEC) listed under the TSC or EPBC Acts.



Plate 5 Pilliga Box –White Cypress Pine Grassy Open Woodland on Alluvial loams, Darling Riverine Plains and Brigalow Belt South



Client: Santos

Right of Way - Vegetation Communities

Compiled by: Glenn Jeffs | Date: 02/10/2012

Approved by: Matt Doherty | Date: 02/10/2012

Figure 7

Project: Leewood - Produced Water and Brine Management Project (Phase 1).

0 330 660 1,320 m

Datum: GDA94

RPS

Source:
Bing Maps 2011
Client provided 2012
RPS 2011

Legend

- Leewood
- Existing Pipeline
- Right of Way
- Local Road
- Blakely's Red Gum riparian woodland of the Pilliga Outwash, Brigalow Belt South Bioregion
- Ironbark shrubby woodlands of the Pilliga area, Brigalow Belt South
- Pilliga Box - Poplar Box- White Cypress Pine grassy open woodland on alluvial loams, Darling Riverine Plains and Brigalow Belt South

Tracking number: JN113369-6 02/10/2012 *Path: J:\JOBS\Santos\All Jobs\113369 Truckstop 2\10- Drafting\ArcGIS_map_documents\113369-6_Figure7_ Vegetation constraints for Right of Way_A4P_20121002.mxd*

4.2.2 Ecological Communities

4.2.2.1 EPBC Act

Six TEC's listed under the EPBC Act were identified as potentially occurring within the locality of the ROW as part of the EPBC Protected Matters Search Tool, including:

- Brigalow (*Acacia harpophylla* dominant and co-dominant);
- Coolibah - Black Box Woodlands of the Darling Riverine Plains and the Brigalow Belt South Bioregions;
- Grey Box (*Eucalyptus microcarpa*) Grassy Woodlands and Derived Native Grasslands of South-eastern Australia;
- Natural grasslands on basalt and fine-textured alluvial plains of northern New South Wales and southern Queensland;
- Weeping Myall Woodlands; and
- White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland;

An assessment for likelihood of occurrence was conducted, and is included in **Appendix 8**. One EPBC Act listed CEEC has been confirmed as occurring within the ROW, namely 'White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland'.

4.2.2.2 TSC Act

The six EPBC listed communities above, all are commensurate with communities listed under the TSC Act with the potential to occur in the Namoi CMA Sub-region and therefore have the potential to occur. These include:

- Brigalow within the Brigalow Belt South, Nandewar and Darling Riverine Plains Bioregions;
- Coolibah - Black Box Woodlands of the Darling Riverine Plains and the Brigalow Belt South Bioregions;
- Inland Grey Box Woodland in the Riverina, NSW South Western Slopes, Cobar Peneplain, Nandewar and Brigalow Belt South Bioregions;
- Native Vegetation on Cracking Clay Soils of the Liverpool Plains;
- Myall Woodland in the Darling Riverine Plains, Brigalow Belt South, Cobar Peneplain, Murray-Darling Depression, Riverina and NSW South western Slopes bioregions; and
- White Box-Yellow Box-Blakely's Red Gum Grassy Woodland.

An assessment for likelihood of occurrence was conducted and is included in **Appendix 8**. One TSC Act listed EEC has been confirmed as occurring within the ROW, namely 'White Box-Yellow Box-Blakely's Red Gum Grassy Woodland'.

4.2.3 Threatened Flora Species

4.2.3.1 EPBC Act

An EPBC Protected Matters Report was generated on the 17th July 2012 via a search of the EPBC Protected Matters Search Tool. The EPBC Protected Matters Report identified nine threatened flora species (**Table 2**) with potential to occur within a 10km radius of the ROW.

Table 2 Potentially occurring threatened flora species (Protecte Matters Search, ROW)

Scientific Name	Common Name	EPBC Act	TSC Act
Bertya opponens	-	V	V
Cadellia pentastylis	Ooline	V	-
Digitaria porrecta	Finger Panic Grass	E	E
Lepidium aschersonii	Spiny Pepper-cress	V	V
Philotheca ericifolia	-	V	-
Prasophyllum sp. Wybong (C.Phelps ORG 5269)	a leek-orchid	CE	-
Pterostylis cobarensis	Cobar Greenhood Orchid	V	V
Rulingia procumbens	-	V	V
Tylophora linearis	-	E	V

Status:
CE = Critically Endangered
E = Endangered
V = Vulnerable

Targeted searches did not confirm the presence of any threatened flora species within the ROW area. Notably searches were conducted out of season for several of these species. An assessment of likelihood of occurrence was completed for this species and is included in **Appendix 8**.

4.2.3.2 TSC Act

The Atlas of NSW Wildlife Database was accessed on the 17th July 2012 resulting in a total of six threatened species having been recorded within 10km of the ROW.

Table 3 Threatened flora species recorded within 10km (NSW Wildlife Atlas, ROW)

Scientific Name	Common Name	EPBC Act	TSC Act
Bertya opponens	-	V	V
Lepidium aschersonii	Spiny Pepper-cress	V	V
Pterostylis cobarensis	Cobar Greenhood Orchid	V	V
Swainsona murrayana	Slender Darling Pea	V	V
Dichanthium setosum	Bluegrass	V	V
Polygala linariifolia	Native Milkwort		E

Status:
E = Endangered
V = Vulnerable

Targeted searches did not confirm the presence of any threatened flora species within the ROW area. Notably searches were conducted out of season for several of these species. An assessment of likelihood of occurrence was completed for this species and is included in **Appendix 8**.

4.2.4 Weeds

A total of eight weed species were recorded along the ROW easement. One of these species, namely Prickly Pear (*Opuntia stricta*), is considered to be a noxious weed in NSW (DPI 2012). Under the provisions of the *Noxious Weeds Act* 1993, Prickly Pears (except *Opuntia ficus-indica*) are classified as Class 4 weeds. This means that the growth and spread of the plant must be controlled according to the measure specified in a management plan published by the local control authority and the plant may not be sold, propagated or knowingly distributed.

The remaining species are grasses or herbs that are not considered noxious in NSW. A complete flora list is compiled in **Appendix 3**.

5.0 Fauna Results

5.1 Leewood Fauna Results

5.1.1 Habitat Values

Three habitats were identified as occurring within the Leewood site. These habitats provide a range of resources for native fauna species, as outlined below, however the site has been subject to clearing and ongoing pressures associated with a history of agriculture which has led to degradation of ecological attributes.

5.1.2 Habitat Type

Condition / Description

The three habitats identified on Leewood ranged between moderate and poor condition. The habitat considered to be in the poorest condition is the cleared portion of the Pilliga Box woodland and offers little in the form of mature canopy trees, hollows for nesting and dwelling, logs, rocks, understorey vegetation and vegetation diversity. Only two small patches of vegetation exist that were observed to attract some bird species throughout various times of day. Feral species including the fox, pig, goat and rabbit were all recorded within this habitat type. Cattle have access to the entire site however their main area of occupancy is within this habitat therefore increasing the level of disturbance through soil compaction, vegetation degradation and soil nutrient disturbance from faecal matter. Various dams are located within this habitat type however their condition to support native wildlife particularly amphibians is considered poor.

Poor-moderate conditioned habitat was located in the Brigalow vegetation to the north of the site. The dense Brigalow stands offered protection for small bird species such as Finches, however the canopy layer scarcely contained taller trees such as Pilliga Box, limiting the range of fauna that could utilise the habitat. Flowering blossoms available for nectivorous bird species were low, hollows were not present for hollow dwelling bird and mammal species and logs of a suitable size for hollow dwelling terrestrial mammals were minimal. Understorey vegetation was scarce and of low diversity. The ground in the majority of this habitat has been compacted by frequent cattle movement.

The habitat with the best condition was the Pilliga Box woodland occurring in the north eastern corner of the property, as well as between the Leewood property boundary and Dog Proof Fence Road. These areas offered a range of habitat for terrestrial mammals including variably sized logs and tree stumps. Antechinus and Dunnart species were recorded on numerous occasions throughout this habitat and nowhere else on Leewood. An understorey was present although diversity was still considered low. Canopy tree species offered a range of hollows varying in size that were observed being used by birds but could also potentially be utilised by nocturnal mammals. Various bird nests were recorded within this habitat type and the highest diversity of bird species occurred within this habitat during daily diurnal bird surveys.

Habitats within the site are strongly connected to the extensive habitats of the Pilliga State Forest. This enables unrestricted movements to and from the site for mobile terrestrial fauna, arboreal fauna and birds into large areas of commensurate and superior habitats. In addition, the surrounding habitats of the Pilliga State Forest provide the same vegetation types and habitat attributes as that found on site. Due to this strong connectivity between the Leewood site and the surrounding forests, the site is considered to form a small, mostly degraded component of habitat for local populations of flora and fauna, including threatened species, which are considered to have potential to occur therein.

5.1.3 Observed Fauna

A total of 53 fauna species were recorded on Leewood including 40 bird, two amphibian, two microchiropteran bat and nine mammal species. The results for each group are discussed further below. One threatened fauna species listed as Vulnerable under the TSC Act was recorded during RPS surveys, namely the Grey-crowned Babbler.

5.1.3.1 Terrestrial Mammals

During trapping surveys, two species of terrestrial mammals were caught, namely the Common Planigale (*Planigale maculata*) and Yellow Footed Antechinus (*Antechinus flavipes*). Other terrestrial species recorded opportunistically were mostly feral species such as Pigs, Goats, Foxes and Rabbits. Eastern Grey Kangaroos (*Macropus giganteus*) were also observed on site.

A full list of mammals recorded within the site is provided in **Appendix 4**.

5.1.3.2 Arboreal Mammals

Arboreal trapping and spotlighting for mammals failed to record any species during trapping surveys.

5.1.3.3 Bats

A total of two microchiropteran bats were confidently identified from echolocations recordings on site, specifically the White-striped Freetail Bat (*Tadarida australis*) and Little Forest Bat (*Vespadelus vulturnus*). One other species, namely the Gould's Wattled Bat (*Chalinolobus gouldii*) was identified as possibly occurring. Numerous other species known to occur in the area were listed in the Anabat Report.

The Anabat Report is supplied in **Appendix 2**.

5.1.3.4 Avifauna Survey

A total of 40 bird species were recorded within the Leewood site during the survey period. The most commonly recorded species were the Galah (*Cacatua roseicapilla*), Noisy Miner (*Manorina melanocephala*), White-winged Chough (*Corcorax melanorhamphos*), Australian Magpie (*Cracticus tibicen*) and Magpie Lark (*Grallina cyanoleuca*). One threatened bird species, namely the Grey Crowned babbler (*Pomatostomus temporalis temporalis*) listed as Vulnerable under the TSC Act was recorded numerous times on site.

A full list of bird species observed within the site is provided in **Appendix 4**.

5.1.3.5 Reptile Survey

Opportunistic surveys were conducted across the site for reptiles however no species were found. Two snake sloughs were found on site although positive identification is difficult due to their poor condition.

5.1.3.6 Amphibian Survey

Opportunistic surveys were conducted for amphibians within the site. Two common amphibian species were recorded within the site including the Green Tree Frog (*Litoria caerulea*) and Desert Tree Frog (*Litoria rubella*).

5.1.3.7 Koala Assessments

No Koalas (*Phascolarctos cinereus*), or signs of their presence, were recorded during the surveys. No primary koala feed trees listed under Schedule 2 of the SEPP 44 were recorded, only secondary Koala feed trees were present.

5.1.4 Regional Context

The study area is immediately surrounded by large tracts of native forest comprising an area of 152,200ha including the Pilliga State Forest to the west, Jack's Creek State Forest to the east and Bibblewindi State Forest to the south. These vegetation parcels have the potential to support a diverse array of fauna guilds ultimately influencing the diversity and abundance of fauna species on site.

5.1.5 Threatened Species

5.1.5.1 EPBC Act

An EPBC Protected Matters Report was generated on the 12th April 2012 via the EPBC Protected Matters Search Tool. The EPBC Protected Matters Report identified 10 threatened fauna species (**Table 4**) with potential to occur within a 10km radius of the Leewood site.

Table 4 Potentially occurring threatened fauna species (Protected Matters Search, Leewood).

Scientific Name	Common Name	Status EPBC Act
Anthochaera phrygia	Regent Honeyeater	E
Geophaps scripta scripta	Squatter Pigeon	V
Leipoa ocellata	Malleefowl	V
Polytelis swainsonii	Superb Parrot	V
Rostratula australis	Australian Painted Snipe	V
Maccullochella peelii peelii	Murray River Cod	V
Chalinolobus dwyeri	Large-eared Pied Bat	V
Nyctophilus timoriensis (South-eastern form)	Greater Long-eared Bat	V
Petrogale penicillata	Brush-tailed Rock Wallaby	V
Pseudomys pilligaensis	Pilliga Mouse	V

Status (EPBC):
E = Endangered Species
V = Vulnerable Species

No threatened fauna species listed under the EPBC Act were recorded on site. An assessment of likelihood of occurrence was completed for all species and is included in **Appendix 5**.

5.1.5.2 TSC Act

The Atlas of NSW Wildlife Database was accessed on the 12th April 2012 resulting in a total of seven threatened fauna species having been recorded within a 10 kilometre radius of the Leewood site (**Table 5**).

Table 5 Threatened fauna species recorded within 10km (NSW Wildlife Atlas, Leewood).

Scientific Name	Common Name	Status TSC Act	No. within 10km
Circus assimilis	Spotted Harrier	V	1
Climacteris picumnus victoriae	Brown treecreeper (Eastern Subspecies)	V	1
Pomatostomus temporalis temporalis	Grey Crowned Babbler	V	2
Phascolarctos cinereus	Koala	V	32
Saccolaimus flaviventris	Yellow-bellied Sheathtail-bat	V	1
Chalinolobus picatus	Little Pied bat	V	1
Vespadelus troughtoni	Eastern cave Bat	V	1

Status (TSC Act):
V = Vulnerable Species

One species, specifically the Grey-crowned Babbler, listed in NSW as Vulnerable under the TSC Act was recorded multiple times across the site (**Figure 8**). Nesting sites were also recorded on site for this species (**Figure 8**).

An assessment of likelihood of occurrence was completed for all species and is included in **Appendix 5**.



Client: Santos

Leewood Fauna Survey Results

Compiled by: Glenn Jeffs | Date: 03/10/2012

Approved by: Matt Doherty | Date: 03/10/2012

Figure 8

Project: Leewood - Produced Water and Brine Management Project (Phase 1).

0 105 210 420 m

Datum: GDA94

RPS

Source:
Bing Maps 2011
Client provided 2012
RPS 2012
LPMA 2007

Tracking number: JN113369-6 03/10/2012 *Path: J:\JOBS\Santos\All Jobs\113369 Truckstop 2\10- Drafting\ArcGIS_map_documents\113369-6_Figure8_Right of Way_Fauna_survey_results_A4P_20121003.mxd*

5.1.6 Migratory Species

Ten species listed as migratory under the EPBC Act have the potential to occur on Leewood. **Table 6** lists all potentially occurring migratory species.

Table 6 Potentially occuring migratory species (Protected Matters Search, Leewood).

Scientific Name	Common Name	Status TSC Act	Status EPBC Act
Anthochaera phrygia	Regent Honeyeater	CE	M, E
Apus pacificus	Fork-tailed Swift		M
Ardea alba	Great Egret		M
Ardea ibis	Cattle Egret		M
Gallinago hardwickii	Latham's Snipe		M
Haliaeetus leucogaster	White-bellied Sea-eagle		M
Hirundapus caudacutus	White-throated Needletail		M
Leipoa ocellata	Malleefowl	E	M, V
Merops ornatus	Rainbow Bee-eater		M
Rostratula australis	Australian Painted Snipe	E	M, V

Status (TSC/EPBC Act):
V = Vulnerable Species
E = Endangered Species
CE = Critically Endangered Species
M = Migratory

None of the above listed species were detected on Leewood during field surveys.

5.1.7 Pests

Six feral fauna species were recorded on Leewood during field surveys. Of these species, four are individually listed as Key Threatening Processes (KTP) under the TSC Act and/or EPBC Act including the rabbit, goat, fox and pig. The KTPs include:

- Competition and land degradation by rabbits (EPBC Act) and Competition and grazing by the feral European rabbit (*Oryctolagus cuniculus*) (TSC Act);
- Competition and land degradation by unmanaged goats (EPBC Act) and Competition and habitat degradation by feral goats (*Capra hircus*) (TSC Act);
- Predation by European red fox (*Vulpes vulpes*) (EPBC Act and TSC Act); and
- Predation, Habitat Degradation, Competition and Disease Transmission by Feral Pigs (*Sus scrofa*) (EPBC Act and TSC Act).

5.2 Right of Way Fauna Results

5.2.1 Habitat Values

The habitat values of the ROW were limited throughout the majority of the area. The ROW itself contains almost no vegetation, resulting in habitat assessment of the adjacent vegetation. The condition and description of the habitat surrounding the ROW is outlined below.

5.2.2 Habitat Type

Condition / Description

The overall condition of the site is considered to be in moderate condition in that it contains a fairly young stand of vegetation, providing some hollows, some variably sized logs, moderate ground debris, a poor shrub layer and exotic flora species scattered throughout.

The primary vegetation type alongside the easement is Ironbark Shrubby Woodland, with a variation of canopy species interchanging at regular intervals. Where *Eucalyptus crebra* was dominant, the availability of hollows in mature trees was more prevalent than with any other canopy species, however hollows were recorded in *Angophora floribunda* also. Hollows provide roosting and nesting opportunities for a wide range of bird and mammalian species. In the areas where hollow bearing trees were recorded, there could be a higher likelihood of hollow utilising bird and mammal species. Overall, the amount of hollows in the vegetation immediately bordering the ROW was considered to be low.

The flora diversity in all stratums was considered to be low. The ground layer consisted mostly of native grasses and herbs, occasionally including exotic species. In some areas ground layer flora was completely nonexistent with leaf litter being the only form of ground cover. In these areas, small to medium sized logs were present also, providing habitat for small reptiles and possibly mammals.

Feral species including the fox, cattle, goat and rabbit were all recorded directly or indirectly along the ROW. Goats and cattle are ungulates that contribute to soil compaction, compressing dormant and buried seeds and preventing the ability of plants to regenerate. As a result, flora diversity becomes limited and weeds often encroach on native vegetation habitats. Rabbits impact upon native seedlings also suppressing their growth, altering the overall composition of the vegetation community. These issues are evident throughout the vegetation alongside the ROW.

The dense understorey of the shrubby woodland offered protection for small bird species such as finches, including the threatened Diamond Firetail (*Stagonopleura guttata*). However, in most areas the species diversity of the shrub layer was limited and often consisted of a monoculture of one or two species. Flowering blossoms available for nectivorous bird species were also low.

One portion of the shrubby woodland contained *Allocasuarina diminuta* subsp*. diminuta* which is a feed tree for the threatened Glossy Black-Cockatoo (*Calyptorhynchus lathami*). Three individual Glossy Black-Cockatoos were observed feeding on this shrub species highlighting its importance in the area.

Few termite mounds were detected along the ROW vegetation which provides a food source for echidnas and nesting sites for certain goanna species.

Habitats within the site are strongly connected to the extensive habitats of the Pilliga State Forest. This enables unrestricted movements to and from the site for mobile terrestrial fauna, arboreal fauna and birds into large areas of commensurate and superior habitats. In addition, the surrounding habitats of the Pilliga State Forest provide the same vegetation types and habitat attributes as that found on site. Due to this strong connectivity between the ROW site and the surrounding forests, the site is considered to form a small, mostly degraded component of habitat for local populations of flora and fauna, including threatened species, which are considered to have potential to occur therein.

5.2.3 Observed Fauna

The ecological survey methodology for the ROW did not include targeted fauna searches as the easement does not contain sufficient vegetation to accommodate an abundance of native fauna. During on site flora

surveys, opportunistic sightings of fauna were recorded. A total of 32 birds, five mammals and one reptile were recorded during opportunistic surveys (**Appendix 4**). Five threatened species listed as Vulnerable under the TSC Act were recorded on site including the Glossy Black-Cockatoo (*Calyptorhynchus lathami*), Diamond Firetail (*Stagonopleura guttata*), Turquoise Parrot (*Neophema pulchella*), Brown Treecreeper (*Climacteris picumnus victoriae*) and Grey-crowned Babbler (*Pomatostomus temporalis temporalis*).

5.2.4 Regional Context

The ROW is situated in the Pilliga East State Forest and is closely bordered by Bibblewindi State Forest to the east and Rutley State Forest to the south. At separate sections it crosses Bohena Creek and the Newell Highway.

5.2.5 Threatened Species

5.2.5.1 EPBC Act

An EPBC Protected Matters Report was generated on the 17th July 2012 via a search of the EPBC Protected Matters Search Tool. The EPBC Protected Matters Report identified 15 threatened fauna species (**Table 7**) with potential to occur within a 10 kilometre radius of the ROW area.

Table 7 Potentially occurring threatened fauna species (Protected Matters Report, ROW).

Scientific Name	Common Name	EPBC Act	TSC Act
Birds			
Anthochaera phrygia	Regent Honeyeater	E	CE
Botaurus poiciloptilus	Australasian Bittern	E	E
Erythrotriorchis radiatus	Red Goshawk	V	E
Geophaps scripta scripta	Squatter Pigeon (southern)	V	E
Lathamus discolor	Swift Parrot	E	E
Leipoa ocellata	Malleefowl	V	E
Polytelis swainsonii	Superb Parrot	V	V
Rostratula australis	Australian Painted Snipe	V	E
Mammals			
Chalinolobus dwyeri	Large-eared Pied Bat	V	V
Nyctophilus corbeni	South-eastern Long-eared Bat	V	V
Petrogale penicillata	Brush-tailed Rock-wallaby	V	E
Phascolarctos cinereus	Koala	V	V
Pseudomys pilligaensis	Pilliga Mouse	V	V
Reptiles			
Anomalopus mackayi	Five-clawed Worm-skink, Long-legged Wormskink	V	V
Uvidicolus sphyrurus	Border Thick-tailed Gecko	V	E

Status (EPBC):
CE = Critically Endangered
E = Endangered Species
V = Vulnerable Species

No threatened fauna species listed under the EPBC Act were recorded on site. An assessment of likelihood of occurrence was completed for all species and is included in **Appendix 8**.

5.2.5.2 TSC Act

The Atlas of NSW Wildlife Database was accessed on the 17th July 2012 resulting in a total of 24 threatened fauna species having been recorded within a 10km radius of the ROW area (**Table 8**).

Table 8 Threatened fauna species recorded within 10km (NSW Wildlife Atlas, ROW).

Scientific Name	Common Name	EPBC Act	TSC Act
Birds			
Polytelis swainsonii	Superb Parrot	V	V
Rostratula australis	Australian Painted Snipe	V	E
Anseranas semipalmata	Magpie Goose	-	V
Circus assimilis	Spotted Harrier	-	V
Hieraaetus morphnoides	Little Eagle	-	V
Ninox connivens	Barking Owl	-	V
Tyto novaehollandiae	Masked Owl	-	V
Climacteris picumnus victoriae	Brown Treecreeper	-	V
Calyptorhynchus lathami	Glossy Black-Cockatoo	-	V
Pomatostomus temporalis temporalis	Grey-crowned Babbler	-	V
Melanodryas cucullata cucullata	Hooded Robin	-	V
Grantiella picta	Painted Honeyeater	-	V
Pyrrholaemus sagittata	Speckled Warbler	-	V
Lophoictinia isura	Square-tailed Kite	-	V
Neophema pulchella	Turquoise Parrot	-	V
Glossopsitta pusilla	Little Lorikeet	-	V
Daphoenositta chrysoptera	Varied Sittella	-	V
Mammals			
Vespadelus troughtoni	Eastern Cave Bat	-	V
Chalinolobus picatus	Little Pied Bat	-	V
Saccolaimus flaviventris	Yellow-bellied Sheathtail-bat	-	V
Macropus dorsalis	Black-striped Wallaby	-	E
Phascolarctos cinereus	Koala	V	V
Petaurus norfolcensis	Squirrel Glider	-	V
Pseudomys pilligaensis	Pilliga Mouse	V	V

Status (TSC Act):
E = Endangered Species
V = Vulnerable Species

Five threatened species listed as Vulnerable under the TSC Act were recorded on site including the Glossy Black-Cockatoo (*Calyptorhynchus lathami*), Diamond Firetail (*Stagonopleura guttata*), Turquoise Parrot (*Neophema pulchella*), Brown Treecreeper (*Climacteris picumnus victoriae*) and Grey-crowned Babbler (*Pomatostomus temporalis temporalis*) (**Figure 9**).

An assessment of likelihood of occurrence was completed for all species and is included in **Appendix 8**.

5.2.6 Migratory Species

Ten species listed as migratory under the EPBC Act have the potential to occur on site. **Table 9** lists all potentially occurring migratory species.

Table 9 Potentially occurring migratory species (Protected Matters Report, ROW).

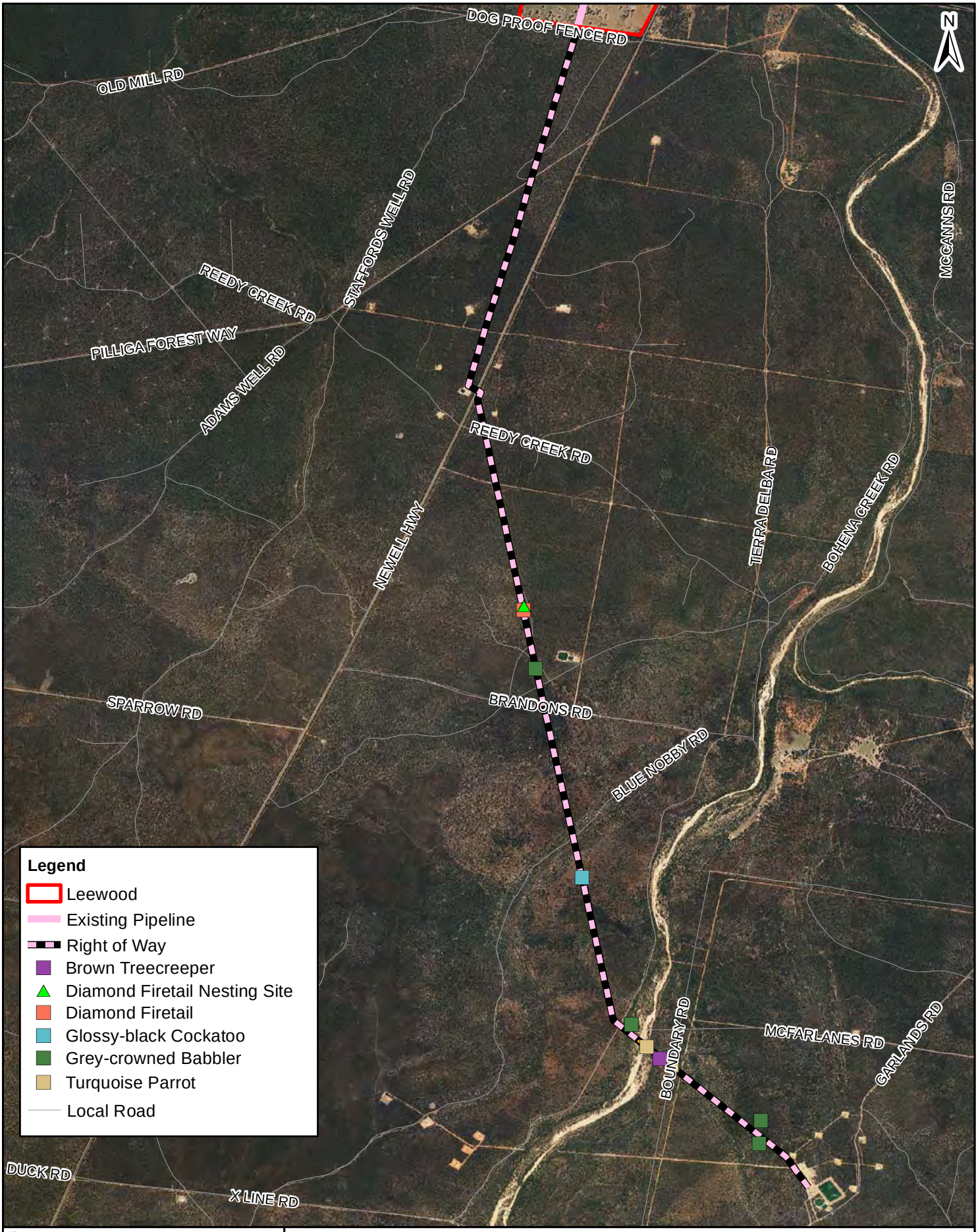
Scientific Name	Common Name	EPBC Act	TSC Act
Apus pacificus	Fork-tailed Swift	M	
Ardea alba	Great Egret	M	
Ardea ibis	Cattle Egret	M	
Haliaeetus leucogaster	White-bellied Sea-Eagle	M	
Hirundapus caudacutus	White-throated Needletail	M	
Leipoa ocellata	Malleefowl	V, M	E
Merops ornatus	Rainbow Bee-eater	M	
Anthochaera phrygia	Regent Honeyeater	E, M	CE
Gallinago hardwickii	Latham's Snipe	M	
Rostratula australis	Australian Painted Snipe	V, M	E

Status (TSC/EPBC Act):
CE = Critically Endangered
E = Endangered Species
V = Vulnerable Species
M = Migratory

None of the above listed species were detected on the ROW area during field surveys.

5.2.7 Pests

Four pest species, namely the Fox (*Vulpes vulpes*), Cow (*Bos taurus*), Goat (*Capra hircus*) and Rabbit (*Oryctolagus cuniculus*) were all recorded on site via visual observations or signs of presence through scat, tracks or carcasses.



Client: Santos	**Right of Way Fauna Survey Results**
Compiled by: Glenn Jeffs — Date: 03/10/2012	
Approved by: Matt Doherty — Date: 03/10/2012	**Figure 9** — Project: Leewood - Produced Water and Brine Management Project (Phase 1).

0 600 1,200 2,400 m

Datum: GDA94

Source:
Bing Maps 2011
Client provided 2012
RPS 2012
LPMA 2007

Tracking number: JN113369-6 03/10/2012 *Path: J:\JOBS\Santos\All Jobs\113369 Truckstop 2\10- Drafting\ArcGIS_map_documents\113369-6_Figure9_17km_pipeline_Ecological_constraints_A4P_20121003.mxd*

6.0 Ecological Impact Assessment

6.1 Potential Ecological Impacts

The proposed actions for Leewood and the ROW are considered to likely result in minimal ecological impacts. The ecologically significant attributes recorded in the study area have been accounted for during the planning process of the project and are considered to be subject to minimal impact as a result of the proposal.

Leewood

The proposal is likely to result in the clearing of approximately 48.2ha of disturbed and previously cleared grazing land within the 'Leewood site'.

Some additional off-site impacts are associated with the access to the site being a short section of access track is to be constructed from Dog Proof Fence Road and the intersection of Dog Proof Fence Road with Newell Highway is to be upgraded accordingly to accommodate B-double site access. These impacts will result in the clearing of approximately 0.8ha of Pilliga Box Woodland within the Pilliga State Forest.

One EEC, namely the '*Brigalow within the Brigalow Belt South, Nandewar and Darling Riverine Plains Bioregions*' (EPBC) commensurate with 'Brigalow (*Acacia harpophylla* dominant and co-dominant)' (TSC), was recorded on Leewood. However, this area is to be retained and protected as part of the proposal.

One threatened fauna species, namely the Grey-crowned Babbler (*Pomatostomus temporalis temporalis*), was recorded along with nesting sites within Leewood. The nesting sites are to be retained and protected as part of the proposal and the area of suboptimal habitat (approximately 48.2ha of cleared, grazed paddocks with scattered paddock trees). Assessment via a seven part test found that the proposal was unlikely to significantly impact on any potentially occurring species listed under the TSC Act (**Appendix 5**). Assessment under the EPBC Act found that the proposal was unlikely to significantly impact on any potentially occurring species listed on the EPBC Act (**Secion 6.2**).

ROW

The ROW is a previously cleared and disturbed existing pipeline and will be re-disturbed for an approximate length of 16km x 12m wide (19.2ha) which is comprised of derived vegetation communities and regrowth of approximately 5 years old.

Five threatened fauna species, namely the Brown Treecreeper, Grey-crowned Babbler, Turquoise Parrot, Glossy Black-Cockatoo and Diamond Firetail, were recorded along the ROW easement. The nesting sites are to be retained and protected as part of the proposal and the area of suboptimal habitat (approximately 19.2ha of previously cleared and disturbed pipeline easement).Assessment via a seven part test found that the proposal was unlikely to significantly impact on any potentially occurring species listed under the TSC Act (**Appendix 8**). Assessment under the EPBC Act found that the proposal was unlikely to significantly impact on any potentially occurring species listed on the EPBC Act (**Appendix 9**).

A small section (220m x 12m – 0.26ha) of the previously cleared 16km pipeline was found to occur within an area which is likely to be commensurate with the *White Box Yellow Box Blakely's Red Gum Woodland* Endangered Ecological Community (EEC) under the TSC Act and *White Box, Yellow Box, Blakely's Red Gum and Derived Grasslands* Critically Endangered Ecological Community (CEEC) under the EPBC Act. The condition of the site was identified as occurring as degraded, specifically as the modified 'derived grassland' form of the listed community.

There will also be disturbance of some remnant vegetation where the pipeline crosses the Newell Highway to accommodate the construction activities resulting in the clearing of an additional area of approximately

0.18ha of a vegetation community which is common in the locality (*Ironbark shrubby woodlands of the Pilliga area, Brigalow Belt South*) and not commensurate with known EEC/ TECs from the region.

6.2 Matters of National Environmental Significance

The EPBC Act focuses Commonwealth interests on matters of National Environmental Significance (NES) including integrated biodiversity conservation and the management of important protected areas. The matters of NES as identified in the Act which require assessment and approval to be addressed by the Commonwealth include:

- World Heritage Properties;
- National Heritage Places;
- Wetlands of International Importance;
- Great Barrier Reef Marine Parks;
- Commonwealth Marine areas;
- Nationally Threatened Species;
- Nationally Threatened Ecological Communities;
- Migratory Species;

The assessment and approval process applies to any action that has, will have or is likely to have a significant impact on a matter of NES. An 'action' is defined as a project, development, undertaking or an activity or series of activities.

The matter of NES and site-specific responses are as follows.

- World Heritage Properties:

The study area is not World Heritage Property, and is not in close proximity to any such property.

- Wetlands of International Importance (RAMSAR convention):

The study area is not part of any Wetland of International Importance, and is not in close proximity to any such area.

- Great Barrier Reef Marine Parks;
- The study area is not part of any Great Barrier Reef Marine Park, and is not in close proximity to any such park.
- Commonwealth Marine Areas

The Proposals will not have a significantly adverse effect on any Commonwealth Marine area, as there are no such marine areas within the region.

- Nationally Listed Threatened Species:

Threatened species listed under the EPBC Act, which occur, or have the potential to occur within the locality of Leewood and the ROW (10km radius) have been assessed for their potential to occur within the site (**Appendix 5** and **Appendix 8**). Those threatened species that were considered to have potential to occur and subsequently may be impacted by the proposal is as follows:

- Leewood

Those EPBC listed threatened species considered to have potential to occur are:

▪ Philotheca ericifolia		V
▪ *Pterostylis cobarensis*	Cobar Greenhood Orchid	V
▪ Rulingia procumbens		V
▪ Tylophora linearis		E
▪ Phascolarctos cinereus	Koala	V
▪ *Leipoa ocellata*	Malleefowl	V
▪ *Polytelis swainsonii*	Superb Parrot	V
▪ *Nyctophilus timoriensis* (South-eastern form)	Greater Long-eared Bat	V
▪ Pseudomys pilligaensis	Pilliga Mouse	V

As discussed in **Section 5.1.2** the Leewood site and the proposed location of the development footprint exists, as a predominately cleared site. This site is surrounded by superior areas of habitat, which would be suitable for the above listed threatened species. Due to the extensive tracts of vegetation within the Pilliga State Forest, supporting the populations of the potentially occurring above listed threatened species, the small area to be impacted upon is unlikely to be essential to the survival of populations of these listed species.

- ROW

Those EPBC listed threatened species considered to have potential to occur are:

▪ Dichanthium setosum	Bluegrass	V
▪ *Lepidium aschersonii*	Spiny Pepper-cress	V
▪ Philotheca ericifolia		V
▪ *Pterostylis cobarensis*	Cobar Greenhood Orchid	V
▪ Rulingia procumbens		V
▪ Tylophora linearis		E
▪ *Lathamus discolor*	Swift Parrot	E
▪ Phascolarctos cinereus	Koala	V
▪ *Leipoa ocellata*	Malleefowl	V
▪ *Polytelis swainsonii*	Superb Parrot	V
▪ Pseudomys pilligaensis	Pilliga Mouse	V
▪ *Nyctophilus corbeni*	South-eastern Long-eared Bat	V
▪ Tyto novaehollandiae	Masked Owl	V

As discussed in **Section 5.2.2** the ROW site and the proposed location of the development footprint exists, as a predominately cleared site. This site is surrounded by superior areas of habitat, which would be suitable for the above listed threatened species. Due to the extensive tracts of vegetation within the Pilliga State Forest, supporting the populations of the potentially occurring above listed threatened species, the small area to be impacted upon is unlikely to be essential to the survival of populations of these listed species.

- Nationally Listed Threatened Ecological Communities:

One threatened Ecological Community, nationally listed under the EPBC Act was recorded on Leewood and one on the ROW, namely Brigalow and White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland respectively. The existing Brigalow within Leewood is proposed to be avoided, whilst only (220m x 12m or 0.264ha) of a 'derived grassland' component of the White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland will be impacted upon within the ROW. The impacts upon these listed communities are not considered to be significant.

Nationally Listed Migratory Species

- Leewood

Those EPBC listed Migratory species considered to have potential to occur are:

- *Circus assimilis* Spotted Harrier
- *Apus pacificus* Fork-tailed Swift
- *Ardea alba* Great Egret
- *Ardea ibis* Cattle Egret

As discussed in **Section 5.1.2** the Leewood site and the proposed location of the development footprint exists, as a predominately cleared site. This site is surrounded by superior areas of habitat, which would be suitable for the above listed Migratory species. Due to the extensive tracts of vegetation within the Pilliga State Forest, supporting the populations of the potentially occurring above listed species, the small area to be impacted upon is unlikely to be essential to the survival of populations of these species.

- ROW

Those EPBC listed Migratory species considered to have potential to occur are:

- *Circus assimilis* Spotted Harrier
- *Apus pacificus* Fork-tailed Swift
- *Ardea alba* Great Egret
- *Ardea ibis* Cattle Egret
- *Merops ornatus* Rainbow Bee-eater

As discussed in **Section 5.2.2** the ROW site and the proposed location of the development footprint exists, as a predominately cleared site. This site is surrounded by superior areas of habitat, which would be suitable for the above listed Migratory species. Due to the extensive tracts of vegetation within the Pilliga State Forest, supporting the populations of the potentially occurring above species, the small area to be impacted upon is unlikely to be essential to the survival of populations of these species.

6.3 NSW State Significance

6.3.1 TSC Act

Section 5A of the EP&A Act lists seven factors that must be taken into account in the determination of the significance of potential impacts proposed activities on 'threatened species, populations or ecological communities (or their habitats)' listed under the TSC Act. The Assessment of Significance (seven part test) is used to determine whether activities are 'likely' to cause 'a significant impact' on threatened biota. **Appendices 5** and **8** contain the assessment for Leewood and ROW respectively for the following species listed in **Table 10**.

Table 10 Threatened species assessed under seven part test

Species	Leewood	ROW
Flora		
Polygala linariifolia		✓
Dichanthium setosum		✓
Pterostylis cobarensis	✓	✓
Rulingia procumbens	✓	✓
Tylophora linearis	✓	✓
Fauna		
Spotted Harrier	✓	✓
Swift Parrot		✓
Malleefowl	✓	✓
Yellow-bellied Sheathtail-bat	✓	✓
Greater Long-eared Bat (South-eastern form)	✓	
Grey-crowned Babbler	✓	✓
Superb Parrot	✓	✓
Koala	✓	✓
Little Pied Bat	✓	✓
Pilliga Mouse	✓	✓
Brown Treecreeper	✓	✓
Barking Owl		✓
Masked Owl		✓
Glossy Black-Cockatoo		✓
Little Eagle		✓
Hooded Robin		✓
Painted Honeyeater		✓
Speckled Warbler		✓
Square-tailed Kite		✓
Little Lorikeet		✓
Varied Sittella		✓
Turquoise Parrot		✓
Diamond Firetail		✓

The assessment determined that no significant impacts such that a local extinction would be likely to occur as a result of the proposal.

6.3.2 Koala

The Koala (*Phascolarctos cinereus*) is listed as Vulnerable under both the TSC Act and EPBC Act. Determining critical Koala habitat and the presence of Koala populations on site is crucial during ecological surveys. Thorough Spot Assessment Techniques (SAT) were conducted over the majority of the study area to determine the presence of Koala populations and primary feed trees. Secondary feed trees were detected on the study area however no primary feed trees or signs of Koala presence were detected during the assessments. Therefore it is unlikely that the proposal will have a significant impact on this species.

7.0 Impact Mitigation and Management

The proposal has been assessed as being likely to have minimal ecological impacts, however to prevent and reduce potential impacts on important ecological features within the study area during the construction and operation phases of this project, the following mitigation and management procedures are recommended.

7.1 Avoid

The following measures are recommended to avoid impacts to known sensitive environs wherever possible:

- No clearing is to occur within the retained remnant vegetation to the sites north which contains the EEC Brigalow and known Grey-crowned Babbler nesting sites;
- Access to this area would be prohibited during the construction phase to maintain the ecological integrity of this habitat. During operation, the existing access track through this vegetation may be utilised by small vehicles, however no additional clearing should occur; and
- No additional clearing should occur outside the existing ROW, other than the HDD work area and associated launch and receive pits on the Newell Highway.

7.2 Minimise

The following measures are recommended to minimise potential impacts:

- Preventing the spread of exotic weed species by ensuring no seeds or plant material is removed from site and all vehicles and personnel are not accidently inhibiting the spread of weeds;
- Vehicle speed should be minimised at all times on site to reduce the risk of fauna strike;
- One creek crossing occurs on the proposed ROW at Bohena Creek which is located approximately 2.5km from Bibblewindi. It is proposed that the creek crossing is completed using ploughing to minimise the impact to the environment. This portion of the creek is generally dry however, ploughing will not be conducted during flooding periods to minimise environmental impact. Further issues that are to be avoided include; and
- An access track is required to intersect vegetation between Dog Proof Fence Road and the Leewood property boundary. Several areas provide a suitable width for the access track that will result in the clearing of *Callitris glaucophylla* and *Allocasuarina luehmanni* only. Clearing of large Eucalypts and hollowing bearing trees will be avoided.
- It is anticipated that minimal potential impact to fauna becoming injured or stuck is likely to occur along the ROW during flow line construction given the use of a ploughing type method of installation, however regular inspections by construction personnel should occur and an environmental representative contacted should an issue arise.

General Mitigation Measures:

- Provide perimeter fencing around the proposed dams to prohibit terrestrial faunal access.
- Provide suitable faunal self rescue points along the dam walls.
- Implementing erosion and sediment controls during construction phase;
- During removal of habitat trees (including any Grey-crowned Babbler Nests) an environmental representative or ecologist should be present to ensure that displaced fauna are handled appropriately;
- Declared Noxious weeds (including Prickly Pear/ Tiger Pear) shall be managed in accordance with local and state guidelines. In the absence of these reference shall be made to the Noxious Weeds Act.

- All disturbed areas outside of the impact footprint should be rehabilitated with endemic native vegetation; and
- Appropriate measures should be employed to ensure that machinery utilised for the Project are free of materials (soils etc.) such that they do not infect vegetation within the study area with *Phytophthora cinnamomi*, or cause the distribution of weed species.

8.0 Conclusion

RPS has been commissioned by Santos to prepare an Ecological Assessment for the proposed Water and Brine Management facility within PEL 238 and an upgrade of a 16km ROW near Narrabri, NSW.

Leewood

The proposal is likely to result in the clearing of approximately 48.2ha of disturbed and previously cleared grazing land within the 'Leewood site'.

Some additional off-site impacts are associated with the access to the site namely a short section of access track is to be constructed along Dog Proof Fence Road to the intersection of Dog Proof Fence Road with Newell Highway in order to upgrade the existing track to accommodate B-double site access. These impacts will result in the clearing of approximately 0.8ha of Pilliga Box Woodland within the Pilliga State Forest.

One EEC, namely the '*Brigalow within the Brigalow Belt South, Nandewar and Darling Riverine Plains Bioregions*' (EPBC) commensurate with 'Brigalow (*Acacia harpophylla* dominant and co-dominant)' (TSC), was recorded on Leewood. However, this area is to be retained and protected as part of the proposal.

One threatened fauna species, namely the Grey-crowned Babbler (*Pomatostomus temporalis temporalis*), was recorded along with nesting sites within Leewood. Assessment via a seven part test found that the proposal was unlikely to significantly impact on any potentially occurring species listed under the TSC Act. Assessment under the EPBC Act found that the proposal was unlikely to significantly impact on any potentially occurring species listed on the EPBC Act

As discussed in **Appendices 6** and **Appendix 7,** there are larger areas of more suitable habitat for threatened species nearby (Pilliga State Forest ~ 160,000ha) and the proposal will affect a small area of sub-optimal habitat (~ 48.2ha of cleared, grazed paddocks with scattered paddock trees and the clearing of approximately 0.8ha of Pilliga Box Woodland within the Pilliga State Forest). Therefore, it is considered that the proposed development is not likely to have an adverse effect on the life cycle of any threatened entities (listed under the TSC Act or the EPBC) such that a viable local population or community is likely to be placed at risk of extinction.

ROW

The ROW is a previously cleared and disturbed existing pipeline and will be re-disturbed for an approximate length of 16km x 12m wide (19.2ha) which is comprised of derived vegetation communities and regrowth of approximately 5 years old.

Five threatened fauna species, namely the Brown Treecreeper, Grey-crowned Babbler, Turquoise Parrot, Glossy Black-Cockatoo and Diamond Firetail, were recorded along the ROW easement. Assessment via a seven part test found that the proposal was unlikely to significantly impact on any potentially occurring species listed under the TSC Act. Assessment under the EPBC Act found that the proposal was unlikely to significantly impact on any potentially occurring species listed on the EPBC Act. The nesting sites are to be retained and protected as part of the proposal and the area of suboptimal habitat (approximately 19.2ha of previously cleared and disturbed pipeline easement). Therefore, it is considered that the proposal will not have a significant impact upon these threatened species.

A small section (220m x 12m) of the previously cleared 16km pipeline was found to occur within an area which is likely to be commensurate with the *White Box Yellow Box Blakely's Red Gum Woodland* Endangered Ecological Community (EEC) under the TSC Act and *White Box, Yellow Box, Blakely's Red Gum and Derived Grasslands* Critically Endangered Ecological Community (CEEC) under the EPBC Act. The condition of the site was identified as occurring as degraded, specifically as the modified 'derived grassland' form of the listed community. The ecological impact of the removal of approximately 220 m x 12 m (approximately 0.264ha) of the derived grassland vegetation has been considered and concluded that the proposal would not have a significant impact upon the ecological community.

There will also be disturbance of some remnant vegetation where the pipeline crosses the Newell Highway this will result in the clearing of an additional area of approximately 0.18ha of a vegetation community which is common in the locality (*Ironbark shrubby woodlands of the Pilliga area, Brigalow Belt South*).

The ecological inspections found that the proposed activities within the two sites are unlikely to have a significant impact on threatened species, populations or ecological communities in the locality providing that the recommended mitigation measures are adopted.

As discussed in **Appendix 9** and **Appendix 10**, there are larger areas of more suitable habitat for threatened entities nearby (Pilliga State Forest ~ 160,000ha) and the proposal will affect a small area of sub-optimal habitat (~ 19.2ha of existing cleared and disturbed easement and the clearing of approximately 0.18ha of Ironbark Shrubby Woodland within the Pilliga State Forest). Therefore, it is considered that the proposed development is not likely to have an adverse effect on the life cycle of any threatened entities (listed under the TSC Act or the EPBC) such that a viable local population or community is likely to be placed at risk of extinction.

In conclusion, the proposal has been assessed as being unlikely to significantly impact on any species, population or ecological community listed under the TSC Act or EPBC Act during the construction and operation phases of the project.

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Appendix 1

EPBC Protected Matters Reports

Australian Government

Department of Sustainability, Environment, Water, Population and Communities

EPBC Act Protected Matters Report

This report provides general guidance on matters of national environmental significance and other matters protected by the EPBC Act in the area you have selected.

Information on the coverage of this report and qualifications on data supporting this report are contained in the caveat at the end of the report.

Information about the EPBC Act including significance guidelines, forms and application process details can be found at http://www.environment.gov.au/epbc/assessmentsapprovals/index.html

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Acknowledgements



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Coordinates

Buffer: 10.0Km



Summary

Matters of National Environment Significance

This part of the report summarises the matters of national environmental significance that may occur in, or may relate to, the area you nominated. Further information is available in the detail part of the report, which can be accessed by scrolling or following the links below. If you are proposing to undertake an activity that may have a significant impact on one or more matters of national environmental significance then you should consider the Administrative Guidelines on Significance - see http://www.environment.gov.au/epbc/assessmentsapprovals/guidelines/index.html

World Heritage Properties:	None
National Heritage Places:	None
Wetlands of International	None
Great Barrier Reef Marine Park:	None
Commonwealth Marine Areas:	None
Threatened Ecological Communities:	6
Threatened Species:	18
Migratory Species:	12

Other Matters Protected by the EPBC Act

This part of the report summarises other matters protected under the Act that may relate to the area you nominated. Approval may be required for a proposed activity that significantly affects the environment on Commonwealth land, when the action is outside the Commonwealth land, or the environment anywhere when the action is taken on Commonwealth land. Approval may also be required for the Commonwealth or Commonwealth agencies proposing to take an action that is likely to have a significant impact on the environment anywhere.

The EPBC Act protects the environment on Commonwealth land, the environment from the actions taken on Commonwealth land, and the environment from actions taken by Commonwealth agencies. As heritage values of a place are part of the 'environment', these aspects of the EPBC Act protect the Commonwealth Heritage values of a Commonwealth Heritage place and the heritage values of a place on the Register of the National Estate. Information on the new heritage laws can be found at http://www.environment.gov.au/heritage/index.html

This part of the report summarises other matters protected under the Act that may relate to the area you nominated. Approval may be required for a proposed activity that significantly affects the environment on Commonwealth land, when the action is outside the Commonwealth land, or the environment anywhere when the action is taken on Commonwealth land. Approval may also be required for the Commonwealth or Commonwealth agencies proposing to take an action that is likely to have a significant impact on the environment anywhere.

A permit may be required for activities in or on a Commonwealth area that may affect a member of a listed threatened species or ecological community, a member of a listed migratory species, whales and other cetaceans, or a member of a listed marine species. Information on EPBC Act permit requirements and application forms can be found at http://www.environment.gov.

Commonwealth Lands:	1
Commonwealth Heritage Places:	None
Listed Marine Species:	8
Whales and Other Cetaceans:	None
Critical Habitats:	None
Commonwealth Reserves:	None

Extra Information

This part of the report provides information that may also be relevant to the area you have

Place on the RNE:	None
State and Territory Reserves:	1
Regional Forest Agreements:	None
Invasive Species:	12
Nationally Important Wetlands:	None

Details

Matters of National Environmental Significance

Threatened Ecological Communities [Resource Information]

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

Name	Status	Type of Presence
Brigalow (Acacia harpophylla dominant and co-dominant)	Endangered	Community known to occur within area
Coolibah - Black Box Woodlands of the Darling	Endangered	Community likely to

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

Name	Status	Type of Presence
Riverine Plains and the Brigalow Belt South Bioregions		occur within area
Grey Box (Eucalyptus microcarpa) Grassy Woodlands and Derived Native Grasslands of South-eastern Australia	Endangered	Community may occur within area
Natural grasslands on basalt and fine-textured alluvial plains of northern New South Wales and southern Queensland	Critically Endangered	Community may occur within area
Weeping Myall Woodlands	Endangered	Community may occur within area
White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland	Critically Endangered	Community may occur within area

Threatened Species		[Resource Information]
Name	Status	Type of Presence
BIRDS		
Anthochaera phrygia		
Regent Honeyeater [82338]	Endangered	Species or species habitat may occur within area
Geophaps scripta scripta		
Squatter Pigeon (southern) [64440]	Vulnerable	Species or species habitat may occur within area
Leipoa ocellata		
Malleefowl [934]	Vulnerable	Species or species habitat may occur within area
Polytelis swainsonii		
Superb Parrot [738]	Vulnerable	Species or species habitat may occur within area
Rostratula australis		
Australian Painted Snipe [77037]	Vulnerable	Species or species habitat may occur within area
FISH		
Maccullochella peelii peelii		
Murray Cod, Cod, Goodoo [68443]	Vulnerable	Species or species habitat may occur within area
MAMMALS		
Chalinolobus dwyeri		
Large-eared Pied Bat, Large Pied Bat [183]	Vulnerable	Species or species habitat may occur within area
Nyctophilus timoriensis (South-eastern form)		
Greater Long-eared Bat, South-eastern Long-eared Bat [66888]	Vulnerable	Species or species habitat may occur within area
Petrogale penicillata		
Brush-tailed Rock-wallaby [225]	Vulnerable	Species or species habitat may occur within area
Pseudomys pilligaensis		
Pilliga Mouse [99]	Vulnerable	Species or species habitat likely to occur within area
PLANTS		
Bertya opponens		
[13792]	Vulnerable	Species or species habitat likely to occur within area
Cadellia pentastylis		
Ooline [9828]	Vulnerable	Species or species habitat likely to occur within area

Name	Status	Type of Presence
Lepidium aschersonii Spiny Pepper-cress [10976]	Vulnerable	Species or species habitat likely to occur within area
Philotheca ericifolia [64942]	Vulnerable	Species or species habitat likely to occur within area
Pterostylis cobarensis Cobar Greenhood Orchid [12993]	Vulnerable	Species or species habitat likely to occur within area
Rulingia procumbens [12903]	Vulnerable	Species or species habitat likely to occur within area
Tylophora linearis [55231]	Endangered	Species or species habitat may occur within area
REPTILES		
Underwoodisaurus sphyrurus Border Thick-tailed Gecko [1660]	Vulnerable	Species or species habitat likely to occur within area

Migratory Species [Resource Information]		
* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.		
Name	Threatened	Type of Presence
Migratory Marine Birds		
Apus pacificus Fork-tailed Swift [678]		Species or species habitat may occur within area
Ardea alba Great Egret, White Egret [59541]		Species or species habitat may occur within area
Ardea ibis Cattle Egret [59542]		Species or species habitat may occur within area
Migratory Terrestrial Species		
Haliaeetus leucogaster White-bellied Sea-Eagle [943]		Species or species habitat likely to occur within area
Hirundapus caudacutus White-throated Needletail [682]		Species or species habitat may occur within area
Leipoa ocellata Malleefowl [934]	Vulnerable	Species or species habitat may occur within area
Merops ornatus Rainbow Bee-eater [670]		Species or species habitat may occur within area
Xanthomyza phrygia Regent Honeyeater [430]	Endangered*	Species or species habitat may occur within area
Migratory Wetlands Species		
Ardea alba Great Egret, White Egret [59541]		Species or species habitat may occur within area
Ardea ibis Cattle Egret [59542]		Species or species habitat may occur within area

Name	Threatened	Type of Presence
Gallinago hardwickii		
Latham's Snipe, Japanese Snipe [863]		Species or species habitat may occur within area
Rostratula benghalensis s. lat.		
Painted Snipe [889]	Vulnerable*	Species or species habitat may occur within area

Other Matters Protected by the EPBC Act

Commonwealth Lands [Resource Information]

The Commonwealth area listed below may indicate the presence of Commonwealth land in this vicinity. Due to the unreliability of the data source, all proposals should be checked as to whether it impacts on a Commonwealth area, before making a definitive decision. Contact the State or Territory government land department for further information.

Name
Commonwealth Land - Australian Telecommunications Commission

Listed Marine Species [Resource Information]

* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.

Name	Threatened	Type of Presence
Birds		
Apus pacificus		
Fork-tailed Swift [678]		Species or species habitat may occur within area
Ardea alba		
Great Egret, White Egret [59541]		Species or species habitat may occur within area
Ardea ibis		
Cattle Egret [59542]		Species or species habitat may occur within area
Gallinago hardwickii		
Latham's Snipe, Japanese Snipe [863]		Species or species habitat may occur within area
Haliaeetus leucogaster		
White-bellied Sea-Eagle [943]		Species or species habitat likely to occur within area
Hirundapus caudacutus		
White-throated Needletail [682]		Species or species habitat may occur within area
Merops ornatus		
Rainbow Bee-eater [670]		Species or species habitat may occur within area
Rostratula benghalensis s. lat.		
Painted Snipe [889]	Vulnerable*	Species or species habitat may occur within area

Extra Information

State and Territory Reserves [Resource Information]

Name	State

Name	State
Brigalow Park	NSW

Invasive Species [Resource Information]

Weeds reported here are the 20 species of national significance (WoNS), along with other introduced plants that are considered by the States and Territories to pose a particularly significant threat to biodiversity. The following feral animals are reported: Goat, Red Fox, Cat, Rabbit, Pig, Water Buffalo and Cane Toad. Maps from Landscape Health Project, National Land and Water Resouces Audit,

Name	Status	Type of Presence
Frogs		
Bufo marinus Cane Toad [1772]		Species or species habitat likely to occur within area
Mammals		
Capra hircus Goat [2]		Species or species habitat likely to occur within area
Felis catus Cat, House Cat, Domestic Cat [19]		Species or species habitat likely to occur within area
Oryctolagus cuniculus Rabbit, European Rabbit [128]		Species or species habitat likely to occur within area
Sus scrofa Pig [6]		Species or species habitat likely to occur within area
Vulpes vulpes Red Fox, Fox [18]		Species or species habitat likely to occur within area
Plants		
Lycium ferocissimum African Boxthorn, Boxthorn [19235]		Species or species habitat may occur within area
Parthenium hysterophorus Parthenium Weed, Bitter Weed, Carrot Grass, False Ragweed [19566]		Species or species habitat may occur within area
Pinus radiata Radiata Pine Monterey Pine, Insignis Pine, Wilding Pine [20780]		Species or species habitat may occur within area
Rubus fruticosus aggregate Blackberry, European Blackberry [68406]		Species or species habitat likely to occur within area
Salix spp. except S.babylonica, S.x calodendron & S.x reichardtiji Willows except Weeping Willow, Pussy Willow and Sterile Pussy Willow [68497]		Species or species habitat likely to occur within area
Tamarix aphylla Athel Pine, Athel Tree, Tamarisk, Athel Tamarisk, Athel Tamarix, Desert Tamarisk, Flowering Cypress, Salt Cedar [16018]		Species or species habitat likely to occur within area

Coordinates

-30.49113 149.61874,-30.49302 149.63517,-30.50725 149.62961,-30.50529 149.61617,
-30.49113 149.61874

Caveat

The information presented in this report has been provided by a range of data sources as acknowledged at the end of the report.

This report is designed to assist in identifying the locations of places which may be relevant in determining obligations under the Environment Protection and Biodiversity Conservation Act 1999. It holds mapped locations of World Heritage and Register of National Estate properties, Wetlands of International Importance, Commonwealth and State/Territory reserves, listed threatened, migratory and marine species and listed threatened ecological communities. Mapping of Commonwealth land is not complete at this stage. Maps have been collated from a range of sources at various

Not all species listed under the EPBC Act have been mapped (see below) and therefore a report is a general guide only. Where available data supports mapping, the type of presence that can be determined from the data is indicated in general terms. People using this information in making a referral may need to consider the qualifications below and may need to seek and consider other

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

For species where the distributions are well known, maps are digitised from sources such as recovery plans and detailed habitat studies. Where appropriate, core breeding, foraging and roosting areas are indicated under 'type of presence'. For species whose distributions are less well known, point locations are collated from government wildlife authorities, museums, and non-government organisations; bioclimatic distribution models are generated and these validated by experts. In some cases, the distribution maps are based solely on expert knowledge.

Only selected species covered by the following provisions of the EPBC Act have been mapped:

- migratory and
- marine

The following species and ecological communities have not been mapped and do not appear in reports produced from this database:

- threatened species listed as extinct or considered as vagrants
- some species and ecological communities that have only recently been listed
- some terrestrial species that overfly the Commonwealth marine area
- migratory species that are very widespread, vagrant, or only occur in small numbers

The following groups have been mapped, but may not cover the complete distribution of the species:

- non-threatened seabirds which have only been mapped for recorded breeding sites
- seals which have only been mapped for breeding sites near the Australian continent

Such breeding sites may be important for the protection of the Commonwealth Marine environment.

Acknowledgements

This database has been compiled from a range of data sources. The department acknowledges the following custodians who have contributed valuable data and advice:

-Department of Environment, Climate Change and Water, New South Wales
-Department of Sustainability and Environment, Victoria
-Department of Primary Industries, Parks, Water and Environment, Tasmania
-Department of Environment and Natural Resources, South Australia
-Parks and Wildlife Service NT, NT Dept of Natural Resources, Environment and the Arts
-Environmental and Resource Management, Queensland
-Department of Environment and Conservation, Western Australia
-Department of the Environment, Climate Change, Energy and Water
-Birds Australia
-Australian Bird and Bat Banding Scheme
-Australian National Wildlife Collection
-Natural history museums of Australia
-Museum Victoria
-Australian Museum
-SA Museum
-Queensland Museum
-Online Zoological Collections of Australian Museums
-Queensland Herbarium
-National Herbarium of NSW
-Royal Botanic Gardens and National Herbarium of Victoria
-Tasmanian Herbarium
-State Herbarium of South Australia
-Northern Territory Herbarium
-Western Australian Herbarium
-Australian National Herbarium, Atherton and Canberra
-University of New England
-Ocean Biogeographic Information System
-Australian Government, Department of Defence

-State Forests of NSW

-Other groups and individuals

The Department is extremely grateful to the many organisations and individuals who provided expert advice and information on numerous draft distributions.

Please feel free to provide feedback via the Contact Us page.

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Australian Government

Department of Sustainability, Environment, Water, Population and Communities

EPBC Act Protected Matters Report

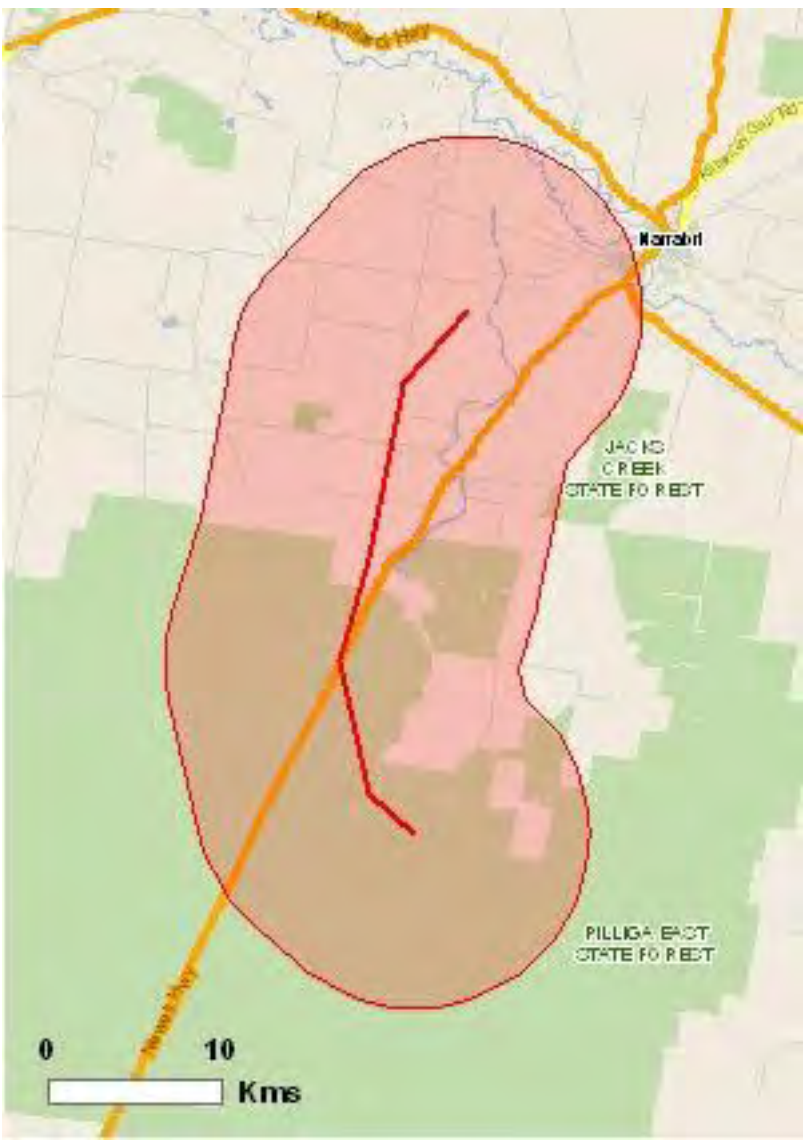
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Report created: 17/07/12 17:51:01

Summary
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Acknowledgements



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Coordinates

Buffer: 10.0Km



Summary

Matters of National Environment Significance

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World Heritage Properties:	None
National Heritage Places:	None
Wetlands of International	None
Great Barrier Reef Marine Park:	None
Commonwealth Marine Areas:	None
Threatened Ecological Communities:	6
Threatened Species:	25
Migratory Species:	12

Other Matters Protected by the EPBC Act

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The EPBC Act protects the environment on Commonwealth land, the environment from the actions taken on Commonwealth land, and the environment from actions taken by Commonwealth agencies. As heritage values of a place are part of the 'environment', these aspects of the EPBC Act protect the Commonwealth Heritage values of a Commonwealth Heritage place and the heritage values of a place on the Register of the National Estate. Information on the new heritage laws can be found at http://www.environment.gov.au/heritage/index.html

This part of the report summarises other matters protected under the Act that may relate to the area you nominated. Approval may be required for a proposed activity that significantly affects the environment on Commonwealth land, when the action is outside the Commonwealth land, or the environment anywhere when the action is taken on Commonwealth land. Approval may also be required for the Commonwealth or Commonwealth agencies proposing to take an action that is likely to have a significant impact on the environment anywhere.

A permit may be required for activities in or on a Commonwealth area that may affect a member of a listed threatened species or ecological community, a member of a listed migratory species, whales and other cetaceans, or a member of a listed marine species. Information on EPBC Act permit requirements and application forms can be found at http://www.environment.gov.

Commonwealth Lands:	2
Commonwealth Heritage Places:	None
Listed Marine Species:	9
Whales and Other Cetaceans:	None
Critical Habitats:	None
Commonwealth Reserves:	None

Extra Information

This part of the report provides information that may also be relevant to the area you have

Place on the RNE:	None
State and Territory Reserves:	1
Regional Forest Agreements:	None
Invasive Species:	12
Nationally Important Wetlands:	None

Details

Matters of National Environmental Significance

Threatened Ecological Communities [Resource Information]

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

Name	Status	Type of Presence
Brigalow (Acacia harpophylla dominant and co-dominant)	Endangered	Community known to occur within area
Coolibah - Black Box Woodlands of the Darling	Endangered	Community likely to

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

Name	Status	Type of Presence
Riverine Plains and the Brigalow Belt South Bioregions		occur within area
Grey Box (Eucalyptus microcarpa) Grassy Woodlands and Derived Native Grasslands of South-eastern Australia	Endangered	Community may occur within area
Natural grasslands on basalt and fine-textured alluvial plains of northern New South Wales and southern Queensland	Critically Endangered	Community likely to occur within area
Weeping Myall Woodlands	Endangered	Community may occur within area
White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland	Critically Endangered	Community may occur within area
Threatened Species		[Resource Information]
Name	Status	Type of Presence
BIRDS		
Anthochaera phrygia Regent Honeyeater [82338]	Endangered	Species or species habitat may occur within area
Botaurus poiciloptilus Australasian Bittern [1001]	Endangered	Species or species habitat may occur within area
Erythrotriorchis radiatus Red Goshawk [942]	Vulnerable	Species or species habitat may occur within area
Geophaps scripta scripta Squatter Pigeon (southern) [64440]	Vulnerable	Species or species habitat may occur within area
Lathamus discolor Swift Parrot [744]	Endangered	Species or species habitat may occur within area
Leipoa ocellata Malleefowl [934]	Vulnerable	Species or species habitat may occur within area
Polytelis swainsonii Superb Parrot [738]	Vulnerable	Species or species habitat may occur within area
Rostratula australis Australian Painted Snipe [77037]	Vulnerable	Species or species habitat likely to occur within area
FISH		
Maccullochella peelii Murray Cod [66633]	Vulnerable	Species or species habitat may occur within area
MAMMALS		
Chalinolobus dwyeri Large-eared Pied Bat, Large Pied Bat [183]	Vulnerable	Species or species habitat may occur within area
Nyctophilus corbeni South-eastern Long-eared Bat [83395]	Vulnerable	Species or species habitat may occur within area
Petrogale penicillata Brush-tailed Rock-wallaby [225]	Vulnerable	Species or species habitat may occur within area
Phascolarctos cinereus (combined populations of Qld, NSW and the ACT) Koala (combined populations of Queensland, New	Vulnerable	Species or species

Name	Status	Type of Presence
South Wales and the Australian Capital Territory) [85104]		habitat known to occur within area
Pseudomys pilligaensis Pilliga Mouse [99]	Vulnerable	Species or species habitat likely to occur within area
PLANTS		
Bertya opponens [13792]	Vulnerable	Species or species habitat likely to occur within area
Cadellia pentastylis Ooline [9828]	Vulnerable	Species or species habitat likely to occur within area
Digitaria porrecta Finger Panic Grass [12768]	Endangered	Species or species habitat likely to occur within area
Lepidium aschersonii Spiny Pepper-cress [10976]	Vulnerable	Species or species habitat likely to occur within area
Philotheca ericifolia [64942]	Vulnerable	Species or species habitat likely to occur within area
Prasophyllum sp. Wybong (C.Phelps ORG 5269) a leek-orchid [81964]	Critically Endangered	Species or species habitat may occur within area
Pterostylis cobarensis Cobar Greenhood Orchid [12993]	Vulnerable	Species or species habitat likely to occur within area
Rulingia procumbens [12903]	Vulnerable	Species or species habitat likely to occur within area
Tylophora linearis [55231]	Endangered	Species or species habitat may occur within area
REPTILES		
Anomalopus mackayi Five-clawed Worm-skink, Long-legged Worm-skink [25934]	Vulnerable	Species or species habitat may occur within area
Uvidicolus sphyrurus Border Thick-tailed Gecko, Granite Belt Thick-tailed Gecko [84578]	Vulnerable	Species or species habitat likely to occur within area

Migratory Species [Resource Information]

* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.

Name	Threatened	Type of Presence
Migratory Marine Birds		
Apus pacificus Fork-tailed Swift [678]		Species or species habitat may occur within area
Ardea alba Great Egret, White Egret [59541]		Species or species habitat may occur within area
Ardea ibis Cattle Egret [59542]		Species or species habitat may occur within area
Migratory Terrestrial Species		
Haliaeetus leucogaster White-bellied Sea-Eagle [943]		Species or species

Name	Threatened	Type of Presence
		habitat likely to occur within area
Hirundapus caudacutus		
White-throated Needletail [682]		Species or species habitat known to occur within area
Leipoa ocellata		
Malleefowl [934]	Vulnerable	Species or species habitat may occur within area
Merops ornatus		
Rainbow Bee-eater [670]		Species or species habitat may occur within area
Xanthomyza phrygia		
Regent Honeyeater [430]	Endangered*	Species or species habitat may occur within area
Migratory Wetlands Species		
Ardea alba		
Great Egret, White Egret [59541]		Species or species habitat may occur within area
Ardea ibis		
Cattle Egret [59542]		Species or species habitat may occur within area
Gallinago hardwickii		
Latham's Snipe, Japanese Snipe [863]		Species or species habitat may occur within area
Rostratula benghalensis (sensu lato)		
Painted Snipe [889]	Vulnerable*	Species or species habitat likely to occur within area

Other Matters Protected by the EPBC Act

Commonwealth Lands [Resource Information]

The Commonwealth area listed below may indicate the presence of Commonwealth land in this vicinity. Due to the unreliability of the data source, all proposals should be checked as to whether it impacts on a Commonwealth area, before making a definitive decision. Contact the State or Territory government land department for further information.

Name
Commonwealth Land - Australian Telecommunications Commission
Commonwealth Land - Commonwealth Scientific & Industrial Research Organisation

Listed Marine Species [Resource Information]

* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.

Name	Threatened	Type of Presence
Birds		
Apus pacificus		
Fork-tailed Swift [678]		Species or species habitat may occur within area
Ardea alba		
Great Egret, White Egret [59541]		Species or species habitat may occur within area
Ardea ibis		
Cattle Egret [59542]		Species or species habitat may occur within area
Gallinago hardwickii		
Latham's Snipe, Japanese Snipe [863]		Species or species habitat may occur within area
Haliaeetus leucogaster		
White-bellied Sea-Eagle [943]		Species or species

Name	Threatened	Type of Presence
		habitat likely to occur within area
Hirundapus caudacutus		
White-throated Needletail [682]		Species or species habitat known to occur within area
Lathamus discolor		
Swift Parrot [744]	Endangered	Species or species habitat may occur within area
Merops ornatus		
Rainbow Bee-eater [670]		Species or species habitat may occur within area
Rostratula benghalensis (sensu lato)		
Painted Snipe [889]	Vulnerable*	Species or species habitat likely to occur within area

Extra Information

State and Territory Reserves	[Resource Information]
Name	State
Brigalow Park	NSW

Invasive Species	[Resource Information]

Weeds reported here are the 20 species of national significance (WoNS), along with other introduced plants that are considered by the States and Territories to pose a particularly significant threat to biodiversity. The following feral animals are reported: Goat, Red Fox, Cat, Rabbit, Pig, Water Buffalo and Cane Toad. Maps from Landscape Health Project, National Land and Water Resouces Audit,

Name	Status	Type of Presence
Frogs		
Bufo marinus		
Cane Toad [1772]		Species or species habitat likely to occur within area
Mammals		
Capra hircus		
Goat [2]		Species or species habitat likely to occur within area
Felis catus		
Cat, House Cat, Domestic Cat [19]		Species or species habitat likely to occur within area
Oryctolagus cuniculus		
Rabbit, European Rabbit [128]		Species or species habitat likely to occur within area
Sus scrofa		
Pig [6]		Species or species habitat likely to occur within area
Vulpes vulpes		
Red Fox, Fox [18]		Species or species habitat likely to occur within area
Plants		
Lycium ferocissimum		
African Boxthorn, Boxthorn [19235]		Species or species habitat may occur within

Name	Status	Type of Presence
		area
Parthenium hysterophorus Parthenium Weed, Bitter Weed, Carrot Grass, False Ragweed [19566]		Species or species habitat may occur within area
Pinus radiata Radiata Pine Monterey Pine, Insignis Pine, Wilding Pine [20780]		Species or species habitat may occur within area
Rubus fruticosus aggregate Blackberry, European Blackberry [68406]		Species or species habitat likely to occur within area
Salix spp. except S.babylonica, S.x calodendron & S.x reichardtii Willows except Weeping Willow, Pussy Willow and Sterile Pussy Willow [68497]		Species or species habitat likely to occur within area
Tamarix aphylla Athel Pine, Athel Tree, Tamarisk, Athel Tamarisk, Athel Tamarix, Desert Tamarisk, Flowering Cypress, Salt Cedar [16018]		Species or species habitat likely to occur within area

Coordinates

-30.63481 149.65028,-30.61404 149.6265,-30.54525 149.61077,-30.49194 149.62667,
-30.39978 149.6442,-30.36273 149.67805

Caveat

The information presented in this report has been provided by a range of data sources as acknowledged at the end of the report.

This report is designed to assist in identifying the locations of places which may be relevant in determining obligations under the Environment Protection and Biodiversity Conservation Act 1999. It holds mapped locations of World Heritage and Register of National Estate properties, Wetlands of International Importance, Commonwealth and State/Territory reserves, listed threatened, migratory and marine species and listed threatened ecological communities. Mapping of Commonwealth land is not complete at this stage. Maps have been collated from a range of sources at various

Not all species listed under the EPBC Act have been mapped (see below) and therefore a report is a general guide only. Where available data supports mapping, the type of presence that can be determined from the data is indicated in general terms. People using this information in making a referral may need to consider the qualifications below and may need to seek and consider other

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

For species where the distributions are well known, maps are digitised from sources such as recovery plans and detailed habitat studies. Where appropriate, core breeding, foraging and roosting areas are indicated under 'type of presence'. For species whose distributions are less well known, point locations are collated from government wildlife authorities, museums, and non-government organisations; bioclimatic distribution models are generated and these validated by experts. In some cases, the distribution maps are based solely on expert knowledge.

Only selected species covered by the following provisions of the EPBC Act have been mapped:

- migratory and
- marine

The following species and ecological communities have not been mapped and do not appear in reports produced from this database:

- threatened species listed as extinct or considered as vagrants
- some species and ecological communities that have only recently been listed
- some terrestrial species that overfly the Commonwealth marine area
- migratory species that are very widespread, vagrant, or only occur in small numbers

The following groups have been mapped, but may not cover the complete distribution of the species:

- non-threatened seabirds which have only been mapped for recorded breeding sites
- seals which have only been mapped for breeding sites near the Australian continent

Such breeding sites may be important for the protection of the Commonwealth Marine environment.

Acknowledgements

This database has been compiled from a range of data sources. The department acknowledges the following custodians who have contributed valuable data and advice:

-Department of Environment, Climate Change and Water, New South Wales
-Department of Sustainability and Environment, Victoria
-Department of Primary Industries, Parks, Water and Environment, Tasmania
-Department of Environment and Natural Resources, South Australia
-Parks and Wildlife Service NT, NT Dept of Natural Resources, Environment and the Arts
-Environmental and Resource Management, Queensland
-Department of Environment and Conservation, Western Australia
-Department of the Environment, Climate Change, Energy and Water
-Birds Australia
-Australian Bird and Bat Banding Scheme
-Australian National Wildlife Collection
-Natural history museums of Australia
-Museum Victoria
-Australian Museum
-SA Museum
-Queensland Museum
-Online Zoological Collections of Australian Museums
-Queensland Herbarium
-National Herbarium of NSW
-Royal Botanic Gardens and National Herbarium of Victoria
-Tasmanian Herbarium
-State Herbarium of South Australia
-Northern Territory Herbarium
-Western Australian Herbarium
-Australian National Herbarium, Atherton and Canberra
-University of New England
-Ocean Biogeographic Information System
-Australian Government, Department of Defence
-State Forests of NSW
-Other groups and individuals

The Department is extremely grateful to the many organisations and individuals who provided expert advice and information on numerous draft distributions.

Please feel free to provide feedback via the Contact Us page.

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Appendix 2

Anabat Analysis Report

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BAT CALL ANALYSIS REPORT
Narrabri, NSW
RPS Australia East Pty Ltd

15 May 2012

Job Reference: A022

This report has been prepared to document the analysis of digital ultrasonic bat echolocation calls received from a third party. The data was not collected by the author and as such no responsibility is taken for the quality of data collection or for the suitability of its subsequent use.

This report was authored by



Anna McConville
B.Env.Sc.

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1.0 Introduction 1

2.0 Methods 2

3.0 Results 3

4.0 Sample Calls 5

5.0 References 6

1.0 INTRODUCTION

This report has been commissioned by RPS Australia East Pty Ltd to analyse bat echolocation call data (Anabat, Titley Electronics) collected from Narrabri, NSW. Data was provided electronically to the author. This report documents the methods involved in analysing bat call data and the results obtained only.

2.0 METHODS

The identification of bat echolocation calls recorded during surveys was undertaken using AnalookW (Version 3.8m) software. The identification of calls was undertaken with reference to Pennay and others (2004) and through the comparison of recorded reference calls from western slopes and plains and north-eastern NSW. Reference calls were obtained from the NSW database.

Each call sequence ('pass') was assigned to one of five categories, according to the confidence with which an identification could be made, being:

- Definite - Pass identified to species level and could not be confused with another species
- Probable - Pass identified to species level and there is a low chance of confusion with another species
- Possible - Pass identified to species level but short duration or poor quality of the pass increases the chance of confusion with another species
- Species group - Pass could not be identified to species level and could belong to one of two or more species. Occurs more frequently when passes are short or of poor quality
- Unknown - Either background 'noise' files or passes by bats which are too short and/or of poor quality to confidently identify.

Call sequences that were less than three pulses in length were not analysed and were assigned to 'Unknown' and only search phase calls were analysed. Furthermore, some species are difficult to differentiate using bat call analysis due to overlapping call frequencies and similar shape of plotted calls and in these cases calls were assigned to species groups.

The total number of passes (call sequences) per unit per night was tallied to give an index of activity.

It should be noted that the activity levels recorded at different sites may not be readily able to be compared. Such comparisons are dependent on many variables which need to be carefully controlled during data collection and statistically analysed. Influential variables include wind, rain, temperature, duration of recording, season, detector and microphone sensitivity, detector placement, weather protection devices etc.

Description of the Characteristics Used to Differentiate Species

Tadarida australis was identified on the basis of characteristic frequency. *Vespadelus vulturnus* was identified at a probable level from *Miniopterus schreibersii oceanensis* by the absence of a down-sweeping tail and even pulses.

3.0 RESULTS

A total of 779 call sequences were recorded, of which 32 call sequences were able to be analysed (ie were not 'noise' files or bat calls of short length). Of the bat calls, 8 call sequences (25%) were able to be confidently identified (those classified as either definite or probable identifications) to species level (Table 1). Species recorded confidently within the site include:

- *Tadarida australis* (White-striped freetail bat)
- *Vespadelus vulturnus* (Little forest bat)

Additional bat species that are known to exist within the locality of the site, but could not be confidently identified to species (those classified as possible or as a species group), include:

- *Chalinolobus gouldii* (Gould's wattled bat)
- *Miniopterus schreibersii oceanensis* (Eastern bentwing bat)
- *Mormopterus* species 2 (Eastern freetail bat)
- *Mormopterus* species 4 (Southern freetail bat)
- *Mormopterus eleryi* (Bristle-nosed freetail bat)
- *Scoteanax rueppellii* (Greater broad-nosed bat)
- *Scotorepens greyii* (Little broad-nosed bat)
- *Scotorepens balstoni* (Inland broad-nosed bat)
- *Scotorepens* species (Central-eastern broad-nosed bat)

It should be noted that additional bat species may be present within the site but were not recorded by the detectors and habitat assessment should be used in conjunction with these results to determine the likelihood of occurrence of other bat species.

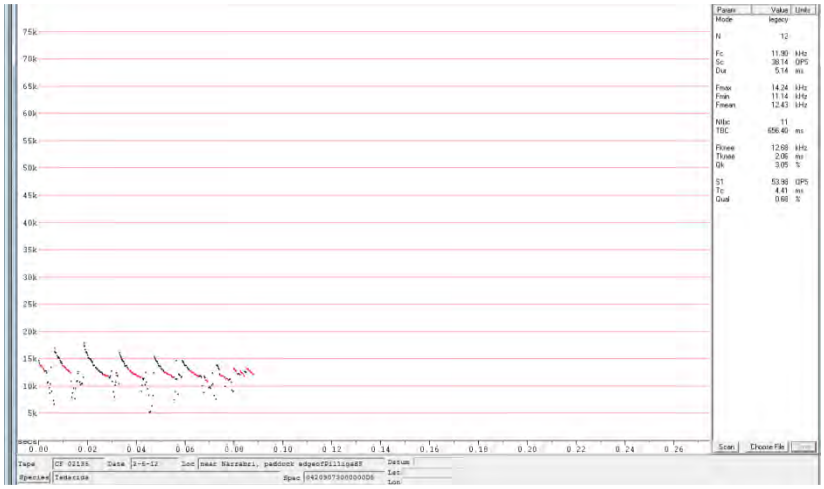
Table 1 below summarises the results of the bat call analysis

Table 1: Results of bat call analysis (number of passes per site per night)

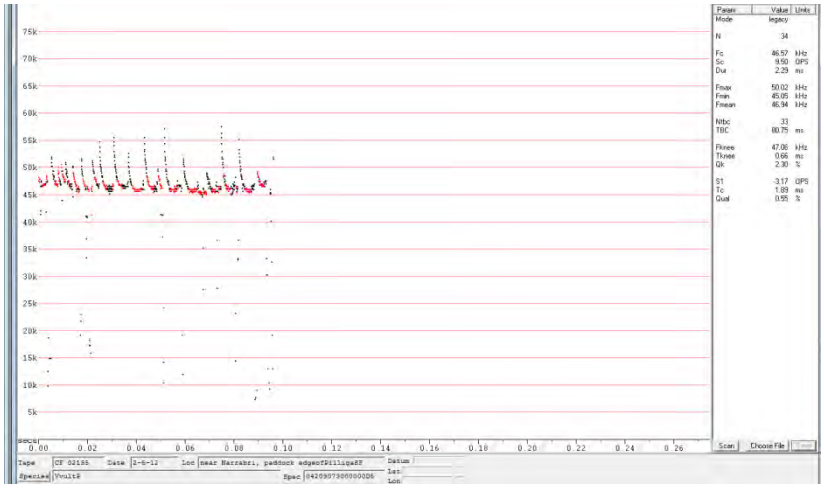
IDENTIFICATION	Anabat 1 2/5/2012	Anabat 1 3/5/2012	Anabat 1 7/5/2012	Anabat 1 8/5/2012	Anabat 1 9/5/2012	Anabat 2 7/5/2012	Anabat 2 8/5/2012	Anabat 2 10/5/2012
DEFINITE								
Tadarida australis	6	-	-	-	-	-	-	-
PROBABLE								
Tadarida australis	1	-	-	-	-	-	-	-
Vespadelus vulturnus	1	-	-	-	-	-	-	-
POSSIBLE								
Chalinolobus gouldii	2	-	-	-	-	-	-	-
SPECIES GROUPS								
Chalinolobus gouldii / Mormopterus species 2 / *Mormopterus* species 4 / *Scotorepens balstoni*	1	-	1	-	-	-	-	-
Chalinolobus gouldii / Scotorepens balstoni / Scoteanax rueppellii	-	8	-	-	-	-	-	-
Miniopterus schreibersii oceanensis / Vespadelus vulturnus	6	1	-	-	-	-	-	-
Mormopterus eleryi / Scotorepens greyii	-	1	-	-	-	-	-	-
Mormopterus Species 2 / Mormopterus Species 4	-	2	-	-	-	-	-	-
Scotorepens greyii / Scotorepens species	2	-	-	-	-	-	-	-
UNKNOWN								
Unknown	10	6	-	5	1	-	-	-
'Noise' files	19	1	1	692	-	2	3	7
TOTAL	**48**	**19**	**2**	**697**	**1**	**2**	**3**	**7**
Time of calls recorded (does not necessarily translate to survey effort, simply when calls were recorded)	**Entire Night**	**5:30pm – 8:50pm**	**4:00pm – 9:30pm**	**9:30am – 6:45pm**	**6:00pm**	**4:55pm**	**8:00 – 8:30 am**	**3:30pm – 4:15pm**

4.0 SAMPLE CALLS

A sample of the calls actually identified from the site for each species is given below.



Tadarida australis – Definite Call



Vespadelus vulturnus – Probable Call

5.0 REFERENCES

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Appendix 3

Flora Species List (Leewood & ROW)

Family Name	Scientific Name	Common Name	Leewood	RoW
Fabaceae/faboideae/Mimosoideae	*Acacia caroleae*			✓
Fabaceae/faboideae/Mimosoideae	*Acacia deanei*	Green Wattle	✓	✓
Fabaceae/faboideae/Mimosoideae	*Acacia harpophylla*	Brigalow	✓	
Fabaceae/faboideae/Mimosoideae	*Acacia spectabilis*	Mudgee Wattle		✓
Polygonaceae	*Acetosella vulgaris**	Sheep Sorrel	✓	
Asteraceae	*Actinotus helianthi*	Flannel Flower		✓
Casuarinaceae	*Allocasuarina luehmannii*	Bulloak	✓	✓
Poaceae	*Aristida jerichoensis*	Jericho Wiregrass	✓	
Poaceae	*Aristida ramosa*	Purple Wiregrass	✓	✓
Poaceae	*Aristida vagans*	Three-awn Speargrass	✓	
Poaceae	*Austrodanthonia bipartita*	Wallaby Grass	✓	
Poaceae	*Austrodanthonia richardsonii*	Straw Wallaby Grass	✓	
Poaceae	*Austrodanthonia tenuior*	Wallaby Grass	✓	
Poaceae	*Austrostipa scabra* subsp. *falcata*		✓	
Poaceae	*Austrostipa scabra* subsp. *scabra*	Speargrass	✓	✓
Poaceae	*Austrostipa setacea*	Corkscrew Grass	✓	
Poaceae	*Austrostipa verticillata*	Slender Bamboo Grass	✓	✓
Asteraceae	*Bidens pilosa*	Cobbler's Pegs		✓
Poaceae	*Bothriochloa decipiens*	Redleg Grass	✓	
Sterculiaceae	*Brachychiton populneus*	Kurrajong		✓
Asteraceae	*Brachyscome sp*		✓	
Pittosporaceae	*Bursaria spinosa* var. *spinosa*	Blackthorn		✓
Myrtaceae	*Callistemon linearis*	Narrow-leaved Bottlebrush		✓
Cupressaceae	*Callitris endlicheri*	Black Cypress Pine		✓
Cupressaceae	*Callitris glaucophylla*	White Cypress Pine	✓	✓
Asteraceae	*Calotis cuneifolia*	Purple Burr Daisy	✓	
Cyperaceae	*Carex pumila*		✓	
Casuarinaceae	*Casuarina cristata*	Belah	✓	
Euphorbiaceae	*Chamaesyce drummondii*	Caustic Weed	✓	
Sinopteridaceae	*Cheilanthes sieberi* subsp. *sieberi*	Poison Rock Fern	✓	✓
Poaceae	*Chloris gayana**	Rhodes Grass	✓	
Poaceae	*Chloris truncata*	Windmill Grass	✓	
Poaceae	*Chloris ventricosa*	Tall Chloris	✓	✓
Asteraceae	*Conyza bonariensis**	Flax-leaf Fleabane		✓
Asteraceae	*Conyza sumatrensis**	Tall Fleabane		✓
Poaceae	*Cymbopogon refractus*	Barbwire Grass		✓
Poaceae	*Cynodon dactylon*	Common Couch	✓	✓
Cyperaceae	*Cyperus* sp.	-	✓	
Fabaceae/faboideae	*Daviesia genistifolia*	Broom Bitter Pea		✓

Family Name	Scientific Name	Common Name	Leewood	RoW
Fabaceae/faboideae	*Desmodium varians*	Slender Tick-trefoil		✓
Phormiaceae	*Dianella revoluta* var. *revoluta*	Spreading Flax Lily		✓
Convolvulaceae	*Dichondra repens*	Kidney Weed	✓	
Sapindaceae	*Dodonaea heteromorpha*	Maple-fruited Hop-bush		✓
Sapindaceae	*Dodonaea viscosa subsp. cuneata*	Wedge-leaf Hop-bush		✓
Poaceae	*Eragrostis brownii*	Brown's Lovegrass		✓
Poaceae	*Eragrostis elongata*	Clustered Lovegrass	✓	
Poaceae	*Eragrostis lacunaria*	Purple Lovegrass	✓	
Poaceae	*Eragrostis parviflora*	Weeping Lovegrass	✓	
Poaceae	*Eragrostis setifolia*	Bristly Love Grass	✓	
Myoporaceae	*Eremophila* sp.		✓	
Myrtaceae	*Eucalyptus blakelyi*	Blakeley's Red Gum		✓
Myrtaceae	*Eucalyptus chloroclada*	Dirty Gum		✓
Myrtaceae	*Eucalyptus crebra*	Narrow-leaved Ironbark	✓	✓
Myrtaceae	*Eucalyptus pilligaensis*	Narrow-leaved Grey Box	✓	✓
Myrtaceae	*Eucalyptus microcarpa*	Grey Box	✓	
Fabaceae/faboideae	*Glycine tabacina*	Twining Glycine	✓	
Goodeniaceae	*Goodenia rotundifolia*			✓
Clusiaceae	*Hypericum gramineum*	Small St Johns Wort		✓
Asteraceae	*Hypochaeris radicata**	Flatweed	✓	
Poaceae	*Imperata cylindrica*	Blady Grass		✓
Juncaceae	*Juncus* sp.	-	✓	
Juncaceae	*Juncus subsecundus*	Finger Rush	✓	✓
Myrtaceae	*Leptospermum polygalifolium* subsp. *polygalifolium*	Tantoon		✓
Lomandraceae	*Lomandra filiformis* subsp. *filiformis*	Wattle Mat-rush		✓
Lomandraceae	*Lomandra leucocephala*			✓
Lomandraceae	*Lomandra multiflora*	Many-flowered Mat-rush		✓
Marsileaceae	*Marsilea hirsuta*	Nardoo	✓	
Myrtaceae	*Melaleuca erubescens*	-		✓
Epacridaceae	*Melichrus urceolatus*	Urn Heath		✓
Menyanthaceae	*Nymphoides indica*	Water Snowflake	✓	
Amaranthaceae	*Gomphrena celosioides*	Gomphrena Weed	✓	
Cactaceae	*Opuntia aurantiaca**	Tiger Pear	✓	
Cactaceae	*Opuntia stricta**	Prickly Pear		✓
Oxalidaceae	*Oxalis* sp.	-	✓	✓
Poaceae	*Panicum effusum*	Hairy Panic	✓	✓
Poaceae	*Panicum simile*	Two Colour Panic	✓	
Poaceae	*Panicum* sp.	-	✓	
Poaceae	*Phragmites australis*	Common Reed		✓
Plantaginaceae	*Plantago lanceolata**	Ribwort		✓

Family Name	Scientific Name	Common Name	Leewood	RoW
Rubiaceae	*Pomax umbellata*	Pomax		✓
Portulacaceae	*Portulaca oleracea*	Purslane	✓	
Chenopodiaceae	*Maireana microphylla*	Small-leaf Bluebush	✓	
Polygonaceae	*Rumex* sp.		✓	
Chenopodiaceae	*Sclerolaena birchii*	Galvanized Burr	✓	
Chenopodiaceae	*Sclerolaena convexula*	Tall Copperburr	✓	
Chenopodiaceae	*Sclerolaena* sp.		✓	
Malvaceae	*Sida corrugata*	-	✓	
Solanaceae	*Solanum amblymerum*		✓	
Solanaceae	*Solanum ferocissimum*	Spiny Potato Bush		✓
Restionaceae	*Sporadanthus gracilis*	Slender Scale-rush	✓	
Poaceae	*Sporobolus creber*	Slender Rat's Tail Grass	✓	✓
Asteraceae	*Taraxacum officinale**	Dandelion		✓
Urticaceae	*Urtica incisa*	Stinging Nettle		✓
Verbenaceae	*Verbena bonariensis**	Purpletop		✓
Asteraceae	*Vittadinia cuneata* var. *cuneata*	Fuzzweed		✓
Campanulaceae	*Wahlenbergia* sp.		✓	
Asteraceae	*Xanthium occidentale**	Noogoora Burr		✓

Appendix 4

Fauna Species List (Leewood & ROW)

Family Name	Scientific Name	Common Name	Leewood	RoW
Avifauna				
ALAUDIDIAE	*Cincloramphus mathewsi*	Rufous Songlark	✓	
ALCEDINIDAE	*Dacelo novaeguineae*	Laughing Kookaburra	✓	✓
ANATIDAE	*Chenonetta jubata*	Australian Wood Duck	✓	
ARDEIDAE	*Ardea pacifica*	White-necked (Pacific) Heron	✓	
	Egretta novaehollandiae	White-faced Heron	✓	
ARTAMIDAE	*Cracticus nigrogularis*	Pied Butcherbird	✓	
	Cracticus tibicen	Australian Magpie	✓	✓
	Cracticus torquatus	Grey Butcherbird	✓	
	Strepera graculina	Pied Currawong	✓	✓
CACATUIDAE	*Cacatua galerita*	Sulphur-crested Cockatoo	✓	✓
	Cacatua roseicapilla	Galah	✓	✓
	Calyptorhynchus lathami	**Glossy Black-Cockatoo**		✓
CAMPEPHAGIDAE	*Coracina tenuirostris*	Cicadabird		✓
CASUARIIDAE	*Dromaius novaehollandiae*	Emu		✓
CLIMACTERIDAE	***Climacteris picumnus victoriae***	**Brown Treecreeper**		✓
	Cormobates leucophaea	White-throated Treecreeper		✓
CHARADRIIDAE	*Vanellus miles*	Masked Lapwing	✓	
COLUMBIDAE	*Geopelia striata*	Peaceful Dove		✓
	Ocyphaps lophotes	Crested Pigeon	✓	✓
	*Streptopelia chinensis**	Spotted Dove	✓	
CORCORACIDAE	*Corcorax melanorhamphos*	White-Winged Chough	✓	✓
	Struthidea cinerea	Apostlebird	✓	
CORVIDAE	*Corvus coronoides*	Australian Raven	✓	✓
DICRURIDAE	*Grallina cyanoleuca*	Magpie-lark	✓	✓
	Rhipidura albiscapa	Grey Fantail	✓	
	Rhipidura leucophrys	Willie Wagtail		✓
ESTRILDIDAE	***Stagonopleura guttata***	**Diamond Firetail**		✓
	Taeniopygia guttata	Zebra Finch	✓	
FALCONIDAE	*Falco cenchroides*	Nankeen Kestrel	✓	
HIRUNDINIDAE	*Hirundo neoxena*	Welcome Swallow	✓	✓
MALURIDAE	*Malurus cyaneus*	Superb Fairy-wren	✓	
MELIPAGIDAE	*Acanthagenys rufogularis*	Spiny-cheeked Honeyeater		✓
	Lichenostomus chrysops	Yellow-faced Honeyeater		✓
	Lichenostomus leucotis	White-eared Honeyeater		✓
	Lichenostomus penicillatus	White-plumed Honeyeater	✓	
	Manorina melanocephala	Noisy Miner	✓	✓
	Philemon citreogularis	Little Friarbird	✓	
	Philemon corniculatus	Noisy Friarbird		✓
	Phylidonyris nigra	White-cheeked Honeyeater	✓	

Family Name	Scientific Name	Common Name	Leewood	RoW
PACHYCEPHALIDAE	*Colluricincla harmonica*	Grey Shrike-thrush		✓
	Pachycephala rufiventris	Rufous Whistler	✓	
PARDALOTIDAE	*Acanthiza nana*	Yellow Thornbill	✓	✓
	Acanthiza reguloides	Buff-rumped Thornbill		✓
	Pardalotus punctatus	Spotted Pardalote	✓	✓
	Smicrornis bevirostris	Weebill		✓
PETROIICIDAE	*Microeca fascinans*	Jacky Winter	✓	✓
PLOCEIDAE	*Taeniopygia bichenovii*	Double-barred Finch	✓	✓
PODARGIDAE	*Podargus strigoides*	Tawny Frogmouth	✓	
POMATOSTOMIDAE	***Pomatostomus temporalis temporalis***	**Grey-crowned Babbler**	✓	✓
PSITTACIDAE	*Aprosmictus erythroterus*	Red-winged Parrot	✓	
	Barnardius zonarius	Australian Ringneck	✓	
	Glossopsitta concinna	Musk Lorikeet	✓	
	Neophema pulchella	**Turquoise Parrot**		✓
	Platycercus eximius	Eastern Rosella	✓	✓
	Psephotus haematonotus	Red-rumped Parrot	✓	
THRESKIORNITHIDAE	*Threskiornis spinicollis*	Straw-necked Ibis	✓	
Mammals				
VESPERTILIONIDAE	*Vespadelus vulturnus*	Little Forest Bat	✓	
	Chalinolobus gouldii	Gould's Wattled Bat	✓	
BOVIDAE	*Bos taurus**	Cattle		✓
	Capra aegagrus hircus	Goat*	✓	✓
CANIDAE	*Vulpes vulpes**	Fox	✓	✓
DASYURIDAE	*Antechinus flavipes*	Yellow-Footed Antechinus	✓	
	Planigale maculata	Common planigale	✓	
LEPORIDAE	*Lepus capensis**	Brown hare	✓	
	*Oryctolagus cuniculus**	Rabbit	✓	✓
MACROPODIDAE	*Macropus giganteus*	Eastern Grey Kangaroo	✓	✓
PHALANGERIDAE	*Trichosurus vulpecula*	Common Brushtail Possum	✓	
SUIDAE	*Sus scrofa**	Wild Boar	✓	
Amphibians				
HYLIDAE	*Litoria caerulea*	Green Tree Frog	✓	
	Litoria rubella	Desert tree Frog	✓	
Reptiles				
SCINCIDAE	*Lampropholis delicata*	Garden Sun Skink		✓

Appendix 5

Likelihood of Occurence – Leewood

Those threatened flora and fauna species (listed under the *TSC Act* and the *EPBC Act*) that have been gazetted / recorded from within the locality have been considered in the following tables. EEC's and Endangered Populations known from the broader area have also been addressed. Each species / community / population is considered for its potential to occur within the study area and the likely level of impact as a result of the proposed activities. The following tables deal with each species / community / population separately and identifies the ecological parameters of significance associated with the proposed activities.

'Species' or **'EEC / Population'** – Lists each threatened species / EEC / population known from the vicinity of the site. The status of each threatened species under the *TSC Act* and *EPBC Act* is also provided.

'Habitat' – Provides a brief account of the species / community / population and the preferred habitat attributes required for the existence / survival of each species / community / population.

'Likelihood of Occurrence'– Assesses the likelihood of each species / community / population to occur within the site in terms of the aforementioned habitat description and taking into account local habitat preferences, results of recent field investigations, data gained from various sources and previously gained knowledge via fieldwork undertaken within other ecological assessments in the locality.

'Potential for Impact' – Through consideration of the likely level / significance of impacts to each species / community / population that would result from the proposed activities, taking into account both short and long-term impacts, a decision has been made whether further assessment is required. This assessment is largely based on the chance of occurrence of each species / community with due recognition to other parameters such as home range, habitat use, connectivity etc. It also considers the scope of the proposed activities.

Ecological Community	TSC Act Status	EPBC Act Status	Habitat	Likelihood of Occurrence	Potential for Impact
Brigalow within the Brigalow Belt South, Nandewar and Darling Riverine Plains Bioregions (TSC). Brigalow (Acacia harpophylla dominant and co-dominant) (EPBC)	E	E	Dominated by *A. harpophylla and* associated with deep gilgaied clays, sedentary clays, alluvial clays and loamy red soils. Can occur with or without various Eucalypt species. Generally poses a dense low tree layer or tall shrub layer. The ground layer is typically sparse but dominated by native grasses.	**Recorded** on site.	There is potential for this community to be impacted upon as a result of the proposed actions. *As there is some degree of impact, it has been assessed in **Appendix 6** and **Appendix 7**.*
Coolibah - Black Box Woodlands of the DarlingRiverine Plains and the Brigalow Belt South Bioregions	E	E	Open eucalypt woodlands formerly occurred across a range of climatic regions of Australia, including semi-arid and humid subtropical zones. The position in the landscape of these woodlands can determine the vegetation structure of the woodlands such as if they occur on the floodplains or uplands and consequently, whether they have a more shrubby or more grassy understorey.	This community was not identified on site during targeted surveys. Therefore, it is considered **unlikely** to occur.	As this community is unlikely to occur on site it is not likely to be impacted upon as a result of the proposed actions. An AoS is not required for this community.
Grey Box (Eucalyptus microcarpa) Grassy Woodlands and Derived Native Grasslands of South-eastern Australia (EPBC) Inland Grey Box Woodland in the Riverina, NSW South Western Slopes, Cobar Peneplain, Nandewar and Brigalow Belt South Bioregions (TSC)	E	E	Dominated by *E. microcarpa* and is found on relatively fertile soils of the western slopes and plains of NSW. Has a sparse shrub layer with a variable ground layer of grass and herbaceous species present almost always. This woodland is 15-25m tall but disturbed patches can experience thinning and clearing which alters the overall height.	This community was not identified on site during targeted surveys. Therefore, it is considered **unlikely** to occur.	As this community is unlikely to occur on site it is not likely to be impacted upon as a result of the proposed actions. An AoS is not required for this community.
Natural grasslands on basalt and fine-textured alluvial plains of northern New South Wales (EPBC) and southern Queensland; Native Vegetation on Cracking Clay Soils of the Liverpool Plains (TSC)	E	CE	This community is generally grassland often dominated by grass species such as *Austrostipa aristiglumis*, *Dichanthium sericeum* or *Panicum queenslandicum* but can also include various shrubs and trees. This community occurs on cracking clay soils within the Liverpool Plains Catchment.	This community was not identified on site during targeted surveys. Therefore, it is considered **unlikely** to occur.	As this community is unlikely to occur on site it is not likely to be impacted upon as a result of the proposed actions. An AoS is not required for this community.

Ecological Community	TSC Act Status	EPBC Act Status	Habitat	Likelihood of Occurrence	Potential for Impact
Weeping Myall Woodlands (EPBC) Myall Woodland in the Darling Riverine Plains, Brigalow Belt South, Cobar Peneplain, Murray-Darling Depression, Riverina and NSW South western Slopes bioregions (TSC)	E	E	This woodland is dominated by *Acacia pendula* (Weeping Myall). It is scattered through the eastern parts of alluvial plains of the Murray-Darling river system. It is generally found on red-brown earths and heavy textured grey brown alluvial soils. The canopy layer reaches 10m in height with an open understorey of chenopod shrubs and other woody plant species. The ground layer is an open to continuous groundcover of grasses and herbs.	This community was not identified on site during targeted surveys. Therefore, it is considered **unlikely** to occur.	As this community is unlikely to occur on site it is not likely to be impacted upon as a result of the proposed actions. An AoS is not required for this community.
White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland (EPBC) White Box-Yellow Box-Blakely's Red Gum Grassy Woodland (TSC)	E	CE	This woodland is found on fertile soils on the tablelands and western slopes of NSW. The distribution of the community spreads between NSW North Coast, New England Tableland, Nandewar, Brigalow Belt, South, Sydney Basin, South Eastern Highlands and NSW South Western Slopes Bioregions. The characteristic species for this woodland are *Eucalyptus albens*, *Eucalyptus melliodora* or *Eucalyptus blakelyi*. Grass and herbaceous species generally characterise the ground layer. In some locations canopy species may be entirely absent due to clearing. Shrubs are generally sparse or absent.	This community was not identified on site during targeted surveys. Therefore, it is considered **unlikely** to occur.	As this community is unlikely to occur on site it is not likely to be impacted upon as a result of the proposed actions. An AoS is not required for this community.

Species	Common Name	TSC Act Status	EPBC Act Status	Habitat	Likelihood of Occurrence	Potential for Impact
Bertya opponens		V	V	Grows on slightly elevated ridges with moderately coarse, sandy soil. The vegetation ranges from mallee shrubland to open woodland.	This species was not recorded on site and records within 10km of the site do not exist (NSW Wildlife Atlas). However, the Protected Matters Search predicted that this species has potential to occur. No suitable habitats in the form of slightly elevated ridges with moderately coarse, sandy soil are present on site. Therefore it is considered **unlikely** to occur on site.	This species is unlikely to occur on site. Therefore it is not likely to be impacted upon as a result of the proposed actions. An AoS is not required for this species.
Cadellia pentastylis	Ooline		V	Ooline occurs on the western edge of the NSW north-west slopes. Ooline grows in dry rainforest, semi-evergreen vine thickets and sclerophyll ecological communities, often locally dominant or as an emergent.	No records for this species exist within a 10km radius of the site (NSW Wildlife Atlas). However, the Protected Matters Search predicted that this species has potential to occur. and it was not detected during comprehensive field surveys to spite it being a distinctive looking small tree. Suitable habitat on site is also suboptimal. Therefore, it is considered **unlikely** to occur.	This species is unlikely to occur on site. Therefore it is not likely to be impacted upon as a result of the proposed actions. An AoS is not required for this species.
Lepidium aschersonii	Spiny Pepper-cress		V	Spiny Peppercress is endemic to mainland southern Australia, where it is widely but patchily distributed from north-eastern New South Wales to Western Australia. There are currently thought to be about 30 populations of Spiny Peppercress with only 14 records existing within NSW. Occurs in periodically wet sites such as gilgai depressions and the margins of	This species has not been recorded within 10km of the site (NSW Wildlife Atlas). However, the Protected Matters Search predicted that this species has potential to occur. This species was not recorded during field surveys. Suitable habitat such as saline marshes and shallow lakes do not occur on site.	This species is unlikely to occur on site. Therefore it is not likely to be impacted upon as a result of the proposed actions. An AoS is not required for this species.

Species	Common Name	TSC Act Status	EPBC Act Status	Habitat	Likelihood of Occurrence	Potential for Impact
				freshwater and saline marshes and shallow lakes, usually on heavy clay soil.	Therefore it is considered **unlikely** to occur.	
Philotheca ericifolia		Delisted	V	This species inhabits the north-western slopes and central western slopes of NSW, from the upper Hunter Valley, to Pilliga and to the Peak Hill district. Occurs in drainage areas in dry sclerophyll open forest or woodland on sandstone and in heath on damp sandy flats and gullies.	The Protected Matters Search predicted that this species has potential to occur. However, no records exist for this species within 10km of the site (NSW Wildlife Atlas) and field surveys did not detect this species on site. In addition, no suitable habitat of damp or drainage areas occur on site. Therefore, it is considered to **unlikely** to occur on site.	This species is unlikely to occur on site. Therefore it is not likely to be impacted upon as a result of the proposed actions. An AoS is not required for this species.
Pterostylis cobarensis	Cobar Greenhood Orchid	V	V	Cobar Greenhood Orchid is known chiefly from the Nyngan–Cobar–Bourke district in the far western plains of NSW. Grows among rocks on low hills and on slopes above streams. Inhabits eucalypt woodland, open mallee, or *Callitris* shrubland on low stony ridges and slopes with skeletal sandy-loam soils. Flowering occurs from September to November	This species was not recorded on site (NSW Wildlife Atlas). However, the Protected Matters Search predicted that this species has potential to occur. Also, it should be noted that at the time of surveys this species would not have been detectable. No records exist within 10km of the site for this species. However, some sub-optimal habitat does occur on site Due to its cryptic nature its occurrence cannot be totally discounted. Therefore, it is considered as having **potential** to occur.	This species is considered to have **potential** to occur on site. Therefore it has potential to be impacted upon as a result of the proposed actions. *As there is potential for impact upon this species it is assessed in **Appendix 6** and **Appendix 7**.*
Rulingia procumbens		V	V	Endemic to NSW and is known from the Dubbo–Medooran–Gilgandra region, the Cobar region, and the	No records for this species exist within 10km of the site (NSW Wildlife Atlas). However, the	This species is considered to have **potential** to occur on site. Therefore it has potential

Species	Common Name	TSC Act Status	EPBC Act Status	Habitat	Likelihood of Occurrence	Potential for Impact
				upper Hunter Valley. Populations of this species have been recorded in Goonoo State Forest (SF), Mt Kaputar National Park, and Pilliga Nature Reserve. Occurs in sandy soils, often in disturbed habitats such as road verges, quarry boundaries, gravel stockpiles, and power line easements.	Protected Matters Search predicted that this species has potential to occur. It was not detected during field surveys. However, some sub-optimal habitat does occur on site therefore, it is considered to have **potential** to occur on site.	to be impacted upon as a result of the proposed actions. *As there is potential for impact upon this species it is assessed in **Appendix 6** and **Appendix 7**.*
Tylophora linearis		V	E	*Tylophora linearis* has rarely been collected and is known from eight localities in the Dubbo area and Mt Crow near Barraba in NSW. Grows in dry scrub, open forest and woodlands associated with *Melaleuca uncinata*, *Eucalyptus fibrosa*, *E. sideroxylon*, *E. albens*, *Callitris endlicheri*, *C. glaucophylla*, *Allocasuarina luehmannii*, *Acacia hakeoides*, *A. lineata*, *Myoporum* spp., and *Casuarina* spp.	This species has not been recorded within 10km of the site (NSW Wildlife Atlas). However, the Protected Matters Search predicted that this species has potential to occur. This species was not detected during field surveys. However, some sub-optimal habitat does occur on site therefore, it is considered to have **potential** to occur on site.	This species is considered to have **potential** to occur on site. Therefore it has potential to be impacted upon as a result of the proposed actions. *As there is potential for impact upon this species it is assessed in **Appendix 6** and **Appendix 7**.*
Circus assimilis	Spotted Harrier	V	M	Occurs throughout the Australian mainland, except in densely forested or wooded habitats of the coast, escarpment and ranges. Individuals disperse widely in NSW and comprise a single population. Grassy open woodland including Acacia and mallee remnants, inland riparian woodland, grassland and shrub steppe (*e.g.* chenopods). It is found most commonly in native grassland, but also occurs in agricultural land, foraging over open habitats including edges of inland wetlands.	This species could utilise the site to forage for prey such as small birds and mammals. Therefore there is **potential** for it to occur on site.	This species is considered to have **potential** to occur on site. Therefore it has potential to be impacted upon as a result of the proposed actions. *As there is potential for impact upon this species it is assessed in **Appendix 6** and **Appendix 7**.*

Species	Common Name	TSC Act Status	EPBC Act Status	Habitat	Likelihood of Occurrence	Potential for Impact
Climacteris picumnus victoriae	Brown Treecreeper (Eastern Subspecies)	V		Frequents drier forests and woodlands, particularly open woodland lacking a dense understorey. Also found in grasslands in proximity to wooded areas where there are sufficient logs, stumps and dead trees nearby. Occasionally found in mallee and *Eucalyptus camaldulensis* (River Red Gum) forest bordering wetlands with an open understorey of *Acacia* sp., *Muehlenbeckia* sp. (Lignum), *Typha* sp. (Cumbungi) and *Poa* sp. (grasses). Feeds on invertebrate larvae and small insects, particularly ants. Utilises hollows for roosting/nesting.	This species has been recorded once within 10km of the site according to NSW Wildlife Atlas records, also, during RPS 2012 surveys this species was detected along the ROW area and suitable habitat does occur on the Leewood site. Therefore, it is considered as having **Potential** to occur.	This species is considered to have **potential** to occur on site. Therefore it has potential to be impacted upon as a result of the proposed actions. *As there is potential for impact upon this species it is assessed in **Appendix 7**.*
Pomatostomus temporalis temporalis	Grey-crowned Babbler	V		Occupies open forests and woodlands, Acacia shrubland and adjoining farmland. Also Box-Gum Woodlands on the divide slopes and Box-Cypress Pine and open Box Woodlands on the plains. They feed on terrestrial invertebrates and insects on lower trunks and branches. Generally they prefer wooded areas with an intact ground cover, although in such areas as the Hunter Valley they occur in sparsely vegetated areas such as properties and golf courses. Appears unable to persist in cleared and highly fragmented habitats. Nest comprise of a dome shape stick nest which is often only a couple of metres from the ground in shrubs or Eucalypt saplings.	**Recorded** on site.	This species was recorded on site and has the potential to be impacted by the proposed actions. *As this species occurs within the study area, it has been assessed in **Appendix 7**.*

Species	Common Name	TSC Act Status	EPBC Act Status	Habitat	Likelihood of Occurrence	Potential for Impact
Phascolarctos cinereus	Koala	V	V	Occurs in forests and woodlands where it requires suitable feed trees (particular Eucalyptus spp.) and habitat linkages. Will occasionally cross open areas, although it becomes more vulnerable to predator attack and road mortality during these excursions.	Secondary feed trees used by this species do occur on site, although comprehensive surveys did not locate this species or signs of this species on site. Nevertheless it is considered as having **potential** to occur.	This species is considered to have **potential** to occur on site. Therefore it has potential to be impacted upon as a result of the proposed actions. *As there is potential for impact upon this species it is assessed in **Appendix 6** and **Appendix 7**.*
Saccolaimus flaviventris	Yellow-bellied Sheathtail-bat	V		Roosts singly or in groups of up to six, in tree hollows and buildings; in treeless areas they are known to utilise mammal burrows. When foraging for insects, flies high and fast over the forest canopy, but lower in more open country. Forages in most habitats across its very wide range, with and without trees; appears to defend an aerial territory.	One record within 10km of the site exists for this species (NSW Wildlife Atlas). However, the Protected Matters Search predicted that this species has potential to occur. This species was not recorded on site. However, some sub-optimal habitat does occur on site therefore, it is considered to have **potential** to occur on site.	This species is considered to have **potential** to occur on site. Therefore it has potential to be impacted upon as a result of the proposed actions. *As there is potential for impact upon this species it is assessed in **Appendix 7**.*
Chalinolobus picatus	Little Pied bat	V		This hollow roosting species occurs mostly in dry, open woodlands throughout its range but can occupy other forms of vegetation communities such as notophyll vine forest and dry sclerophyll forest. Little Pied Bats appear to be at their highest density in the mallee woodlands of the Willandra Lakes area of NSW. They have been known to roost in trees, caves and abandoned mines and buildings.	This species was not recorded within a 10km radius of the site (NSW Wildlife Atlas). However, the Protected Matters Search predicted that this species has potential to occur. . Optimal habitat in the form of Mallee woodland is not present on site, however there are hollow bearing eucalypt species that could potentially provide roosting sites for this species. Therefore it is considered as having **potential** to occur on	This species is unlikely to be impacted by the proposed action. *Nevertheless, as there is some degree of likelihood that this species occurs seasonally within the study area, it has been assessed in **Appendix 7**.*

Species	Common Name	TSC Act Status	EPBC Act Status	Habitat	Likelihood of Occurrence	Potential for Impact
					site.	
Vespadelus troughtoni	Eastern Cave Bat	V	V	This species' distribution ranges from northern QLD through to Northern NSW. They have been found roosting in sandstone overhangs, boulder pipes, mines and occasionally buildings. They commonly utilise abandoned fairy martin nests under bridges and in culverts. All existing records are in close proximity to sandstone or volcanic escarpment. Vegetation communities in which they inhabit include tropical mixed woodland and wet and dry sclerophyll along the coast and the Great Dividing Range. This species has a relatively small foraging range of approximately 33ha.	This species was not recorded within 10km of the study area (NSW Wildlife Atlas). However, the Protected Matters Search predicted that this species has potential to occur. Due to the lack of sandstone or volcanic escarpments in close proximity to the site, it is considered **unlikely** to occur on site.	This species is considered unlikely to occur on site. Therefore, this species is unlikely to be impacted upon as a result of the proposed actions and an AoS is not required.
Underwoodisaurus sphyrurus	Border Thick-tailed Gecko	V	V	*U. sphyrurus* has a patchy distribution spread throughout the north-west slopes and northern tablelands of NSW. Habitat preferred by this species is dry sclerophyll open forest and woodland associated with outcrops of granite, basalt, sandstone and metamorphic rocks. Most known populations occur on sites with granite rocks. Sites favouring an easterly aspect have also been found to harbour more populations of this species. This species has been known to shelter under rocks, barks, logs and litter in rocky rubble.	This species was not recorded on site and records within 10km of the site do not exist (NSW Wildlife Atlas). However, the Protected Matters Search predicted that this species has potential to occur. No suitable habitat in the form of granite rocky outcrops occurs on site. Therefore it is considered **unlikely** to occur.	This species is considered unlikely to occur on site. Therefore, this species is unlikely to be impacted upon as a result of the proposed actions and an AoS is not required.
Anthochaera phrygia	Regent Honeyeater	CE	E	Nomadic Honeyeater that disperses to non-breeding areas, including the	This species has not been recorded within 10km of the site	This species is considered unlikely to occur on site.

Species	Common Name	TSC Act Status	EPBC Act Status	Habitat	Likelihood of Occurrence	Potential for Impact
				coast, in winter, where flowering trees are sought. Within the region, mostly recorded in Box-Ironbark Eucalypt associations along creek flats, river valleys and foothills. Coastal swamp forests in Lower Hunter are used when more western resources fail. The main feed tree for coastal areas is *Eucalyptus robusta* (Swamp Mahogany). Hunter records are more common in near coastal areas such as Cessnock LGA. Feed trees in this region are Corymbia maculata (Spotted Gum), *E. fibrosa* (Broad-leaved Ironbark), *E. crebra* (Narrow-leaved Ironbark) and various stringybark sp.. Nests mainly west of the divide, although local breeding attempts have occurred at Quorrobolong.	(NSW Wildlife Atlas). However, the Protected Matters Search predicted that this species has potential to occur. This species was not recorded during field surveys. Flowering Eucalypt blossoms are available within the vegetated sections of the site in which this species could potentially forage. However due to the extensive amount of suitable forest surrounding the site and lack of records in the vicinity, it is considered **unlikely** to occur.	Therefore, this species is unlikely to be impacted upon as a result of the proposed actions and an AoS is not required.
Geophaps scripta scripta	Squatter Pigeon	E	V	Occurs on the inland slopes of the Great Dividing Range with a distribution that extends from the Burdekin-Lynd divide in central Queensland, west to Charleville and Longreach, east to the coast from Prosperine to Port Curtis, and south to scattered sites in south-eastern Queensland. Inhabits grassy woodlands and open forests that are dominated by eucalypts. No confirmed records have been made since the 1970s.	No records exist within 10km of the site (NSW Wildlife Atlas). However, the Protected Matters Search predicted that this species has potential to occur.This species was not detected during field surveys. No records have been made since the late 1970s, therefore it is considered **unlikely** to occur.	This species is considered unlikely to occur on site. Therefore, this species is unlikely to be impacted upon as a result of the proposed actions and an AoS is not required.
Leipoa ocellata	Malleefowl	E	V	Inhabits semi-arid regions of southern Australia. In New South Wales, it typically occurs west of the Great	No records exist within 10km of the site for this species and it was not detected during field	This species is considered to have **potential** to occur on site. Therefore it has potential

Species	Common Name	TSC Act Status	EPBC Act Status	Habitat	Likelihood of Occurrence	Potential for Impact
				Dividing Range. Extends from Pilliga south-west to the districts of Griffith and Wentworth. The extent of occurrence is known to be decreasing. The distribution of the Malleefowl was formerly more extensive, extending over a large proportion of mainland southern Australia, including the south-western region of the Northern Territory. Occupies shrublands and low woodlands that are dominated by mallee vegetation. It also occurs in other habitat types including Eucalypt or native pine *Callitris* woodlands, Acacia shrublands, Broombush *Melaleuca uncinata* vegetation or coastal heathlands.	surveys. Callitris and Acacia woodlands do persist on site and they are sub-optimal habitat. Therefore, it is considered to have **potential** to occur on site.	to be impacted upon as a result of the proposed actions. *As there is potential for impact upon this species it is assessed in **Appendix 6** and **Appendix 7**.*
Polytelis swainsonii	Superb Parrot	V	V	The Superb Parrot occurs only in south-eastern Australia. The Superb Parrot is found in NSW and northern Victoria, where it occurs on the inland slopes of the Great Divide and on adjacent plains, especially along the major river-systems; vagrants have also been recorded in southern Queensland. Mainly inhabits forests and woodlands dominated by eucalypts, especially River Red Gums (*Eucalyptus camaldulensis*) and box eucalypts such as Yellow Box (*Eucalyptus melliodora*) or Grey Box (*E. microcarpa*). The species also seasonally occurs in box-pine (*Callitris*) and Boree (*Acacia pendula*) woodland.	This species has not been recorded within 10km of the site (NSW Wildlife Atlas). However, the Protected Matters Search predicted that this species has potential to occur. This species was no recorded during field surveys. Some *E. microcarpa* and *Callitris* species occur on site which could potentially be used as foraging trees by this species. Therefore it is considered as having **potential** to occur on site.	This species is unlikely to be impacted upon as a result of the proposed actions. *Nevertheless, as there is some degree of likelihood that this species occurs seasonally within the study area, it has been assessed in **Appendix 6** and **Appendix 7**.*

Species	Common Name	TSC Act Status	EPBC Act Status	Habitat	Likelihood of Occurrence	Potential for Impact
Rostratula australis	Australian Painted Snipe	E	V	A small freshwater and estuarine wader, which prefers fringes of swamps, dams and nearby marshy areas where there is a cover of grasses, lignum, low scrub or open timber.	No suitable habitat exists on site for this species. Therefore, it is considered **unlikely** to occur.	This species is unlikely to occur on site. Therefore it is not likely to be impacted upon as a result of the proposed actions. An AoS is not required for this species.
Maccullochella peelii peelii	Murray River Cod		V	Murray Cod is the largest freshwater fish found in Australia, growing up to 1.8 m in length and weighing over 100 kg. The Murray Cod is found extensively throughout the Murray Darling Basin in the south-eastern region of Australia.	No bodies of water apart from small dams utilised by cattle exists on site. Therefore it is considered **unlikely** to occur on site.	This species is unlikely to occur on site. Therefore it is not likely to be impacted upon as a result of the proposed actions. An AoS is not required for this species.
Chalinolobus dwyeri	Large-eared Pied Bat	V	V	This species forages in tall open forests and the edges of rainforest. It roosts in mine shafts and similar structures. Roosts in caves (near their entrances), crevices in cliffs, old mine workings and in the disused, bottle-shaped mud nests of *Hirundo ariel* (Fairy Martin), frequenting low to mid-elevation dry open forest and woodland close to these features.	No records for this species exist within 10km of the site(NSW Wildlife Atlas). However, the Protected Matters Search predicted that this species has potential to occur. Suitable habitat is scarce. It is therefore considered **unlikely** to occur.	This species is unlikely to occur on site. Therefore it is not likely to be impacted upon as a result of the proposed actions. An AoS is not required for this species.
Nyctophilus timoriensis (South-eastern form)	Greater Long-eared Bat	V	V	It's distribution is limited to the Murray-Darling Basin and records are scattered within this region. Occurs in a range of inland woodland vegetation types, including box, ironbark and cypress pine woodlands. An insectivorous species that commonly feeds on moths, beetles and crickets.	This species has not been recorded within 10km of the site (NSW Wildlife Atlas). However, the Protected Matters Search predicted that this species has potential to occur. Some sub-optimal habitat does occur on site therefore, it is considered to have **potential** to occur on site.	This species is considered to have **potential** to occur on site. Therefore it has potential to be impacted upon as a result of the proposed actions. *As there is potential for impact upon this species it is assessed in **Appendix 6** and **Appendix 7**.*

Species	Common Name	TSC Act Status	EPBC Act Status	Habitat	Likelihood of Occurrence	Potential for Impact
Petrogale penicillata	Brush-tailed Rock Wallaby	E	V	Occurs in forests and woodlands along the Great Divide and on the western slopes in escarpment country with rocky outcrops, steep rocky slopes, gorges, boulders and isolated rocky areas. The majority of populations favour north-facing aspects, but some southern aspects have been recorded. Apart from the critical rock structure *Petrogale penicillata* also requires adjacent vegetation types, associated types include, dense rainforest, wet sclerophyll, vine thicket, dry sclerophyll forest and open forest.	No records for this species exist within 10km of the site. (NSW Wildlife Atlas). However, the Protected Matters Search predicted that this species has potential to occur. No suitable habitat in the form of rocky outcrops exists on site. Therefore it is considered **unlikely** to occur on site.	This species is unlikely to occur on site. Therefore it is not likely to be impacted upon as a result of the proposed actions. An AoS is not required for this species.
Pseudomys pilligaensis	Pilliga Mouse	V	V	This species is known only from the Pilliga region of NSW including the Pilliga state forest and Pilliga nature reserve. A defined habitat for this species is hard to characterise as the vegetation type in which this species has been found varies. Eucalypt, Callitris and Acacia woodlands are vegetation types in which this species has been found. It has been found mostly in gullies that have experienced recent fire events. Habitat features that appear to be preferential for this species include a moderate to high low-shrub cover; site moisture retention; and groundcover of plants, litter and fungi. Topography of sites where this species is found include rolling landscapes with low relief on sandy soil and sandstone ridges.	No records for this species exist within 10km of the site(NSW Wildlife Atlas). However, the Protected Matters Search predicted that this species has potential to occur.The site lies within its known range. Therefore it is considered as having **potential** to occur.	There is potential for this species to occur on site, therefore it has potential to be impacted upon as a result of the proposed actions. *As there is some degree of likelihood that this species occurs seasonally within the study area, it has been assessed in **Appendix 6** and **Appendix 7**.*

Species	Common Name	TSC Act Status	EPBC Act Status	Habitat	Likelihood of Occurrence	Potential for Impact
Pandion cristatus	Eastern Osprey	V	M	*P. cristatus* have an extensive distribution that covers the entire circumference of Australia. *P. cristatus* inhabits mangroves, rivers, lakes, estuaries, inshore seas, coastal islands and headlands. Its diet primarily consists of fish, molluscs and crustaceans but can also include small birds and mammals.	This species was not recorded on or within a 1km radius of the site. (NSW Wildlife Atlas). However, the Protected Matters Search predicted that this species has potential to occur. No suitable coastal habitat in which this species prefers exists on site, and the site lies outside of its known distribution. Therefore it is considered **unlikely** to occur on site.	This species is unlikely to occur on site. Therefore, it is not likely to be impacted upon as a result of the proposed actions. An AoS is not required for this species.
Anthochaera phrygia	Regent Honeyeater	CE	E, M	Nomadic Honeyeater that disperses to non-breeding areas, including the coast, in winter, where flowering trees are sought. Within the region, mostly recorded in Box-Ironbark Eucalypt associations along creek flats, river valleys and foothills. Coastal swamp forests in Lower Hunter are used when more western resources fail. The main feed tree for coastal areas is *Eucalyptus robusta* (Swamp Mahogany). Hunter records are more common in near coastal areas such as Cessnock LGA. Feed trees in this region are Corymbia maculata (Spotted Gum), *E. fibrosa* (Broad-leaved Ironbark), *E. crebra* (Narrow-leaved Ironbark) and various stringybark sp.. Nests mainly west of the divide, although local breeding attempts have occurred at Quorrobolong.	This species has not been recorded within 10km of the site (NSW Wildlife Atlas). However, the Protected Matters Search predicted that this species has potential to occur.. This species was not recorded during field surveys. Flowering Eucalypt blossoms are available within the vegetated sections of the site in which this species could potentially forage. However due to the extensive amount of suitable forest surrounding the site and lack of records in the vicinity, it is considered **unlikely** to occur.	This species is unlikely to occur on site. Therefore, it is not likely to be impacted upon as a result of the proposed actions. An AoS is not required for this species.
Apus pacificus	Fork-tailed Swift		M	This incredibly fast swift has a wide distribution covering most of the	This species has not been recorded within 10km of the site	This species is considered to have potential to occur on site.

Species	Common Name	TSC Act Status	EPBC Act Status	Habitat	Likelihood of Occurrence	Potential for Impact
				Australian continent. In NSW, the Fork-tailed Swift is recorded in all regions. Many records occur east of the Great Divide, however, a few populations have been found west of the Great Divide. These are widespread but scattered further west of the line joining Bourke and Dareton. Sightings have been recorded at Milparinka, the Bulloo River and Thurloo Downs (Higgins 1999). The Fork-tailed Swift is almost exclusively aerial, flying from less than 1 m to at least 300 m above ground and probably much higher. They mostly occur over inland plains but sometimes above foothills or in coastal areas. They often occur over cliffs and beaches and also over islands and sometimes well out to sea. They also occur over settled areas, including towns, urban areas and cities. They mostly occur over dry or open habitats, including riparian woodland and tea-tree swamps, low scrub, heathland or saltmarsh (Higgins 1999).	(NSW Wildlife Atlas). However, the Protected Matters Search predicted that this species has potential to occur. This species was not recorded during field surveys. Due to the wide variety of habitats in which this species occurs, it cannot be ruled out from occurring on site. Therefore it is considered as having **potential** to occur on site.	Therefore it has potential to be impacted upon as a result of the proposed actions. *As there is potential for impact upon this species it is further assessed in **Appendix 6**.*
Ardea alba	Great Egret		M	This species is wide spread across Australia, occurring in wetland habitats such as estuaries, littoral habitats and moist grasslands (Marchant and Higgins 1990). They regularly use areas inundated with water such as freshwater meadows, flooded grasslands, ovals, pastoral lands and agricultural lands. Also	This species was not recorded on site or within a 10km radius of the site (NSW Wildlife Atlas). However, the Protected Matters Search predicted that this species has potential to occur. Man made dams do exist on site, and although they are considered as suboptimal	This species is considered to have potential to occur on site. Therefore it has potential to be impacted upon as a result of the proposed actions. *As there is potential for impact upon this species it is further assessed in **Appendix 6**.*

Species	Common Name	TSC Act Status	EPBC Act Status	Habitat	Likelihood of Occurrence	Potential for Impact
				regularly use saline habitats. They breed in wetlands fringed with trees or tall vegetation.	habitat for this species, it cannot be ruled out that the dams will not be utilised by this species. Therefore it is considered as having **potential** to occur.	
Ardea ibis	Cattle Egret		M	*A. ibis* is distributed widely across Australia, occupying most of the continent with the exception of the arid western centre. The Cattle Egret occurs in tropical and temperate grasslands, wooded lands and terrestrial wetlands. It has occasionally been seen in arid and semi-arid regions however this is extremely rare. High numbers have been observed in moist, low-lying poorly drained pastures with an abundance of high grass; it avoids low grass pastures. It has been recorded on earthen dam walls and ploughed fields. It is commonly associated with the habitats of farm animals, particularly cattle, but also pigs, sheep, horses and deer.	This species was not recorded on site or within a 10km radius of the site (NSW Wildlife Atlas). However, the Protected Matters Search predicted that this species has potential to occur. The site does not offer suitable habitat for this species, however with the occurrence of dams on site it could utilise these areas. Therefore it is considered as having **potential** to occur.	This species is considered to have potential to occur on site. Therefore it has potential to be impacted upon as a result of the proposed actions. *As there is potential for impact upon this species it is further assessed in **Appendix 6**.*

Species	Common Name	TSC Act Status	EPBC Act Status	Habitat	Likelihood of Occurrence	Potential for Impact
Gallinago hardwickii	Latham's Snipe		M	Latham's Snipe occurs across the eastern half of Australia in fresh water wetlands and saltmarshes. They usually inhabit open, freshwater wetlands with low, dense vegetation (e.g. swamps, flooded grasslands or heathlands, around bogs and other water bodies) however, they can also occur in habitats with saline or brackish water, in modified or artificial habitats, and in habitats located close to humans or human activity. This species does not breed in Australia.	This species was not recorded on site or within a 10km radius of the site (NSW Wildlife Atlas). However, the Protected Matters Search predicted that this species has potential to occur. Suitable wetland habitat does not occur on site for this species and it is highly unlikely to utilise the man made dams that exist on site. Therefore it is considered **unlikely** to occur.	This species is not likely to occur on site. Therefore, it is not likely to be impacted upon as a result of the proposed actions. An AoS is not required for this species.
Haliaeetus leucogaster	White-bellied Sea-eagle		M	The White-bellied Sea-Eagle is distributed along the coastline (including offshore islands) of mainland Australia and Tasmania. It also extends inland along some of the larger waterways, especially in eastern Australia. The White-bellied Sea-Eagle is found in coastal habitats (especially those close to the sea-shore) and around terrestrial wetlands in tropical and temperate regions of mainland Australia and its offshore islands. The habitats occupied by the sea-eagle are characterised by the presence of large areas of open water (larger rivers, swamps, lakes, the sea).	This species was not recorded on site or within a 10km radius of the site (NSW Wildlife Atlas). However, the Protected Matters Search predicted that this species has potential to occur. This species may be observed flying over the site however suitable habitat for utilisation does not occur on site. Therefore it is considered **unlikely** to occur.	This species is not likely to occur on site. Therefore, it is not likely to be impacted upon as a result of the proposed actions. An AoS is not required for this species.
Hirundapus caudacutus	White-throated Needletail		M	The White-throated Needletail is widespread in eastern and south-eastern Australia (Simpson and Day 2010). In eastern Australia, it is recorded in all coastal regions of Queensland and NSW, extending	This species has not been recorded on or within 10km of the site(NSW Wildlife Atlas). However, the Protected Matters Search predicted that this species has potential to occur.	This species is not likely to occur on site. Therefore, it is not likely to be impacted upon as a result of the proposed actions. An AoS is not required

Species	Common Name	TSC Act Status	EPBC Act Status	Habitat	Likelihood of Occurrence	Potential for Impact
				inland to the western slopes of the Great Divide and occasionally onto the adjacent inland plains. Almost exclusively aerial, from heights of less than 1 m up to more than 1000 m above the ground. Because they are aerial, it has been stated that conventional habitat descriptions are inapplicable but there are, nevertheless, certain preferences exhibited by the species. Although they occur over most types of habitat, they are probably recorded most often above wooded areas, including open forest and rainforest, and may also fly between trees or in clearings, below the canopy, but they are less commonly recorded flying above woodland.	Although there is potential for this species to fly over the site, it is unlikely to be utilising the ecological attributes of the site. Therefore it is considered **unlikely** to occur.	for this species.
Merops ornatus	Rainbow Bee-eater		M	This species covers the majority of the Australian mainland with the exception of the arid western centre (Simpson and Day 2010). Inhabits a wide variety of open country generally near water, as well as habitat edges of parks, forests and gardens (Higgins 1999). Vegetation communities in which this species is known to occur include dry open sclerophyll forest, mallee, open woodland and shrubland, Spinifex tussock grassland with scattered trees and riverine or littoral assemblages (Higgins 1999). They nest in sandy banks or level ground, mostly in river banks and similar habitats.	This species has not been recorded on or within 10km of the site (NSW Wildlife Atlas). However, the Protected Matters Search predicted that this species has potential to occur. The vegetation on site is not considered to be in a condition suitable for this species to occupy. Therefore it is **unlikely** to occur.	This species is not likely to occur on site. Therefore, it is not likely to be impacted upon as a result of the proposed actions. An AoS is not required for this species.

Species	Common Name	TSC Act Status	EPBC Act Status	Habitat	Likelihood of Occurrence	Potential for Impact
Myiagra cyanoleuca	Satin Flycatcher		M	The Satin Flycatcher is widespread in eastern Australia and vagrant to New Zealand (Simpson and Day 2010). In NSW, they are widespread on and east of the Great Divide and sparsely scattered on the western slopes, with very occasional records on the western plains. Inhabit heavily vegetated gullies in eucalypt-dominated forests and taller woodlands, and on migration, occur in coastal forests, woodlands, mangroves and drier woodlands and open forests.	This species has not been recorded on or within 10km of the site (NSW Wildlife Atlas). However, the Protected Matters Search predicted that this species has potential to occur. The vegetation on site is considered sub optimal for this species and is therefore considered **unlikely** to occur.	This species is not likely to occur on site. Therefore, it is not likely to be impacted upon as a result of the proposed actions. An AoS is not required for this species.
Rhipidura rufifrons	Rufous Fantail		M	The Rufous Fantail occurs from Coastal Victoria along the east coast of NSW and QLD to the northern coast of the NT (Simpson and Day 2010). Habitat types in which this species occupies include Coastal and Hummock Grassland, Heathland, Eucalypt Woodland, Eucalypt forest, Melaleuca forest, Mangroves and Coastal Thickets (Woinarski et. al, 2001). However, the most commonly preferred habitat type is moist eucalypt forests and rainforests, where they usually inhabit the dense, shady undergrowth of gullies (Birdlife 2012b)	This species has not been recorded on or within 10km of the site (NSW Wildlife Atlas). However, the Protected Matters Search predicted that this species has potential to occur. No suitable habitat for this species occurs on site. Therefore it is **unlikely** to occur.	This species is unlikely to occur on site. Therefore, it is not likely to be impacted upon as a result of the proposed actions. An AoS is not required for this species.
Rostratula australis	Painted Snipe	E	M, V	The Painted Snipe has a scattered distribution in Australia, primarily occurring along the east coast from north Queensland to the Eyre Peninsula in South Australia, and including the majority of New South	This species has not been recorded on or within 10km of the site (NSW Wildlife Atlas). However, the Protected Matters Search predicted that this species has potential to occur.	This species is unlikely to occur on site. Therefore, it is not likely to be impacted upon as a result of the proposed actions. An AoS is not required

Species	Common Name	TSC Act Status	EPBC Act Status	Habitat	Likelihood of Occurrence	Potential for Impact
				Wales and Victoria. The Painted Snipe inhabits inland and coastal shallow freshwater wetlands, occurring in both ephemeral and permanent wetlands, particularly where there is grass. Individuals have been spotted in artificial dams, sewage ponds and waterlogged grasslands (Birdlife 2012).	Suitable habitat for this species does not occur on site. Therefore it is **unlikely** to occur.	for this species.

Appendix 6

EPBC Act - Assessment of Significance - Leewood

The EPBC Act focuses Commonwealth interests on matters of National Environmental Significance (NES) including integrated biodiversity conservation and the management of important protected areas. The matters of NES as identified in the Act which require assessment and approval to be addressed by the Commonwealth include:

- World Heritage Properties;
- National Heritage Places;
- Wetlands of International Importance;
- Great Barrier Reef Marine Parks;
- Commonwealth Marine areas;
- Nationally Threatened Species;
- Nationally Threatened Ecological Communities;
- Migratory Species;

The assessment and approval process applies to any action that has, will have or is likely to have a significant impact on a matter of NES. An 'action' is defined as a project, development, undertaking or an activity or series of activities.

The matter of NES and site-specific responses are as follows.

- World Heritage Properties:

The study area is not World Heritage Property, and is not in close proximity to any such property.

- Wetlands of International Importance (RAMSAR convention):

The study area is not part of any Wetland of International Importance, and is not in close proximity to any such area.

- Great Barrier Reef Marine Parks;
- The study area is not part of any Great Barrier Reef Marine Park, and is not in close proximity to any such park.
- Commonwealth Marine Areas

The proposals will not have a significantly adverse effect on any Commonwealth Marine area, as there are no such marine areas within the region.

- Nationally Listed Threatened Species:

Threatened species listed under the EPBC Act, which occur, or have the potential to occur within the locality of Leewood (10km radius) have been assessed for their potential to occur within the site (**Appendix 5**). Those EPBC listed threatened species that were considered to have potential to occur and subsequently may be impacted by the proposal are as follows:

- *Pterostylis cobarensis*	Cobar Greenhood Orchid	V
- Rulingia procumbens		V
- Tylophora linearis		E

- Phascolarctos cinereus — Koala — V
- *Leipoa ocellata* — Malleefowl — V
- *Polytelis swainsonii* — Superb Parrot — V
- *Nyctophilus timoriensis* (South-eastern form) — Greater Long-eared Bat — V
- Pseudomys pilligaensis — Pilliga Mouse — V
-
- These threatened species require assessment under the EPBC Act significant Impact Guidelines 1.1 with regards to the relevant significant impact criteria:
-

Table 11 Critically endangered and endangered species - Significant Impact Criteria Assessment

Significant Impacts	*Tylophora linearis*
Lead to a long-term decrease in the size of a population	**Unlikely.** This species was not recorded on site and only 0.8ha of potential habitat (woodlands associated with *C. glaucophylla*) will be removed as a result of the proposal. Due to the large area of more suitable habitat within the wider area, *Tylophora linearis* will not be losing any significant habitat due to the proposed activities on site. Therefore no long-term decrease in population size is likely to occur.
Reduce the area of occupancy of the species	**Unlikely**. This species was not recorded on site so it is unlikely that its area of occupancy on site will be reduced as a result of the proposed activities.
Fragment an existing population into two or more populations	**No**. No existing populations are known on site or within 10km of the site (Wildlife Atlas Search). Therefore, it is unlikely that any populations will be fragmented as a result of this project.
Adversely affect habitat critical to the survival of a species	**No.** No critical habitat for this species exists on site.
Disrupt the breeding cycle of a population	**Unlikely**. The area is potentially used for breeding (propagation). However, due to the large area of more suitable habitat in the form of 'woodlands associated with *C. glaucophylla',* nearby (within the majority of the adjoining Pilliga State Forest ~160,000ha), the size of the potential breeding habitat to be impacted upon on site (0.8ha) is not considered to be significant. The impacts of the proposed actions are therefore, not considered likely to disrupt the breeding cycle of this species.
Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline	**Unlikely**. Although 0.8ha of potential habitat would be reduced, given the large area of more suitable habitat in the form of 'woodlands associated with *C. glaucophylla',* nearby (Pilliga State Forest ~ 160,000ha), it is considered unlikely that the impacts would cause this species to decline.
Result in invasive species that are harmful to a critically endangered or endangered species becoming established in the endangered or critically endangered species' habitat	**Unlikely**. It is unlikely that the impacted area will increase invasive species, such as exotic weed or pest species becoming established to any greater degree than what already exists.
Introduce disease that may cause the species to decline, or	**Unlikely**. There are no diseases which have been associated with the decline of this species. As a consequence the proposed activities are not expected to introduce any diseases that may cause this species to decline.
Interfere with the recovery of the species.	**Unlikely.** Due to the small area of impact and the large extent of more suitable habitat available for this species within the surrounding area, it is considered unlikely that the impacts of the proposal will substantially interfere with the recovery of the species.

Table 12 Vulnerable species - Significant Impact Criteria Assessment

Significant Impacts	*Pterostylis cobarensis*	*Rulingia procumbens*	Superb Parrot	Malleefowl	Koala	Greater Long-eared Bat	Pilliga Mouse
Lead to a long-term decrease in the size of an important population of a species	**Unlikely**. This species was not recorded on site and the site does not contain preferred habitat of rocks, slopes or low hills. However, potential habitat for this species occurs within the disturbed Callitris woodlands on the site. Due to the large area of more suitable habitat within the wider area, *Pterostylis cobarensis* will not be losing any significant habitat due to the proposed activities on site. Therefore, no long-term decrease in population size is likely to occur.	**Unlikely**. This species was not recorded on site and The site does contain the preferred habitat of sandy soils, often in disturbed habitats. Due to the large area of more suitable habitat within the wider area, *Rulingia procumbens* will not be losing any significant habitat due to the proposed activities on site. Therefore, no long-term decrease in population size is likely to occur.	**Unlikely**. The site does contain suitable Eucalypt species and Callitris (which provides seasonal habitat) in which this species could forage. This species was not recorded on site and due to the large area of more suitable habitat within the wider area, it is considered that Superb Parrot will not be losing any significant habitat due to the proposed activities on site. Therefore, no long-term decrease in population size is likely to occur.	**Unlikely**. This species was not recorded on site and the site does contain suitable Eucalypt woodlands and Callitris woodlands in which this species could forage. Due to the large area of more suitable habitat within the wider area, Mallefowl will not be losing any significant habitat due to the proposed activities on site. Therefore, no long-term decrease in population size is likely to occur.	**Unlikely**. This species was not recorded on site and only suboptimal foraging habitat is present (secondary feed trees). Due to the large area of more suitable habitat within the wider area, the Koala will not be losing any significant habitat due to the proposed activities on site. Therefore no long-term decrease in population size is likely to occur.	**Unlikely**. This species was not recorded on site and the site does contain suitable inland woodland vegetation types, including box, ironbark and cypress pine woodlands in which this species could forage. Due to the large area of more suitable habitat within the wider area, Greater Long-eared Bat will not be losing any significant habitat due to the proposed activities on site. Therefore, no long-term decrease in population size is likely to occur.	**Unlikely.** This species was not recorded on site and only suboptimal foraging habitat is present. Due to the large area of more suitable habitat within the wider area, the Pilliga Mouse will not be losing any significant habitat due to the proposed activities on site. Therefore no long-term decrease in population size is likely to occur.
Reduce the area of occupancy of an important population	**Unlikely**. This species was not recorded on site so it is unlikely that its area of occupancy on site will be reduced as a result of the proposed activities.	**Unlikely**. This species was not recorded on site so it is unlikely that its area of occupancy on site will be reduced as a result of the proposed activities.	**Unlikely**. This species was not recorded on site so it is unlikely that its area of occupancy on site will be reduced as a result of the proposed activities.	**Unlikely**. This species was not recorded on site so it is unlikely that its area of occupancy on site will be reduced as a result of the proposed activities.	**Unlikely**. This species was not recorded on site so it is unlikely that its area of occupancy will be reduced as a result of the proposed activities.	**Unlikely**. This species was not recorded on site so it is unlikely that its area of occupancy on site will be reduced as a result of the proposed activities.	**Unlikely**. This species was not recorded on site so it is unlikely that its area of occupancy on site will be reduced as a result of the proposed activities.
Fragment an existing important population into two or more populations	**Unlikely**. No existing populations are known on site. Therefore, it is unlikely that any populations will be fragmented as a result of this project.	**Unlikely**. No existing populations are known on site. Therefore, it is unlikely that any populations will be fragmented as a result of this project.	**Unlikely**. No existing populations are known on site. Therefore, it is unlikely that any populations will be fragmented as a result of this project.	**Unlikely**. No existing populations are known on site. Therefore, it is unlikely that any populations will be fragmented as a result of this project.	**No**. No existing populations are known on site so it is unlikely that any populations will be fragmented as a result of this project.	**Unlikely**. No existing populations are known on site. Therefore, it is unlikely that any populations will be fragmented as a result of this project.	**No**. No existing populations are known on site so it is unlikely that any populations will be fragmented as a result of this project.
Adversely affect habitat critical to the survival of a species	**No**. No critical habitat for this species exists on site.	**No**. No critical habitat for this species exists on site.	**No**. No critical habitat for this species exists on site.	**No**. No critical habitat for this species exists on site.	**No**. No critical habitat for this species exists on site.	**No**. No critical habitat for this species exists on site.	**No.** No critical habitat for this species exists on site.
Disrupt the breeding cycle of an important population	**Unlikely**. The area is potentially used for breeding (propagation). However, due to the large area of more suitable habitat in the form of 'Callitris woodlands', nearby (within the majority of the adjoining Pilliga State Forest ~160,000ha), the size of the potential breeding habitat to be impacted upon on site (0.8ha) is not considered to be significant. The impacts of the proposed actions are therefore, not considered likely to disrupt the breeding cycle of this species.	**Unlikely**. The area is potentially used for breeding (propagation). However, due to the large area of more suitable habitat in the form of 'sandy soils, often in disturbed habitats', nearby (within the majority of the adjoining Pilliga State Forest ~160,000ha), the size of the potential breeding habitat to be impacted upon on site (approximately 48.2ha of marginal habitat and 0.8ha of potential habitat) is not considered to be significant. The impacts of the proposed actions are therefore, not considered likely to disrupt the breeding cycle of this species.	**Unlikely**. The breeding range of the Superb Parrot is divided into three main areas: the first, along the Murray and Edward Rivers; the second, along the Murrumbidgee River; and the third, in a triangle bounded by Molong, Yass and Young (Barrett et al. 2003; Birds Australia n.d.; Christie 2004; Davidson & Chambers 1991; Higgins 1999; Webster 1988; Webster & Ahern 1992).The site is not within or close to these three breeding areas, therefore, the proposal is not considered likely to disrupt the breeding cycle of this species.	**Unlikely**. The area is potentially used for breeding. However, due to the large area of more suitable habitat in the form of 'Eucalypt woodlands and Callitris woodlands in which this species could forage, nearby (within the majority of the adjoining Pilliga State Forest ~160,000ha),, the size of the potential breeding habitat on site (approximately 48.2ha of marginal habitat and 0.8ha of potential habitat) is not considered to be significant. The impacts of the proposed actions are therefore, not considered likely to disrupt the breeding cycle of this species.	**Unlikely**. The area is potentially used for breeding. However, due to the large area of more suitable habitat in the form of 'Eucalypt woodlands'in which this species could forage, nearby (within the majority of the adjoining Pilliga State Forest ~160,000ha), the size of the potential breeding habitat on site (approximately 48.2ha of marginal habitat and 0.8ha of potential habitat) is not considered to be significant. The impacts of the proposed actions are therefore, not considered likely to disrupt the breeding cycle of this species	**Unlikely**. The area is potentially used for breeding. However, due to the large area of more suitable habitat in the form of 'inland woodland vegetation types, including box, ironbark and cypress pine woodlands' in which this species could forage, nearby (within the majority of the adjoining Pilliga State Forest ~160,000ha),, the size of the potential breeding habitat on site (approximately 48.2ha of marginal habitat and 0.8ha of potential habitat) is not considered to be significant. The impacts of the proposed actions are therefore, not considered likely to disrupt the breeding cycle of this species.	**Potential**. The area is potentially used for breeding. However, due to the large area of more suitable habitat in the form of '*Blakely's Red Gum Riparian Woodland of the Pilliga Outwash Brigalow Belt South Bioregion'* and '*Rough-barked Apple - Blakely's Red Gum riparian grassy woodlands, Brigalow Belt South and Nandewar'* within the adjacent Pilliga State Forest, the size of the potential breeding habitat on site (0.264ha) is not considered to be significant. The impacts of the proposed actions are therefore not considered likely to disrupt the breeding cycle of this species.

Significant Impacts	*Pterostylis cobarensis*	*Rulingia procumbens*	Superb Parrot	Malleefowl	Koala	Greater Long-eared Bat	Pilliga Mouse
Modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline	**Unlikely**. Although 0.8ha of potential would be reduced, given the large area of more suitable habitat in the form of 'Callitris woodlands', nearby (within the majority of the adjoining Pilliga State Forest ~160,000ha), it is considered unlikely that the impacts would cause this species to decline.	**Unlikely**. Although approximately 48.2ha of marginal habitat and 0.8ha of potential habitat would be reduced, given the large area of more suitable habitat in the form of 'sandy soils, often in disturbed habitats', nearby (within the majority of the adjoining Pilliga State Forest ~160,000ha), it is considered unlikely that the impacts would cause this species to decline.	**Unlikely**. Although approximately 48.2ha of marginal habitat and 0.8ha would be reduced, given the large area of more suitable habitat in the form of 'Suitable Eucalypt species and Callitris (which provides seasonal habitat) in which this species could forage', nearby (within the majority of the adjoining Pilliga State Forest ~160,000ha) it is considered unlikely that the impacts would cause this species to decline.	**Unlikely**. Although, approximately 48.2ha of marginal habitat and 0.8ha of potential habitat would be reduced, given the large area of more suitable habitat in the form of 'Eucalypt woodlands and Callitris woodlands' in which this species could forage, nearby (within the majority of the adjoining Pilliga State Forest ~160,000ha), it is considered unlikely that the impacts would cause this species to decline.	**Unlikely**. Although approximately 48.2ha of marginal habitat and 0.8ha habitat would be reduced, given the large area of more suitable habitat in the form of 'Eucalypt woodlands' in which this species could forage, nearby (within the majority of the adjoining Pilliga State Forest ~160,000ha), it is considered unlikely that the impacts would cause this species to decline..	**Unlikely**. Although, approximately 48.2ha of marginal habitat and 0.8ha of potential habitat would be reduced, given the large area of more suitable habitat in the form of 'inland woodland vegetation types, including box, ironbark and cypress pine woodlands' in which this species could forage, nearby (within the majority of the adjoining Pilliga State Forest ~160,000ha), it is considered unlikely that the impacts would cause this species to decline.	**Potential**. Although 1ha of potential habitat would be reduced, given the large area of more suitable habitat in the form of '*Blakely's Red Gum Riparian Woodland of the Pilliga Outwash Brigalow Belt South Bioregion'* and '*Rough-barked Apple - Blakely's Red Gum riparian grassy woodlands, Brigalow Belt South and Nandewar'* available within within the the adjoining Pilliga State Forest, it is considered unlikely that the impacts would cause this species to decline.
Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat	**Unlikely**. It is unlikely that the impacted area will increase invasive species, such as exotic weed or pest species becoming established to any greater degree than what already exists.	**Unlikely**. It is unlikely that the impacted area will increase invasive species, such as exotic weed or pest species becoming established to any greater degree than what already exists.	**Unlikely**. It is unlikely that the impacted area will increase invasive species, such as exotic weed or pest species becoming established to any greater degree than what already exists.	**Unlikely**. It is unlikely that the impacted area will increase invasive species, such as exotic weed or pest species becoming established to any greater degree than what already exists.	**Unlikely.** It is unlikely that the impacted area will increase invasive species, such as foxes or cats becoming established to any greater degree than what already exists.	**Unlikely**. It is unlikely that the impacted area will increase invasive species, such as exotic weed or pest species becoming established to any greater degree than what already exists.	**Unlikely**. It is unlikely that the impacted area will increase invasive species, such as foxes or cats becoming established to any greater degree than what already exists.
Introduce disease that may cause the species to decline, or	**Unlikely**. There are no diseases which have been associated with the decline of this species. As a consequence the proposed activities are not expected to introduce any diseases that may cause this species to decline.	**Unlikely**. There are no diseases which have been associated with the decline of this species. As a consequence the proposed activities are not expected to introduce any diseases that may cause this species to decline.	**Unlikely**. There are no diseases which have been associated with the decline of this species. As a consequence the proposed activities are not expected to introduce any diseases that may cause this species to decline.	**Unlikely**. There are no diseases which have been associated with the decline of this species. As a consequence the proposed activities are not expected to introduce any diseases that may cause this species to decline.	**Unlikely**. Due to the small amount of clearing and lack of koala presence on site, it is unlikely that the proposal will contribute to the introduction of any related diseases. As a consequence the proposed activities are not expected to introduce any diseases that may cause this species to decline.	**Unlikely**. There are no diseases which have been associated with the decline of this species. As a consequence the proposed activities are not expected to introduce any diseases that may cause this species to decline.	**Unlikely**. There are no diseases which have been associated with the decline of this species. As a consequence the proposed activities are not expected to introduce any diseases that may cause this species to decline.
Interfere substantially with the recovery of the species	**Unlikely**. Due to the small area of impact and the large extent of more suitable habitat available for this species within the surrounding area, it is considered unlikely that the impacts of the proposal will substantially interfere with the recovery of the species.	**Unlikely**. Due to the small area of impact and the large extent of more suitable habitat available for this species within the surrounding area, it is considered unlikely that the impacts of the proposal will substantially interfere with the recovery of the species.	**Unlikely**. Due to the small area of impact and the large extent of more suitable habitat available for this species within the surrounding area, it is considered unlikely that the impacts of the proposal will substantially interfere with the recovery of the species.	**Unlikely**. Due to the small area of impact and the large extent of more suitable habitat available for this species within the surrounding area, it is considered unlikely that the impacts of the proposal will substantially interfere with the recovery of the species.	**Unlikely**. Due to the small area of impact and the large extent of more suitable habitat available for this species within the surrounding area, it is considered unlikely that the impacts of the proposal will substantially interfere with the recovery of the species.	**Unlikely**. Due to the small area of impact and the large extent of more suitable habitat available for this species within the surrounding area, it is considered unlikely that the impacts of the proposal will substantially interfere with the recovery of the species.	**Unlikely.** Due to the small area of impact and the large extent of more suitable habitat available for this species within the surrounding area, it is considered unlikely that the impacts of the proposal will substantially interfere with the recovery of the species.

- Nationally Listed Threatened Ecological Communities:

One Endangered Ecological Community, nationally listed under the EPBC Act was recorded on Leewood, namely Brigalow (*Acacia harpophylla* dominant and co-dominant). The existing Brigalow within Leewood is proposed to be avoided. This community is commensurate with the Threatened Ecological Community '*Brigalow within the Brigalow Belt South, Nandewar and Darling Riverine Plains Bioregions'* under the TSC Act. The area of proposed disturbance does not interfere with this EEC's location on site and will not be directly affected by the proposal as the proposal will retain this vegetation. In addition, this vegetation community will not be affected indirectly by the proposal provided the mitigation measures within **Section 7** are adhered to. Therefore, the potential indirect impacts upon this listed community is not considered to be significant.

Nationally Listed Migratory Species

Those EPBC listed Migratory species considered to have potential to occur are:

- *Circus assimilis* Spotted Harrier
- *Apus pacificus* Fork-tailed Swift
- *Ardea alba* Great Egret
- *Ardea ibis* Cattle Egret

As discussed in **Section 5.1.2** the Leewood site and the proposed location of the development footprint exists, as a predominately cleared site. This site is surrounded by superior areas of habitat, which would be suitable for the above listed Migratory species. Due to the extensive tracts of vegetation within the Pilliga State Forest (within the majority of the adjoining Pilliga State Forest ~160,000ha), supporting the populations of the potentially occurring above listed species, the small area to be impacted upon (approximately 48.2ha of marginal habitat and 0.8ha of potential habitat) is unlikely to be essential to the survival of populations of these species.

Appendix 7

Seven Part Test - Leewood

a) In the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction,

Flora

Pterostylis cobarensis (Cobar Greenhood Orchid)

Pterostylis cobarensis, Family Orchidaceae, also known as Cobar Greenhood Orchid, is a terrestrial orchid with 7–11 narrow-elliptic leaves which form a basal rosette, each 1.5–2.5 cm long and 5–8 mm wide. Three to eight flowers grow on stems up to 40 cm high, with 3–5 closely sheathing stem leaves. Flowers are transparent with brown and green markings, each flower about 1.2 cm long. Flowering occurs from September to November. Vegetative reproduction is not common in this group of Greenhoods, but some species may form more than one daughter tuber annually. Plants are deciduous and die back to the large, underground tubers after seed release. New rosettes are produced following soaking autumn and winter rains. Pterostylis cobarensis is pollinated by the males of small gnats which are attracted to the flower by some pseudosexual perfume (DECC, 2008a). Cobar Greenhood Orchid is known chiefly from the Nyngan–Cobar–Bourke district in the far western plains of NSW. It grows among rocks on low hills and on slopes above streams and inhabits eucalypt woodland, open mallee, or Callitris shrubland on low stony ridges and slopes with skeletal sandy-loam soils. Flowering occurs from September to November.

This species was not recorded on site and no records exist within 10km of the site (NSW Wildlife Atlas). However, it should be noted that at the time of surveys this species would not have been detectable and the Protected Matters Search predicted that this species has potential to occur. Some sub-optimal habitat does occur on site. Therfore, due to its cryptic nature its occurrence cannot be totally discounted. As such it has potential to be impacted upon as a result of the proposed actions.

Leewood is highly disturbed with a long history of clearing and grazing. In addition, there are larger areas of more suitable habitat nearby (Pilliga State Forest ~ 160,000ha) and the proposal will affect a small area of sub-optimal habitat (~ 48.2ha of cleared, grazed paddocks with scattered paddock trees and the clearing of approximately 0.8ha of Pilliga Box Woodland within the Pilliga State Forest). Therefore, it is considered that the proposed development is not likely to have an adverse effect on the life cycle of this species such that a viable local population of the species is likely to be placed at risk of extinction.

Rulingia procumbens

Rulingia procumbens is endemic to NSW and is known from the Dubbo–Medooran–Gilgandra region, the Cobar region, and the upper Hunter Valley (Harden, 2000). Populations of this species have been recorded in Goonoo State Forest (SF), Mt Kaputar National Park, and Pilliga Nature Reserve and other populations occur on crown land, state forests, and on private land (DECC NSW, 2005a). *R. procumbens* occurs within the Border Rivers–Gwydir, Central West, Hunter–Central Rivers, Namoi, and Western (NSW) Natural Resource Management Regions. The species occurs in sandy soils, often in disturbed habitats such as road verges, quarry boundaries, gravel stockpiles, and power line easements. *R. procumbens* is often found in communities of *Eucalyptus dealbata–E. sideroxylon* woodland, *Melaleuca uncinata* shrubland, and mallee eucalypt with *Calytrix tetragona* understorey. Associated species include *Acacia triptera*, *Callitris endlicheri*, *Eucalyptus melliodora*, *Allocasuarina diminuta*, *Philotheca salsolifolia*, *Xanthorrhoea* spp., *Exocarpos cupressiformis*, *Leptospermum parvifolium*, and *Kunzea parvifolia.*

No records for this species exist within 10km of the site and it was not detected during field surveys. However, some sub-optimal habitat does occur on site therefore and as such potential exists for this species to occur on site.

Leewood is highly disturbed with a long history of clearing and grazing. In addition, there are larger areas of more suitable habitat nearby (Pilliga State Forest ~ 160,000ha) and the proposal will affect a small area of sub-optimal habitat (~ 48.2ha of cleared, grazed paddocks with scattered paddock trees and the clearing of approximately 0.8ha of Pilliga Box Woodland within the Pilliga State Forest). Therefore, it is considered that the proposed development is not likely to have an adverse effect on the life cycle of this species such that a viable local population of the species is likely to be placed at risk of extinction.

Tylophora linearis

Tylophora linearis is a herbaceous climber with clear latex that grows to about 2 m long. The stems are cylindrical, up to 3 mm in diameter with internodes up to 100 mm long. Leaves are dark green, linear, up to 100 mm long and 4 mm wide, and extra-floral nectaries are absent from the base of the leaf. Flowers are clustered in radiating groups of 3–8. Flowers are 6–22 mm in diameter, with petals olive-green externally, dark purple internally and with short hairs internally concentrated towards the tip. Fruits form follicles 95–100 mm long and 5 mm wide (Forster, 1992; Forster et al., 2004). *Tylophora linearis* has rarely been collected and is known from eight localities in the Dubbo area and Mt Crow near Barraba in NSW. Grows in dry scrub, open forest and woodlands associated with *Melaleuca uncinata, Eucalyptus fibrosa, E. sideroxylon, E. albens, Callitris endlicheri, C. glaucophylla, Allocasuarina luehmannii, Acacia hakeoides, A. lineata, Myoporum* spp., and *Casuarina spp.*

This species has not been recorded within 10km of the site (NSW Wildlife Atlas) and it was not detected during field surveys. However, the Protected Matters Search predicted that this species has potential to occur and some sub-optimal habitat does occur on site. Therefore, it is considered to have potential to occur on site.

Leewood is highly disturbed with a long history of clearing and grazing. In addition, there are larger areas of more suitable habitat nearby (Pilliga State Forest ~ 160,000ha) and the proposal will affect a small area of habitat (the clearing of approximately 0.8ha of Pilliga Box Woodland within the Pilliga State Forest). Therefore, it is considered that the proposed development is not likely to have an adverse effect on the life cycle of this species such that a viable local population of the species is likely to be placed at risk of extinction.

Fauna

Spotted Harrier

Spotted Harrier (*Circus assimilis*) is one of two resident Harriers in Australia. Spotted Harrier is a large raptor with a wingspan of 1.2m. Flys with upward swept wings and soars high when moving areas and flys low when searching for food. It is similar in appearance to Swamp Harrier in which the main distinguishing features of Spotted Harrier are the rump is mottled black, where Swamp Harrier has a pale white rump, Spotted Harrier tail is banded dark grey, underparts paler buff, upperparts chestnut. Hovers low with slowly beating wings, tailed fanned, long legs trailing (Pizzey 2007). In flight often lowers legs, overhead note contrast of black, unbarred spread 'fingertips' and white undersides of flight feathers, regularly barred black, unlike C. approximans (Pizzey 2007).

Spotted Harrier ranges across all of Australia except for Tasmania. Most commonly found inland to near coastal eastern and south eastern Australia. During times of rodent and quail irruptions they will disperse to areas not commonly found. Found in open and wooded country in which it hunts over low vegetation or woodland where hunting at low levels is possible due to vegetation breaks.

Usually silent, breeding birds utter piercing squeaks and rapid chatter (Marchant and Higgins 1993). Nest in trees in open remnant woodland, in agricultural areas, often near ripening crop used for hunting (Marchant and Higgins 1993).

This species could utilise the site to forage for prey such as small birds and mammals. This species is considered to have potential to occur on site.

Leewood is highly disturbed with a long history of clearing and grazing. In addition, there are larger areas of more suitable habitat nearby (Pilliga State Forest ~ 160,000ha) and the proposal will affect a small area of sub-optimal habitat (~ 48.2ha of cleared, grazed paddocks with scattered paddock trees and the clearing of approximately 0.8ha of Pilliga Box Woodland within the Pilliga State Forest). Therefore, it is considered that the proposed development is not likely to have an adverse effect on the life cycle of this species such that a viable local population of the species is likely to be placed at risk of extinction.

Brown Treecreeper

The eastern subspecies of the Brown Treecreeper, *Climacteris picumnus* ssp. *victoriae*, is distributed through central NSW on the western side of the Great Dividing Range and sparsely scattered to the east of the Range in drier areas such as the Cumberland Plain of Western Sydney, and in parts of the Hunter, Clarence, Richmond and Snowy River valleys.

The Brown Treecreeper is a medium-sized insectivorous bird that frequents drier forests and woodlands, particularly open woodland lacking a dense understorey, but also grasslands where there are sufficient logs, stumps and dead trees nearby. It spends up to half its time on the ground and on fallen logs, often well away from cover, pecking at the bases of grass tussocks, turning over leaves and litter, feeding on invertebrate larvae and small insects, particularly ants. It frequently hops along the entire length of logs and spirals up live and dead tree trunks, to feed on ants and flying insects. Brown treecreepers sleep inside hollow branches or trunks of trees, both living and dead, sometimes at great heights, and sometimes using old nest sites (Noske 1982).

Brown Treecreepers are threatened by clearance and the fragmentation of the woodland habitat including removal of dead timber. Increased isolation decreases treecreeper agility and increases the vulnerability of populations to extinction as a result of stochastic events. This species appears unable to maintain viable populations in remnants less than 200ha and its abundance decreases as remnant size decreases (Barrett et al. 1994). Fragmentation also leads to a skewed sex ratio in Brown Treecreeper populations because female birds are unable to disperse to isolated remnants, increasing the chance of local extinctions. Habitat degradation, including loss of hollow bearing trees threatens Brown Treecreeper populations. Grazing by stock in woodland areas leads to a decrease in diversity of ground-dwelling invertebrates decreasing the availability of food for the birds (Bromham et al. 1999).

This species was not recorded within Leewood during field surveys. Leewood is highly disturbed with a long history of clearing and grazing. In addition, there are larger areas of more suitable habitat nearby (Pilliga State Forest ~ 160,000ha) and the proposal will affect a small area of sub-optimal habitat (~ 48.2ha of cleared, grazed paddocks with scattered paddock trees and the clearing of approximately 0.8ha of Pilliga Box Woodland within the Pilliga State Forest). Therefore, it is considered that the proposed development is

not likely to have an adverse effect on the life cycle of this species such that a viable local population of the species is likely to be placed at risk of extinction.

Malleefowl

Malleefowl's Inhabit semi-arid regions of southern Australia. In New South Wales, it typically occurs west of the Great Dividing Range. Extends from Pilliga south-west to the districts of Griffith and Wentworth. The extent of occurrence is known to be decreasing. The distribution of the Malleefowl was formerly more extensive, extending over a large proportion of mainland southern Australia, including the south-western region of the Northern Territory. Occupies shrublands and low woodlands that are dominated by mallee vegetation. It also occurs in other habitat types including Eucalypt or native pine Callitris woodlands, Acacia shrublands, Broombush Melaleuca uncinata vegetation or coastal heathlands.

No records exist within 10km of the site for this species and it was not detected during field surveys. Callitris and Acacia woodlands do persist on site and provide sub-optimal habitat. Therefore, it is considered to have potential to occur on site.

Leewood is highly disturbed with a long history of clearing and grazing. In addition, there are larger areas of more suitable habitat nearby (Pilliga State Forest ~ 160,000ha) and the proposal will affect a small area of sub-optimal habitat (~ 48.2ha of cleared, grazed paddocks with scattered paddock trees and the clearing of approximately 0.8ha of Pilliga Box Woodland within the Pilliga State Forest). Therefore, it is considered that the proposed development is not likely to have an adverse effect on the life cycle of this species such that a viable local population of the species is likely to be placed at risk of extinction.

Superb Parrot

Superb parrots are ground feeders where they spend most of their time foraging for seeds and herbaceaous plants. They have been known to eat pollen, nectar and fruits and leaf buds, and occasionally they visit farmlands to feed on wheat and oats. During winter Superb parrots will spend most of its time feeding on green weeds including, Sonchus oleraceus (Milk Thistle), Sisymbrium spp. (Wild Mustard) and Uritica urens (Stinging Nettle). During spring and summer, Superb Parrots are attracted to flowering eucalypts; particularly favoured are Eucalyptus melliodora (Yellow box), and E. cladocalyx (Sugar Gum) (Forshaw, 1991).

Superb parrots are distributed within inland NSW and north most Victoria. The breeding range in southern NSW is centred on the Murrumbidgee River valley, between Hay in the west and Canberra in the east. Birds over-winter to the north. In the east, they are restricted to riparian habitats, being generally along the Namoi River, between Narrabri and Gunnedah, and along the Castlereagh River and its tributaries, between Coonamble and Gilgandra. Superb parrots breeds from September to December. Its nest is a hollow limb or hole in a tree, at great height. It lays four to six eggs, which are white and rounded. The young leave the nest about four weeks after hatching. They gradually acquire full adult plumage over the next 6-9 months.

This species was not recorded within Leewood during field surveys, however, the study area contains suitable habitat, in the form of large Eucalypts providing potential roosting sites and foraging resources. Leewood is highly disturbed with a long history of clearing and grazing. In addition, there are larger areas of more suitable habitat nearby (Pilliga State Forest ~ 160,000ha) and the proposal will affect a small area of sub-optimal habitat (~ 48.2ha of cleared, grazed paddocks with scattered paddock trees and the clearing of approximately 0.8ha of Pilliga Box Woodland within the Pilliga State Forest). Therefore, it is considered that the proposed development is not likely to have an adverse effect on the life cycle of this species such that a viable local population of the species is likely to be placed at risk of extinction.

Grey Crowned Babbler

The eastern subspecies of Grey-crowned Babbler (*Pomatostomus temporalis temporalis*) ranges from Mt Lofty Range, SA to Cape York Peninsula, Qld, generally in areas receiving an average annual rainfall between 250 and 1000 mm. Grey-crowned Babblers inhabit open Eucalypt woodlands with a grassy groundcover and sparse, tall shrub layer. Grey-crowned Babblers may also be observed along streams in cleared areas and grassy road verges (Morcombe, 2000). Grey-crowned Babblers forage mainly on insects and spiders, spending the majority of their time searching through leaf litter and soil for food, but also venturing into vegetation. Grey-crowned Babblers live in extended families usually consisting of a breeding pair with offspring. Pairs mate for life and are usually the only breeding birds within the group. The other group members help them build the nest and feed the young.

Breeding occurs between July and February. Their large domed nests (up to 50cm wide) are constructed in trees at a height of about 4-7m. They tend to be built into an upward sloping or horizontal, multiple forked branches in a tree's upper outer foliage and have a side entrance tunnel (Morcombe, 2000). Nest-like structures are also used for overnight roosts. The group as a whole defends a territory (usually about 12 hectares) throughout the year.

Individuals of this species along with nesting locations were recorded on Leewood. The Eucalypt woodland vegetation occupied by this species and their nests is not being removed as a part of the proposal. Additionally there are large areas of suitable habitat nearby (Pilliga State Forest ~ 160,000ha) and the proposal will to affect a small area of sub-optimal habitat (~ 48.2ha of cleared, grazed paddocks with scattered paddock trees). Due to the available surrounding habitat, habitat retained on site and this species high level of mobility it is considered unlikely to be impacted upon as a result of the proposal such that a local extinction is likely to occur.

Koala

Koala (*Phascolarctos cinereus*) occurs along the east coast of Australia and extends into Woodland, Mulga and River Red Gum forests west of the Great Dividing Range. The range of the Koala covers all such suitable areas of NSW. In drier forested areas, Koalas are generally observed as individuals in low densities. They are more abundant in coastal woodland and in open forest, where they have been found in densities as high as ten individuals per hectare. They are rare or absent in wet forests in the southern part of their range above 600 m which may be due more to distribution of Eucalypt species than climate, as the Koala is limited to areas where there are acceptable food trees.

The diet is generally restricted to that of Eucalypt leaves. On occasion, non-Eucalypt foliage is eaten. The foliage of *Eucalyptus camaldulensis* (River Red Gum), *E. microcorys* (Tallowwood), *E. tereticornis* (Forest Red Gum), *E. punctata* (Grey Gum), *E. viminalis* (Ribbon Gum) and E. robusta (Swamp Mahogany) are some of the preferred Eucalypt species. Within the Port Stephens area, other tree species such as *E. parramattensis* (Drooping Red Gum) and *E. pilularis* (Blackbutt) are known to be regularly used. Koala use a wide variety of tree sizes, and do not preferentially use large or tall trees in NSW forests, although this has been listed as a habitat preference in areas where trees are generally small, stunted or nutrient deprived. The breeding biology of this species is characterised by the occurrence of discrete core, sedentary breeding groups. A core group may comprise up to several dozen individuals that are usually well separated from other breeding groups. These core groups produce a continual supply of dispersing nomadic sub-adults. Individuals within core breeding groups occupy semi-exclusive territories. There is interaction with and marginal overlap of territories between adjacent individual animals. The territories of breeding males generally occur within a matrix of adjacent territories of breeding females. In the overlap zones of adjacent territories of breeding individuals, individual trees occur that are habitually used for interaction between the two animals concerned. These breeding core interaction trees (sometimes termed "home range trees") are

readily identifiable by scratched "trails" up the bole and copious dung deposits at the base of the tree. Breeding occurs in summer and young females produce one young (rarely twins) each year.

No Koalas or signs of their presence were recorded during the surveys at Leewood. No primary Koala feed trees listed under the SEPP 44 were recorded on Leewood, only secondary Koala feed trees were present. Although Koalas have potential to occur within the Leewood they were not detected during field work. Leewood is highly disturbed with a long history of clearing and grazing evident across the site. In addition, there are larger areas of more suitable habitat nearby (Pilliga State Forest ~ 160,000ha) and the proposal is unlikely to affect a significant area of habitat for this species which is noted to offer only secondary foraging resources (~ 48.2ha of cleared, grazed paddocks with scattered paddock trees). Therefore, it is considered that the proposed development is not likely to have an adverse effect on the life cycle of this species such that a viable local population of the species is likely to be placed at risk of extinction.

Pilliga Mouse

No specific habitat type has been identified for the Pilliga Mouse as specimens have been captured in different vegetation types within the Pilliga Scrub (Fox and Briscoe 1980). These included mixed Eucalyptus, Acacia and Callitris open forest. The Pilliga Mouse is found in greatest abundance in recently burnt moist gullies, areas dominated by broombush and areas containing an understorey of Acacia burrowii with a Corymbia trachyphloia overstorey. Consistent features of the latter two habitats were: relatively high plant species richness; a moderate to high low-shrub cover; site moisture retention; and groundcover of plants, litter and fungi. Areas with high rates of capture have extensive low grasses and sedges, with little shrub cover and large areas of ash-covered ground (Fox and Briscoe 1980; NSW DECC 2005; Tokushima et al. 2008).

No records for this species exist within 10km of the site (NSW Wildlife Atlas). However, the Protected Matters Search predicted that this species has potential to occur and the site lies within its known range. Therefore it is considered as having potential to occur. Although Pilliga Mice have potential to occur within the study area they were not detected during field work. The study area is highly disturbed with a long history of clearing and grazing is evident across the site. In addition, there are larger areas of more suitable habitat nearby (Pilliga State Forest ~ 160,000ha) and the proposal is unlikely to affect a significant area (~ 48.2ha of cleared, grazed paddocks with scattered paddock trees) of suitable habitat. Therefore, it is considered that the proposed development is not likely to have an adverse effect on the life cycle of this species such that a viable local population of the species is likely to be placed at risk of extinction.

Yellow-bellied Sheathtail-bat

Yellow-bellied Sheathtail-bat roosts singly or in groups of up to six, in tree hollows and buildings; in treeless areas they are known to utilise mammal burrows. When foraging for insects, flies high and fast over the forest canopy, but lower in more open country. Forages in most habitats across its very wide range, with and without trees; appears to defend an aerial territory.

One record within 10km of the site exists for this species (NSW Wildlife Atlas). However, the Protected Matters Search predicted that this species has potential to occur. This species was not recorded on site. Although, some sub-optimal habitat does occur on site therefore, it is considered to have potential to occur on site.

Leewood is highly disturbed with a long history of clearing and grazing. In addition, there are larger areas of more suitable habitat nearby (Pilliga State Forest ~ 160,000ha) and the proposal will affect a small area of sub-optimal habitat (~ 48.2ha of cleared, grazed paddocks with scattered paddock trees and the clearing of approximately 0.8ha of Pilliga Box Woodland within the Pilliga State Forest). Therefore, it is considered that

the proposed development is not likely to have an adverse effect on the life cycle of this species such that a viable local population of the species is likely to be placed at risk of extinction.

Greater Long-eared Bat (South-eastern form)

Greater Long-eared Bat is split into three distinct population ranges Greater Long-eared Bat occurs from the Eyre Peninsula in South Australia across the south western quarter of the mainland, North eastern Tasmania and across a broad swathe covering the far east of South Australia, North-western Victoria, inland NSW largely west of the divide and South-eastern Queensland north and west of the extreme south-eastern corner.

Greater Long-eared Bat frequents woodland and mallee habitats within its range and its distribution overlaps that of other *Nyctophilus* sp. It is known to roost under loose bark and within the hollows of trees, but more detailed basic information about its breeding requirements and ecology are unknown.

This species has not been recorded within 10km of the site (NSW Wildlife Atlas). However, the Protected Matters Search predicted that this species has potential to occur.. Although, some sub-optimal habitat does occur on site therefore, it is considered to have potential to occur on site.

Leewood is highly disturbed with a long history of clearing and grazing. In addition, there are larger areas of more suitable habitat nearby (Pilliga State Forest ~ 160,000ha) and the proposal will affect a small area of sub-optimal habitat (~ 48.2ha of cleared, grazed paddocks with scattered paddock trees and the clearing of approximately 0.8ha of Pilliga Box Woodland within the Pilliga State Forest). Therefore, it is considered that the proposed development is not likely to have an adverse effect on the life cycle of this species such that a viable local population of the species is likely to be placed at risk of extinction. .

Little Pied Bat

Little Pied Bat (*Chalinolobus pictatus*) is distributed throughout semi arid interior regions of northern NSW and Southern QLD avoiding coastal areas (Churchill 2008). The greatest abundance of Little Pied Bat occurs in the mallee and mixed species woodlands of the Willandra Lakes area of NSW. They have been captured in dry open forest, open woodland, Callitris forest and Casuarina pauper woodlands (Churchill 2008). C. pictatus roosts in trees, caves, abandoned mines and buildings where colonies of up to and over 50 individuals can congregate (Churchill 2008).

Little Pied Bat is fast in flight and highly acrobatic. They forage for moths and presumably other insect species whilst flying through canopy trees and amongst foliage (Churchill 2008).

No records for this species exist within 10km of the site (NSW Wildlife Atlas). However, the Protected Matters Search predicted that this species has potential to occur and the site lies within its known range. Therefore, it is considered as having potential to occur.. Although Little Pied Bat has potential to occur within the study area it was not detected during field work. In addition, there are larger areas of more suitable habitat nearby (Pilliga State Forest ~ 160,000ha) and the proposal will affect a small area of sub-optimal habitat (~ 48.2ha of cleared, grazed paddocks with scattered paddock trees and the clearing of approximately 0.8ha of Pilliga Box Woodland within the Pilliga State Forest). Therefore, it is considered that the proposed development is not likely to have an adverse effect on the life cycle of this species such that a viable local population of the species is likely to be placed at risk of extinction.

b) In the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction,

No endangered populations were identified within or surrounding the study area.

c) In the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:

(i) Is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or

(ii) Is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction,

One EEC was identified on site, notably *Brigalow within the Brigalow Belt South, Nandewar and Darling Riverine Plains Bioregions*. The area of proposed disturbance does not interfere with this EEC's location on site and will not be directly affected by the proposal as the proposal will retain this vegetation. Inaddition, this vegetation will not be indirectly impacted upon provided that rthe recommendations within this report are adhered to. Therefore, the proposal is not likely to place this EEC at risk of extinction.

d) In relation to the habitat of a threatened species, population or ecological community:

Flora Species

- Pterostylis cobarensis
- Rulingia procumbens
- Tylophora linearis

Fauna Species

- Spotted Harrier
- Brown Treecreeper
- Superb Parrot
- Grey-crowned Babbler
- Koala
- Pilliga Mouse
- Yellow-bellied Sheathtail-bat
- Little Pied Bat
- Greater Long-eared Bat
- Malleefowl

(i) The extent to which habitat is likely to be removed or modified as a result of the action proposed, and

- Pterostylis cobarensis

Potential habitat for this species occurs within the woodland and paddock on the study area. Approximately 48.2ha of marginal habitat and 0.8ha of potential habitat will be removed or modified as part of this proposal.

- Rulingia procumbens

Potential habitat for this species occurs within the woodland and paddock on the study area. Approximately 48.2ha of marginal habitat and 0.8ha of potential habitat will be removed or modified as part of this proposal.

- Tylophora linearis

Potential habitat for this species occurs within the woodland and paddock on the study area. Approximately 0.8ha of potential habitat will be removed or modified as part of this proposal.

- Spotted Harrier

Potential foraging habitat for this species occurs within the woodland and paddock on the study area. Approximately 48.2ha of marginal habitat and 0.8ha of potential habitat will be removed or modified as part of this proposal.

- Brown Treecreeper

Potential foraging habitat for this species occurs within the woodland and paddock on the study area. Approximately 48.2ha of marginal habitat and 0.8ha of potential habitat will be removed or modified as part of this proposal.

- Superb Parrot

Potential habitat for this species occurs within the woodland and paddock on the study area. Approximately 48.2ha of marginal habitat and 0.8ha of potential habitat will be removed or modified as part of this proposal.

- Grey-crowned Babbler

Potential habitat for this species occurs within the woodland and paddock on the study area. Approximately 49ha of potential habitat will be removed or modified as part of this proposal.

- Koala

Potential habitat for this species occurs within the woodland and paddock on the study area. Approximately 48.2ha of marginal habitat and 0.8ha of potential habitat will be removed or modified as part of this proposal.

- Pilliga Mouse

Potential habitat for this species occurs within the woodland on the study area. Only 0.8ha of potential habitat will be removed or modified as part of this proposal.

- Yellow-bellied Sheathtail-bat

Potential habitat for this species occurs within the woodland on the study area. Only 0.8ha of potential habitat will be removed or modified as part of this proposal.

- Little Pied Bat

Potential habitat for this species occurs within the woodland and paddock on the study area. 49ha of potential foraging habitat will be modified as part of the current proposal.

- Greater Long-eared Bat

Potential habitat for this species occurs within the woodland on the study area. Only 0.8ha of potential habitat will be removed or modified as part of this proposal.

- Malleefowl

Potential habitat for this species occurs within the woodland on the study area. Only 0.8ha of potential habitat will be removed or modified as part of this proposal.

(ii) Whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and

No area of habitat is likely to become fragmented or isolated from other areas of habitat as part of this proposal.

(iii) The importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality.

Approximately 48.2ha of the study area will be developed within the cleared and grazed area with scattered paddock trees and 0.8ha of remnant vegetation will be removed for access to the site. The study area adjoins large contiguous parcels of land that are part of the Pilliga State Forest which has the potential to support various guilds of flora and fauna.

The potential habitat to be modified within its bounds is considered to be of low importance in terms of the long term survival of the species, populations or ecological communities in the locality.

e) Whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly),

No areas of critical habitat occur within or adjacent to the study area.

f) Whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan,

The proposed action will not act against and will be consistent with the objectives or actions of the recovery or threat abatement plans that exist for the following species:

- Koala

The remaining species do not have an associated recovery or threat abatement plan; however the proposal is equally likely to be consistent with potential objectives in the recovery of these species:

Flora Species

- Pterostylis cobarensis
- Rulingia procumbens
- Tylophora linearis

Fauna Species

- Spotted Harrier
- Brown Treecreeper
- Superb Parrot
- Grey-crowned Babbler
- Pilliga Mouse
- Yellow-bellied Sheathtail-bat
- Little Pied Bat
- Greater Long-eared Bat
- Malleefowl

g) Whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.

The proposal will incrementally contribute to the following KTPs:

- Clearing of native vegetation

The proposal will require the removal of multiple Eucalypt trees across the study area.

Given that a level of disturbance already exists within the area it is not expected to increase the impact on native flora and fauna and as such in considering the overall extent of native vegetation within the locality, this KTP will not have a major impact.

Appendix 8

Likelihood of Occurence – ROW

Those threatened flora and fauna species (listed under the *TSC Act* and the *EPBC Act*) that have been gazetted / recorded from within the locality have been considered in the following tables. EEC's and Endangered Populations known from the broader area have also been addressed. Each species / community / population is considered for its potential to occur within the study area and the likely level of impact as a result of the proposed activities. The following tables deal with each species / community / population separately and identifies the ecological parameters of significance associated with the proposed activities.

'Species' or **'EEC / Population'** – Lists each threatened species / EEC / population known from the vicinity of the site. The status of each threatened species under the *TSC Act* and *EPBC Act* is also provided.

'Habitat' – Provides a brief account of the species / community / population and the preferred habitat attributes required for the existence / survival of each species / community / population.

'Likelihood of Occurrence'– Assesses the likelihood of each species / community / population to occur within the site in terms of the aforementioned habitat description and taking into account local habitat preferences, results of recent field investigations, data gained from various sources and previously gained knowledge via fieldwork undertaken within other ecological assessments in the locality.

'Potential for Impact' – Through consideration of the likely level / significance of impacts to each species / community / population that would result from the proposed activities, taking into account both short and long-term impacts, a decision has been made whether further assessment is required. This assessment is largely based on the chance of occurrence of each species / community with due recognition to other parameters such as home range, habitat use, connectivity etc. It also considers the scope of the proposed activities.

Ecological Community	TSC Act Status	EPBC Act Status	Habitat	Likelihood of Occurrence	Potential for Impact
Brigalow within the Brigalow Belt South, Nandewar and Darling Riverine Plains Bioregions (TSC). Brigalow (*Acacia harpophylla* dominant and co-dominant) (EPBC)	E	E	Dominated by *A. harpophylla and* associated with deep gilgaied clays, sedentary clays, alluvial clays and loamy red soils. Can occur with or without various Eucalypt species. Generally poses a dense low tree layer or tall shrub layer. The ground layer is typically sparse but dominated by native grasses.	This community was not identified on site during targeted surveys. Therefore, it is considered **unlikely** to occur.	As this community is unlikely to occur on site it is not likely to be impacted upon as a result of the proposed actions. An AoS is not required for this community.
Coolibah - Black Box Woodlands of the DarlingRiverine Plains and the Brigalow Belt South Bioregions	E	E	Open eucalypt woodlands formerly occurred across a range of climatic regions of Australia, including semi-arid and humid subtropical zones. The position in the landscape of these woodlands can determine the vegetation structure of the woodlands such as if they occur on the floodplains or uplands and consequently, whether they have a more shrubby or more grassy understorey.	This community was not identified on site during targeted surveys. Therefore, it is considered **unlikely** to occur.	As this community is unlikely to occur on site it is not likely to be impacted upon as a result of the proposed actions. An AoS is not required for this community.
Grey Box (*Eucalyptus microcarpa*) Grassy Woodlands and Derived Native Grasslands of South-eastern Australia (EPBC) Inland Grey Box Woodland in the Riverina, NSW South Western Slopes, Cobar Peneplain, Nandewar and Brigalow Belt South Bioregions (TSC)	E	E	Dominated by *E. microcarpa* and is found on relatively fertile soils of the western slopes and plains of NSW. Has a sparse shrub layer with a variable ground layer of grass and herbaceous species present almost always. This woodland is 15-25m tall but disturbed patches can experience thinning and clearing which alters the overall height.	This community was not identified on site during targeted surveys. Therefore, it is considered **unlikely** to occur.	As this community is unlikely to occur on site it is not likely to be impacted upon as a result of the proposed actions. An AoS is not required for this community.
Natural grasslands on basalt and fine-textured alluvial plains of northern New South Wales (EPBC) and southern Queensland;	E	CE	This community is generally grassland often dominated by grass species such as *Austrostipa aristiglumis*, *Dichanthium sericeum* or *Panicum queenslandicum* but can also include various shrubs and trees. This	This community was not identified on site during targeted	As this community is unlikely to occur on site it is not likely to be impacted upon as a result of the proposed actions. An AoS is not required for this community.

Ecological Community	TSC Act Status	EPBC Act Status	Habitat	Likelihood of Occurrence	Potential for Impact
Native Vegetation on Cracking Clay Soils of the Liverpool Plains (TSC)			community occurs on cracking clay soils within the Liverpool Plains Catchment.	surveys. Therefore, it is considered **unlikely** to occur.	
Weeping Myall Woodlands (EPBC) Myall Woodland in the Darling Riverine Plains, Brigalow Belt South, Cobar Peneplain, Murray-Darling Depression, Riverina and NSW South western Slopes bioregions (TSC)	E	E	This woodland is dominated by *Acacia pendula* (Weeping Myall). It is scattered through the eastern parts of alluvial plains of the Murray-Darling river system. It is generally found on red-brown earths and heavy textured grey brown alluvial soils. The canopy layer reaches 10m in height with an open understorey of chenopod shrubs and other woody plant species. The ground layer is an open to continuous groundcover of grasses and herbs.	This community was not identified on site during targeted surveys. Therefore, it is considered **unlikely** to occur.	As this community is unlikely to occur on site it is not likely to be impacted upon as a result of the proposed actions. An AoS is not required for this community.
White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland (EPBC) White Box-Yellow Box-Blakely's Red Gum Grassy Woodland (TSC)	E	CE	This woodland is found on fertile soils on the tablelands and western slopes of NSW. The distribution of the community spreads between NSW North Coast, New England Tableland, Nandewar, Brigalow Belt, South, Sydney Basin, South Eastern Highlands and NSW South Western Slopes Bioregions. The characteristic species for this woodland are *Eucalyptus albens*, *Eucalyptus melliodora* or *Eucalyptus blakelyi*. Grass and herbaceous species generally characterise the ground layer. In some locations canopy species may be entirely absent due to clearing. Shrubs are generally sparse or absent.	**Recorded** on site.	There is potential for this community to be impacted upon as a result of the proposed actions. *Therefore, this species has been assessed in **Appendix 9** and **Appendix 10**.*

Species	Common Name	TSC Act Status	EPBC Act Status	Habitat	Likelihood of Occurrence	Potential for Impact
Bertya opponens		V	V	Grows on slightly elevated ridges with moderately coarse, sandy soil. The vegetation ranges from mallee shrubland to open woodland.	This species was not recorded on site but one record exists within 10km of the site (NSW Wildlife Atlas). However, the Protected Matters Search predicted that this species has potential to occur. This species preferred habitat specifically elevated ridges in association with mallee shrubland does not occur on site. Therefore it is considered **unlikely** to occur on site.	This species is unlikely to occur on site due to the lack of suitable habitat. Therefore it is not likely to be impacted upon as a result of the proposed actions. An AoS is not required for this species.
Cadellia pentastylis	Ooline		V	Ooline occurs on the western edge of the NSW north-west slopes. Ooline grows in dry rainforest, semi-evergreen vine thickets and sclerophyll ecological communities, often locally dominant or as an emergent. Prefers high fertile soils.	No records for this species exist within a 10km radius of the site (NSW Wildlife Atlas). However, the Protected Matters Search predicted that this species has potential to occur. This species was not detected during comprehensive field surveys to spite it being a distinctive looking small tree. Suitable habitat on site is also sub-optimal. Therefore, it is considered **unlikely** to occur.	This species is unlikely to occur on site. Therefore it is not likely to be impacted upon as a result of the proposed actions. An AoS is not required for this species.
Dichanthium setosum	Bluegrass	V	V	Bluegrass is associated with heavy basaltic black soils and stony red-brown hard setting loam with clay subsoil. It is found in moderately disturbed areas such as cleared woodland, grassy roadside remnants, grazed land and highly disturbed pasture.	Two records for this species exist within 10km of the site (NSW Wildlife Atlas). The Protected Matters Search predicted that this species has potential to occur. Although, it was not recorded during field surveys. Although these soils do not persist on site, there are areas of disturbance where this species could inhabit. Therefore it is considered as having **potential** to occur.	Due to this species inhabiting disturbed areas, there is potential for it to be impacted upon as a result of the proposal if it does persist on site. *Therefore, this species has been assessed in **Appendix 9** and **Appendix 10**.*

Species	Common Name	TSC Act Status	EPBC Act Status	Habitat	Likelihood of Occurrence	Potential for Impact
Lepidium aschersonii	Spiny Pepper-cress		V	Spiny Peppercress is endemic to mainland southern Australia, where it is widely but patchily distributed from north-eastern New South Wales to Western Australia. There are currently thought to be about 30 populations of Spiny Peppercress with only 14 population records existing within NSW. Occurs in periodically wet sites such as gilgai depressions and the margins of freshwater and saline marshes and shallow lakes, usually on heavy cracking clay soil.	This species has been recorded 27 times within 10km of the site (NSW Wildlife Atlas) and the Protected Matters Search predicted that this species has potential to occur. but was not detected during field surveys. The site includes a portion of Bohena Creek which does not form on heavy cracking clay soils however it is periodically wet and could provide some potential habitat for this species. It is considered as having **potential** to occur.	This species is considered to have **potential** to occur on site. Therefore it has potential to be impacted upon as a result of the proposed actions. *As there is potential for impact upon this species it is assessed in **Appendix 9**.*
Philotheca ericifolia		De-listed	V	This species inhabits the north-western slopes and central western slopes of NSW, from the upper Hunter Valley, to Pilliga and to the Peak Hill district. Occurs in drainage areas in dry sclerophyll open forest or woodland on sandstone and in heath on damp sandy flats and gullies, and occasionally dry sandy creek beds.	No records exist for this species within 10km of the site (NSW Wildlife Atlas) and field surveys did not detect this species on site. However, the Protected Matters Search predicted that this species has potential to occur and the easement crosses Bohena Creek that provides damp sandy habitat for this species to occur in. It is therefore considered as having **potential** to occur on site.	This species is considered to have **potential** to occur on site. Therefore it has potential to be impacted upon as a result of the proposed actions. *As there is potential for impact upon this species it is assessed and in **Appendix 9**.*
Polygala linariifolia	Native Milkwort	E		An incredibly rare species that has been recorded only once in the region in 1976 (Cunningham et al. 2011). Grows in dry sclerophyll communities from Warialda area to Weebah gate on the Qld border. Flowering from September to February.	One record exists for this species within 10km of the site (NSW Wildlife Atlas). However, the Protected Matters Search predicted that this species has potential to occur. It was not detected on site during surveys, however the surveys were not	This species is considered to have **potential** to occur on site. Therefore it has potential to be impacted upon as a result of the proposed actions. *As there is potential for*

Species	Common Name	TSC Act Status	EPBC Act Status	Habitat	Likelihood of Occurrence	Potential for Impact
					conducted during its flowering time and individuals may have gone undetected. Due to its cryptic nature its occurrence cannot be totally discounted. Therefore, it is considered as having **potential** to occur.	*impact upon this species it is assessed in **Appendix 9** and **Appendix 10**.*
Pterostylis cobarensis	Cobar Greenhood Orchid	V	V	Cobar Greenhood Orchid is known chiefly from the Nyngan–Cobar–Bourke district in the far western plains of NSW. Grows among rocks on low hills and on slopes above streams. Inhabits eucalypt woodland, open mallee, or *Callitris* shrubland on low stony ridges and slopes with skeletal sandy-loam soils.	This species was recorded once within 10km of the site (NSW Wildlife Atlas). However, the Protected Matters Search predicted that this species has potential to occur. Although it was not detected during field surveys. Eucalypt woodland in which this species can occur and associated species including *Callitris glaucophylla*, *Geijera parviflora* do exist within the vegetation alongside the easement. Therefore it is considered as having **potential** to occur.	This species is considered to have **potential** to occur on site. Therefore it has potential to be impacted upon as a result of the proposed actions. *As there is potential for impact upon this species it is assessed in **Appendix 9** and **Appendix 10**.*
Rulingia procumbens		V	V	Endemic to NSW and is known from the Dubbo–Medooran–Gilgandra region, the Cobar region, and the upper Hunter Valley. Populations of this species have been recorded in Goonoo State Forest (SF), Mt Kaputar National Park, and Pilliga Nature Reserve. Occurs in sandy soils, often in disturbed habitats such as road verges, quarry boundaries, gravel stockpiles, and power line easements.	No records for this species exist within 10km of the site (NSW Wildlife Atlas). However, the Protected Matters Search predicted that this species has potential to occur. Although it was not detected during field surveys. Sandy soils are the main soil type along the easement in which this species prefers and the site is currently in a disturbed state. It is therefore considered as having **potential** to occur.	The disturbed easement in which this species could occur is being cleared and hence impacted upon. For this reason there is potential for the proposal to impact upon this species if it does occur on site. *Therefore, this species has been assessed in **Appendix 9** and **Appendix 10**.*

Species	Common Name	TSC Act Status	EPBC Act Status	Habitat	Likelihood of Occurrence	Potential for Impact
Swainsona murrayana	Slender Darling Pea	V	V	Found in grassland, herbland, and open Black-box woodland, often in depressions. This species grows in heavy grey or brown clay, loam, or red cracking clays. It is often associated with low chenopod shrubs (*Maireana* spp.), wallaby-grass (*Austrodanthonia* spp), and spear grass (*Austrostipa* spp.).	This species has not been recorded within 10km of the site and it was not detected during field surveys. Suitable habitats with the appropriate soils do not occur on site. Therefore it is considered **unlikely** to occur.	This species is unlikely to occur, therefore is unlikely to be impacted upon as a result of the proposal. An AoS is not required for this species.
Tylophora linearis		V	E	*Tylophora linearis* has rarely been collected and is known from eight localities in the Dubbo area and Mt Crow near Barraba in NSW. Grows in dry scrub, open forest and woodlands associated with *Melaleuca uncinata*, *Eucalyptus fibrosa*, *E. sideroxylon*, *E. albens*, *Callitris endlicheri*, *C. glaucophylla*, *Allocasuarina luehmannii*, *Acacia hakeoides*, *A. lineata*, *Myoporum* spp., and *Casuarina* spp.	This species has not been recorded within 10km of the site (NSW Wildlife Atlas). However, the Protected Matters Search predicted that this species has potential to occur. Although, it was not detected during field surveys. However, some sub-optimal habitat does occur on site therefore, it is considered to have **potential** to occur on site.	This species is considered to have **potential** to occur on site. Therefore it has potential to be impacted upon as a result of the proposed actions. *As there is potential for impact upon this species it is assessed in **Appendix 9** and **Appendix 10**.*

Species	Common Name	TSC Act Status	EPBC Act Status	Habitat	Likelihood of Occurrence	Potential for Impact
Circus assimilis	Spotted Harrier	V	M	Occurs throughout the Australian mainland, except in densely forested or wooded habitats of the coast, escarpment and ranges. Individuals disperse widely in NSW and comprise a single population. Grassy open woodland including acacia and mallee remnants, inland riparian woodland, grassland and shrub steppe (*e.g.* chenopods). It is found most commonly in native grassland, but also occurs in agricultural land, foraging over open habitats including edges of inland wetlands.	This species could utilise the site to forage for prey such as small birds and mammals. Therefore there is **potential** for it to occur on site.	This species is considered to have **potential** to occur on site. Therefore it has potential to be impacted upon as a result of the proposed actions. *As there is potential for impact upon this species it is assessed in **Appendix 9** and **Appendix 10**.*
Botaurus poiciloptilus	Australasian Bittern	E	E	This species is sedentary in permanent habitat with possible regular short distance movements during winter and occasional irruptions associated with wet years. It lives alone or in loose groups and favours permanent fresh-waters dominated by sedges, rushes, reeds or cutting grasses (e.g. Phragmites, Scirpus, Eleocharis, Juncus, Typha, Baumea and Gahnia spp.).	This species was not recorded within 10km of the site (NSW Wildlife Atlas). However, the Protected Matters Search predicted that this species has potential to occur. Where the site crosses Bohena Creek, suitable Phragmites habitat does occur for this species. Therefore there is **potential** for this species to occur.	Despite there being potential for this species to occur, the habitats in which it would occur is not being impacted upon as a result of the proposal. Therefore no impact is considered to occur to this species. An AoS is not required.

Species	Common Name	TSC Act Status	EPBC Act Status	Habitat	Likelihood of Occurrence	Potential for Impact
Erythrotriorchis radiatus	Red Goshawk	E	V	Red Goshawks are found from across northern Australia, down the east coast of Qld and into the northern coast of NSW. In NSW records are rare. Listed as having occurred south to Port Stephens. Its habitat consists of wooded and forested areas. Prefers forest and woodland with a mosaic of vegetation types, large populations of birds for prey and permanent water. Riverine vegetation is highly utilised by this species. Its habits are not well known, but it is considered to be a solitary, sedentary bird. They nest in tree forks of *Eucalypt* sp. and *Melaleuca* sp. or those nests of other large birds such as Magpies or Crows. The nests are generally built of sticks, which are lined with soft twigs and leaves.	This species distribution in NSW is restricted to the north-eastern corner. Therefore, it is **unlikely** for this species to occur.	As this species is unlikely to occur, it is also unlikely to be impacted as a result of the proposal.

Species	Common Name	TSC Act Status	EPBC Act Status	Habitat	Likelihood of Occurrence	Potential for Impact
Lathamus discolor	Swift Parrot	E	E	During winter Swift Parrots inhabit mainland Australia from Adelaide (S.A.) through Victoria, and up the east coast to South-East Queensland, as well as visiting the South and Central Western Slopes and the Riverina in NSW. They return to eastern Tasmania in spring to breed. In NSW, they occur in a range of habitat types from coastal forests and heaths to dry open woodlands on the western slopes. Key habitat for Swift Parrots is on the coast and coastal plains of NSW include *Corymbia maculata* (Spotted Gum), *Eucalyptus robusta* (Swamp Mahogany) and *Eucalyptus tereticornis* (Forest Red Gum) forests. They are dependent on habitats that provide winter foraging resources such as nectar and lerps (sugary exudates from leaf insects). Within these habitats, they prefer foraging in mature trees that provide a higher quality and quantity of nectar than regrowth trees. They have previously been found to select mature trees over 40 cm DBH with an emphasis on trees greater than 60cm DBH.	This species has not been recorded within 10km of the site (NSW Wildlife Atlas). However, the Protected Matters Search predicted that this species has potential to occur and some suitable foraging habitat occurs. Therefore, there is **potential** for this species to occur.	This species is considered to have **potential** to occur on site. Therefore it has potential to be impacted upon as a result of the proposed actions. *As there is potential for impact upon this species it is assessed in **Appendix 9** and **Appendix 10**.*

Species	Common Name	TSC Act Status	EPBC Act Status	Habitat	Likelihood of Occurrence	Potential for Impact
Climacteris picumnus victoriae	Brown Treecreeper (Eastern Subspecies)	V		Frequents drier forests and woodlands, particularly open woodland lacking a dense understorey. Also found in grasslands in proximity to wooded areas where there are sufficient logs, stumps and dead trees nearby. Occasionally found in mallee and *Eucalyptus camaldulensis* (River Red Gum) forest bordering wetlands with an open understorey of *Acacia* sp., *Muehlenbeckia* sp. (Lignum), *Typha* sp. (Cumbungi) and *Poa* sp. (grasses). Feeds on invertebrate larvae and small insects, particularly ants. Utilises hollows for roosting/nesting.	**Recorded** on site.	This species was recorded on site and has the **potential** to be impacted by the proposed actions. *Therefore, this species has been assessed in **Appendix 10**.*

Species	Common Name	TSC Act Status	EPBC Act Status	Habitat	Likelihood of Occurrence	Potential for Impact
Pomatostomus temporalis temporalis	Grey-crowned Babbler	V		Occupies open forests and woodlands, Acacia shrubland and adjoining farmland. Also Box-Gum Woodlands on the divide slopes and Box-Cypress Pine and open Box Woodlands on the plains. They feed on terrestrial invertebrates and insects on lower trunks and branches. Generally they prefer wooded areas with an intact ground cover, although in such areas as the Hunter Valley they occur in sparsely vegetated areas such as properties and golf courses. Appears unable to persist in cleared and highly fragmented habitats. Nest comprise of a dome shape stick nest which is often only a couple of metres from the ground in shrubs or Eucalypt saplings.	**Recorded** on site.	This species was recorded on site and has the **potential** to be impacted by the proposed actions. *Therefore, this species has been assessed in **Appendix 10**.*

Species	Common Name	TSC Act Status	EPBC Act Status	Habitat	Likelihood of Occurrence	Potential for Impact
Phascolarctos cinereus	Koala	V	V	Koalas occur along the east coast of Australia and extend into Woodland, Mulga and River Red Gum forests west of the Great Dividing Range. The range of the Koala covers all such suitable areas of NSW. In drier forested areas, Koalas are generally observed as individuals in low densities. They are more abundant in coastal woodland and in open forest, where they have been found in densities as high as ten individuals per hectare. They are rare or absent in wet forests in the southern part of their range above 600 m which may be due more to distribution of Eucalypt species than climate, as the Koala is limited to areas where there are acceptable food trees. The diet is generally restricted to that of Eucalypt leaves. On occasion, non-Eucalypt foliage is eaten. The foliage of *Eucalyptus camaldulensis* (River Red Gum), *E. microcorys* (Tallowwood), *E. tereticornis* (Forest Red Gum), *E. punctata* (Grey Gum), *E. viminalis* (Ribbon Gum) and *E. robusta* (Swamp Mahogany) are some of the preferred Eucalypt species.	Various records for this species occur within 10km of the site. Secondary feed trees used by this species do occur on site, although surveys did not locate this species or signs of this species on site. Nevertheless it is considered as having **potential** to occur.	Due the low number of non-preferred feed tress to be removed by the proposal, this species is unlikely to be impacted by the proposed action. *Nevertheless, as there is some degree of likelihood that this species occurs within the study area, it has been assessed in **Appendix 9** and **Appendix 10**.*

Species	Common Name	TSC Act Status	EPBC Act Status	Habitat	Likelihood of Occurrence	Potential for Impact
Saccolaimus flaviventris	Yellow-bellied Sheathtail-bat	V		Range of habitats from rainforest to arid shrubland, roosts in tree-hollows. Yellow-bellied Sheathtail Bats seem to migrate in winter from cooler areas in southern Australia to warmer northern areas.	Six records within 10km of the (NSW Wildlife Atlas) and the Protected Matters Search predicted that this species has potential to occur. Some sub-optimal habitat does occur on site. Therefore, it is considered to have **potential** to occur on site.	This species is considered to have **potential** to occur on site. Therefore it has potential to be impacted upon as a result of the proposed actions. *As there is potential for impact upon this species it is assessed by a seven part test immediately below this table.*
Chalinolobus picatus	Little Pied Bat	V		This hollow roosting species occurs mostly in dry, open woodlands throughout its range but can occupy other forms of vegetation communities such as notophyll vine forest and dry sclerophyll forest. Little Pied Bats appear to be at their highest density in the mallee woodlands of the Willandra Lakes area of NSW. They have been known to roost in trees, caves and abandoned mines and buildings.	Three records within 10km of the (NSW Wildlife Atlas). However, the Protected Matters Search predicted that this species has potential to occur and some sub-optimal habitat does occur on site. Therefore, it is considered to have **potential** to occur on site.	This species is considered to have **potential** to occur on site. Therefore it has potential to be impacted upon as a result of the proposed actions. *As there is potential for impact upon this species it is assessed in **Appendix 10**.*

Species	Common Name	TSC Act Status	EPBC Act Status	Habitat	Likelihood of Occurrence	Potential for Impact
Vespadelus troughtoni	Eastern Cave Bat	V	V	This species' distribution ranges from northern QLD through to Northern NSW. They have been found roosting in sandstone overhangs, boulder pipes, mines and occasionally buildings. They commonly utilise abandoned fairy martin nests under bridges and in culverts. All existing records are in close proximity to sandstone or volcanic escarpment. Vegetation communities in which they inhabit include tropical mixed woodland and wet and dry sclerophyll along the coast and the Great Dividing Range. This species has a relatively small foraging range of approximately 33ha.	Two records for this species exist within 10km of the site (NSW Wildlife Atlas) and the Protected Matters Search predicted that this species has potential to occur. Due to the lack of sandstone or volcanic escarpments in close proximity to the site, it is considered **unlikely** to occur on site.	No caves are likely to be impacted by the proposal. Therefore, this species is considered unlikely to be impacted by the proposal and an AoS is not required.

Species	Common Name	TSC Act Status	EPBC Act Status	Habitat	Likelihood of Occurrence	Potential for Impact
Underwoodisaurus sphyrurus	Border Thick-tailed Gecko	V	V	*U. sphyrurus* has a patchy distribution spread throughout the north-west slopes and northern tablelands of NSW. Habitat preferred by this species is dry sclerophyll open forest and woodland associated with outcrops of granite, basalt, sandstone and metamorphic rocks. Most known populations occur on sites with granite rocks. Sites favouring an easterly aspect have also been found to harbour more populations of this species. This species has been known to shelter under rocks, barks, logs and litter in rocky rubble.	This species was not recorded on or within 10km of the site (NSW Wildlife Atlas). However, the Protected Matters Search predicted that this species has potential to occur. No suitable habitat in the form of granite rocky outcrops occurs on site. Therefore it is considered **unlikely** to occur.	Due to lack of suitable habitat this species is unlikely to occur. Therefore, this species is considered unlikely to be impacted by the proposal and an AoS is not required

Species	Common Name	TSC Act Status	EPBC Act Status	Habitat	Likelihood of Occurrence	Potential for Impact
Anomalopus mackayi	Five-clawed Worm-skink	E	V	The species' known distribution in New South Wales is confined to the Namoi River and Gwydir River floodplains and the lower north-western slopes of the Great Dividing Range. The species ranges from the Wallangra-Masterman Range area in the east, south-west to the Narrabri-Wee Waa area, west along the northern edge of the Pilliga outwash demarcation to the south-west corner of the Namoi catchment south of Walgett. Known to occur in both remnant and non-remnant woodlands with low grass cover Individuals also occur in open grassy paddocks with scattered eucalypts and moist black soil. It uses fallen logs and timber as sheltering sites and digs in loose soil to create permanent tunnel like burrows. In areas modified by agriculture and other human activities, the species has been found sheltering under artificial materials lying flat on the ground, such as discarded railway sleepers, sheet metal and hay bales.	This species was not recorded on site or within 10km of the site (NSW Wildlife Atlas). However, the Protected Matters Search predicted that this species has potential to occur. The soil on the site is not the preferred substance in which this species burrows in. Therefore it is considered **unlikely** to occur.	This species is unlikely to occur on site, therefore it is unlikely to be impacted upon as a result of the proposed actions and an AoS is not required for this species.

Species	Common Name	TSC Act Status	EPBC Act Status	Habitat	Likelihood of Occurrence	Potential for Impact
Anthochaera phrygia	Regent Honeyeater	CE	E	Nomadic Honeyeater that disperses to non-breeding areas, including the coast, in winter, where flowering trees are sought. Within the region, mostly recorded in Box-Ironbark Eucalypt associations along creek flats, river valleys and foothills. Coastal swamp forests in Lower Hunter are used when more western resources fail. The main feed tree for coastal areas is *Eucalyptus robusta* (Swamp Mahogany). Hunter records are more common in near coastal areas such as Cessnock LGA. Feed trees in this region are *Corymbia maculata* (Spotted Gum), *E. fibrosa* (Broad-leaved Ironbark), *E. crebra* (Narrow-leaved Ironbark) and various stringybark sp.. Nests mainly west of the divide, although local breeding attempts have occurred at Quorrobolong.	This species has not been recorded within 10km of the site (NSW Wildlife Atlas). However, the Protected Matters Search predicted that this species has potential to occur Although it was not recorded during field surveys. Flowering Eucalypt blossoms are available within the vegetated sections of the site in which this species could potentially forage. However due to the lack of records in the vicinity, it is considered **unlikely** to occur.	This species is unlikely to occur on site, therefore it is unlikely to be impacted upon as a result of the proposed actions and an AoS is not required for this species.

Species	Common Name	TSC Act Status	EPBC Act Status	Habitat	Likelihood of Occurrence	Potential for Impact
Geophaps scripta scripta	Squatter Pigeon	E	V	Occurs on the inland slopes of the Great Dividing Range with a distribution that extends from the Burdekin-Lynd divide in central Queensland, west to Charleville and Longreach, east to the coast from Prosperine to Port Curtis, and south to scattered sites in south-eastern Queensland. Inhabits grassy woodlands and open forests that are dominated by eucalypts. No confirmed records have been made since the 1970s.	No records exist within 10km of the site (NSW Wildlife Atlas). However, the Protected Matters Search predicted that this species has potential to occur. Although, it was not detected during field surveys. No records have been made since the late 1970s, therefore it is considered **unlikely** to occur.	This species was considered unlikely to occur. Therefore it is unlikely to be impacted upon as a result of the proposed actions. An AoS is not required for this species.

Species	Common Name	TSC Act Status	EPBC Act Status	Habitat	Likelihood of Occurrence	Potential for Impact
Leipoa ocellata	Malleefowl	E	V	Inhabits semi-arid regions of southern Australia. In New South Wales, it typically occurs west of the Great Dividing Range. Extends from Pilliga south-west to the districts of Griffith and Wentworth. The extent of occurrence is known to be decreasing. The distribution of the Malleefowl was formerly more extensive, extending over a large proportion of mainland southern Australia, including the south-western region of the Northern Territory. Occupies shrublands and low woodlands that are dominated by mallee vegetation. It also occurs in other habitat types including eucalypt or native pine *Callitris* woodlands, acacia shrublands, Broombush *Melaleuca uncinata* vegetation or coastal heathlands.	No records exist within 10km of the site for this species (NSW Wildlife Atlas). However, the Protected Matters Search predicted that this species has potential to occur.. Callitris and Acacia woodlands do persist on site and they are sub-optimal habitat. Therefore, it is considered to have **potential** to occur on site.	This species is considered to have **potential** to occur on site. Therefore it has potential to be impacted upon as a result of the proposed actions. *As there is potential for impact upon this species it is assessed in **Appendix 9** and **Appendix 10**.*

Species	Common Name	TSC Act Status	EPBC Act Status	Habitat	Likelihood of Occurrence	Potential for Impact
Polytelis swainsonii	Superb Parrot	V	V	The Superb Parrot occurs only in south-eastern Australia. The Superb Parrot is found in NSW and northern Victoria, where it occurs on the inland slopes of the Great Divide and on adjacent plains, especially along the major river-systems; vagrants have also been recorded in southern Queensland. Mainly inhabits forests and woodlands dominated by eucalypts, especially River Red Gums (*Eucalyptus camaldulensis*) and box eucalypts such as Yellow Box (*Eucalyptus melliodora*) or Grey Box (*E. microcarpa*). The species also seasonally occurs in box-pine (*Callitris*) and Boree (*Acacia pendula*) woodland.	This species has been recorded twice within 10km of the (NSW Wildlife Atlas). However, the Protected Matters Search predicted that this species has potential to occur.. Suitable eucalypt species do exist in the vegetation surrounding the easement in which this species could forage. Therefore it is considered as having **potential** to occur.	This species is unlikely to be impacted upon as a result of the proposed actions. *Nevertheless, as there is some degree of likelihood that this species occurs seasonally within the study area, it has been assessed in **Appendix 9** and **Appendix 10**.*
Rostratula australis	Australian Painted Snipe	E	V	A small freshwater and estuarine wader, which prefers fringes of swamps, dams and nearby marshy areas where there is a cover of grasses, lignum, low scrub or open timber.	No suitable habitat exists on site for this species. Therefore it is considered **unlikely** to occur.	This species is unlikely to occur on site. Therefore it is not likely to be impacted upon as a result of the proposed actions. An AoS is not required for this species.

Species	Common Name	TSC Act Status	EPBC Act Status	Habitat	Likelihood of Occurrence	Potential for Impact
Chalinolobus dwyeri	Large-eared Pied Bat	V	V	This species forages in tall open forests and the edges of rainforest. It roosts in mine shafts and similar structures. Roosts in caves (near their entrances), crevices in cliffs, old mine workings and in the disused, bottle-shaped mud nests of *Hirundo ariel* (Fairy Martin), frequenting low to mid-elevation dry open forest and woodland close to these features.	No records for this species exist within 10km of the site (NSW Wildlife Atlas) and suitable habitat is not present. It is therefore considered **unlikely** to occur.	This species is unlikely to occur on site. Therefore it is not likely to be impacted upon as a result of the proposed actions. An AoS is not required for this species.
Nyctophilus corbeni	South-eastern Long-eared Bat		V	The South-eastern Long-eared Bat occurs in a range of inland woodland vegetation types, including box, ironbark and cypress pine woodlands.	This species was not recorded on or within 10km of the site (NSW Wildlife Atlas). However, the Protected Matters Search predicted that this species has potential to occur and some suitable habitat occurs in the adjacent vegetation in which this species can roost and forage. It is therefore considered as having **potential** to occur.	This species is considered to have **potential** to occur on site. Therefore it has potential to be impacted upon as a result of the proposed actions. *As there is potential for impact upon this species it is assessed in **Appendix 9**.*

Species	Common Name	TSC Act Status	EPBC Act Status	Habitat	Likelihood of Occurrence	Potential for Impact
Petrogale penicillata	Brush-tailed Rock Wallaby	E	V	Occurs in forests and woodlands along the Great Divide and on the western slopes in escarpment country with rocky outcrops, steep rocky slopes, gorges, boulders and isolated rocky areas. The majority of populations favour north-facing aspects, but some southern aspects have been recorded. Apart from the critical rock structure *Petrogale penicillata* also requires adjacent vegetation types, associated types include, dense rainforest, wet sclerophyll, vine thicket, dry sclerophyll forest and open forest.	No records for this species exist within 10km of the site (NSW Wildlife Atlas). However, the Protected Matters Search predicted that this species has potential to occur. No suitable habitat in the form of rocky outcrops exists on site. Therefore it is considered **unlikely** to occur on site.	This species is unlikely to occur on site. Therefore it is not likely to be impacted upon as a result of the proposed actions. An AoS is not required for this species.

Species	Common Name	TSC Act Status	EPBC Act Status	Habitat	Likelihood of Occurrence	Potential for Impact
Pseudomys pilligaensis	Pilliga Mouse	V	V	This species is known only from the Pilliga region of NSW including the Pilliga state forest and Pilliga nature reserve. A defined habitat for this species is hard to characterise as the vegetation type in which this species has been found varies. Eucalypt, Callitris and Acacia woodlands are vegetation types in which this species has been found. It has been found mostly in gullies that have experienced recent fire events. Habitat features that appear to be preferential for this species include a moderate to high low-shrub cover; site moisture retention; and groundcover of plants, litter and fungi. Topography of sites where this species is found include rolling landscapes with low relief on sandy soil and sandstone ridges.	Records for this species exist within 10km of the site (NSW Wildlife Atlas) and the site is within this species' known range. Therefore it is considered as having **potential** to occur.	There is potential for this species to occur on site, therefore it has potential to be impacted upon as a result of the proposed actions. *Therefore, this species has been assessed in **Appendix 9** and **Appendix 10**.*
Anseranas semipalmata	Magpie Goose	V		Often seen in trios or flocks of 100 to 5,000, on shallow wetlands (especially those with a dense growth of rushes or sedges), drying ephemeral swamps, wet grasslands and floodplains, often roosting in fringing Paperbarks (*Melaleuca* spp.). The diet of this species is composed of grass seeds and sedge rhizomes.	Three records for this species exist within 10km of the site (NSW Wildlife Atlas) Suitable habitat in the form of wetlands and swamps do not occur on site. Therefore it is **unlikely** to occur.	This species is unlikely to occur on site. Therefore it is not likely to be impacted upon as a result of the proposed actions. An AoS is not required for this species.

Species	Common Name	TSC Act Status	EPBC Act Status	Habitat	Likelihood of Occurrence	Potential for Impact
Hieraaetus morphnoides	Little Eagle	V		*H. morphnoides* is a solitary raptor which occurs in woodland and also open habitat, rarely found around dense forest. Can be found across most of Australia, but more commonly found near coastal to inland regions in NSW and Victoria. This species is part-migratory to nomadic and dispersive in some areas.	One record exists for this species within 10km of the site (NSW Wildlife Atlas). It was not detected during field surveys. Due to the wide range of habitats in which this species forages, it cannot be ruled out as occurring on site. Therefore it has **potential** to occur.	The proposal impacts potential foraging habitat for this species, therefore there is potential for this species to be impacted upon. *Therefore, this species has been assessed in **Appendix 10**.*

Species	Common Name	TSC Act Status	EPBC Act Status	Habitat	Likelihood of Occurrence	Potential for Impact
Ninox connivens	Barking Owl	V		Occurs in forests, woodlands, and savannah and riverine woodland, and although rainforests may be used for roosting, more open country is favoured for foraging and large hollow-bearing eucalypts for breeding. *N. connivens* is widespread within New South Wales, with records from coastal areas along with the slopes, plains, tablelands, and far western plains. Records of *N. connivens* have been documented from lowland / floodplain open forest on the coast *Eucalyptus tereticornis* (Forest Red Gum), box/ ironbark/ cypress woodlands; *Eucalyptus camaldulensis* (River Red Gum), riverine forests; and *Angophora floribunda* (Rough Barked Apple) / *Eucalyptus melliodora* (Yellow Box) woodland with *Casuarina spp.* Barking Owls are opportunistic predators, foraging on terrestrial, arboreal and flying prey. Diurnal birds comprise a large proportion of diet, and apparently arboreal mammals are preferred over terrestrial prey.	Ten records exist for this species within 10km of the site (NSW Wildlife Atlas). The site offers suitable foraging habitat for this species but no hollow bearing trees large enough to support a barking owl are present on the easement. It is considered as having **potential** to occur.	The proposal impacts potential foraging habitat for this species, therefore there is potential for this species to be impacted upon. *Therefore, this species has been assessed in **Appendix 10**.*

Species	Common Name	TSC Act Status	EPBC Act Status	Habitat	Likelihood of Occurrence	Potential for Impact
Tyto novaehollandiae	Masked Owl	V	V	In NSW Masked Owls are distributed throughout the length of the Great Dividing Range and extend from the coast to the western slopes. Recent surveys in south-eastern NSW have shown Masked Owls to be widespread, albeit at very low population densities. It occupies a range of environments from tall, wet Eucalypt forest to dry woodland, and often, but not always, at the ecotone with cleared land. Masked Owls nest and prefer to roost by day in hollows inside large, old trees. These trees are often but not always in or near gullies. The species generally requires an entrance to the tree hollow of around 20-25 cm in diameter. They also roost by day among the dense foliage of leafy trees such as *Acmena smithii* (Lillypilly) and other rainforest species.	Two records exist for this species within 10km of the site (NSW Wildlife Atlas).The easement and surrounding vegetation is suitable foraging habitat for this species so its presence cannot be ruled out. It therefore has the **potential** to occur.	The proposal impacts potential foraging habitat for this species, therefore there is potential for this species to be impacted upon. *Therefore, this species has been assessed in **Appendix 9** and **Appendix 10**.*

Species	Common Name	TSC Act Status	EPBC Act Status	Habitat	Likelihood of Occurrence	Potential for Impact
Calyptorhynchus lathami	Glossy Black-Cockatoo	V		*Calyptorhynchus lathami* (Glossy Black-Cockatoo) is sparsely distributed along the east coast and immediate inland districts from western Victoria to Rockhampton in Queensland. In NSW, the species is found as far west as Cobar to Hillston and Griffith in isolated mountain range. The inland distribution of the species is restricted by the occurrence of the various *Casuarinaceae spp*. *C. lathami* characteristically inhabits forests on sites with low soil-nutrients status, reflecting the distribution of key Allocasuarina spp. The drier forest types with intact and less rugged landscapes are preferred by the species. It prefers highlands towards the north but may be found closer to the coast where conditions are suitable. In the south they are widespread in lowland coastal forests, dense mountain forests, semi-arid woodland and trees bordering water courses.	**Recorded** on site.	This species was recorded on site and has the potential to be impacted by the proposed actions. *Therefore, this species has been assessed in **Appendix 10**.*

Species	Common Name	TSC Act Status	EPBC Act Status	Habitat	Likelihood of Occurrence	Potential for Impact
Melanodryas cucullata cucullata	Hooded Robin	V		Hooded Robin ranges from about Mundubbera, Qld, to the Spencer Gulf, SA, intergrading with other subspecies through the northern Murray-Darling Basin. They occupy drier Eucalypt forest, woodland and scrub as well as grasses and low shrubs. They will also use cleared paddocks with regrowth or stumps in close proximity to wooded areas. It avoids dense forests and urban areas. The species is a quiet, shy and largely sedentary bird. It is frequently observed in pairs or small groups. *M. cucullata cucullata* hunts for invertebrates by 'perch and pounce' in grassy clearings where rocks and fallen timber litter the ground.	This species has been recorded four times within 10km of the site (NSW Wildlife Atlas), however was not detected on site during surveys. Suitable foraging and nesting habitat occurs in the vegetation alongside the easement therefore it has **potential** to occur.	This species is considered to have **potential** to occur on site. Therefore it has potential to be impacted upon as a result of the proposed actions. *As there is potential for impact upon this species it is assessed in **Appendix 10**.*

Species	Common Name	TSC Act Status	EPBC Act Status	Habitat	Likelihood of Occurrence	Potential for Impact
Grantiella picta	Painted Honeyeater	V		Painted Honeyeater can be found throughout eastern and parts of northern Australia. It is generally considered to be a rare species. It is migratory and nomadic and birds can often be found in the same location year after year following yearly patterns of mistletoe flower. It lives almost entirely on the berries of mistletoes, and therefore its movements are tied to the flowering and fruiting of these plants, other food sources consist of nectar and insects. This species has a particular liking for mistletoes associated with *Acacia* sp. for example. *Acacia pendula*.	Five records exist for this species within 10km of the site (NSW Wildlife Atlas) but it was not detected on site during field surveys. Mistletoe is prevalent throughout the vegetation alongside the easement. Therefore it is considered as having **potential** to occur.	This species is considered to have **potential** to occur on site. Therefore it has potential to be impacted upon as a result of the proposed actions. *As there is potential for impact upon this species it is assessed in **Appendix 10**.*

Species	Common Name	TSC Act Status	EPBC Act Status	Habitat	Likelihood of Occurrence	Potential for Impact
Chthonicola sagittata	Speckled Warbler	V		Speckled Warbler ranges in South-Eastern Australia, from South-West Victoria through eastern New South Wales to Central Queensland, mostly on the western slopes and tablelands of the Great Dividing Range, and in the drier areas of coast. They live in a wide range of Eucalypt dominated vegetation that has a grassy and shrubby understorey often on rocky ridges or gullies. It is a sedentary species with a home range that varies from 6-12 hectares. This species appears to be extinct from areas without vegetation fragments larger than 48.2ha. Prefers woodland areas where ground cover consists of shrubs, grass, fallen leaves and bark. This ground foraging bird feeds on insects, insect larvae and small seeds.	Ten records for this species exist within 10km of the site (NSW Wildlife Atlas), but it was not detected during field surveys. Suitable habitat in the form of open woodlands exists alongside the easement for this species. Therefore it is considered as having **potential** to occur.	This species is considered to have **potential** to occur on site. Therefore it has potential to be impacted upon as a result of the proposed actions. *As there is potential for impact upon this species it is assessed in **Appendix 10**.*

Species	Common Name	TSC Act Status	EPBC Act Status	Habitat	Likelihood of Occurrence	Potential for Impact
Lophoictinia isura	Square-tailed Kite	V		Square-tailed Kite is endemic to Australia and is widespread throughout the mainland (absent from Tasmania). It is recorded mainly in coastal and sub-coastal regions, although it has been observed inland. It is migratory throughout its range and is a spring-summer breeding migrant to south-eastern, southern and south-western Australia. It inhabits open forests and woodlands, particularly those on fertile soils with abundant passerines. It may also range in nearby open habitats but not into extensive treeless regions. It is notably absent from alpine regions and small isolated remnant woodlands in large open areas. Within NSW *L. isura* has been recorded in ridge and gully forests dominated by *Eucalyptus longifolia* (Woollybutt), *Eucalyptus elata* (River Peppermint), *Eucalyptus smithii* (Blackbutt Peppermint) and *Corymbia maculata* (Spotted Gum), as well as in forests of *Angophora* and *Callitris* with shrubby understorey.	One record exists for this species within 10km of the site (NSW Wildlife Atlas). It was not detected during field surveys. Due to the wide range of habitats in which this species forages, it cannot be ruled out as occurring on site. Therefore it has **potential** to occur.	This species is considered to have **potential** to occur on site. Therefore it has potential to be impacted upon as a result of the proposed actions. *As there is potential for impact upon this species it is assessed in **Appendix 10**.*

Species	Common Name	TSC Act Status	EPBC Act Status	Habitat	Likelihood of Occurrence	Potential for Impact
Neophema pulchella	Turquoise Parrot	V		The main distribution of the Turquoise Parrot is in grassy woodlands of the western slopes and tablelands from the Darling Downs in Queensland to northern Victoria, particularly along watercourses. In NSW, it is typically recorded west of the Great Divide on the tablelands and western slopes, extending to the coastal districts through the dry forest corridor of the Hunter Valley. It occurs in eucalypt woodlands and open forests, with a ground cover of grasses and low understorey of shrubs. It has also been recorded in a variety of other habitats, including savannah and riparian woodlands and farmland, preferring edges of forest and pasture and other grasses. They are usually seen in pairs or small groups, although flocks up to 30 birds have been reported. Most of the day is spent on the ground, searching for seeds of grasses and herbaceous plants or browsing on vegetative matter. They forage primarily on the seeds of shrubs, grasses and herbs, both native and introduced, and the spore cases of mosses. They prefer to feed in the shade of a tree or near the cover of woodland. Partly nomadic, flocks move locally and regionally following seasonal abundances of seed.	**Recorded** on site.	This species was recorded on site and has the potential to be impacted by the proposed actions. *Therefore, this species has been assessed in **Appendix 10**.*

Species	Common Name	TSC Act Status	EPBC Act Status	Habitat	Likelihood of Occurrence	Potential for Impact
Glossopsitta pusilla	Little Lorikeet	V		This species is more commonly encountered in near coastal habitats and on the divide. Habitat is mainly dry, open sclerophyll forests and woodlands, usually dominated by Eucalyptus, sometimes in plantations of *Eucalyptus cladocalyx* (Sugar Gum). They can be found in large flocks of hundreds of birds spread out across blossoming eucalypts. Movements of Little Lorikeets are largely unknown, but the belief is that they follow abundant blossom. Some areas they are sedentary and move within the local area in response to blossom. Nesting of *G. pusilla* consists of holes, including knotholes, in bend, top or side of limb, usually living or in main trunk of tree, occasionally over water, recorded in *Eucalyptus camaldulensis* (River Red Gum), *Eucalyptus grandis* (Flooded Gum) and *Casuarina cunninghamiana* (River Oak).	Only one record for this species exists within 10km of the site (NSW Wildlife Atlas). Suitable foraging habitat occurs on site with various species of eucalypts being present. Therefore it is considered as having **potential** to occur.	This species is considered to have **potential** to occur on site. Therefore it has potential to be impacted upon as a result of the proposed actions. *As there is potential for impact upon this species it is assessed in **Appendix 10**.*

Species	Common Name	TSC Act Status	EPBC Act Status	Habitat	Likelihood of Occurrence	Potential for Impact
Daphoenositta chrysoptera	Varied Sittella	V		The Varied Sittella can be reasonably common in some areas and also nomadic in others, where as they also can be sedentary. Habitat across the varying races is similar, although they can be found in a wide range of habitats. Open eucalypt forests and woodlands are the preferred habitat, but this species may also be found in mallee, coastal tea-tree scrubs, inland acacia communities, golf courses orchards and scrubby gardens. The nest of *the* Varied Sittella consists of deep cup of bark which is well camouflaged with spider's web and lichen. They favour the use of tree species for nesting such as Eucalypts, paperbarks, she-oaks and tea-trees.	Three records for this species exist within 10km of the site (NSW Wildlife Atlas), but it was not detected on site during surveys. Suitable habitat for this species occurs throughout the eucalypt woodland adjacent to the easement. It is therefore considered as having **potential** to occur.	This species is considered to have **potential** to occur on site. Therefore it has potential to be impacted upon as a result of the proposed actions. *As there is potential for impact upon this species it is assessed in **Appendix 10**.*

Species	Common Name	TSC Act Status	EPBC Act Status	Habitat	Likelihood of Occurrence	Potential for Impact
Petaurus norfolcensis	Squirrel Glider	V		Squirrel Gliders usually inhabit dry open sclerophyll forests and woodland but there have been some observations in moist regenerating forest, moist gullies and coastal forest. Individuals have been recorded in a diverse range of vegetation communities, including Blackbutt Forest, Red Gum and red Bloodwood Forests, Coastal Banksia heathland and Grey Gum / Spotted Gum / Grey Ironbark dry hardwood forests. Important habitat includes areas where one or more Eucalypt species occur, that flower heavily in winter, or the presence of good stands of winter-flowering Banksias. Movements of up to one kilometre from foraging sites to a favoured den hollow have been recorded. Recent research on the home ranges and movements of this species indicate a home range of about 13 hectares.	One record for this species exists within 10km of the site (NSW Wildlife Atlas). Suitable habitat in which this species prefers is not prevalent in the surrounding vegetation of the easement. It is considered **unlikely** to occur.	This species is unlikely to occur. Therefore it is unlikely to be impacted. An AoS is not required for this species.

Species	Common Name	TSC Act Status	EPBC Act Status	Habitat	Likelihood of Occurrence	Potential for Impact
Macropus dorsalis	Black-striped Wallaby	E		Black-striped Wallaby occurs throughout the wettish parts of southern Queensland and northern NSW, on either side of the Great Dividing Range. Forested country with a dense shrub layer is the preferred habitat, including rainforest margins, open forest and even Lantana thickets. By day it rests in groups in the cover of undergrowth particularly in Brigalow stands, emerging in the evening via established runways to open country where it feeds on grasses and herbs.	436 records exist for this species within 10km of the site (NSW Wildlife Atlas). These records are limited largely to one core population. No Brigalow vegetation occurs along the site however it does occur in the area. It is therefore considered as having **potential** to occur on site.	Despite there being potential for this species to occur on site, no habitat in which this species utilises is being impacted as a result of the proposal. Therefore it is unlikely to be impacted. An AoS is not required for this species.

Species	Common Name	TSC Act Status	EPBC Act Status	Habitat	Likelihood of Occurrence	Potential for Impact
Stagonopleura guttata	Diamond Firetail	V		Diamond Firetail ranges in Eastern Australia from the Eyre Peninsula, SA to Clermont, QLD. It occurs in a wide range of Eucalypt-dominated vegetation communities that have a grassy understorey, including woodland, open forests and mallee. Most occur on the inland slopes of the Great Dividing range, with only small pockets near the coast. As with most Australian Finch species, *S. guttata* are highly sociable birds. Members of a breeding colony feed in open areas next to their nests, mostly eating ripe and half ripe grass seeds, and occasionally insects. They drink frequently throughout the day and are generally found near water. Much of their habitat has been cleared, and remaining fragments are gradually becoming unstable.	**Recorded** on site.	This species was recorded on site and has the potential to be impacted by the proposed actions. *Therefore, this species has been assessed in **Appendix 10**.*

Species	Common Name	TSC Act Status	EPBC Act Status	Habitat	Likelihood of Occurrence	Potential for Impact
Anthochaera phrygia	Regent Honeyeater	CE	E, M	Nomadic Honeyeater that disperses to non-breeding areas, including the coast, in winter, where flowering trees are sought. Within the region, mostly recorded in Box-Ironbark Eucalypt associations along creek flats, river valleys and foothills. Coastal swamp forests in Lower Hunter are used when more western resources fail. The main feed tree for coastal areas is *Eucalyptus robusta* (Swamp Mahogany). Hunter records are more common in near coastal areas such as Cessnock LGA. Feed trees in this region are Corymbia maculata (Spotted Gum), *E. fibrosa* (Broad-leaved Ironbark), *E. crebra* (Narrow-leaved Ironbark) and various stringybark sp.. Nests mainly west of the divide, although local breeding attempts have occurred at Quorrobolong.	This species has not been recorded within 10km of the site (NSW Wildlife Atlas). However, the Protected Matters Search predicted that this species has potential to occur. Although, it was not recorded during field surveys. Flowering Eucalypt blossoms are available within the vegetated sections of the site in which this species could potentially forage. However due to the lack of records in the vicinity, it is considered **unlikely** to occur.	This species is unlikely to occur on site, therefore it is unlikely to be impacted upon as a result of the proposed actions and an AoS is not required for this species.

Species	Common Name	TSC Act Status	EPBC Act Status	Habitat	Likelihood of Occurrence	Potential for Impact
Apus pacificus	Fork-tailed Swift		M	This incredibly fast swift has a wide distribution covering most of the Australian continent. In NSW, the Fork-tailed Swift is recorded in all regions. Many records occur east of the Great Divide, however, a few populations have been found west of the Great Divide. These are widespread but scattered further west of the line joining Bourke and Dareton. Sightings have been recorded at Milparinka, the Bulloo River and Thurloo Downs (Higgins 1999). The Fork-tailed Swift is almost exclusively aerial, flying from less than 1 m to at least 300 m above ground and probably much higher. They mostly occur over inland plains but sometimes above foothills or in coastal areas. They often occur over cliffs and beaches and also over islands and sometimes well out to sea. They also occur over settled areas, including towns, urban areas and cities. They mostly occur over dry or open habitats, including riparian woodland and tea-tree swamps, low scrub, heathland or saltmarsh (Higgins 1999).	This species has not been recorded within 10km of the site (NSW Wildlife Atlas). However, the Protected Matters Search predicted that this species has potential to occur. Although, it was not recorded during field surveys. Due to the wide variety of habitats in which this species occurs, it cannot be ruled out from occurring on site. Therefore it is considered as having **potential** to occur on site.	This species is considered to have potential to occur on site. Therefore it has potential to be impacted upon as a result of the proposed actions. *As there is potential for impact upon this species it is further assessed in **Appendix 9**.*

Species	Common Name	TSC Act Status	EPBC Act Status	Habitat	Likelihood of Occurrence	Potential for Impact
Ardea alba	Great Egret		M	This species is wide spread across Australia, occurring in wetland habitats such as estuaries, littoral habitats and moist grasslands (Marchant and Higgins 1990). They regularly use areas inundated with water such as freshwater meadows, flooded grasslands, ovals, pastoral lands and agricultural lands. Also regularly use saline habitats. They breed in wetlands fringed with trees or tall vegetation.	This species was not recorded on site or within a 10km radius of the site (NSW Wildlife Atlas). However, the Protected Matters Search predicted that this species has potential to occur Bohena creek could be utilised by this species for foraging when it is inundated with water. Therefore it is considered as having **potential** to occur.	This species was not recorded on site and Bohena Creek is not being significantly or permanently impacted as a result of the proposal. Therefore it is not likely to be impacted upon as a result of the proposed actions. An AoS is not required for this species.
Ardea ibis	Cattle Egret		M	*A.ibis* is distributed widely across Australia, occupying most of the continent with the exception of the arid western centre. The Cattle Egret occurs in tropical and temperate grasslands, wooded lands and terrestrial wetlands. It has occasionally been seen in arid and semi-arid regions however this is extremely rare. High numbers have been observed in moist, low-lying poorly drained pastures with an abundance of high grass; it avoids low grass pastures. It has been recorded on earthen dam walls and ploughed fields. It is commonly associated with the habitats of farm animals, particularly cattle, but also pigs, sheep, horses and deer.	This species was not recorded on site or within a 10km radius of the site (NSW Wildlife Atlas). However, the Protected Matters Search predicted that this species has potential to occur. Bohena creek could be utilised by this species for foraging when it is inundated with water. Therefore it is considered as having **potential** to occur.	This species was not recorded on site and Bohena Creek is not being significantly or permanently impacted as a result of the proposal. Therefore it is not likely to be impacted upon as a result of the proposed actions. An AoS is not required for this species.

Species	Common Name	TSC Act Status	EPBC Act Status	Habitat	Likelihood of Occurrence	Potential for Impact
Gallinago hardwickii	Latham's Snipe		M	Latham's Snipe occurs across the eastern half of Australia in fresh water wetlands and saltmarshes. They usually inhabit open, freshwater wetlands with low, dense vegetation (e.g. swamps, flooded grasslands or heathlands, around bogs and other water bodies) however, they can also occur in habitats with saline or brackish water, in modified or artificial habitats, and in habitats located close to humans or human activity. This species does not breed in Australia.	This species was not recorded on site or within a 10km radius of the site (NSW Wildlife Atlas). However, the Protected Matters Search predicted that this species has potential to occur. Suitable wetland habitat does not occur on site for this species and it is highly unlikely to utilise the ephemeral habitat of Bohena Creek Therefore it is considered **unlikely** to occur.	This species is unlikely to occur on site. Therefore, it is not likely to be impacted upon as a result of the proposed actions. An AoS is not required for this species
Haliaeetus leucogaster	White-bellied Sea-eagle		M	The White-bellied Sea-Eagle is distributed along the coastline (including offshore islands) of mainland Australia and Tasmania. It also extends inland along some of the larger waterways, especially in eastern Australia. The White-bellied Sea-Eagle is found in coastal habitats (especially those close to the sea-shore) and around terrestrial wetlands in tropical and temperate regions of mainland Australia and its offshore islands. The habitats occupied by the sea-eagle are characterised by the presence of large areas of open water (larger rivers, swamps, lakes, the sea).	This species was not recorded on site or within a 10km radius of the site (NSW Wildlife Atlas). However, the Protected Matters Search predicted that this species has potential to occur. This species may be observed flying over the site however suitable habitat for utilisation does not occur on site. Therefore it is considered **unlikely** to occur.	This species is unlikely to occur on site. Therefore, it is not likely to be impacted upon as a result of the proposed actions. An AoS is not required for this species

Species	Common Name	TSC Act Status	EPBC Act Status	Habitat	Likelihood of Occurrence	Potential for Impact
Hirundapus caudacutus	White-throated Needletail		M	The White-throated Needletail is widespread in eastern and south-eastern Australia (Simpson and Day 2010). In eastern Australia, it is recorded in all coastal regions of Queensland and NSW, extending inland to the western slopes of the Great Divide and occasionally onto the adjacent inland plains. Almost exclusively aerial, from heights of less than 1 m up to more than 1000 m above the ground. Because they are aerial, it has been stated that conventional habitat descriptions are inapplicable but there are, nevertheless, certain preferences exhibited by the species. Although they occur over most types of habitat, they are probably recorded most often above wooded areas, including open forest and rainforest, and may also fly between trees or in clearings, below the canopy, but they are less commonly recorded flying above woodland.	This species has not been recorded on or within 10km of the site (NSW Wildlife Atlas). However, the Protected Matters Search predicted that this species has potential to occur. Although there is potential for this species to fly over the site, it is unlikely to be utilising the ecological attributes of the site. Therefore it is considered **unlikely** to occur.	This species is unlikely to occur on site. Therefore, it is not likely to be impacted upon as a result of the proposed actions. An AoS is not required for this species

Species	Common Name	TSC Act Status	EPBC Act Status	Habitat	Likelihood of Occurrence	Potential for Impact
Leipoa ocellata	Malleefowl	E	V, M	Inhabits semi-arid regions of southern Australia. In New South Wales, it typically occurs west of the Great Dividing Range. Extends from Pilliga south-west to the districts of Griffith and Wentworth. The extent of occurrence is known to be decreasing. The distribution of the Malleefowl was formerly more extensive, extending over a large proportion of mainland southern Australia, including the south-western region of the Northern Territory. Occupies shrublands and low woodlands that are dominated by mallee vegetation. It also occurs in other habitat types including eucalypt or native pine *Callitris* woodlands, Acacia shrublands, Broombush *Melaleuca uncinata* vegetation or coastal heathlands.	No records exist within 10km of the site for this species and it was not detected during field surveys (NSW Wildlife Atlas). However, the Protected Matters Search predicted that this species has potential to occur. and Callitris and Acacia woodlands do persist adjacent to the easement. Therefore this species has potential to occur.	This species is considered to have potential to occur on site. Therefore it has potential to be impacted upon as a result of the proposed actions. *As this species has potential to occur on site this species is assessed in **Appendix 9** and **Appendix 10**.*

Species	Common Name	TSC Act Status	EPBC Act Status	Habitat	Likelihood of Occurrence	Potential for Impact
Merops ornatus	Rainbow Bee-eater		M	This species covers the majority of the Australian mainland with the exception of the arid western centre. Inhabits a wide variety of open country generally near water, as well as habitat edges of parks, forests and gardens (Higgins 1999). Vegetation communities in which this species is known to occur include dry open sclerophyll forest, mallee, open woodland and shrubland, Spinifex tussock grassland with scattered trees and riverine or littoral assemblages (Higgins 1999). They nest in sandy banks or level ground, mostly in river banks and similar habitats.	This species was not recorded on or within 10km of the site (NSW Wildlife Atlas). However, the Protected Matters Search predicted that this species has potential to occur. Due to the wide range of habitats in which this species can occur, and the site being located within its known distribution, it considered as having **potential** to occur on site.	This species is considered to have potential to occur on site. Therefore it has potential to be impacted upon as a result of the proposed actions. *As there is potential for impact upon this species it is further assessed in **Appendix 9**.*
Rostratula australis	Australian Painted Snipe	E	V, M	The Painted Snipe has a scattered distribution in Australia, primarily occurring along the east coast from north Queensland to the Eyre Peninsula in South Australia, and including the majority of New South Wales and Victoria. The Painted Snipe inhabits inland and coastal shallow freshwater wetlands, occurring in both ephemeral and permanent wetlands, particularly where there is grass. Individuals have been spotted in artificial dams, sewage ponds and waterlogged grasslands (Birdlife 2012).	This species has not been recorded on or within 10km of the site. Suitable habitat for this species does not occur on site. Therefore it is **unlikely** to occur.	This species is unlikely to occur on site. Therefore, it is not likely to be impacted upon as a result of the proposed actions. An AoS is not required for this species.

Appendix 9

EPBC Act - Assessment of Significance - ROW

The EPBC Act focuses Commonwealth interests on matters of National Environmental Significance (NES) including integrated biodiversity conservation and the management of important protected areas. The matters of NES as identified in the Act which require assessment and approval to be addressed by the Commonwealth include:

- World Heritage Properties;
- National Heritage Places;
- Wetlands of International Importance;
- Great Barrier Reef Marine Parks;
- Commonwealth Marine areas;
- Nationally Threatened Species;
- Nationally Threatened Ecological Communities;
- Migratory Species;

The assessment and approval process applies to any action that has, will have or is likely to have a significant impact on a matter of NES. An 'action' is defined as a project, development, undertaking or an activity or series of activities.

The matter of NES and site-specific responses are as follows.

- World Heritage Properties:

The study area is not World Heritage Property, and is not in close proximity to any such property.

- Wetlands of International Importance (RAMSAR convention):

The study area is not part of any Wetland of International Importance, and is not in close proximity to any such area.

- Great Barrier Reef Marine Parks;
- The study area is not part of any Great Barrier Reef Marine Park, and is not in close proximity to any such park.
- Commonwealth Marine Areas

The Proposals will not have a significantly adverse effect on any Commonwealth Marine area, as there are no such marine areas within the region.

- Nationally Listed Threatened Species:

Threatened species listed under the EPBC Act, which occur, or have the potential to occur within the locality of the ROW (10km radius) have been assessed for their potential to occur within the site (**Appendix 8**). Those threatened species that were considered to have potential to occur and subsequently may be impacted by the proposal are as follows:

Those EPBC listed threatened species considered to have potential to occur are:

Dichanthium setosum	Bluegrass	V
Lepidium aschersonii	Spiny Pepper-cress	V

- Philotheca ericifolia V
- *Pterostylis cobarensis* Cobar Greenhood Orchid V
- Rulingia procumbens V
- Tylophora linearis E
- *Lathamus discolor* Swift Parrot E
- Phascolarctos cinereus Koala V
- *Leipoa ocellata* Malleefowl V
- *Polytelis swainsonii* Superb Parrot V
- Pseudomys pilligaensis Pilliga Mouse V
- *Nyctophilus corbeni* South-eastern Long-eared Bat V
- Tyto novaehollandiae Masked Owl V
-
- These threatened species require assessment under the EPBC Act significant Impact Guidelines 1.1 with regards to the relevant significant impact criteria (**Table 11**).
-

Table 13 Critically endangered and endangered species - Significant Impact Criteria Assessment

Significant Impacts	*Tylophora linearis*	Swift Parrot
Lead to a long-term decrease in the size of a population	**Unlikely.** This species was not recorded on site and only 0.18ha of potential habitat (woodlands associated with *C. glaucophylla*) will be removed as a result of the proposal. Due to the large area of more suitable habitat within the wider area, *Tylophora linearis* will not be losing any significant habitat due to the proposed activities on site. Therefore, no long-term decrease in population size is likely to occur.	**Unlikely.** This species was not recorded on site and only 0.18ha of foraging habitat will be impacted upon on site. Due to the large area of more suitable habitat within the wider area, Swift Parrot will not be losing any significant habitat due to the proposed activities on site. Therefore, no long-term decrease in population size is likely to occur.
Reduce the area of occupancy of the species	**Unlikely**. This species was not recorded on site so it is unlikely that its area of occupancy on site will be reduced as a result of the proposed activities.	**Unlikely**. This species was not recorded on site so it is unlikely that its area of occupancy on site will be reduced as a result of the proposed activities.
Fragment an existing population into two or more populations	**No**. No existing populations are known on site or within 10km of the site (Wildlife Atlas Search). Therefore, it is unlikely that any populations will be fragmented as a result of this project.	**No**. No existing populations are known on site or within 10km of the site (Wildlife Atlas Search). Therefore, it is unlikely that any populations will be fragmented as a result of this project.
Adversely affect habitat critical to the survival of a species	**No.** No critical habitat for this species exists on site.	**No.** No critical habitat for this species exists on site.
Disrupt the breeding cycle of a population	**Unlikely**. The area is potentially used for breeding (propagation). However, due to the large area of more suitable habitat in the form of 'woodlands associated with *C. glaucophylla',* nearby (within the majority of the adjoining Pilliga State Forest ~160,000ha), the size of the potential breeding habitat to be impacted upon on site (0.18ha) is not considered to be significant. The impacts of the proposed actions are therefore, not considered likely to disrupt the	**Unlikely**. The area is potentially used for breeding. However, due to the large area of more suitable habitat in the form of 'mature woodlands (with trees >40cm DBH)', nearby (within the majority of the adjoining Pilliga State Forest ~160,000ha), the size of the potential breeding habitat on site (0.18ha) is not considered to be significant. The impacts of the proposed actions are therefore, not considered likely to disrupt the breeding

Significant Impacts	*Tylophora linearis*	Swift Parrot
	breeding cycle of this species.	cycle of this species.
Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline	**Unlikely**. Although 0.18ha of potential habitat would be reduced, given the large area of more suitable habitat in the form of 'woodlands associated with *C. glaucophylla'*, nearby (Pilliga State Forest ~ 160,000ha), it is considered unlikely that the impacts would cause this species to decline.	**Unlikely**. Although 0.18ha of potential habitat would be reduced, given the large area of more suitable habitat in the form of 'mature trees over 40 cm DBH', nearby (within the majority of the adjoining Pilliga State Forest ~160,000ha),it is considered unlikely that the impacts would cause this species to decline.
Result in invasive species that are harmful to a critically endangered or endangered species becoming established in the endangered or critically endangered species' habitat	**Unlikely**. It is unlikely that the impacted area will increase invasive species, such as exotic weed or pest species becoming established to any greater degree than what already exists.	**Unlikely**. It is unlikely that the impacted area will increase invasive species, such as exotic weed or pest species becoming established to any greater degree than what already exists.
Introduce disease that may cause the species to decline, or	**Unlikely**. There are no diseases which have been associated with the decline of this species. As a consequence the proposed activities are not expected to introduce any diseases that may cause this species to decline.	**Unlikely**. There are no diseases which have been associated with the decline of this species. As a consequence the proposed activities are not expected to introduce any diseases that may cause this species to decline.
Interfere with the recovery of the species.	**Unlikely.** Due to the small area of impact and the large extent of more suitable habitat available for this species within the surrounding area, it is considered unlikely that the impacts of the proposal will substantially interfere with the recovery of the species.	**Unlikely.** Due to the small area of impact and the large extent of more suitable habitat available for this species within the surrounding area, it is considered unlikely that the impacts of the proposal will substantially interfere with the recovery of the species.

Table 14 Vulnerable Flora species - Significant Impact Criteria Assessment

Significant Impacts	*Pterostylis cobarensis*	*Rulingia procumbens*	*Dichanthium setosum*	*Lepidium aschersonii*	*Philotheca ericifolia*
Lead to a long-term decrease in the size of an important population of a species	**Unlikely**. This species was not recorded on site and the site does not contain preferred habitat of rocks, slopes or low hills. However, potential habitat for this species occurs within the disturbed Callitris woodlands to be impacted upon on site (~ 19.2ha of existing cleared and disturbed easement and the clearing of approximately 0.18ha of Ironbark Shrubby Woodland within the Pilliga State Forest). Due to the large area of more suitable habitat within the wider area, *Pterostylis cobarensis* will not be losing any significant habitat due to the proposed activities on site. Therefore, no long-term decrease in population size is likely to occur.	**Unlikely**. This species was not recorded on site and the site does contain the preferred habitat of sandy soils, often in disturbed habitats. Due to the large area of more suitable habitat within the wider area, *Rulingia procumbens* will not be losing any significant habitat due to the proposed activities on site. Therefore, no long-term decrease in population size is likely to occur.	**Unlikely**. The site does contain suitable cleared and disturbed woodland in which this species could exist. This species was not recorded on site and due to the large area of more suitable habitat within the wider area, it is considered that *Dichanthium setosum* will not be losing any significant habitat due to the proposed activities on site. Therefore, no long-term decrease in population size is likely to occur.	**Unlikely**. This species was not recorded on site, however, the site does contain suitable periodically wet habitat at the Bohena Creek crossing. Due to the large area of more suitable habitat within the wider area, *Lepidium aschersonii* will not be losing any significant habitat due to the proposed activities on site. Therefore, no long-term decrease in population size is likely to occur.	**Unlikely**. This species was not recorded on site, however, the site does contain suitable 'dry sandy creek bed' habitat at the Bohena Creek crossing. Due to the large area of more suitable habitat within the wider area, *Philotheca ericifolia* will not be losing any significant habitat due to the proposed activities on site. Therefore, no long-term decrease in population size is likely to occur.
Reduce the area of occupancy of an important population	**Unlikely**. This species was not recorded on site so it is unlikely that its area of occupancy on site will be reduced as a result of the proposed activities.	**Unlikely**. This species was not recorded on site so it is unlikely that its area of occupancy on site will be reduced as a result of the proposed activities.	**Unlikely**. This species was not recorded on site so it is unlikely that its area of occupancy on site will be reduced as a result of the proposed activities.	**Unlikely**. This species was not recorded on site so it is unlikely that its area of occupancy on site will be reduced as a result of the proposed activities.	**Unlikely**. This species was not recorded on site so it is unlikely that its area of occupancy on site will be reduced as a result of the proposed activities.
Fragment an existing important population into two or more populations	**Unlikely**. No existing populations are known on site. Therefore, it is unlikely that any populations will be fragmented as a result of this project.	**Unlikely**. No existing populations are known on site. Therefore, it is unlikely that any populations will be fragmented as a result of this project.	**Unlikely**. No existing populations are known on site. Therefore, it is unlikely that any populations will be fragmented as a result of this project.	**Unlikely**. No existing populations are known on site. Therefore, it is unlikely that any populations will be fragmented as a result of this project.	**Unlikely**. No existing populations are known on site. Therefore, it is unlikely that any populations will be fragmented as a result of this project.
Adversely affect habitat critical to the survival of a species	**No**. No critical habitat for this species exists on site.	**No**. No critical habitat for this species exists on site.	**No**. No critical habitat for this species exists on site.	**No**. No critical habitat for this species exists on site.	**No**. No critical habitat for this species exists on site.
Disrupt the breeding cycle of an important population	**Unlikely**. The area is potentially used for breeding (propagation). However, due to the large area of more suitable habitat in the form of 'Callitris woodlands', nearby (within the majority of the adjoining Pilliga State Forest ~160,000ha), the size of the potential breeding habitat to be impacted upon on site (~ 19.2ha of existing cleared and disturbed easement and the clearing of approximately 0.18ha of Ironbark Shrubby Woodland within the Pilliga State Forest) is not considered to be significant. The impacts of the proposed actions are therefore, not considered likely to disrupt the breeding cycle of this species.	**Unlikely**. The area is potentially used for breeding (propagation). However, due to the large area of more suitable habitat in the form of 'sandy soils, often in disturbed habitats', nearby (within the majority of the adjoining Pilliga State Forest ~160,000ha), the size of the potential breeding habitat to be impacted upon on site (~ 19.2ha of existing cleared and disturbed easement and the clearing of approximately 0.18ha of Ironbark Shrubby Woodland within the Pilliga State Forest). is not considered to be significant. The impacts of the proposed actions are therefore, not considered likely to disrupt the breeding cycle of this species.	**Unlikely**. The area is potentially used for breeding (propagation). However, due to the large area of more suitable habitat in the form of 'cleared and disturbed woodland, nearby (within the majority of the adjoining Pilliga State Forest ~160,000ha), the size of the potential breeding habitat to be impacted upon on site (~ 19.2ha of existing cleared and disturbed easement and the clearing of approximately 0.18ha of Ironbark Shrubby Woodland within the Pilliga State Forest). is not considered to be significant. The impacts of the proposed actions are therefore, not considered likely to disrupt the breeding cycle of this species.	**Unlikely**. The area is potentially used for breeding. However, due to the large area of more suitable habitat in the form of 'suitable periodically wet areas' in which this species could exist, nearby (within the adjoining Pilliga State Forest ~160,000ha), the size of the potential breeding habitat on site (approximately 0.264ha) is not considered to be significant. The impacts of the proposed actions are therefore, not considered likely to disrupt the breeding cycle of this species.	**Unlikely**. The area is potentially used for breeding. However, due to the large area of more suitable habitat in the form of 'dry sandy creek beds' in which this species could exist, nearby (within the adjoining Pilliga State Forest ~160,000ha), the size of the potential breeding habitat on site (approximately 0.264ha) is not considered to be significant. The impacts of the proposed actions are therefore, not considered likely to disrupt the breeding cycle of this species.
Modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline	**Unlikely**. Although 0.18ha of potential habitat would be reduced, given the large area of more suitable habitat in the form of 'Callitris woodlands', nearby (within the majority of the adjoining Pilliga State Forest ~160,000ha), it is considered unlikely that the impacts would cause this species to decline.	**Unlikely**. Although approximately 19.38ha of potential habitat would be reduced, given the large area of more suitable habitat in the form of 'sandy soils, often in disturbed habitats', nearby (within the majority of the adjoining Pilliga State Forest ~160,000ha), it is considered unlikely that the impacts would cause this species to decline.	**Unlikely**. Although approximately 19.38ha of potential habitat would be reduced, given the large area of more suitable habitat in the form of 'cleared and disturbed woodland' in which this species could exist, nearby (within the majority of the adjoining Pilliga State Forest ~160,000ha) it is considered unlikely that the impacts would cause this species to decline.	**Unlikely**. Although, approximately 0.264ha of potential habitat would be reduced, given the large area of more suitable habitat in the form of 'suitable periodically wet habitat' in which this species could exist, nearby (within the adjoining Pilliga State Forest ~160,000ha), it is considered unlikely that the impacts would cause this species to decline.	**Unlikely**. Although, approximately 0.264ha of potential habitat would be reduced, given the large area of more suitable habitat in the form of 'dry sandy creek bed' habitat in which this species could exist, nearby (within the adjoining Pilliga State Forest ~160,000ha), it is considered unlikely that the impacts would cause this species to decline.

Significant Impacts	*Pterostylis cobarensis*	*Rulingia procumbens*	*Dichanthium setosum*	*Lepidium aschersonii*	*Philotheca ericifolia*
Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat	**Unlikely**. It is unlikely that the impacted area will increase invasive species, such as exotic weed or pest species becoming established to any greater degree than what already exists.	**Unlikely**. It is unlikely that the impacted area will increase invasive species, such as exotic weed or pest species becoming established to any greater degree than what already exists.	**Unlikely**. It is unlikely that the impacted area will increase invasive species, such as exotic weed or pest species becoming established to any greater degree than what already exists.	**Unlikely**. It is unlikely that the impacted area will increase invasive species, such as exotic weed or pest species becoming established to any greater degree than what already exists.	**Unlikely**. It is unlikely that the impacted area will increase invasive species, such as exotic weed or pest species becoming established to any greater degree than what already exists.
Introduce disease that may cause the species to decline, or	**Unlikely**. There are no diseases which have been associated with the decline of this species. As a consequence the proposed activities are not expected to introduce any diseases that may cause this species to decline.	**Unlikely**. There are no diseases which have been associated with the decline of this species. As a consequence the proposed activities are not expected to introduce any diseases that may cause this species to decline.	**Unlikely**. There are no diseases which have been associated with the decline of this species. As a consequence the proposed activities are not expected to introduce any diseases that may cause this species to decline.	**Unlikely**. There are no diseases which have been associated with the decline of this species. As a consequence the proposed activities are not expected to introduce any diseases that may cause this species to decline.	**Unlikely**. There are no diseases which have been associated with the decline of this species. As a consequence the proposed activities are not expected to introduce any diseases that may cause this species to decline.
Interfere substantially with the recovery of the species	**Unlikely**. Due to the small area of impact and the large extent of more suitable habitat available for this species within the surrounding area, it is considered unlikely that the impacts of the proposal will substantially interfere with the recovery of the species.	**Unlikely**. Due to the small area of impact and the large extent of more suitable habitat available for this species within the surrounding area, it is considered unlikely that the impacts of the proposal will substantially interfere with the recovery of the species.	**Unlikely**. Due to the small area of impact and the large extent of more suitable habitat available for this species within the surrounding area, it is considered unlikely that the impacts of the proposal will substantially interfere with the recovery of the species.	**Unlikely**. Due to the small area of impact and the large extent of more suitable habitat available for this species within the surrounding area, it is considered unlikely that the impacts of the proposal will substantially interfere with the recovery of the species.	**Unlikely**. Due to the small area of impact and the large extent of more suitable habitat available for this species within the surrounding area, it is considered unlikely that the impacts of the proposal will substantially interfere with the recovery of the species.

Table 15 Vulnerable Fauna species - Significant Impact Criteria Assessment

Significant Impacts	Masked Owl	Superb Parrot	Malleefowl	Koala	South-eastern Long-eared Bat	Pilliga Mouse
Lead to a long-term decrease in the size of an important population of a species	**Unlikely**. This species was not recorded on site and The site does contain potential foraging habitat within the easement and surrounding areas. Due to the large area of suitable habitat within the wider area, Masked Owl will not be losing any significant habitat due to the proposed activities on site. Therefore, no long-term decrease in population size is likely to occur.	**Unlikely**. The site does contain suitable Eucalypt species and Callitris (which provides seasonal habitat) in which this species could forage. This species was not recorded on site and due to the large area of more suitable habitat within the wider area it is considered that Superb Parrot will not be losing any significant habitat due to the proposed activities on site. Therefore, no long-term decrease in population size is likely to occur.	**Unlikely**. This species was not recorded on site and the site does contain suitable Eucalypt woodlands and Callitris woodlands in which this species could forage. Due to the large area of more suitable habitat within the wider area, Mallefowl will not be losing any significant habitat due to the proposed activities on site. Therefore, no long-term decrease in population size is likely to occur.	**Unlikely**. This species was not recorded on site and only suboptimal foraging habitat is present (secondary feed trees). Due to the large area of more suitable habitat within the wider area, the Koala will not be losing any significant habitat due to the proposed activities on site. Therefore no long-term decrease in population size is likely to occur.	**Unlikely**. This species was not recorded on site and the site does contain suitable inland woodland vegetation types, including box, ironbark and cypress pine woodlands in which this species could forage. Due to the large area of more suitable habitat within the wider area, South-eastern Long-eared Bat will not be losing any significant habitat due to the proposed activities on site. Therefore, no long-term decrease in population size is likely to occur.	**Unlikely.** This species was not recorded on site and only suboptimal foraging habitat is present. Due to the large area of more suitable habitat within the wider area, the Pilliga Mouse will not be losing any significant habitat due to the proposed activities on site. Therefore, no long-term decrease in population size is likely to occur.
Reduce the area of occupancy of an important population	**Unlikely**. This species was not recorded on site so it is unlikely that its area of occupancy on site will be reduced as a result of the proposed activities.	**Unlikely**. This species was not recorded on site so it is unlikely that its area of occupancy on site will be reduced as a result of the proposed activities.	**Unlikely**. This species was not recorded on site so it is unlikely that its area of occupancy on site will be reduced as a result of the proposed activities.	**Unlikely**. This species was not recorded on site so it is unlikely that its area of occupancy will be reduced as a result of the proposed activities.	**Unlikely**. This species was not recorded on site so it is unlikely that its area of occupancy on site will be reduced as a result of the proposed activities.	**Unlikely**. This species was not recorded on site so it is unlikely that its area of occupancy on site will be reduced as a result of the proposed activities.
Fragment an existing important population into two or more populations	**Unlikely**. No existing populations are known on site. Therefore, it is unlikely that any populations will be fragmented as a result of this project.	**Unlikely**. No existing populations are known on site. Therefore, it is unlikely that any populations will be fragmented as a result of this project.	**Unlikely**. No existing populations are known on site. Therefore, it is unlikely that any populations will be fragmented as a result of this project.	**No**. No existing populations are known on site so it is unlikely that any populations will be fragmented as a result of this project.	**Unlikely**. No existing populations are known on site. Therefore, it is unlikely that any populations will be fragmented as a result of this project.	**No**. No existing populations are known on site so it is unlikely that any populations will be fragmented as a result of this project.
Adversely affect habitat critical to the survival of a species	**No**. No critical habitat for this species exists on site.	**No**. No critical habitat for this species exists on site.	**No**. No critical habitat for this species exists on site.	**No**. No critical habitat for this species exists on site.	**No**. No critical habitat for this species exists on site.	**No.** No critical habitat for this species exists on site.
Disrupt the breeding cycle of an important population	**Unlikely**. The area is potentially used for breeding. However, due to the large area of more suitable habitat in the form of 'hollows inside large, old trees', nearby (within the the adjoining Pilliga State Forest ~160,000ha), the size of the potential breeding habitat to be impacted upon on site approximately 0.18ha of Ironbark Shrubby Woodland within the Pilliga State Forest) which does not currently contain any sufficient hollows for breeding in and hence is not considered to be significant. The impacts of the proposed actions are therefore, not considered likely to disrupt the breeding cycle of this species.	**Unlikely**. The breeding range of the Superb Parrot is divided into three main areas: the first, along the Murray and Edward Rivers; the second, along the Murrumbidgee River; and the third, in a triangle bounded by Molong, Yass and Young (Barrett et al. 2003; Birds Australia n.d.; Christie 2004; Davidson & Chambers 1991; Higgins 1999; Webster 1988; Webster & Ahern 1992).The site is not within or close to these three breeding areas, therefore, the proposal is not considered likely to disrupt the breeding cycle of this species.	**Unlikely**. The area is potentially used for breeding. However, due to the large area of more suitable habitat in the form of 'Eucalypt woodlands and Callitris woodlands in which this species could breed, nearby (within the majority of the adjoining Pilliga State Forest ~160,000ha), the size of the potential breeding habitat to be impacted upon on site (~ 19.2ha of existing cleared and disturbed easement and the clearing of approximately 0.18ha of Ironbark Shrubby Woodland within the Pilliga State Forest) is not considered to be significant. The impacts of the proposed actions are therefore, not considered likely to disrupt the breeding cycle of this species.	**Unlikely**. The area is potentially used for breeding. However, due to the large area of more suitable habitat in the form of 'Eucalypt woodlands' in which this species could breed, nearby (within the majority of the adjoining Pilliga State Forest ~160,000ha), the size of the potential breeding to be impacted upon on site (the clearing of approximately 0.18ha of Ironbark Shrubby Woodland within the Pilliga State Forest). is not considered to be significant. The impacts of the proposed actions are therefore, not considered likely to disrupt the breeding cycle of this species	**Unlikely**. The area is potentially used for breeding. However, due to the large area of more suitable habitat in the form of 'inland woodland vegetation types, including box, ironbark and cypress pine woodlands' in which this species could breed, nearby (within the majority of the adjoining Pilliga State Forest ~160,000ha), the size of the potential breeding habitat on site (approximately 0.18ha of potential breeding habitat) is not considered to be significant. The impacts of the proposed actions are therefore, not considered likely to disrupt the breeding cycle of this species.	**Potential**. The area is potentially used for breeding. However, due to the large area of more suitable habitat in the form of '*Blakely's Red Gum Riparian Woodland of the Pilliga Outwash Brigalow Belt South Bioregion'* and '*Rough-barked Apple - Blakely's Red Gum riparian grassy woodlands, Brigalow Belt South and Nandewar'* within the adjacent Pilliga State Forest, the size of the potential breeding habitat on site (0.264ha of the aforementioned community) is not considered to be significant. The impacts of the proposed actions are, therefore, not considered likely to disrupt the breeding cycle of this species.

Significant Impacts	Masked Owl	Superb Parrot	Malleefowl	Koala	South-eastern Long-eared Bat	Pilliga Mouse
Modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline	**Unlikely**. Although approximately 19.38ha of foraging habitat would be reduced, given the large area of more suitable nesting and breeding habitat in the form of 'hollows inside large, old trees', nearby (within the adjoining Pilliga State Forest ~160,000ha), it is considered unlikely that the impacts would cause this species to decline.	**Unlikely**. Although approximately 0.18ha of potential foraging habitat would be reduced, given the large area of more suitable habitat in the form of 'Suitable Eucalypt species and Callitris (which provides seasonal habitat) in which this species could forage', nearby (within the majority of the adjoining Pilliga State Forest ~160,000ha) it is considered unlikely that the impacts would cause this species to decline.	**Unlikely**. Although approximately 19.2ha of marginal habitat and 0.18ha of potential habitat would be reduced, given the large area of more suitable habitat in the form of 'Eucalypt woodlands and Callitris woodlands' in which this species could forage, nearby (within the majority of the adjoining Pilliga State Forest ~160,000ha), it is considered unlikely that the impacts would cause this species to decline.	**Unlikely**. Although approximately 0.18ha of potential habitat would be reduced, given the large area of more suitable habitat in the form of 'Eucalypt woodlands' in which this species could forage, nearby (within the majority of the adjoining Pilliga State Forest ~160,000ha), it is considered unlikely that the impacts would cause this species to decline..	**Unlikely**. Although approximately 19.2ha of marginal habitat and 0.18ha of potential habitat would be reduced, given the large area of more suitable habitat in the form of 'inland woodland vegetation types, including box, ironbark and cypress pine woodlands' in which this species could forage, nearby (within the majority of the adjoining Pilliga State Forest ~160,000ha), it is considered unlikely that the impacts would cause this species to decline.	**Potential**. Although 19.2ha of marginal habitat and 0.18ha of potential habitat would be reduced, given the large area of more suitable habitat in the form of '*Blakely's Red Gum Riparian Woodland of the Pilliga Outwash Brigalow Belt South Bioregion'* and '*Rough-barked Apple - Blakely's Red Gum riparian grassy woodlands, Brigalow Belt South and Nandewar'* available within the Pilliga State Forest, it is considered unlikely that the impacts would cause this species to decline.
Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat	**Unlikely**. It is unlikely that the impacted area will increase invasive species, such as exotic weed or pest species becoming established to any greater degree than what already exists.	**Unlikely**. It is unlikely that the impacted area will increase invasive species, such as exotic weed or pest species becoming established to any greater degree than what already exists.	**Unlikely**. It is unlikely that the impacted area will increase invasive species, such as exotic weed or pest species becoming established to any greater degree than what already exists.	**Unlikely.** It is unlikely that the impacted area will increase invasive species, such as foxes or cats becoming established to any greater degree than what already exists.	**Unlikely**. It is unlikely that the impacted area will increase invasive species, such as exotic weed or pest species becoming established to any greater degree than what already exists.	**Unlikely**. It is unlikely that the impacted area will increase invasive species, such as foxes or cats becoming established to any greater degree than what already exists.
Introduce disease that may cause the species to decline, or	**Unlikely**. There are no diseases which have been associated with the decline of this species. As a consequence the proposed activities are not expected to introduce any diseases that may cause this species to decline.	**Unlikely**. There are no diseases which have been associated with the decline of this species. As a consequence the proposed activities are not expected to introduce any diseases that may cause this species to decline.	**Unlikely**. There are no diseases which have been associated with the decline of this species. As a consequence the proposed activities are not expected to introduce any diseases that may cause this species to decline.	**Unlikely**. Due to the small amount of clearing and lack of koala presence on site, it is unlikely that the proposal will contribute to the introduction of any related diseases. As a consequence the proposed activities are not expected to introduce any diseases that may cause this species to decline.	**Unlikely**. There are no diseases which have been associated with the decline of this species. As a consequence the proposed activities are not expected to introduce any diseases that may cause this species to decline.	**Unlikely**. There are no diseases which have been associated with the decline of this species. As a consequence the proposed activities are not expected to introduce any diseases that may cause this species to decline.
Interfere substantially with the recovery of the species	**Unlikely**. Due to the small area of impact and the large extent of more suitable habitat available for this species within the surrounding area, it is considered unlikely that the impacts of the proposal will substantially interfere with the recovery of the species.	**Unlikely**. Due to the small area of impact and the large extent of more suitable habitat available for this species within the surrounding area, it is considered unlikely that the impacts of the proposal will substantially interfere with the recovery of the species.	**Unlikely**. Due to the small area of impact and the large extent of more suitable habitat available for this species within the surrounding area, it is considered unlikely that the impacts of the proposal will substantially interfere with the recovery of the species.	**Unlikely**. Due to the small area of impact and the large extent of more suitable habitat available for this species within the surrounding area, it is considered unlikely that the impacts of the proposal will substantially interfere with the recovery of the species.	**Unlikely**. Due to the small area of impact and the large extent of more suitable habitat available for this species within the surrounding area, it is considered unlikely that the impacts of the proposal will substantially interfere with the recovery of the species.	**Unlikely.** Due to the small area of impact and the large extent of more suitable habitat available for this species within the surrounding area, it is considered unlikely that the impacts of the proposal will substantially interfere with the recovery of the species.

- Nationally Listed Threatened Ecological Communities:

One Critically Endangered Ecological Community, nationally listed under the EPBC Act was recorded, namely White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland. The condition of the site was identified as occurring as degraded, specifically as the modified 'derived grassland' form of the listed community. This site currently occurs as a cleared pipeline easement and with approximately 5 years regrowth present. The proposal will remain within the previously disturbed easement and hence, will not involve the removal of any mature mid or canopy layer vegetation. In addition, the ground layer vegetation which previously regrew within the existing easement is highly likely to regrow following the proposal, therefore, the disturbance can be considered as temporary.

The temporary ecological impact within the previously disturbed easement will directly impact upon 220 m x 12 m (~ 0.264ha) of the derived grassland vegetation. In addition, the ploughing rather than trenching method for implementing the proposal is likely to cause less ecological damage and this vegetation community will not be affected indirectly by the proposal provided the mitigation measures within **Section 7** are adhered to. Therefore, the potential direct and indirect impacts upon this listed community are not considered to be significant.

- Nationally Listed Migratory Species:

Those EPBC listed Migratory species considered to have potential to occur are:

- *Circus assimilis* Spotted Harrier
- *Apus pacificus* Fork-tailed Swift
- *Ardea alba* Great Egret
- *Ardea ibis* Cattle Egret
- *Merops ornatus* Rainbow Bee-eater

As discussed in **Section 5.2.2** the ROW site and the proposed location of the development footprint exists, as a predominately cleared site. This site is surrounded by superior areas of habitat, which would be suitable for the above listed Migratory species. Due to the extensive tracts of vegetation within the Pilliga State Forest (~160,000ha), supporting the populations of the potentially occurring above species, the small area to be impacted upon (19.2ha of marginal habitat and 0.18ha of potential habitat) is unlikely to be essential to the survival of populations of these species.

Appendix 10

Seven Part Test - ROW

a) In the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction,

Flora

Dichanthium setosum

Dichanthium setosum occurs chiefly on the northern tablelands in the Saumarez area, west of Armidale, and 18-30 km east of Guyra. It is more rarely found on the north-western slopes, central western slopes and north-western plains of NSW, extending west to Narrabri. *D. setosum* is associated with heavy basaltic black soils and stony red-brown hardsetting loam with clay subsoil and is found in moderately disturbed areas such as cleared woodland, grassy roadside remnants, grazed land and highly disturbed pasture. The extent to which this species tolerates disturbance is unknown. D. setosum occurs within the Border Rivers−Gwydir, Central West, Namoi, Northern Rivers (NSW), South East and Fitzroy (Queensland) Natural Resources Management Regions.

D. setosum was not detected during field surveys although two records exist within 10km of the site. The soils in which it prefers do not occur on the ROW, however its presence cannot be ruled out. In addition, there are larger areas of more suitable habitat nearby (Pilliga State Forest ~ 160,000ha) and the proposal will affect a small area of sub-optimal habitat (~ 19.2ha of existing cleared and disturbed easement and the clearing of approximately 0.18ha of Ironbark Shrubby Woodland within the Pilliga State Forest). Therefore, it is considered that the proposed development is not likely to have an adverse effect on the life cycle of this species such that a viable local population of the species is likely to be placed at risk of extinction.

Rulingia procumbens

Rulingia procumbens is endemic to NSW and is known from the Dubbo–Medooran–Gilgandra region, the Cobar region, and the upper Hunter Valley (Harden, 2000). Populations of this species have been recorded in Goonoo State Forest (SF), Mt Kaputar National Park, and Pilliga Nature Reserve and other populations occur on crown land, state forests, and on private land (DECC NSW, 2005a). *R. procumbens* occurs within the Border Rivers–Gwydir, Central West, Hunter–Central Rivers, Namoi, and Western (NSW) Natural Resource Management Regions. The species occurs in sandy soils, often in disturbed habitats such as road verges, quarry boundaries, gravel stockpiles, and power line easements. *R. procumbens* is often found in communities of *Eucalyptus dealbata–E. sideroxylon* woodland, *Melaleuca uncinata* shrubland, and mallee eucalypt with *Calytrix tetragona* understorey. Associated species include *Acacia triptera*, *Callitris endlicheri*, *Eucalyptus melliodora*, *Allocasuarina diminuta*, *Philotheca salsolifolia*, *Xanthorrhoea* spp., *Exocarpos cupressiformis*, *Leptospermum parvifolium*, and *Kunzea parvifolia.*

No records for this species exist within 10km of the site (NSW Wildlife Atlas) and it was not detected during field surveys. However, the Protected Matters Search predicted that this species has potential to occur and some sub-optimal habitat does occur on site. Therefore, it is considered to have potential to occur on site. Therefore, it has potential to be impacted upon as a result of the proposed actions. In addition, there are larger areas of more suitable habitat nearby (Pilliga State Forest ~ 160,000ha) and the proposal will affect a small area of sub-optimal habitat (~ 19.2ha of existing cleared and disturbed easement and the clearing of approximately 0.18ha of Ironbark Shrubby Woodland within the Pilliga State Forest). Therefore, it is

considered that the proposed development is not likely to have an adverse effect on the life cycle of this species such that a viable local population of the species is likely to be placed at risk of extinction.

Pterostylis cobarensis (Cobar Greenhood Orchid)

Pterostylis cobarensis also known as Cobar Greenhood Orchid, is a terrestrial orchid with 7–11 narrow-elliptic leaves which form a basal rosette, each 1.5–2.5 cm long and 5–8 mm wide. Three to eight flowers grow on stems up to 40 cm high, with 3–5 closely sheathing stem leaves. Flowers are transparent with brown and green markings, each flower about 1.2 cm long. Flowering occurs from September to November. Vegetative reproduction is not common in this group of Greenhoods, but some species may form more than one daughter tuber annually. Plants are deciduous and die back to the large, underground tubers after seed release. New rosettes are produced following soaking autumn and winter rains. Pterostylis cobarensis is pollinated by the males of small gnats which are attracted to the flower by some pseudosexual perfume (DECC, 2008a). Cobar Greenhood Orchid is known chiefly from the Nyngan–Cobar–Bourke district in the far western plains of NSW. *Pterostylis cobarensis* grows among rocks on low hills and on slopes above streams. It inhabits eucalypt woodland, open mallee, or Callitris shrubland on low stony ridges and slopes with skeletal sandy-loam soils. Flowering occurs from September to November.

This species was not recorded on site (NSW Wildlife Atlas). However, the Protected Matters Search predicted that this species has potential to occur. At the time of surveys this species would not have been detectable and some sub-optimal habitat does occur on site. Due to this species' cryptic nature its occurrence cannot be totally discounted. Therefore, it is considered as having potential to occur on site.

There are larger areas of more suitable habitat nearby (Pilliga State Forest ~ 160,000ha) and the proposal will affect a small area of sub-optimal habitat (~ 19.2ha of existing cleared and disturbed easement and the clearing of approximately 0.18ha of Ironbark Shrubby Woodland within the Pilliga State Forest). Therefore, it is considered that the proposed development is not likely to have an adverse effect on the life cycle of this species such that a viable local population of the species is likely to be placed at risk of extinction.

Tylophora linearis

Tylophora linearis is a herbaceous climber with clear latex that grows to about 2 m long. The stems are cylindrical, up to 3 mm in diameter with internodes up to 100 mm long. Leaves are dark green, linear, up to 100 mm long and 4 mm wide, and extra-floral nectaries are absent from the base of the leaf. Flowers are clustered in radiating groups of 3–8. Flowers are 6–22 mm in diameter, with petals olive-green externally, dark purple internally and with short hairs internally concentrated towards the tip. Fruits form follicles 95–100 mm long and 5 mm wide (Forster, 1992; Forster et al., 2004). *Tylophora linearis* has rarely been collected and is known from eight localities in the Dubbo area and Mt Crow near Barraba in NSW. Grows in dry scrub, open forest and woodlands associated with *Melaleuca uncinata, Eucalyptus fibrosa, E. sideroxylon, E. albens, Callitris endlicheri, C. glaucophylla, Allocasuarina luehmannii, Acacia hakeoides, A. lineata, Myoporum* spp., and *Casuarina spp.*

This species has not been recorded within 10km of the site (NSW Wildlife Atlas) and it was not detected during field surveys. However, the Protected Matters Search predicted that this species has potential to occur and some sub-optimal habitat does occur on site. Therefore, it is considered to have potential to occur on site.

There are larger areas of more suitable habitat nearby (Pilliga State Forest ~ 160,000ha) and the proposal will affect a small area of sub-optimal habitat (~ 19.2ha of existing cleared and disturbed easement and the clearing of approximately 0.18ha of Ironbark Shrubby Woodland within the Pilliga State Forest). Therefore, it is considered that the proposed development is not likely to have an adverse effect on the life cycle of this species such that a viable local population of the species is likely to be placed at risk of extinction.

Polygala linariifolia (Native Milkwort)

P. linariifolia grows in dry sclerophyll communities from Warialda area to Weebah gate on the Qld border. Sandy soils in dry eucalypt forest and woodland with a sparse understorey. The species has been recorded from the Inverell and Torrington districts growing in dark sandy loam on granite in shrubby forest of *Eucalyptus caleyi, Eucalyptus dealbata* and *Callitris*, and in yellow podsolic soil on granite in layered open forest.

In the Pilliga area, this species has been recorded in Fuzzy Box woodland, White Cypress Pine-Bulloak - Ironbark woodland, Rough-barked Apple riparian forb-grass open forest, and Ironbark - Brown Bloodwood shrubby woodland.

Other associated species include *Eucalyptus trachyphloia, Eucalyptus sphaerocarpa, Angophora floribunda, Angophora leiocarpa, Tristania suaveolens, Allocasuarina torulosa* and *Wahlenbergia* species in the understorey. Flowers from spring to summer.

One record exists for this species within 10km of the site (NSW Wildlife Atlas) and the Protected Matters Search predicted that this species has potential to occur. It was not detected on site during surveys, however, the surveys were not conducted during its flowering time and individuals may have gone undetected. Due to its partially cryptic nature its occurrence cannot be totally discounted. Therefore, it is considered as having potential to occur.

There are larger areas of more suitable habitat nearby (Pilliga State Forest ~ 160,000ha) and the proposal will affect a small area of sub-optimal habitat (~ 19.2ha of existing cleared and disturbed easement and the clearing of approximately 0.18ha of Ironbark Shrubby Woodland within the Pilliga State Forest). Therefore, it is considered that the proposed development is not likely to have an adverse effect on the life cycle of this species such that a viable local population of the species is likely to be placed at risk of extinction.

Fauna

Spotted Harrier

Spotted Harrier (*Circus assimilis*) is one of two resident Harriers in Australia. Spotted Harrier is a large raptor with a wingspan of 1.2m. Flies with upward swept wings and soars high when moving areas and flys low when searching for food. It is similar in appearance to *Circus approximans* (Swamp Harrier) in which the main distinguishing features of Spotted Harrier are the rump is mottled black.

Spotted Harrier ranges across all of Australia except for Tasmania. Most commonly found inland to near coastal eastern and south eastern Australia. During times of rodent and quail irruptions they will disperse to areas not commonly found. Found in open and wooded country in which it hunts over low vegetation or woodland where hunting at low levels is possible due to vegetation breaks.

Usually silent, breeding birds utter piercing squeaks and rapid chatter (Marchant and Higgins 1993). Nest in trees in open remnant woodland, in agricultural areas, often near ripening crop used for hunting (Marchant and Higgins 1993).

Spotted Harrier (*Circus assimilis*) Occurs throughout the Australian mainland, except in densely forested or wooded habitats of the coast, escarpment and ranges. Individuals disperse widely in NSW and comprise a single population. Grassy open woodland including acacia and mallee remnants, inland riparian woodland, grassland and shrub steppe (e.g. chenopods). It is found most commonly in native grassland, but also occurs in agricultural land, foraging over open habitats including edges of inland wetlands. This species could utilise the site to forage for prey such as small birds and mammals. This species is considered to have potential to

occur on site. In addition, there are larger areas of more suitable habitat nearby (Pilliga State Forest ~ 160,000ha) and the proposal will affect a small area of sub-optimal habitat (~ 19.2ha of existing cleared and disturbed easement and the clearing of approximately 0.18ha of Ironbark Shrubby Woodland within the Pilliga State Forest). Therefore, it is considered that the proposed development is not likely to have an adverse effect on the life cycle of this species such that a viable local population of the species is likely to be placed at risk of extinction.

Swift Parrot

During winter Swift Parrots inhabit mainland Australia from Adelaide (S.A.) through Victoria, and up the east coast to South-East Queensland, as well as visiting the South and Central Western Slopes and the Riverina in NSW. They return to eastern Tasmania in spring to breed. In NSW, they occur in a range of habitat types from coastal forests and heaths to dry open woodlands on the western slopes. Key habitat for Swift Parrots is on the coast and coastal plains of NSW include *Corymbia maculata* (Spotted Gum*), Eucalyptus robusta* (Swamp Mahogany) and *Eucalyptus tereticornis* (Forest Red Gum) forests. They are dependent on habitats that provide winter foraging resources such as nectar and lerps (sugary exudates from leaf insects). Within these habitats, they prefer foraging in mature trees that provide a higher quality and quantity of nectar than regrowth trees. They have previously been found to select mature trees over 40 cm DBH with an emphasis on trees greater than 60cm DBH.

This species has not been recorded within 10km of the site previously (NSW Wildlife Atlas). However, the Protected Matters Search predicted that this species has potential to occur and some suitable foraging habitat occurs on site. This species is considered to have potential to occur on site. Therefore, it has potential to be impacted upon as a result of the proposed actions. However, there are larger areas of more suitable habitat nearby (Pilliga State Forest ~ 160,000ha) and the proposal is unlikely to affect a significant area of foraging habitat (the clearing of approximately 0.18ha of Ironbark Shrubby Woodland within the Pilliga State Forest). Therefore, it is considered unlikely to be impacted upon as a result of the proposal. Therefore, it is considered that the proposed development is not likely to have an adverse effect on the life cycle of this species such that a viable local population of the species is likely to be placed at risk of extinction.

Brown Treecreeper

The eastern subspecies of the Brown Treecreeper, *Climacteris picumnus ssp. victoriae*, is distributed through central NSW on the western side of the Great Dividing Range and sparsely scattered to the east of the Range in drier areas such as the Cumberland Plain of Western Sydney, and in parts of the Hunter, Clarence, Richmond and Snowy River valleys.

The Brown Treecreeper is a medium-sized insectivorous bird that frequents drier forests and woodlands, particularly open woodland lacking a dense understorey, but also grasslands where there are sufficient logs, stumps and dead trees nearby. It spends up to half its time on the ground and on fallen logs, often well away from cover, pecking at the bases of grass tussocks, turning over leaves and litter, feeding on invertebrate larvae and small insects, particularly ants. It frequently hops along the entire length of logs and spirals up live and dead tree trunks, to feed on ants and flying insects. Brown treecreepers sleep inside hollow branches or trunks of trees, both living and dead, sometimes at great heights, and sometimes using old nest sites (Noske 1982).

Brown Treecreepers are threatened by clearance and the fragmentation of the woodland habitat including removal of dead timber. Increased isolation decreases treecreeper agility and increases the vulnerability of populations to extinction as a result of stochastic events. This species appears unable to maintain viable populations in remnants less than 200ha and its abundance decreases as remnant size decreases (Barrett

et al. 1994). Fragmentation also leads to a skewed sex ratio in Brown Treecreeper populations because female birds are unable to disperse to isolated remnants, increasing the chance of local extinctions. Habitat degradation, including loss of hollow bearing trees threatens Brown Treecreeper populations. Grazing by stock in woodland areas leads to a decrease in diversity of ground-dwelling invertebrates decreasing the availability of food for the birds (Bromham et al. 1999).

Individuals of this species were recorded on the ROW area. The woodland occupied by this species may be impacted as a result of this proposal. In addition, there are larger areas of more suitable habitat nearby (Pilliga State Forest ~ 160,000ha) and the proposal will affect a small area of sub-optimal habitat (~ 19.2ha of existing cleared and disturbed easement and the clearing of approximately 0.18ha of Ironbark Shrubby Woodland within the Pilliga State Forest). Therefore, it is considered that the proposed development is not likely to have an adverse effect on the life cycle of this species such that a viable local population of the species is likely to be placed at risk of extinction.

Grey-crowned Babbler

The eastern subspecies of the Grey-crowned Babbler (*Pomatostomus temporalis temporalis*) ranges from Mt Lofty Range, SA to Cape York Peninsula, Qld, generally in areas receiving an average annual rainfall between 250 and 1000 mm. The Grey Crowned Babbler inhabits open Eucalypt woodlands with a grassy groundcover and sparse, tall shrub layer. Grey-crowned Babblers may also be observed along streams in cleared areas and grassy road verges (Morcombe, 2000). Grey-crowned Babblers forage mainly on insects and spiders, spending the majority of their time searching through leaf litter and soil for food, but also venturing into vegetation. Grey-crowned Babblers live in extended families usually consisting of a breeding pair with offspring. Pairs mate for life and are usually the only breeding birds within the group. The other group members help them build the nest and feed the young.

Breeding occurs between July and February. Their large domed nests (up to 50cm wide) are constructed in trees at a height of about 4-7m. They tend to be built into an upward sloping or horizontal, multiple forked branches in a tree's upper outer foliage and have a side entrance tunnel (Morcombe, 2000). Nest-like structures are also used for overnight roosts. The group as a whole defends a territory (usually about 12 hectares) throughout the year.

Individuals of this species were recorded on site. The Ironbark woodland vegetation occupied by this species may be impacted however to an insignificant amount. In addition, there are larger areas of more suitable habitat nearby (Pilliga State Forest ~ 160,000ha) and the proposal will affect a small area of sub-optimal habitat (~ 19.2ha of existing cleared and disturbed easement and the clearing of approximately 0.18ha of Ironbark Shrubby Woodland within the Pilliga State Forest). Therefore, it is considered that the proposed development is not likely to have an adverse effect on the life cycle of this species such that a viable local population of the species is likely to be placed at risk of extinction.

Koala

The Koala (*Phascolarctos cinereus*) occurs along the east coast of Australia and extends into Woodland, Mulga and River Red Gum forests west of the Great Dividing Range. The range of the Koala covers all such suitable areas of NSW. In drier forested areas, Koalas are generally observed as individuals in low densities. They are more abundant in coastal woodland and in open forest, where they have been found in densities as high as ten individuals per hectare. They are rare or absent in wet forests in the southern part of their range above 600 m which may be due more to distribution of Eucalypt species than climate, as the Koala is limited to areas where there are acceptable food trees.

Koala's diet is generally restricted to that of Eucalypt leaves. On occasion, non-Eucalypt foliage is eaten. The foliage of *Eucalyptus camaldulensis* (River Red Gum), *E. microcorys* (Tallowwood), *E. tereticornis* (Forest Red Gum), *E. punctata* (Grey Gum), *E. viminalis* (Ribbon Gum) and *E. robusta* (Swamp Mahogany) are some of the preferred Eucalypt species. Koalas use a wide variety of tree sizes, and do not preferentially use large or tall trees in NSW forests, although this has been listed as a habitat preference in areas where trees are generally small, stunted or nutrient deprived. The breeding biology of this species is characterised by the occurrence of discrete core, sedentary breeding groups. A core group may comprise up to several dozen individuals that are usually well separated from other breeding groups. These core groups produce a continual supply of dispersing nomadic sub-adults. Individuals within core breeding groups occupy semi-exclusive territories. There is interaction with and marginal overlap of territories between adjacent individual animals. The territories of breeding males generally occur within a matrix of adjacent territories of breeding females. In the overlap zones of adjacent territories of breeding individuals, individual trees occur that are habitually used for interaction between the two animals concerned. These breeding core interaction trees (sometimes termed "home range trees") are readily identifiable by scratched "trails" up the bole and copious dung deposits at the base of the tree. Breeding occurs in summer and young females produce one young (rarely twins) each year.

No Koala's or signs of their presence were recorded during the surveys. No primary koala feed trees listed under the SEPP 44 were recorded on the ROW area, only secondary Koala feed trees were present. Although Koalas have potential to occur within the ROW they were not detected during field work. In addition, there are larger areas of more suitable habitat nearby (Pilliga State Forest ~ 160,000ha) and the proposal will affect a small area of sub-optimal habitat (~ 19.2ha of existing cleared and disturbed easement and the clearing of approximately 0.18ha of Ironbark Shrubby Woodland within the Pilliga State Forest). Therefore, it is considered that the proposed development is not likely to have an adverse effect on the life cycle of this species such that a viable local population of the species is likely to be placed at risk of extinction.

Pilliga Mouse

No specific habitat type has been identified for the Pilliga Mouse as specimens have been captured in different vegetation types within the Pilliga Scrub (Fox and Briscoe 1980). These included mixed Eucalyptus, Acacia and Callitris open forest. The Pilliga Mouse is found in greatest abundance in recently burnt moist gullies, areas dominated by broombush and areas containing an understorey of Acacia burrowii with a Corymbia trachyphloia overstorey. Consistent features of the latter two habitats were: a relatively high plant species richness; a moderate to high low-shrub cover; site moisture retention; and groundcover of plants, litter and fungi. Areas with high rates of capture have extensive low grasses and sedges, with little shrub cover and large areas of ash-covered ground (Fox and Briscoe 1980; NSW DECC 2005; Tokushima et al. 2008).

Four records for this species exist within 10km of the ROW area; however it was not detected during surveys. There is potential for this species to occur on site, therefore it has potential to be impacted upon as a result of the proposed actions. In addition, there are larger areas of more suitable habitat nearby (Pilliga State Forest ~ 160,000ha) and the proposal will affect a small area of sub-optimal habitat (~ 19.2ha of existing cleared and disturbed easement and the clearing of approximately 0.18ha of Ironbark Shrubby Woodland within the Pilliga State Forest). Therefore, it is considered that the proposed development is not likely to have an adverse effect on the life cycle of this species such that a viable local population of the species is likely to be placed at risk of extinction.

Malleefowl

Malleefowl (*Leipoa ocellata*) inhabits semi-arid regions of southern Australia. In New South Wales, it typically occurs west of the Great Dividing Range. Extends from Pilliga south-west to the districts of Griffith and Wentworth. The extent of occurrence is known to be decreasing. The distribution of the Malleefowl was formerly more extensive, extending over a large proportion of mainland southern Australia, including the south-western region of the Northern Territory. Occupies shrublands and low woodlands that are dominated by mallee vegetation. It also occurs in other habitat types including eucalypt or native pine Callitris woodlands, acacia shrublands, Broombush Melaleuca uncinata vegetation or coastal heathlands.

No records exist within 10km of the site for this species and it was not detected during field surveys. Callitris and Acacia woodlands do persist on site and they are sub-optimal habitat. Therefore, it is considered to have potential to occur on site. In addition, there are larger areas of more suitable habitat nearby (Pilliga State Forest ~ 160,000ha) and the proposal will affect a small area of sub-optimal habitat (~ 19.2ha of existing cleared and disturbed easement and the clearing of approximately 0.18ha of Ironbark Shrubby Woodland within the Pilliga State Forest). Therefore, it is considered that the proposed development is not likely to have an adverse effect on the life cycle of this species such that a viable local population of the species is likely to be placed at risk of extinction.

Little Eagle

Little Eagle (*Hieraaetus morphnoides*) is a compact small eagle standing around 55cm with a wing span of up to 1.3m. Blackish crown, eyebrow and cheeks and short black crest on nape, long, closely feathered legs and square-cut tail, pale band across upperwing when perched in flight (Pizzey 2007). Little Eagle can come in two morphs being Pale Morph and Dark Morph, dark birds can be sandy brown to reddish brown in colour. This species can be identified by the square-cut tail and 'fingertips' on end of wing which are upturned in soaring flight. Territorial males perform high, linked , 'fish-hooks' display on closed wings, with quick upshots, uttering quick, disyllabic whistle (Pizzey 2007). H. morphnoides is a solitary raptor which occurs in woodland and also open habitat, rarely found around dense forest.

Can be found across most of Australia, but more commonly found near coastal to inland regions in NSW and Victoria. This species is part-migratory to nomadic and dispersive in some areas. Characteristic wind hanging hunting attitude, wings held slightly forward, alulae projected, tail fanned, may drop several stages in this posture, also make vertical stoops, with wings folded, talons stretched forward in final stage of attack (Marchant and Higgins 1993). Display flight also distinctive, series of aerial undulations with or without wing-beats on upswept wings, in light morph, pale belly and underwing flash conspicuously in sunlight, whistling call given loudly and often (Marchant and Higgins 1993).

One record exists for this species within 10km of the site. It was not detected during field surveys. Due to the wide range of habitats in which this species forages, it cannot be ruled out as occurring on site. In addition, there are larger areas of more suitable habitat nearby (Pilliga State Forest ~ 160,000ha) and the proposal will affect a small area of sub-optimal habitat (~ 19.2ha of existing cleared and disturbed easement and the clearing of approximately 0.18ha of Ironbark Shrubby Woodland within the Pilliga State Forest). Therefore, it is considered that the proposed development is not likely to have an adverse effect on the life cycle of this species such that a viable local population of the species is likely to be placed at risk of extinction.

Barking Owl

The Barking Owl (*Ninox connivens*) is documented as occurring in forests, woodlands, and savannah and riverine woodland, and although rainforests may be used for roosting, more open country is favoured for foraging and large hollow-bearing eucalypts for breeding. The Barking Owl is widespread within New South

Wales, with records from coastal areas along with the slopes, plains, tablelands, and far western plains. Records of Barking Owls have been documented from lowland / floodplain open forest on the coast *Eucalyptus tereticornis* (Forest Red Gum), box/ ironbark/ cypress woodlands; *Eucalyptus camaldulensis* (River Red Gum), riverine forests; and *Angophora floribunda* (Rough Barked Apple) / *Eucalyptus melliodora* (Yellow Box) woodland with *Casuarina spp.* (Pizzey 2007*).* Barking Owls are infrequent in the denser habitats occupied by *Ninox strenua* (Powerful Owl) and *Tyto tenebricosa* (Sooty Owl), preferring lowland areas in riparian and well-watered situations dominated by open forest or woodland. Hollands (1991) regards the habitat of Barking Owls as open country with a choice of large trees for roosting and nesting. Prey species taken by this species include mammals (such as rabbits, young hares, rats, mice, sugar gliders, possums, insectivorous bats), birds (Honeyeaters, Ducks, Dollarbird, Starling, Galah, Kookaburra, Parrots, Rosellas, Pheasant Coucal, Magpie and Tawny Frogmouth) as well as insects and other invertebrates (Readers Digest 1982).

The Barking Owl is an opportunistic predator, foraging on terrestrial, arboreal and flying prey. Diurnal birds comprise a large proportion of diet, and apparently arboreal mammals are preferred over terrestrial prey. Barking Owls nest in large tree hollows, from near ground level up to 29 metres in height. Known nest trees recorded include *E. camaldulensis* (River Red Gum), *Eucalyptus pilularis ssp. pilularis* (Blackbutt), *Angophora floribunda* (Rough-barked Apple), *Eucalyptus viminalis* (Manna Gum) and dead trees. Barking Owls commonly roosts in non-eucalypt or mid-storey shrubs, especially *Casuarina cunninghamiana* (River She-oak) gallery forest, Acacia thickets, densely crowned *A. floribunda* (Rough-barked Apple), *Geijera parviflora* (Wilga trees), and gully rainforest. Roost trees appear to be selected to provide dense cover, usually of more protective value than that provided by most Eucalypts. The species may roost in isolated stands of trees in open country.

Barking Owls are usually found in pairs which occupy permanent territories, generally greater than 100 ha. Each pair has a number of sites where they roost by day - usually in a leafy tree, close to the trunk, though not always well hidden. They breed August to October in large open hollows.

Records of this species exist in close proximity to the ROW area. The vegetation along the entire ROW is potential foraging habitat for this species, some of which will be incrementally impacted upon. In addition, there are larger areas of more suitable habitat nearby (Pilliga State Forest ~ 160,000ha) and the proposal will affect a small area of sub-optimal habitat (~ 19.2ha of existing cleared and disturbed easement and the clearing of approximately 0.18ha of Ironbark Shrubby Woodland within the Pilliga State Forest). Therefore, it is considered that the proposed development is not likely to have an adverse effect on the life cycle of this species such that a viable local population of the species is likely to be placed at risk of extinction.

Masked Owl

In NSW Masked Owls (*Tyto novaehollandiae*) are distributed throughout the length of the Great Dividing Range and extend from the coast to the western slopes. Recent surveys in south-eastern NSW have shown Masked Owls to be widespread, albeit at very low population densities. Masked Owls occupies a range of environments from tall, wet Eucalypt forest to dry woodland, and often, but not always, at the ecotone with cleared land.

Their diet is comprised almost exclusively of ground-dwelling or scansorial prey. Such prey includes Rats, Marsupial Mice, Bandicoots and sometimes Rabbits. On occasions other prey such as small arboreal mammals or birds are taken.

Masked Owls nest and prefer to roost by day in hollows inside large, old trees. These trees are often but not always in or near gullies. The species generally requires an entrance to the tree hollow of around 20-25 cm in diameter. They also roost by day among the dense foliage of leafy trees such as *Acmena smithii*

(Lillypilly) and other rainforest species. There are several records of Masked Owls nesting and roosting in caves on the Nullabor Plain. The breeding season, like that for other Tyto owls, is variable but there is a tendency for breeding to occur in autumn-winter. Two or three young are produced, although some pairs do not breed in every year. Pairs appear to mate for life and occupy exclusive territories in the order of 1000ha in size.

Multiple records exist in close proximity to the ROW area. The vegetation along the entire ROW is potential foraging habitat for this species, some of which will be incrementally impacted upon. In addition, there are larger areas of more suitable habitat nearby (Pilliga State Forest ~ 160,000ha) and the proposal will affect a small area of sub-optimal habitat (~ 19.2ha of existing cleared and disturbed easement and the clearing of approximately 0.18ha of Ironbark Shrubby Woodland within the Pilliga State Forest). Therefore, it is considered that the proposed development is not likely to have an adverse effect on the life cycle of this species such that a viable local population of the species is likely to be placed at risk of extinction.

Glossy Black-Cockatoo

The Glossy Black-Cockatoo (*Calyptorhynchus lathami*) is sparsely distributed along the east coast and immediate inland districts from western Victoria to Rockhampton in Queensland (Crome & Shields 1992). In NSW, the species is found as far west as Cobar to Hillston and Griffith in isolated mountain ranges (Pizzey 2007). The inland distribution of the species is restricted by the occurrence of the various *Casuarinaceae* spp..

Glossy Black-Cockatoos characteristically inhabit forests on sites with low soil-nutrients status, reflecting the distribution of key *Allocasuarina* spp. (Tanton 1994). The drier forest types with intact and less rugged landscapes are preferred by the species (NPWS 2002). It prefers highlands towards the north but may be found closer to the coast where conditions are suitable. In the south they are widespread in lowland coastal forests, dense mountain forests, semi-arid woodland and trees bordering water courses.

It forages primarily on the seeds of Casuarinas, but will also take wood borers from large Acacia stems. *Allocasuarina torulosa*, *A. littoralis*, *A. distyla* and *A. verticillata* are the predominant food trees. They have also been observed eating Angophora, Acacia and Eucalyptus seeds. It now appears to supplement its diet with the seeds of exotic pine trees. A sign that foraging individuals have recently fed at a site is a scattering of leaves, twigs and freshly chewed cones under the Casuarinas. While feeding they are tame and relatively easy to approach. Flocks of Glossy Black-Cockatoos have been seen but are not common. They are usually seen in threes, a pair and their young or feeding groups consisting of 10-12 birds, which are loose family aggregations. Glossy Black-Cockatoos generally occupy an area permanently and have a distinctive flight pattern of slow, shallow wing-beats. Nesting takes place from March through August in the hollows of large Eucalypts, 10-20m above the ground, where a single egg is laid.

Individuals of this species were recorded on site, feeding in *Allocasuarina diminuta* subsp. *diminuta stands* along the ROW. It is unlikely that this species of Allocasuarina will be impacted upon as a result of the proposal, as the vegetation exists outside of the area to be cleared on the ROW. In addition, there are larger areas of more suitable habitat nearby (Pilliga State Forest ~ 160,000ha) and the proposal will affect a small area of sub-optimal habitat (~ 19.2ha of existing cleared and disturbed easement and the clearing of approximately 0.18ha of Ironbark Shrubby Woodland within the Pilliga State Forest). Therefore, it is considered that the proposed development is not likely to have an adverse effect on the life cycle of this species such that a viable local population of the species is likely to be placed at risk of extinction.

Hooded Robin

The south-eastern subspecies of the Hooded Robin (*Melanodryas cucllata*) ranges from about Mundubbera, Qld, to the Spencer Gulf, SA, intergrading with other subspecies through the northern Murray-Darling Basin (Garnett et al, 2000). They occupy drier Eucalypt forest, woodland and scrub as well as grasses and low shrubs. Hooded Robin will also use cleared paddocks with regrowth or stumps in close proximity to wooded areas. It uses stumps, posts or fallen timber from which to locate prey on the ground. It avoids dense forests and urban areas. The species is a quiet, shy and largely sedentary bird. It is frequently observed in pairs or small groups. *M. cucullata* hunts for invertebrates by 'perch and pounce' in grassy clearings where rocks and fallen timber litter the ground where it darts from one object to the next between feeds (Sullivan, 1993)

The size of territories throughout Australia has been estimated to be between 5 to 50 hectares. Small territories are defended in the breeding season (between August and December) and the birds occupy larger home ranges in the non-breeding season. Established pairs keep to their territory year round, banding into family groups only briefly after breeding. (Schodde and Tidemann, 1986). During breeding, both sexes defend the nest. M. cucllata builds its nest from bark strips, grass and spiders web often placed on stumps in a cavity in a broken trunk or horizontal fork or branch 1-6 m above the ground (Pizzey 2007). It lays a clutch of 2-3 eggs.

This species has been recorded four times within 10km of the site (NSW Wildlife Atlas). However, the Protected Matters Search predicted that this species has potential to occur. Although it was not detected on site during surveys. Suitable foraging and nesting habitat occurs in the vegetation alongside the easement therefore it has potential to occur. In addition, there are larger areas of more suitable habitat nearby (Pilliga State Forest ~ 160,000ha) and the proposal will affect a small area of sub-optimal habitat (~ 19.2ha of existing cleared and disturbed easement and the clearing of approximately 0.18ha of Ironbark Shrubby Woodland within the Pilliga State Forest). Therefore, it is considered that the proposed development is not likely to have an adverse effect on the life cycle of this species such that a viable local population of the species is likely to be placed at risk of extinction.

Painted Honeyeater

Painted Honeyeater (*Granitella picta*) can be found throughout eastern and parts of northern Australia. It is a generally rare species. Painted Honeyeater is migratory and nomadic, birds can often found in the same location year after year following yearly patterns of mistletoe flower (authors pers. obs.). Painted Honeyeater lives almost entirely on the berries of mistletoes, and therefore its movements are tied to the flowering and fruiting of these plants, other food sourced consists of nectar and insects. This species has a particular liking for mistletoes associated with acacia sp. eg. Acacia pendula (authors pers. obs.). It usually appears in south-eastern Australia in September and departs in February or March.

The calls of the bird are loud, clear and distinctive. Courting males call from tree tops, and in song-flight, chase in dipping, weaving pursuits. The nest is a small, cup shaped, lace-like structure composed of fine rootlets and fibre bound with cobweb. It is placed in the outermost drooping branches of a Eucalypt, Tea-tree or Oak at 5-20m from the ground. Although apparently very fragile (the eggs can often be seen from below) the nest is really quite strong. Breeding season is October to February with two or rarely three eggs being laid.

Five records exist for this species within 10km of the site (NSW Wildlife Atlas). However, the Protected Matters Search predicted that this species has potential to occur. AlthoughIt was not detected on site during field surveys. Mistletoe is prevalent throughout the vegetation alongside the easement. This species is considered to have potential to occur on site. In addition, there are larger areas of more suitable habitat

nearby (Pilliga State Forest ~ 160,000ha) and the proposal will affect a small area of sub-optimal habitat (~ 19.2ha of existing cleared and disturbed easement and the clearing of approximately 0.18ha of Ironbark Shrubby Woodland within the Pilliga State Forest). Therefore, it is considered that the proposed development is not likely to have an adverse effect on the life cycle of this species such that a viable local population of the species is likely to be placed at risk of extinction.

Speckled Warbler

Speckled Warbler (*Chthonicola sagittata*) ranges in South-Eastern Australia, from South-West Victoria through eastern New South Wales to Central Queensland, mostly on the western slopes and tablelands of the Great Dividing Range, and in the drier areas of coast. Speckled Warbler's live in a wide range of Eucalypt dominated vegetation that has a grassy and shrubby understorey often on rocky ridges or gullies (Garnett et al, 2000).

Speckled Warbler is a sedentary species with a home range that varies from 6-12 hectares (Readers Digest, 1982). This species appears to be extinct from areas without vegetation fragments larger than 100ha. *C. sagittata* appears to prefer woodland areas where ground cover consists of shrubs grass, fallen leaves and bark. This ground foraging bird feeds on insects, insect larvae and small seeds (Readers Digest, 1982). A study from the Armidale area indicated that beetles were a major food source, ants were often eaten and larvae, flies and spiders were also taken (Ford, 1985). Speckled Warblers congregate in small family groups of two or three and breed from September to March. Dome shaped nests are constructed of dried grasses and bark strips and are camouflaged under a tuft of grass usually beneath fallen branches or at the base of a small shrub (Hoskin, 1991; Readers Digest, 1982). *C. sagittata* is one of the most common hosts of *Chalcites osculans* (Black-eared Cuckoo) chicks.

Ten records for this species exist within 10km of the site (NSW Wildlife Atlas). However, the Protected Matters Search predicted that this species has potential to occurIt was not detected during field surveys. Suitable habitat in the form of open woodlands exists alongside the easement for this species. Therefore it is considered as having potential to occur. In addition, there are larger areas of more suitable habitat nearby (Pilliga State Forest ~ 160,000ha) and the proposal will affect a small area of sub-optimal habitat (~ 19.2ha of existing cleared and disturbed easement and the clearing of approximately 0.18ha of Ironbark Shrubby Woodland within the Pilliga State Forest). Therefore, it is considered that the proposed development is not likely to have an adverse effect on the life cycle of this species such that a viable local population of the species is likely to be placed at risk of extinction.

Square-tailed Kite

Square-tailed Kite (*Lophoictinia isura*) is endemic to Australia and is widespread throughout the mainland (absent from Tasmania). It is recorded mainly in coastal and sub-coastal regions, although it has been observed inland. Square-tailed Kite is migratory throughout its range and is a spring-summer breeding migrant to south-eastern, southern and south-western Australia. Square-tailed Kite inhabits open forests and woodlands, particularly those on fertile soils with abundant passerines. *L. isura* may also range in nearby open habitats but not into extensive treeless regions. Square-tailed Kite is notably absent from alpine regions and small isolated remnant woodlands in large open areas. Within NSW *L. isura* has been recorded in ridge and gully forests dominated by *Eucalyptus longifolia* (Woollybutt) *Eucalyptus elata* (River Peppermint), *Eucalyptus smithii* (Blackbutt Peppermint) and *Corymbia maculata* (Spotted Gum), as well as in forests of *Angophora* and *Callitris* sps. with shrubby understorey.

Square-tailed Kite hunts mostly passerines and foliage insects, though it also known to take mammals and lizards. Most prey is taken from the canopy and rarely from shrubs or in the air. Breeding occurs from July to February with an average clutch size of 3 eggs. Nests are built as a platform or bowl of sticks lined with

green Eucalyptus leaves in forks or large horizontal branches of Eucalypts, Angophora or Melaleuca trees and may be used in successive years.

Except when breeding Square-tailed Kite tends to be a solitary bird, usually seen hunting alone high within, or just above the tree canopy in coastal or sub-coastal rainforest, forest or woodland. Nests have been reported in *Eucalyptus* spp., *Angophora* spp. and native pine forests. Prey taken has included fledging birds, insects, rabbits and lizards. Square-tailed Kite has been known to frequent suburban areas within close proximity to nearby forest, searching for prey in suburban backyard vegetation (authors pers. obs.).

One record exists for this species within 10km of the site (NSW Wildlife Atlas). However, the Protected Matters Search predicted that this species has potential to occur. It was not detected during field surveys. Due to the wide range of habitats in which this species forages, it cannot be ruled out as occurring on site. In addition, there are larger areas of more suitable habitat nearby (Pilliga State Forest ~ 160,000ha) and the proposal will affect a small area of sub-optimal habitat (~ 19.2ha of existing cleared and disturbed easement and the clearing of approximately 0.18ha of Ironbark Shrubby Woodland within the Pilliga State Forest). Therefore, it is considered that the proposed development is not likely to have an adverse effect on the life cycle of this species such that a viable local population of the species is likely to be placed at risk of extinction.

Little Lorikeet

Little Lorikeet (*Glossopsitta pusilla*) is the smallest of the lorikeets in Australia. There size is ranges from about 15-16.5cm. The colouring is mostly all a lime green with bright red on the forehead and throat surrounding the bill and up to the eye. The rear of the neck is a yellow-brown colour. Little Lorikeet ranges from about Cooktown in Qld, coastally and to the west of the ranges down to Victoria and occasionally into South Australia. This species is more commonly encountered in near coastal habitats and on the divide.

Habitat is mainly dry, open sclerophyll forests and woodlands, usually dominated by Eucalyptus, sometimes in plantations of *Eucalyptus cladocalyx* (Sugar Gum) (Higgins 1999). *G. pusilla* can be found in large flocks of hundreds of birds spread out across blossoming eucalypts, such feeding congregations have been recorded within areas such as Werekata N.P. at Cessnock when *Corymbia maculata* (Spotted Gum) has abundant flowering periods (authors pers. obs.). Little Lorikeet can be found feeding with other lorikeets species such as *Trichoglossus haematodus* (Rainbow Lorikeet), *Glossopsitta porphyrocephala* (Purple-crowned Lorikeet) and *Glossopsitta concinna* (Musk Lorikeet). In the Hunter Valley they are often found with flocks of *G. concinna* (authors pers. obs.). Little Lorikeet prefers to feed in the upper canopy and rarely comes below the uppermost blossom. During feeding show great agility, hanging and crawling through foliage, can also be very inconspicuous whilst feeding. Generally though Little Lorikeet can often be heard by the mass of calls, which can be deafening when large flocks are feeding together. The call is a distinctive thin, high-pitched rolling metallic ‘zit’ or ‘zit zit’, repeated, also utter constant soft chatter while feeding (Higgins 1999). The call can be distinguished from most of the other lorikeet species due to the short length of the call.

Movements of the Little Lorikeets is largely unkown, but the belief is that they follow abundant blossom. Some areas they are sedentary and move within the local area in response to blossom. Nesting of *G. pusilla* consists of holes, including knotholes, in bend, top or side of limb, usually living or in main trunk of tree, occasionally over water, recorded in *Eucalyptus camaldulensis* (River Red Gum), *Eucalyptus grandis* (Flooded Gum) and *Casuarina cunninghamiana* (River Oak) (Higgins 1999).

Only one record for this species exists within 10km of the site (NSW Wildlife Atlas). However, the Protected Matters Search predicted that this species has potential to occur. Suitable foraging habitat occurs on site with various species of eucalypts being present. This species is considered to have potential to occur on site.

Therefore it has potential to be impacted upon as a result of the proposed actions. In addition, there are larger areas of more suitable habitat nearby (Pilliga State Forest ~ 160,000ha) and the proposal will affect a small area of sub-optimal habitat (~ 19.2ha of existing cleared and disturbed easement and the clearing of approximately 0.18ha of Ironbark Shrubby Woodland within the Pilliga State Forest). Therefore, it is considered that the proposed development is not likely to have an adverse effect on the life cycle of this species such that a viable local population of the species is likely to be placed at risk of extinction.

Varied Sittella

Varied Sittella (*Daphoenositta chrysoptera*) is a small 'treecreeper' like bird that covers the majority of Australia. There are 5 races of Varied Sittella of which 3 occur within NSW. The nominate race which occurs across the majority of NSW, sometimes referred to as the 'Orange-winged Sittella'. The second race is Race *leucocephala* which occurs within the far north eastern corner of NSW and is sometimes known as ''White-headed Sittella'. The third race is *Race pileata* which occurs within the far western areas of NSW and is commonly called 'Black-capped Sittella'. Varied Sittella can be reasonably common in some areas and also nomadic in others, where as they also can be sedentary.

Habitat across the varying races is similar, although they can be found in a wide range of habitats. Open eucalypt forests and woodlands are the preferred habitat, but this species may also be found in mallee, coastal tea-tree scrubs, inland acacia communities, golf courses orchards and scrubby gardens. In flight, wings seem too large for the bird: broad, pale orange wing band, white rump and white tail tips conspicuous (Pizzey 2007). Varied Sittella can be heard sometimes before it is seen, the call, a high pitched 'chip chip' can often be heard as groups of these birds move through the upper canopy. Groups forage together, flying into heads of trees, typically working down branches and trunk with constant rocking-horse motion, probing and levering bark flakes with longish, slightly upturned bills, maintaining contact with constant chitterings, before flying on to next tree (Pizzey 2007).

The nest of Varied Sittella consists of deep cup of bark which is well camouflaged with spiders web and lichen. They favour the use of tree species for nesting such as Eucalypts, paperbarks, she-oaks and tea-trees. When breeding, one female appears to lay, but all members of group feed the young (Pizzey 2007).

Three records for this species exist within 10km of the site (NSW Wildlife Atlas). However, the Protected Matters Search predicted that this species has potential to occur. It was not detected on site during surveys. Suitable habitat for this species occurs throughout the eucalypt woodland adjacent to the easement. This species is considered to have potential to occur on site. In addition, there are larger areas of more suitable habitat nearby (Pilliga State Forest ~ 160,000ha) and the proposal will affect a small area of sub-optimal habitat (~ 19.2ha of existing cleared and disturbed easement and the clearing of approximately 0.18ha of Ironbark Shrubby Woodland within the Pilliga State Forest). Therefore, it is considered that the proposed development is not likely to have an adverse effect on the life cycle of this species such that a viable local population of the species is likely to be placed at risk of extinction.

Diamond Firetail

Diamond Firetail (*Stagonopleura guttata*) ranges in Eastern Australia from the Eyre Peninsula, SA to Clermont, QLD. Diamond Firetails occur in a wide range of Eucalypt-dominated vegetation communities that have a grassy understorey, including woodland, open forests and mallee. Most occur on the inland slopes of the Great Dividing Range, with only small pockets near the coast (Garnett et al, 2000). As with most Australian Finch species, Diamond Firetails are highly sociable birds. Members of a breeding colony feed in open areas next to their nests, mostly eating ripe and half ripe grass seeds, and occasionally insects. Diamond Firetails drink frequently throughout the day and are generally found near water.

Diamond Firetails breed from August to January. Diamond Firetails build a bulky, bottle shaped nest of long grass blades and stems. Both parents incubate the four to seven eggs, the young hatch within 12-15 days and leave the nest about 25 days later.

Much of the Diamond Firetail habitat has been cleared, and remaining fragments are gradually becoming unstable. Factors that have been postulated to be adversely affecting this species include the loss of key plants and habitats as a result of invasion of exotic grasses that are more suitable for flock-foraging species (Garnett et al, 2000). The noted expansion of *Neochmia temporalis* (Red-browed Firetails) has disadvantaged Diamond Firetails in some areas (Read, 1994).

Individuals of this species were recorded on site, drinking from an ephemeral puddle. Approximately 19.2ha of previously cleared/disturbed vegetation and 0.18ha of remnant vegetation is potentially utilised by this species (primarily for foraging) and will be incrementally impacted as a result of the proposal. The surrounding area (Pilliga State Forest ~ 160,000ha) also holds extensive amounts of suitable foraging and nesting habitat in which the Diamond Firetail can sufficiently use. Due to the available surrounding habitat and this species' high level of mobility it is considered unlikely to be impacted upon as a result of the proposal. Therefore, it is considered that the proposed development is not likely to have an adverse effect on the life cycle of this species such that a viable local population of the species is likely to be placed at risk of extinction.

Turquoise Parrot

The main distribution of the Turquoise Parrot (*Neophema pulchella*) is in grassy woodlands of the western slopes and tablelands from the Darling Downs in Queensland to northern Victoria, particularly along watercourses. In NSW, Turquoise Parrots are typically recorded west of the Great Divide on the tablelands and western slopes, extending to the coastal districts through the dry forest corridor of the Hunter Valley (Crome & Shields, 1992). Turquoise Parrots occur in eucalypt woodlands and open forests, with a ground cover of grasses and low understorey of shrubs (NPWS, 2002*).* Turquoise Parrots have also been recorded in a variety of other habitats, including savannah and riparian woodlands and farmland, preferring edges of forest and pasture and other grasses (Morris 1980; Quinn and Reid 1996). They are usually seen in pairs or small groups, although flocks up to 30 birds have been reported. Most of the day is spent on the ground, searching for seeds of grasses and herbaceous plants or browsing on vegetative matter. Turquoise Parrots forage primarily on the seeds of shrubs, grasses and herbs, both native and introduced, and the spore cases of mosses. They prefer to feed in the shade of a tree or near the cover of woodland. Partly nomadic, flocks move locally and regionally following seasonal abundances of seed. Breeding pairs nest in small hollow branches of Eucalypts, usually 1m above the ground from August through December and from April to May. Two to five eggs are laid and young leave the nest after 30 days though they remain with the parents.

Individuals of this species were recorded on site, within the Blakely's Red Gum dominated CEEC. Approximately 19.2ha of previously cleared/disturbed vegetation and 0.18ha of remnant vegetation is potentially utilised by this species (primarily for foraging) and will be incrementally impacted as a result of the proposal. The surrounding area (Pilliga State Forest ~ 160,000ha) also holds extensive amounts of suitable foraging and nesting habitat in which the Turquoise Parrot can sufficiently use. Due to the available surrounding habitat and this species' high level of mobility it is considered unlikely to be impacted upon as a result of the proposal. Therefore, it is considered that the proposed development is not likely to have an adverse effect on the life cycle of this species such that a viable local population of the species is likely to be placed at risk of extinction.

Yellow-bellied Sheathtail-bat

Yellow-bellied Sheathtail-bat (*Saccolaimus flaviventris*) is widespread across Australia and its apparent rarity is probably due to its flying so high and fast that it is seldom collected. It has been reported from a wide variety of habitats. Hunting height appears to vary depending upon the height of the dominant vegetation in Eucalypt forests it feeds above the canopy, but in mallee or open country it comes lower to the ground. Prey species include beetles, long-horned grasshoppers, shield bugs and flying ants.

Usually solitary, but occasionally occurring in colonies of less than ten individuals, the *S. flaviventris* roosts in tree hollows, animal burrows, dry clay cracks, under rock slabs, abandoned *Petaurus breviceps* (Sugar Glider) nests, and has been found resting on the walls of buildings in broad daylight, and one such individual, caught at Queanbeyan, NSW, appeared to be so exhausted that it made no effort to escape. Similar reports suggest that it is migratory in southern Australia and that individuals found resting in the open are in the course of a winter migration from the cooler to warmer areas. They have been reported from southern Australia only between January and June.

Males have a prominent throat-pouch which is devoid of glandular tissue but a subcutaneous gland lies behind it. The throat-pouch is represented by a rudimentary fold of skin in the female. There is no seasonal difference in testicular size in males and there is no relationship between reproductive condition in males and the size of the throat pouch. Pregnancy is always restricted to the right uterine horn. Single young are born between December and mid-March.

Six records within 10km of the site exist for this species (NSW Wildlife Atlas). However, the Protected Matters Search predicted that this species has potential to occur. Although, some sub-optimal habitat does occur on site therefore, it is considered to have potential to occur on site. Therefore it has potential to be impacted upon as a result of the proposed actions. In addition, there are larger areas of more suitable habitat nearby (Pilliga State Forest ~ 160,000ha) and the proposal will affect a small area of sub-optimal habitat (~ 19.2ha of existing cleared and disturbed easement and the clearing of approximately 0.18ha of Ironbark Shrubby Woodland within the Pilliga State Forest). Therefore, it is considered that the proposed development is not likely to have an adverse effect on the life cycle of this species such that a viable local population of the species is likely to be placed at risk of extinction.

Little Pied Bat

Little Pied Bat (*Chalinolobus pictatus*) is distributed throughout semi arid interior regions of northern NSW and Southern QLD avoiding coastal areas (Churchill 2008). The greatest abundance of Little Pied Bat occurs in the mallee and mixed species woodlands of the Willandra Lakes area of NSW. They have been captured in dry open forest, open woodland, *Callitris* forest and *Casuarina pauper* woodlands (Churchill 2008). Little Pied Bat roosts in trees, caves, abandoned mines and buildings where colonies of up to and over 50 individuals can congregate (Churchill 2008).

Little Pied Bat is fast in flight and highly acrobatic. They forage for moths and presumably other insect species whilst flying through canopy trees and amongst foliage (Churchill 2008).

Three records within 10km of the site exist for this species (NSW Wildlife Atlas). However, the Protected Matters Search predicted that this species has potential to occur. Although, some sub-optimal habitat does occur on site therefore, it is considered to have potential to occur on site. Therefore it has potential to be impacted upon as a result of the proposed actions. In addition, there are larger areas of more suitable habitat nearby (Pilliga State Forest ~ 160,000ha) and the proposal will affect a small area of sub-optimal habitat (~ 19.2ha of existing cleared and disturbed easement and the clearing of approximately 0.18ha of Ironbark Shrubby Woodland within the Pilliga State Forest). Therefore, it is considered that the proposed development

is not likely to have an adverse effect on the life cycle of this species such that a viable local population of the species is likely to be placed at risk of extinction.

b) In the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction,

No endangered populations were identified within or surrounding the ROW.

c) In the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:

> *(i) Is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or*
>
> *(ii) Is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction,*
>
> One CEEC was identified on the ROW, namely *White Box, Yellow Box, Blakely's Red Gum Woodland and Derived Grasslands* (EPBC Act) commensurate with the EEC *White Box, Yellow Box, Blakely's Red Gum Woodland* (TSC Act). This TEC has been disturbed previously (approximately 5 years ago) for the ROW establishment and no further clearing of the insitu TEC outside the ROW is likely to occur as a result of the proposal, hence not placing it at a risk of extinction.

d) In relation to the habitat of a threatened species, population or ecological community:

Flora Species

- Pterostylis cobarensis
- Rulingia procumbens
- Tylophora linearis
- Dichanthium setosum
- Polygala linariifolia

Fauna Species

- Spotted Harrier
- Swift Parrot
- Brown Treecreeper
- Superb Parrot
- Grey-crowned Babbler
- Koala
- Pilliga Mouse
- Yellow-bellied Sheathtail-bat
- Little Pied Bat
- Malleefowl

- Little Eagle
- Barking Owl
- Masked Owl
- Glossy Black-Cockatoo
- Hooded Robin
- Painted Honeyeater
- Speckled Warbler
- Square-tailed Kite
- Little Lorikeet
- Varied Sittella
- Diamond Firetail
- Turquoise Parrot

(i) The extent to which habitat is likely to be removed or modified as a result of the action proposed, and

Flora

- Pterostylis cobarensis
- Potential habitat for this species occurs within the Shrubby woodlands on the ROW. Approximately 0.18ha of remnant vegetation is potentially utilised by this species and will be incrementally impacted as a result of the proposal.
- Dichanthium setosum
- Potential habitat for this species occurs within all vegetation types on the ROW. Approximately 19.2ha of previously cleared/disturbed vegetation and 0.18ha of remnant vegetation is potential habitat for this species and will be removed or modified as part of this proposal
- Rulingia procumbens
- Potential habitat for this species occurs within all vegetation types on the ROW. Approximately 19.2ha of previously cleared/disturbed vegetation and 0.18ha of remnant vegetation is potential habitat for this species and will be removed or modified as part of this proposal
- Polygala linariifolia
- Potential habitat for this species occurs within all vegetation types on the ROW. Approximately 19.2ha of previously cleared/disturbed vegetation and 0.18ha of remnant vegetation is potential habitat for this species and will be removed or modified as part of this proposal
- Tylophora linearis
- Potential habitat for this species occurs within all vegetation types on the ROW. Approximately 19.2ha of previously cleared/disturbed vegetation and 0.18ha of remnant vegetation is potential habitat for this species and will be removed or modified as part of this proposal

Fauna

- Spotted Harrier

Potential foraging habitat for this species occurs within all vegetation types on the ROW. Approximately 19.2ha of previously cleared/disturbed vegetation and 0.18ha of remnant vegetation is potentially utilised by this species (primarily for foraging) and will be incrementally impacted as a result of the proposal.

- Swift Parrot

Potential habitat for this species occurs within the Shrubby woodlands on the ROW. Approximately 0.18ha of remnant vegetation is potentially utilised by this species (primarily for foraging) and will be incrementally impacted as a result of the proposal.

- Brown Treecreeper

Potential habitat for this species occurs within the Shrubby woodlands on the ROW. Approximately 0.18ha of remnant vegetation is potentially utilised by this species (primarily for foraging) and will be incrementally impacted as a result of the proposal.

- Grey-crowned Babbler

Potential habitat for this species occurs within all vegetation types on the ROW. Approximately 19.2ha of previously cleared/disturbed vegetation and 0.18ha of remnant vegetation is potentially utilised by this species (primarily for foraging) and will be incrementally impacted as a result of the proposal.

- Koala

Potential habitat for this species occurs within all vegetation types on the ROW. Approximately 0.18ha of potential habitat will be removed or modified as part of this proposal.

- Pilliga Mouse

Potential habitat for this species occurs within the areas of woodland containing dense shrub layers and high floristic diversity on the ROW. Approximately 19.2ha of previously cleared/disturbed vegetation and 0.18ha of remnant vegetation is potential habitat for this species and will be removed or modified as part of this proposal.

- Barking Owl

Potential habitat for this species occurs within all vegetation types on the ROW. Approximately 19.2ha of previously cleared/disturbed vegetation and 0.18ha of remnant vegetation is potential habitat for this species and will be removed or modified as part of this proposal.

- Masked Owl

Potential habitat for this species occurs within all vegetation types on the ROW. Approximately 19.2ha of previously cleared/disturbed vegetation and 0.18ha of remnant vegetation is potential habitat for this species and will be removed or modified as part of this proposal.

Glossy Black-Cockatoo

- Potential habitat for this species occurs where the preferred *Allocasuarina diminuta subsp. diminuta* occurs on the ROW. No potential habitat will be removed or modified as part of this proposal.
- Yellow-bellied Sheathtail-bat

Potential foraging habitat for this species occurs within all vegetation types on the ROW. Approximately 19.2ha of previously cleared/disturbed vegetation and 0.18ha of remnant vegetation is potentially utilised by this species (primarily for foraging) and will be incrementally impacted as a result of the proposal.

- Little Pied Bat

Potential foraging habitat for this species occurs within all vegetation types on the ROW. Approximately 19.2ha of previously cleared/disturbed vegetation and 0.18ha of remnant vegetation is potentially utilised by this species (primarily for foraging) and will be incrementally impacted as a result of the proposal.

- Malleefowl

Potential habitat for this species occurs within the Shrubby woodlands on the ROW. Approximately 0.18ha of remnant vegetation is potentially utilised by this species (primarily for foraging) and will be incrementally impacted as a result of the proposal.

- Little Eagle

Potential foraging habitat for this species occurs within all vegetation types on the ROW. Approximately 19.2ha of previously cleared/disturbed vegetation and 0.18ha of remnant vegetation is potentially utilised by this species (primarily for foraging) and will be incrementally impacted as a result of the proposal.

- Hooded Robin

Potential habitat for this species occurs within the Shrubby woodlands on the ROW. Approximately 0.18ha of remnant vegetation is potentially utilised by this species (primarily for foraging) and will be incrementally impacted as a result of the proposal.

- Painted Honeyeater

Potential habitat for this species occurs within the Shrubby woodlands on the ROW. Approximately 0.18ha of remnant vegetation is potentially utilised by this species (primarily for foraging) and will be incrementally impacted as a result of the proposal.

- Speckled Warbler

Potential habitat for this species occurs within the Shrubby woodlands on the ROW. Approximately 0.18ha of remnant vegetation is potentially utilised by this species (primarily for foraging) and will be incrementally impacted as a result of the proposal.

- Square-tailed Kite

Potential habitat for this species occurs within all vegetation types on the ROW. Approximately 19.2ha of previously cleared/disturbed vegetation and 0.18ha of remnant vegetation is potentially utilised by this species (primarily for foraging) and will be incrementally impacted as a result of the proposal.

- Little Lorikeet

Potential habitat for this species occurs within the Shrubby woodlands on the ROW. Approximately 0.18ha of remnant vegetation is potentially utilised by this species (primarily for foraging) and will be incrementally impacted as a result of the proposal.

- Varied Sittella

Potential habitat for this species occurs within the Shrubby woodlands on the ROW. Approximately 0.18ha of remnant vegetation is potentially utilised by this species (primarily for foraging) and will be incrementally impacted as a result of the proposal.

- Turquoise Parrot

Potential habitat for this species occurs within all vegetation types on the ROW. Approximately 19.2ha of previously cleared/disturbed vegetation and 0.18ha of remnant vegetation is potentially utilised by this species (primarily for foraging) and will be incrementally impacted as a result of the proposal.

- Diamond Firetail

Potential habitat for this species occurs within the areas of dense shrub layers throughout the ROW. Approximately 19.2ha of previously cleared/disturbed vegetation and 0.18ha of remnant vegetation is potentially utilised by this species (primarily for foraging) and will be incrementally impacted as a result of the proposal.

> *(ii) Whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and*
>
> No area of habitat is likely to become fragmented or isolated from other areas of habitat as part of this proposal.

(iii) The importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality.

A small area of habitat is to be removed, however, the removal is taking place predominantly in a pre-disturbed area 19.2ha and several smaller impact areas totalling 0.18ha. Due to the relatively small areas of remnant vegetation to be cleared (0.18ha) and the pre-disturbed nature of the remaining disturbance area (19.2ha) it is considered that the proposal will not contribute to fragmentation and will not have an impact on the survival of species, population or ecological community in the locality.

e) Whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly),

No areas of critical habitat occur within or adjacent to the study area.

f) Whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan,

The proposed action will not act against and will be consistent with the objectives or actions of the recovery or threat abatement plans that exist for the following species:

- Koala;
- Barking Owl; and
- Masked Owl;

The remaining species do not have an associated recovery or threat abatement plan; however the proposal is equally likely to be consistent with potential objectives in the recovery of these species:

Flora Species

- Pterostylis cobarensis
- Rulingia procumbens
- Tylophora linearis
- Dichanthium setosum
- Polygala linariifolia

Fauna Species

- Spotted Harrier
- Swift Parrot
- Brown Treecreeper
- Superb Parrot
- Grey-crowned Babbler
- Pilliga Mouse
- Yellow-bellied Sheathtail-bat
- Little Pied Bat
- Malleefowl

- Little Eagle
- Glossy Black-Cockatoo
- Hooded Robin
- Painted Honeyeater
- Speckled Warbler
- Square-tailed Kite
- Little Lorikeet
- Varied Sittella
- Diamond Firetail
- Turquoise Parrot

g) Whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.

The proposal will incrementally contribute to the following KTPs:

- Clearing of native vegetation

Given that the areas of remnant vegetation to be cleared are relatively small (0.18ha) and the pre-disturbed nature of the remaining disturbance area (19.2ha) within the area it is not expected to significantly increase the impact on native flora and fauna. Therefore, it is considered that this KTP will not have a significant impact to the overall extent of similar adjoining native vegetation within the locality (~160,000ha within the Pilliga State Forest).

Appendix 6

Agricultural Impact Statement

Leewood – Produced Water & Brine Management Ponds

Agricultural Impact Statement

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1.0 Introduction

Santos Limited (Santos) seeks approval under Part 5 of the *Environmental Planning and Assessment Act 1979* to construct and operate produced water and brine management ponds at a property known as "Leewood", together with associated infrastructure within Petroleum Assessment Lease 2 (PAL 2) in north-west New South Wales (NSW) (the Project).

The land is formally described as Lot 1 on DP771141 and has a total site area of 246 hectares. The subject site is located on the Newell Highway, approximately twenty-four (24) kilometres, south west of Narrabri Township.

The Project is proposed to enable produced water and brine to be transferred from the existing Bibblewindi Water Management Facility located approximately 15 kilometres south of Leewood in the Pilliga State Forest, to the new Leewood ponds, which are located outside the Pilliga State Forest. It will also enable the existing, approved pilot appraisal program within PAL 2 and Petroleum Exploration Licence 238 (PEL 238) to continue.

The transfer of produced water and brine to Leewood will allow Santos to locate the produced water and brine storage ponds outside of the Pilliga, thereby reducing the risk of adverse environmental impact on the forest environment from the water storage. This will involve the construction of the following infrastructure on the subject site:

- One (1) 300 ML Produced Water Pond;
- One (1) 300 ML Brine Pond;
- One (1) Produced Water Distribution Manifold; and
- A flow line and return flow line connecting from the Right of Way to the Water Distribution Manifold.

Pursuant to the provisions of the Strategic Regional Land Use Plan – New England North West, this Agricultural Impact Statement (AIS) has been prepared to evaluate the impact of the Project on agricultural resources and production on the subject site and within the surrounding Narrabri Shire.

The subject site is not currently used for cattle grazing and it is not proposed that the subject site will be used for agricultural purposes during the construction or operational phases of the project. Notwithstanding, the proposed activities will quarantine land that could otherwise be utilised for cattle grazing, albeit that cattle grazing on the subject site itself is not considered to be economically viable due to the quality of the existing unimproved pasture and property size.

To this end, the proposed development will have an impact on potential agricultural production during the construction and operational phases of the project however, the impact on production value is negligible in terms of the gross value of livestock production in the Narrabri Shire and therefore, the proposed development would not have an unreasonable impact on agricultural resources and production at the subject site or within the Narrabri Shire.

It is noted that the project also involves works on developed land being within an existing Right of Way and the Bibblewindi Water Management Facility. Both the Right of Way and Bibblewindi are located within cleared areas within the Pilliga State Forest. These areas have no existing productive agricultural value and therefore, the additional works proposed within these cleared zones will not impact on agricultural resources and production and, therefore, these areas have not been considered in detail in the following AIS.

2.0 Project Description

2.1 Property & Locality Description

This AIS relates to the land formally described as Lot 1 on DP771141 which is located approximately twenty-four (24) kilometres, south east of Narrabri, New South Wales ("the subject site") (**Figure 1**). The subject site, known as "Leewood", has a total site area of 246.30 hectares and is located within the Narrabri Shire Council municipality. The subject site is owned by Santos and is not currently used for agricultural purposes. It is not proposed to be used for agricultural purposes during the construction or operational phases of the project.

The subject site is bound by the Newell Highway (east) and the Pilliga State Forrest (south). An unsealed road (Old Mill Road) provides vehicular access from the Newell Highway to the subject site's southern boundary. An existing gas flow line traverses the subject site on a north-south alignment, connecting Bibblewindi to the Wilga Park Power Station.

The majority of native vegetation on the subject site has been cleared in the past to allow for the grazing of cattle. The subject site is covered by grass species, with the exception of a limited number of canopy (or paddock) trees and a stand of dense vegetation located to the north-east corner.

In addition to the Lewood land, it is noted that works are also proposed within the existing Right of Way that connects the subject site to Bibblewindi as well as within the Bibblewindi site itself. Both the Right of Way and the Bibblewindi Water Treatment Plant are developed sites, as such, there is no impact on agricultural resources in these areas. Refer to Section 3.0 for additional information.

2.2 Proposed Activities

It is proposed to construct the Project on the subject site, within the existing Right of Way and at Bibblewindi. The Project will facilitate Santos centralising their water handling and treatment operations outside of the Pilliga State forest and to reduce the potential for their operations to impact on the forest environment.

It is proposed to transfer produced water and brine from Bibblewindi to the subject site via two (2) water flow lines that are proposed to be constructed within the existing Right of Way (**Figure 2**).

The project involves the construction of the following infrastructure to the north-west of the subject site:

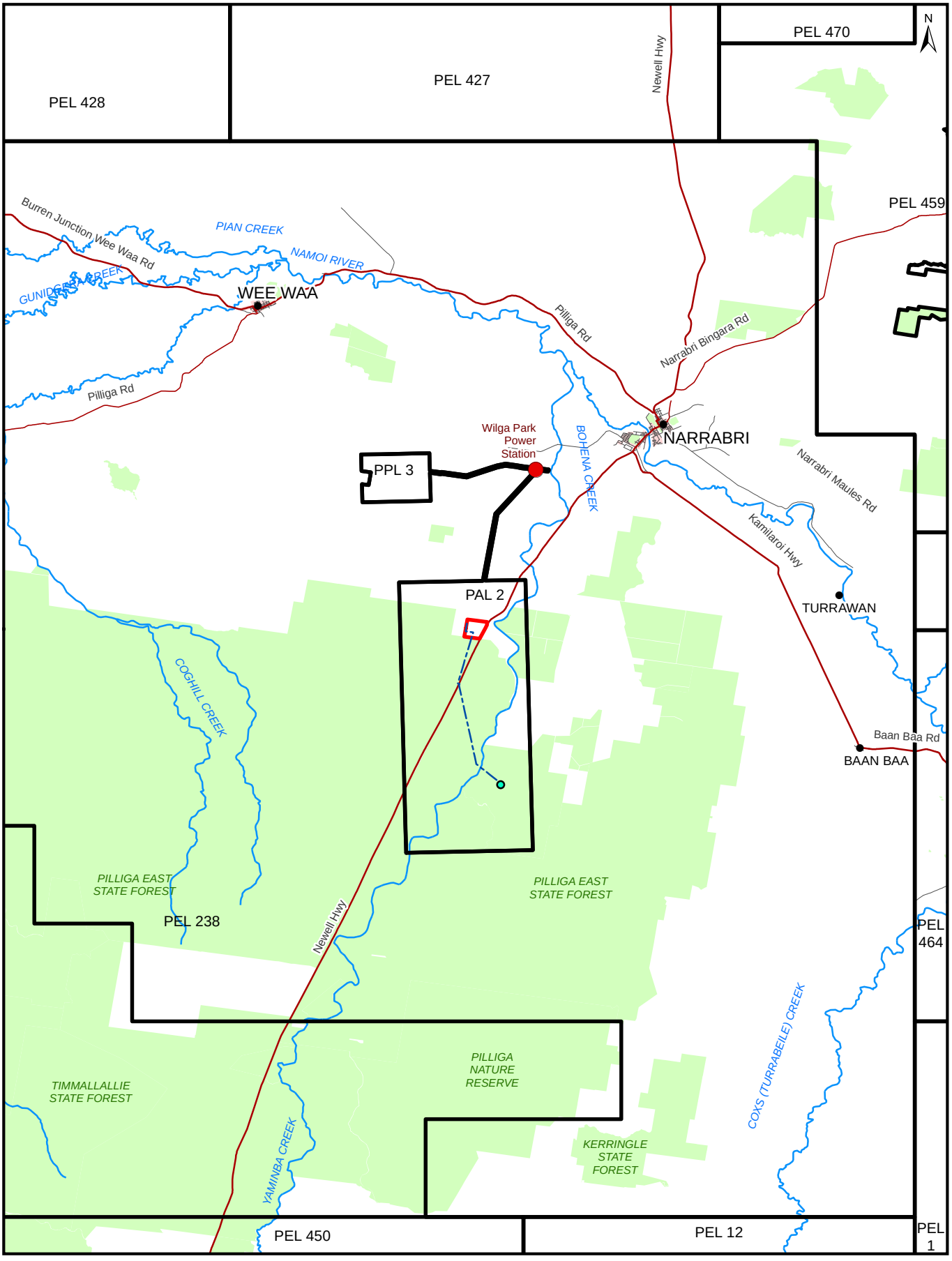
- One (1) 300 ML Produced Water Pond;
- One (1) 300 ML Brine Pond;
- One (1) Produced Water Distribution Manifold; and
- A flow line and return flow line connecting from the Right of Way to the Water Distribution Manifold.

The following infrastructure is proposed within the existing Right of Way;

- A flow line and return flow line connecting the subject site to the Bibblewindi Pond 3.

The following infrastructure is proposed within at Bibblewindi;

- One (1) 5 ML tank with an associated pumping station and power supply located adjacent to Bibblewindi Pond 3; and
- New piping to connect the existing water gathering systems at the Bibblewindi Water Treatment Plant to the new infrastructure stated above.





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Kilometres

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DATA SOURCES

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LEGEND

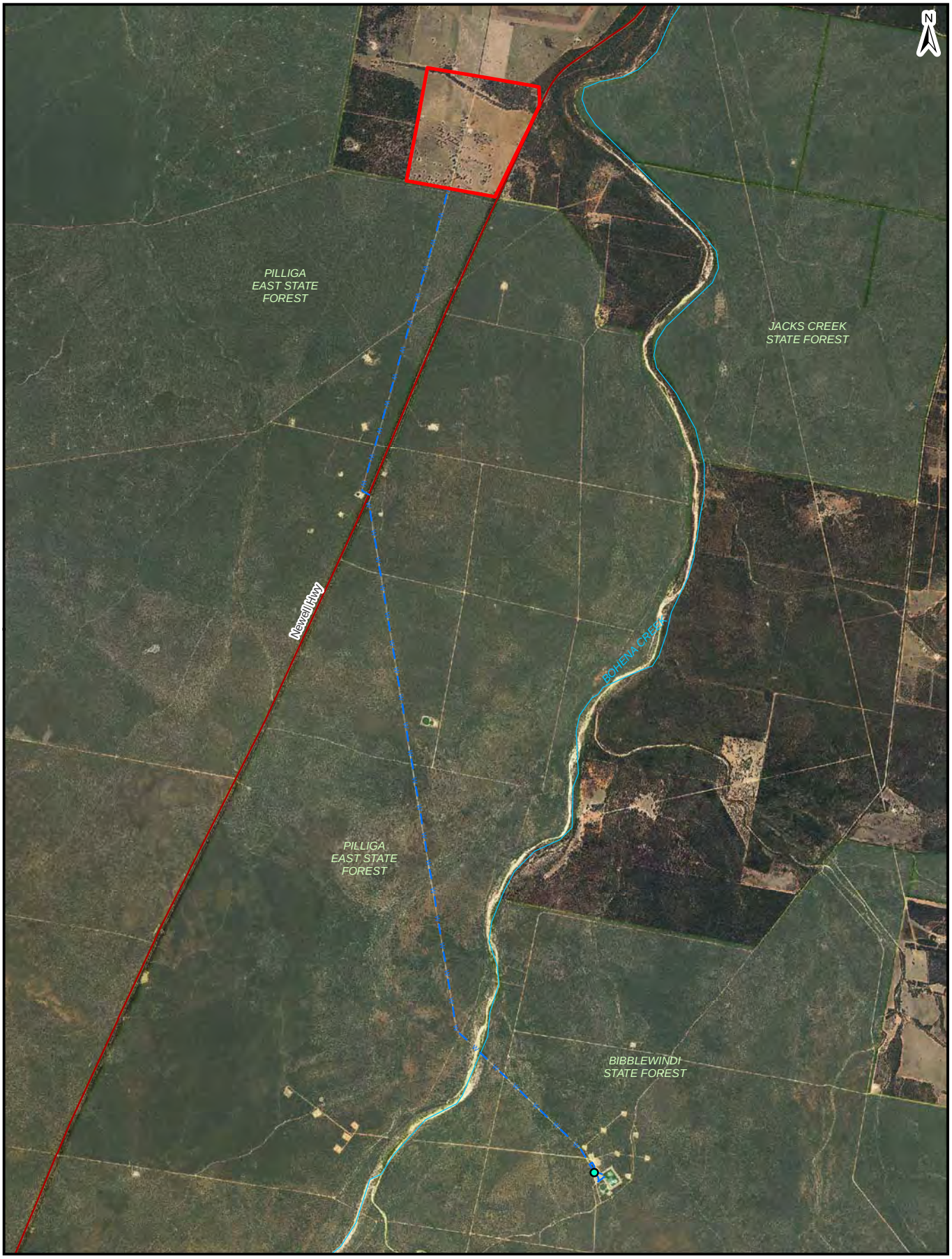
Leewood Water Treatment Facility

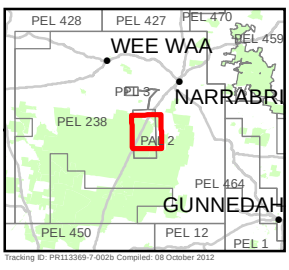
- Bibblewindi
- Flow Line (Right of Way)
- Leewood
- Town / Locality
- Power Station
- Highway
- Main Road
- Local Road
- Built UpArea
- State Forest / Reserve / Park

RPS

FIGURE 1

Site Locality





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N

1 0 1 2

Kilometres

APPROX SCALE 75,000 @ A4

GDA 1994 MGA Zone 55

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DATA SOURCES

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LEGEND

Leewood Water Treatment Facility

Bibblewindi

Flow Line (Right of Way)

Leewood

Highway

State Forest

RPS

FIGURE 2

Proposed Site Layout Plan

3.0 Agricultural Enterprise and Resources

The following section identifies the agricultural enterprises that exist on the subject site and within the surrounding Narrabri Shire.

The Right of Way and Bibblewindi have not been considered in the following sections of this report by reason they are existing developed areas located within Pilliga State Forest that do not sustain any agricultural use. All development proposed within the Right of Way and at Bibblewindi will be contained within a cleared area, with only minor vegetation clearing or expansion of disturbed areas required to accommodate the proposed works. Accordingly, there is no potential impact on agricultural resources or industries from works at these locations and, therefore, no further agricultural impact assessment is warranted.

3.1 Agricultural Enterprise

The Narrabri Shire area sustains expansive cropping activities, with the two (2) largest crops produced in the region being cotton and wheat. Other crops grown in the region include sorghum, sunflowers, cereal grains, oilseeds and legumes. Grazing of beef cattle, sheep and pigs is also a significant contributor to the agricultural productivity within the region (AEC, 2011).

Agricultural employment data recorded in 2009 / 2010 has been reproduced below to represent the diversity of agricultural enterprise across the Narrabri Shire. The data demonstrates that the largest agricultural enterprises in the region are the cotton and grain industries, which employ approximately 47% of the agricultural workforce.

The subject site is not currently used for any agricultural enterprise however, vegetation on the subject site has previously been cleared and two small dams constructed to allow for grazing of beef cattle across the 246 hectares.

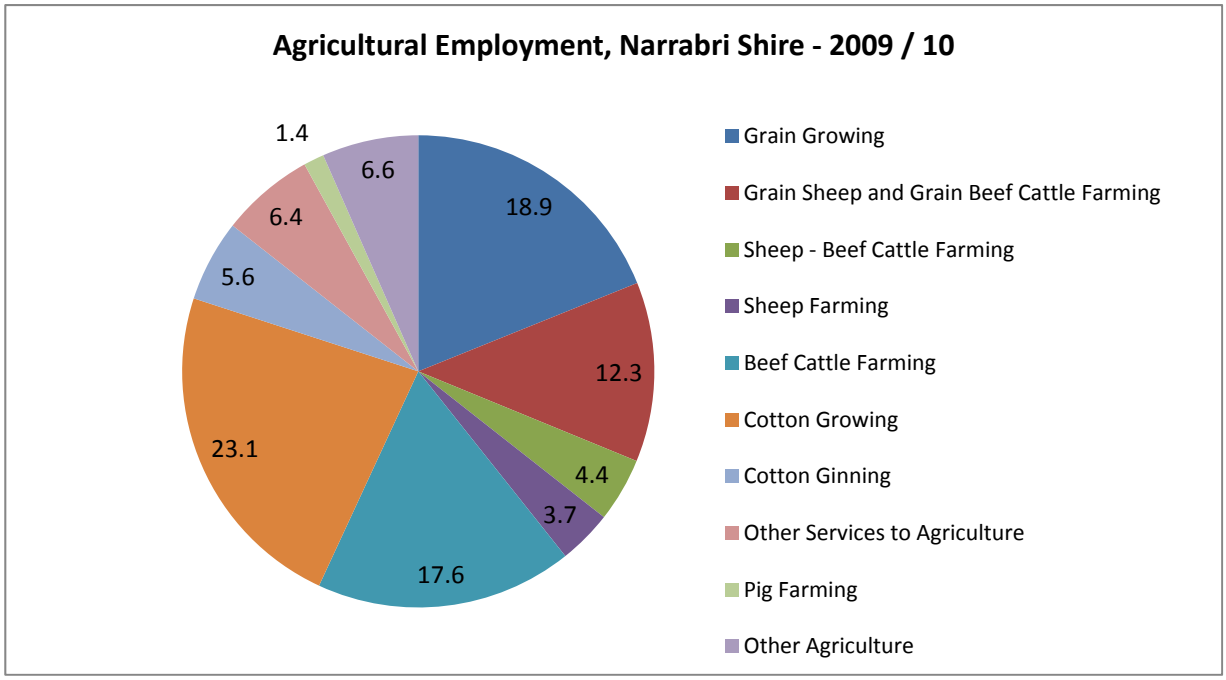


Figure 3 Agricultural Employment by Place of Work (Reproduced from AEC, 2011)

Due to the scale, diversity and productivity of agricultural enterprise within the Narrabri Shire, processing companies, research and development facilities, transport and warehousing and other service industries have established in the Narrabri Shire to support the agricultural industry (DPI, 2012).

3.1.2 Agricultural Production Value

In 2009 / 2010 the Narrabri Shire recorded a Gross Regional Product (GRP) of $730 million, with agriculture forestry and fishing contributing $115.30 million (15.8%) of total GRP (AEC, 2011), resulting in sector being the second largest contributor to GRP in Narrabri Shire, behind the mining sector.

In 2006, gross value of agricultural production in Narrabri Shire was $260.50 million, with crop value contributing $215.10 million (82.5%) to total production value. Livestock slaughtering and livestock products contributed $41.40 million (15.9%) and $4.0 million (1.5%) to total production value, respectively.

No data on the historic production value for the subject site was available. Therefore, to examine the potential productive value of the subject site, an estimated carrying capacity for the subject site was identified using the Dry Sheep Equivalent (DSE) for natural pasture in the Northern Plains, being 0.3 – 2.0 DSE / hectare (DPI, 2012) which, based on the total site area of 246 ha, equates to a carrying capacity range of between 78 – 492 DSE. To produce an indicative estimate on the number of head that could be sustained on the subject site, the DSE range was converted using the 350 kg yearling (gaining 0 kg / day) cattle class (DPI, 2012). This cattle class was selected due to the type of pasture and poor soil quality on the subject site and, adopting the corresponding DSE ratio of 5.3, produced a carrying capacity range for the subject site of between 14 – 92 head of cattle.

Although an estimated carrying capacity was produced, a production value was not attributed to the estimated carrying capacity for the subject site by reason that, based on the quality of the pasture and size of the subject site, it is estimated that the cattle grazing on the subject site under current circumstances would not be economically viable and, therefore, there would not be a positive contribution to agricultural production without pasture improvement.

3.1.3 Employment

As stated at Section 3.1, agricultural enterprise was the largest employer in the Narrabri Shire (2009 / 10), employing approximately 25.1% of the workforce (or 1,527 people), which exceeds the average rate of employment for both the northern statistical district and the New South Wales State Average (AEC 2011).

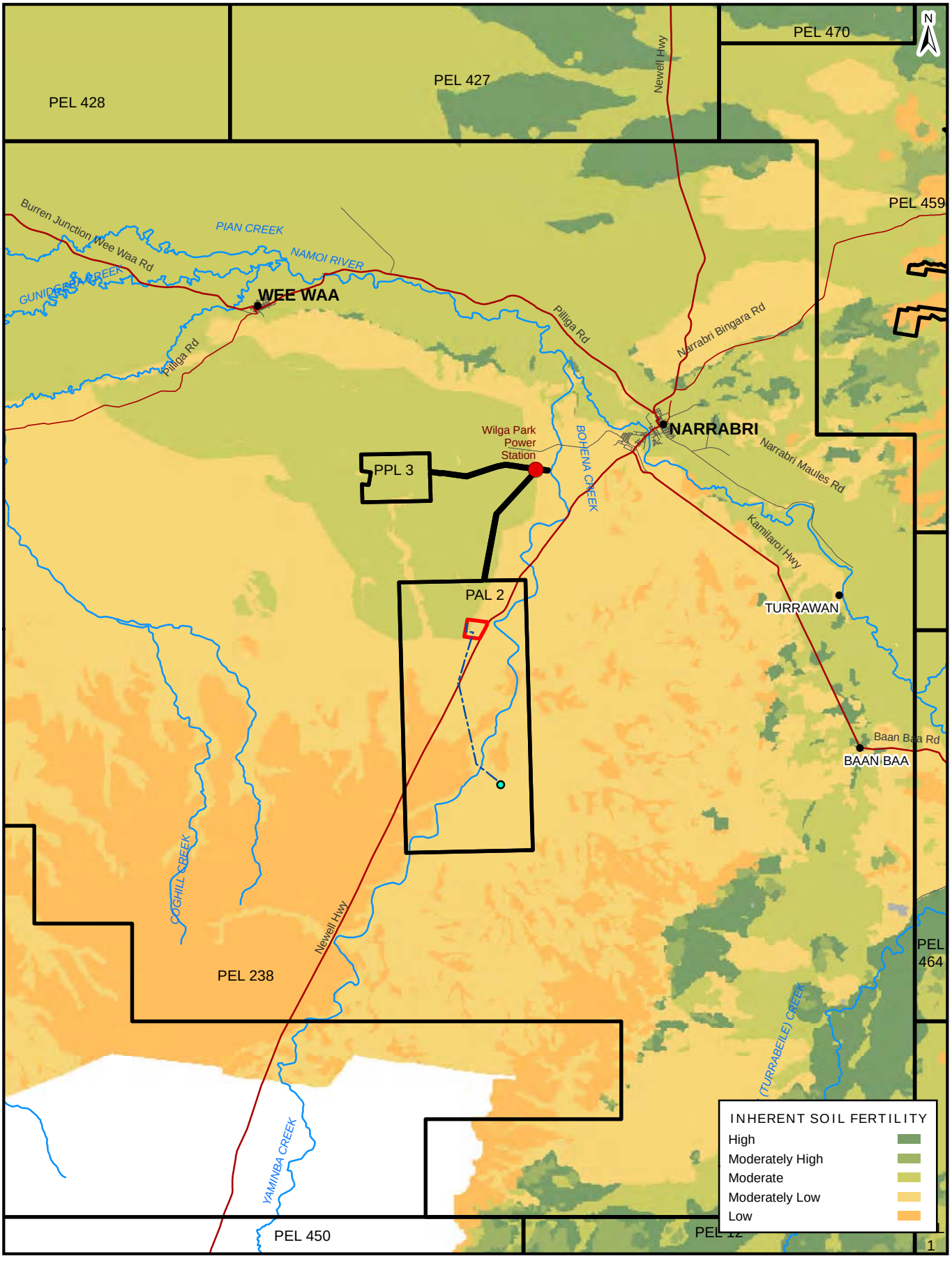
There is currently no agricultural enterprise on the subject site and, therefore, there is no employment associated with the subject site.

3.2 Agricultural Resources

3.2.1 Agricultural Land Use Suitability

3.2.1.1 Land Use Capability and Soil Fertility

Draft Inherent Soil Fertility and Draft Land and Soil Capability (LSC) mapping prepared by the Office of Environment and Heritage (OEH) (2102a and 2012b) for the Upper Hunter and New England North West Strategic Regional Landuse Areas was reviewed (Figures 4 and 5). This broad scale mapping is not suitable for property level assessment however it was utilised to provide an indication of the suitability of the subject site and surrounding areas for agricultural use.





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Kilometres

APPROX SCALE 500,000 @ A4

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DATA SOURCES

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LEGEND

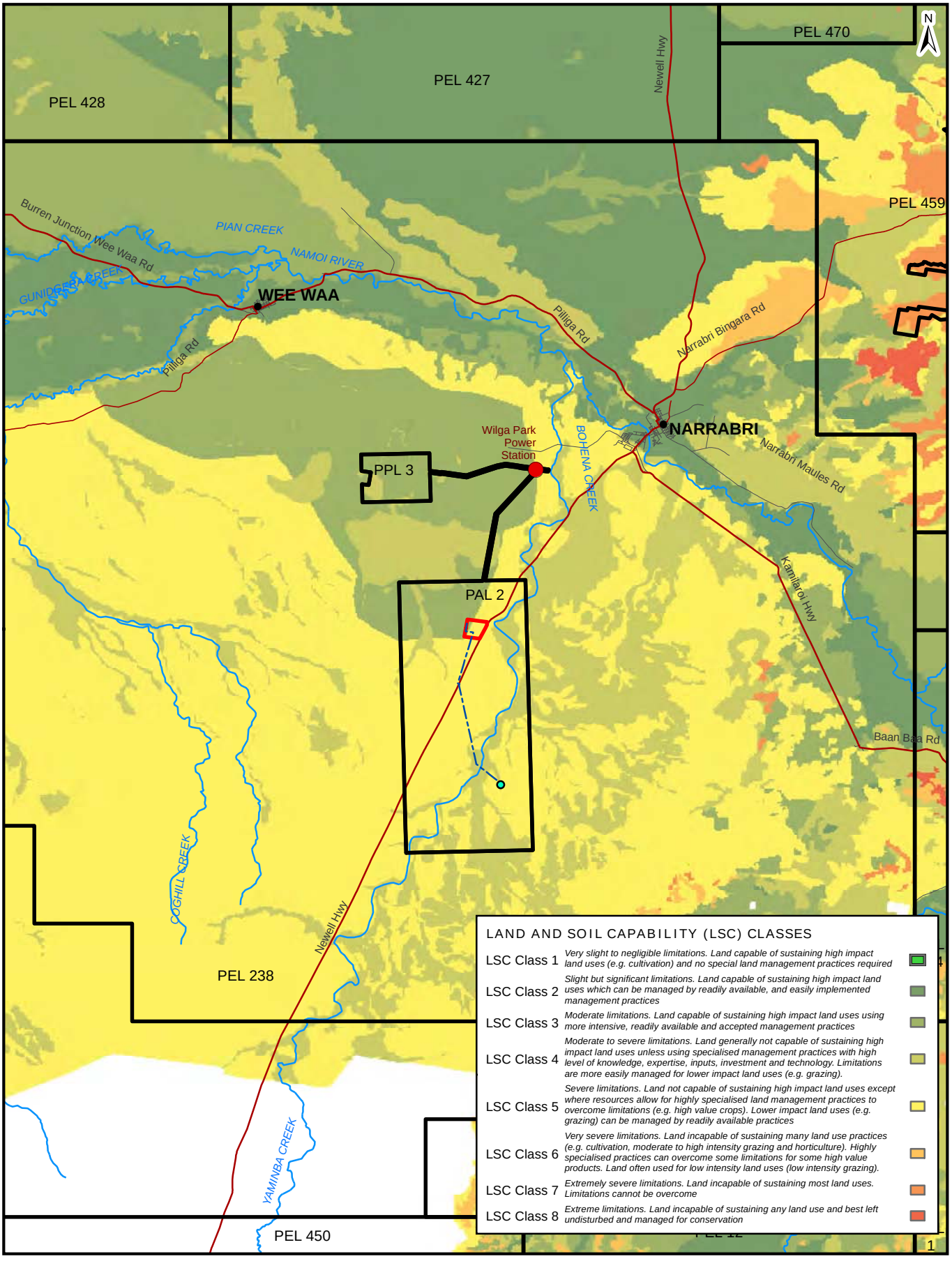
Leewood Water Treatment Facility

- Bibblewindi
- Flow Line (Right of Way)
- Leewood
- Town / Locality
- Power Station
- Highway
- Main Road
- Local Road
- Built UpArea

RPS

FIGURE 4

Draft Inherent Soil Fertility Mapping





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Kilometres

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LEGEND

Leewood Water Treatment Facility

Bibblewindi

Flow Line (Right of Way)

Leewood

Town / Locality

Power Station

Highway

Main Road

Local Road

Built UpArea

RPS

FIGURE 5

Draft Land and Soil Capability Mapping

The subject site was described by OEH (2012) as having moderately low inherent soil fertility and was assigned LSC Class 5. Land in LSC Class 5 is described as having severe limitations and is not capable of sustaining high impact land uses except where resources allow for highly specialised land management practices to overcome limitations (e.g. high value crops). Lower impact land uses (e.g. grazing) can be managed by readily available practices.

The area to the south and west of the subject site was dominated by LSC Class 5 with low to moderately low inherent soil fertility. Areas to the north and east of the subject site were described as LSC Class 4 (moderate to severe limitations) and 5 with low to moderately low inherent soil fertility. The area to the north west of the subject site was dominated by LSC Class 3 (moderate limitations) with moderate inherent soil fertility.

3.2.1.2 Strategic Agricultural Land Classification

Strategic Agricultural Land (SAL) is highly productive land that has both unique natural resource characteristics as well as socio-economic value (DPI, 2012). Based on this definition there are two (2) categories of SAL: Critical Industry Clusters (CIC) and biophysical SAL.

A Critical Industry Cluster (CIC) is a localised concentration of interrelated productive industries based on an agricultural product that provides significant employment opportunities and contributes to the identity of the region (DPI, 2012). No CIC's have been identified in the New England North West Region (DPI, 2012).

Biophysical SAL is land with the best quality landforms, soil and water resources which are naturally capable of sustaining high levels of productivity with minimal management practices (DPI, 2012). The New England North West SRLUP includes SAL mapping to identify areas of biophysical SAL. The subject site and the broader surrounding area are not classified as biophysical SAL.

3.2.2 Agricultural Support Infrastructure

There are no CICs within the New England North West Region. Other agricultural support infrastructure includes road and rail.

The subject site is located on the Newell Highway which is part of the National Land Transport Network and forms a major linkage between regional centres in north west NSW to Brisbane and Melbourne (DPI, 2012). Approximately half of the traffic which utilises the Newell Highway consists of heavy vehicles carrying freight.

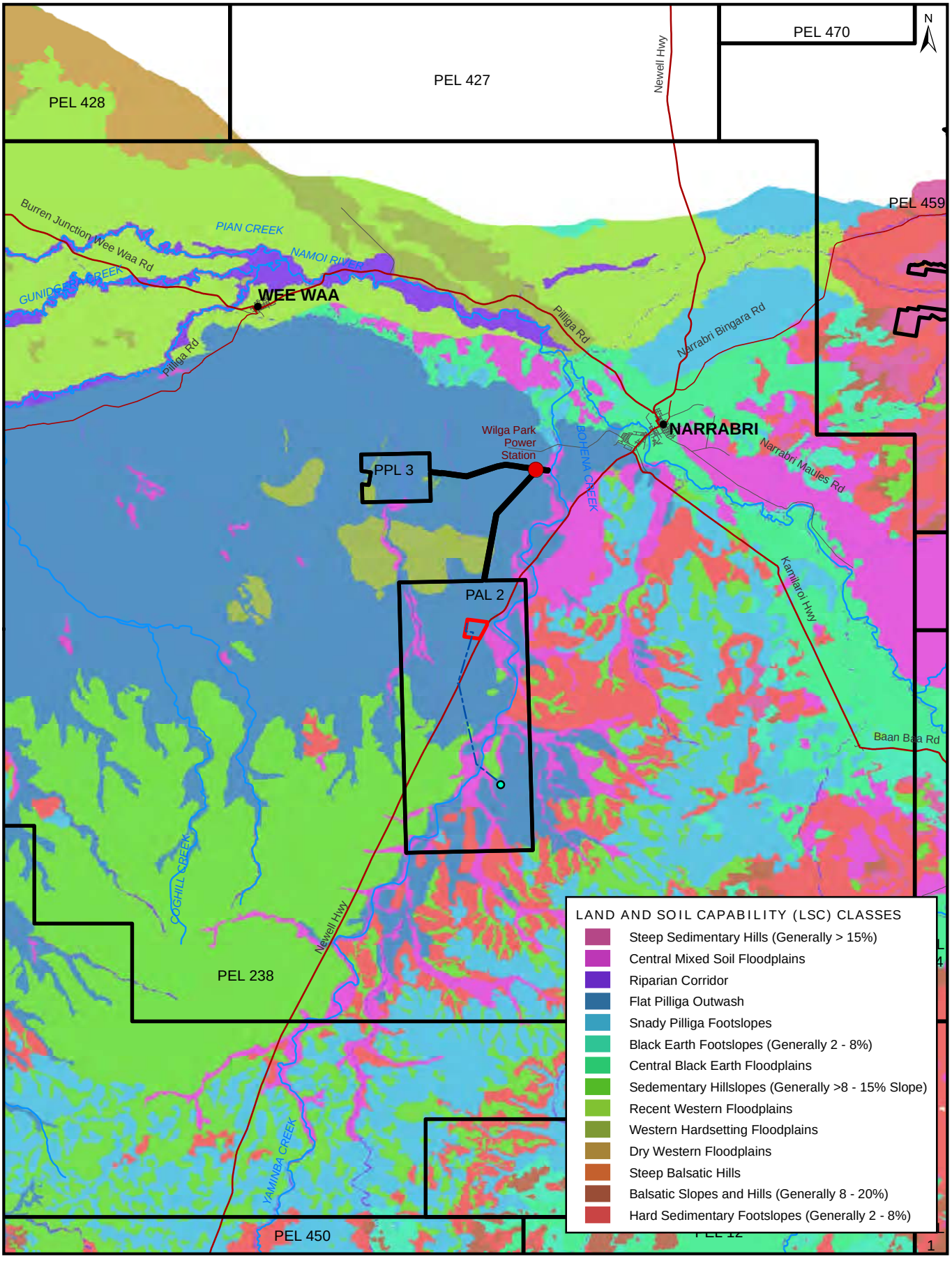
There is no rail infrastructure within the broader surrounds of the subject site.

3.2.3 Soils

The subject site is located in the Flat Pilliga Outwash Land Management Unit (LMU) which is dominated by deep Sodosols (sodic soils) with sandy to loamy Tenosols (shallow sandy soils) (Namoi CMA, 2009a) (Figure 6).

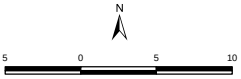
Soil profile data for the subject site was compiled by Golder Associates (2012) as part of geotechnical investigations at the site. Borehole logs indicated that soils were deep texture contrast soils (Sodosols). The soil profile at the site typically included a light textured A horizon to 0.5 m depth over a heavier textured silty clay B horizon typically to 1.8 to 2.0m.

Soil chemistry and fertility data indicated that topsoil at the subject site was strongly (pH 5.4) to slightly acidic (pH 6.2). The optimum range for plant establishment is pH 6 to ph 7, however most crops or pasture/forage will tolerate a range between pH 5.5 to pH 7.0 (Hazelton and Murphy, 2009).





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DATA SOURCES

Base topographic data © Commonwealth of Australia (Geoscience Australia) 2006. Land Management Units created by Namoi CMA for general public use.

LEGEND

Leewood Water Treatment Facility

Bibblewindi

Flow Line (Right of Way)

Leewood

Town / Locality

Power Station

Highway

Main Road

Local Road

Built UpArea

RPS

FIGURE 6

Land Management Unit Mapping

Golder Associates (2012) commented that the topsoil was characterised by low levels of plant available nutrients, below ideal concentrations for establishing most pasture species. The Exchangeable Sodium Percentage (ESP) values of the topsoil samples indicated non-sodic (4.3%) to sodic (14.7%) soil conditions. Subsoil ESP values (11.3 to 14.9%) indicated sodic subsoil conditions. Topsoil and subsoils are non-saline.

The Namoi CMA (2010) identified a number of issues associated with these soils of the Namoi catchment that must be considered with respect to land use and management:

- Soils tend to be relatively shallow and have low fertility;
- Soils tend have poor soil structure and low water holding capacity;
- Much of this area is prone to erosion and severe scalding;
- Soils can set hard and can be prone to wind erosion;
- Soils are highly erodible and are easily degraded if over used;
- Runoff can be high when soils are degraded;
- Effective groundcover can be hard to maintain; and
- Salinity is found within this LMU.

Land capability class of the Sodosol soils within the Flat Pilliga Outwash LMU is generally 5 (grazing land). As such grazing is the most common use on cleared lands as long term continuous cropping is not recommended due to the inherent soil attributes and potential land management problems (Namoi CMA, 2010).

The soil data presented above confirms the accuracy of the OEH (2012a and 2012b) broad scale draft LSC and soil fertility mapping for the subject site.

3.2.4 Topography

The subject site is located at an elevation of approximately 250 m AHD. The topography of the site generally slopes towards a drainage feature which grades downwards through the site from its south east corner in a north westerly direction. Surface grades on the site are generally shallow with typical grades encountered being approximately 1 in 400.

3.2.5 Climate

Long term climate data for the area were obtained from the Bureau of Meteorology's (BOM) Narrabri West post Office monitoring station (Site number 053030). The data indicated that the area experiences a temperate climate with cold winters (mean min. temperature 4.5^{o}C) and hot summers (mean max. temperature 33.3^{o}C). Median annual rainfall is 669.4 mm, most of which occurs between December and February.

3.2.6 Water Resources

The subject site is located in the Namoi River catchment which is part of the Murray-Darling Basin (MDB). The Namoi catchment has significant surface water and groundwater resources which have been heavily developed for agricultural and urban purposes. A description of key water resources and primary issues of concern identified by the Namoi CMA (2009b) is summarised below.

3.2.6.1 Surface water

The Namoi River is the predominant river system in the region flowing from its south-eastern to western margins over a total distance of 659 km. The subject site is located approximately 25 km south of the Namoi

River. Bohena Creek which is a tributary of the Namoi River is located approximately 500m east of the subject site (**Figure 7**).

The region has three key water supply storages including:

- Split Rock Dam on the Manilla River in the north-east with a storage capacity of 397,000 ML;
- Keepit Dam on the Namoi River in the upper catchment with a storage capacity of 423,000 ML; and
- Chaffey Dam regulates the flow of the Peel River with a total storage capacity of 62,000 ML.

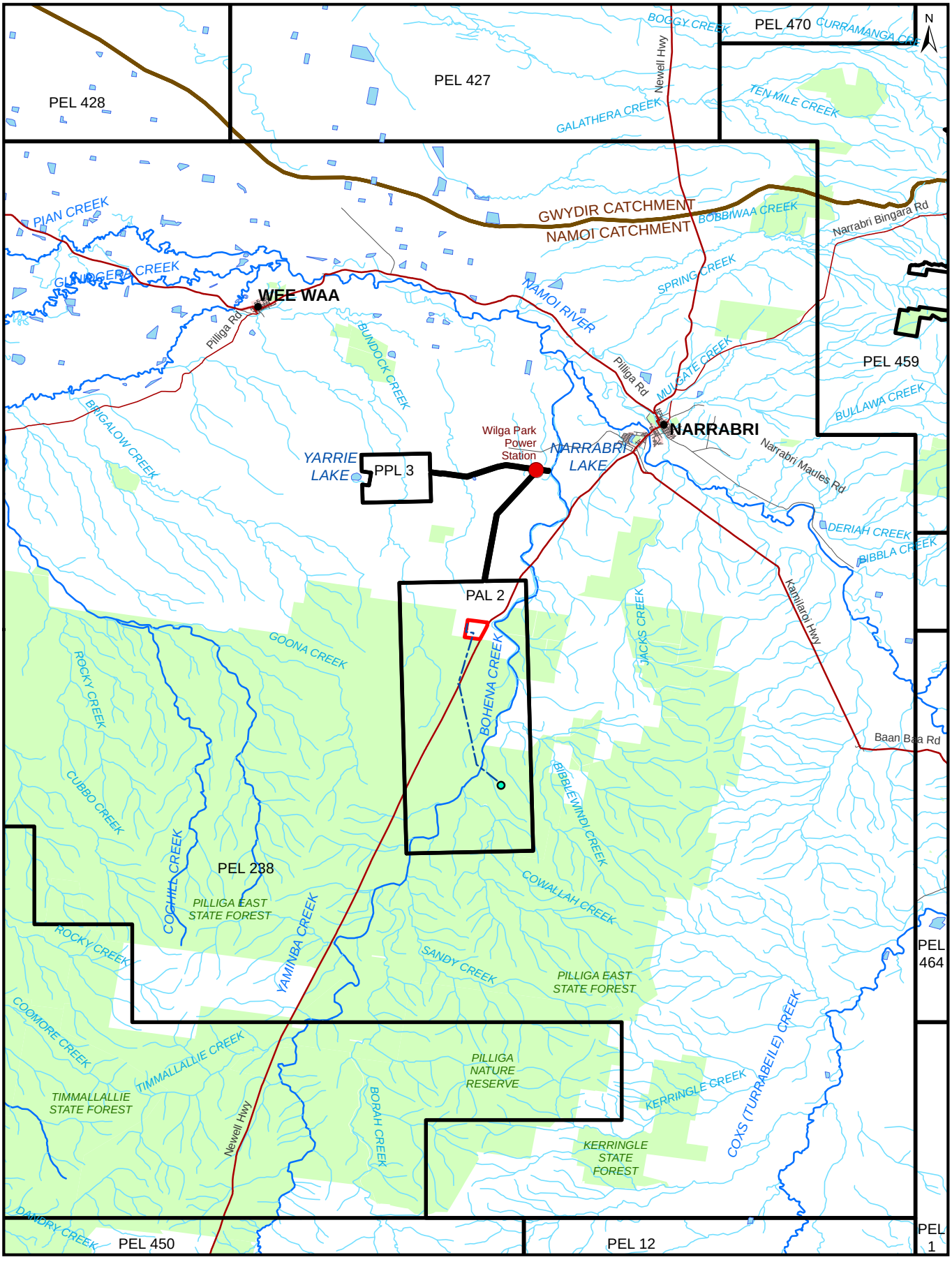
Overall trends indicate a decline in surface water quantity and quality in the Namoi catchment. The Namoi River basin has one of the largest irrigated areas in the northern MDB, accounting for 15% of the total irrigated area in 2000-01 (MDBC, 2008 cited in CMA, 2009b). Average surface water availability in the Namoi Region is 965 GL/year, with 37% (357 GL) of this water being used. The high demand on surface water resources is attributed to surface water diversions (260 GL/year) and stream flow losses induced by groundwater use (99 GL/year) (CMA, 2009b).

Surface water quality in the catchment is influenced by a number of direct and indirect land use pressures, including urban and agricultural runoff, stormwater inflows, sewage discharges and the clearing of native vegetation. There three water quality parameters which are of concern for the Namoi catchment includes nutrients, salinity and turbidity.

3.2.6.2 Groundwater

Groundwater is a significant resource in the Namoi catchment and has been extensively developed for irrigation, stock and domestic uses, with the catchment having the highest rate of groundwater use in NSW. Within the catchment there are alluvial, fractured rock and porous rock groundwater management areas. The highest yielding and most actively used bores being located in unconsolidated alluvial sediment aquifers associated with the Namoi River and its tributaries (**Figure 8**). The subject site is located approximately 25 km south of the Namoi Groundwater Source.

As with surface water, over-allocation beyond sustainable extraction limits is a key concern for groundwater in the Namoi catchment. With over 700 licence holders, the Namoi region has the highest level of groundwater development in NSW and one of the highest levels of groundwater extraction in the MDB (Namoi CMA, 2012). Groundwater use is approximately 261 GL, which comprises about 15% of the MDB total (DWE, 2008 and CSIRO, 2007 cited in Namoi CMA, 2009b). Approximately 39% of this extraction is from the Upper Namoi Alluvium groundwater management unit (GWMU) and about 35% is from the Lower Namoi Alluvium GWMU (CSIRO, 2007 cited in Namoi CMA, 2009b).





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Kilometres

APPROX SCALE 500,000 @ A4

GDA 1994

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DATA SOURCES

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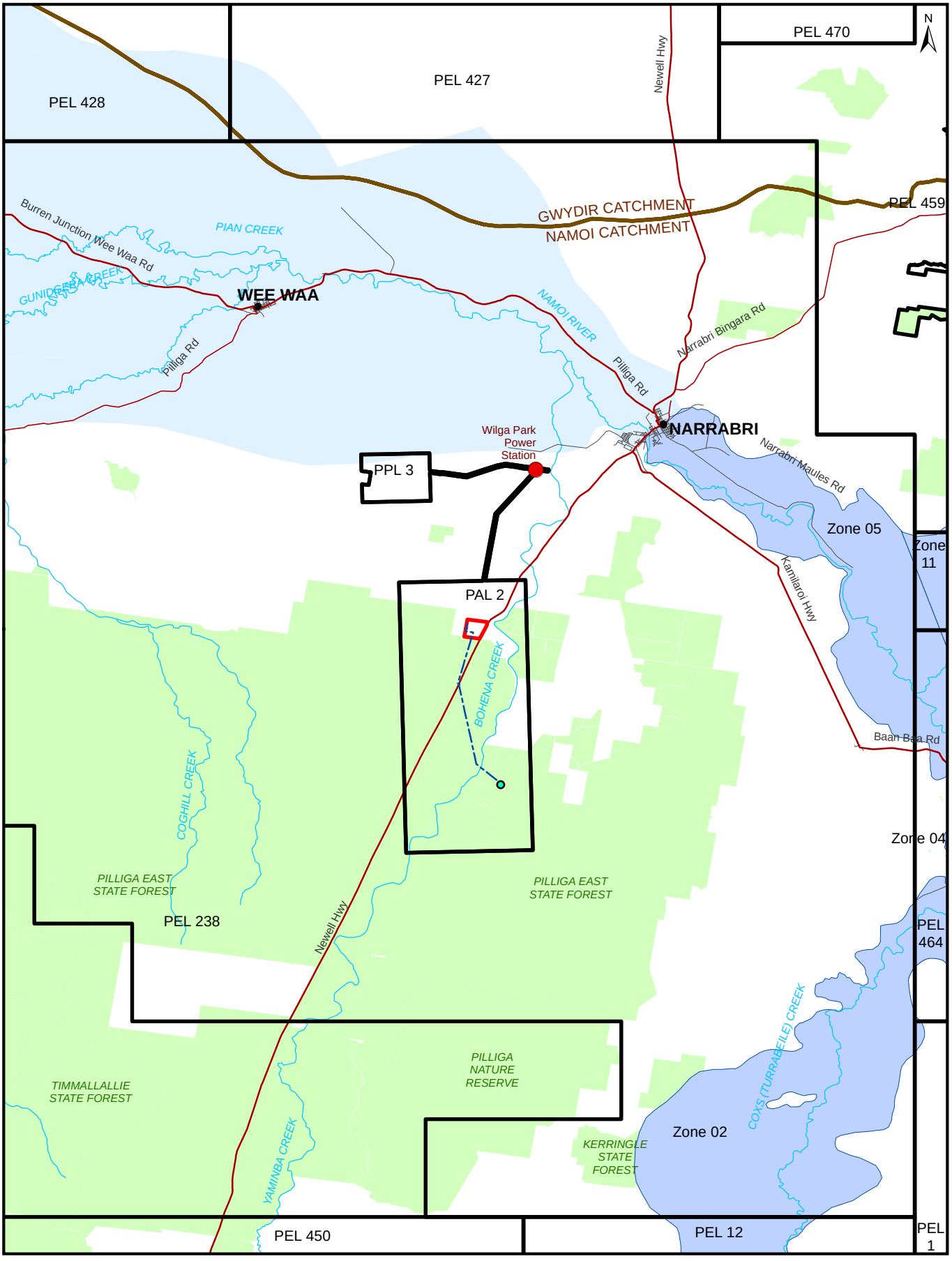
LEGEND

- Town / Locality
- Power Station
- Highway
- Main Road
- Local Road
- Built UpArea
- Lake / Dam
- Catchment Boundary
- **Leewood Water Treatment Facility**
- Bibblewindi
- Flow Line (Right of Way)
- Leewood

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FIGURE 7

Surface Water Resources





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Kilometres

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DATA SOURCES

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LEGEND

- Town / Locality
- Power Station
- Highway
- Main Road
- Local Road
- Upper Namoi Ground Water Source
- Lower Namoi Ground Water Source

Leewood Water Treatment Facility

- Bibblewindi
- Flow Line (Right of Way)
- Leewood

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FIGURE 8

Groundwater Resources

4.0 Construction Phase Impacts

4.1 Socio-Economic Impacts

4.1.1 Agricultural Enterprises and Support Services

The subject site (246 ha) will not be used for agricultural purposes during the construction or operational phases of the project. However, based on the current extent of proposed works, it is possible that the subject site may be returned to agricultural use post operation, following removal of surface infrastructure and rehabilitation of disturbed areas.

Whilst the subject site is not currently used for grazing cattle, an estimated carrying capacity for the subject site was produced using the DSE for natural pastures in the Northern Plains (DPI, 2012). Based on this rate, it is estimated that the carrying capacity for the subject site is between 14 – 92 head of cattle, using the DSE for a 350 kg yearling (gaining 0 kg / day).

Although an estimated carrying capacity was produced, a production value was not attributed to the estimated carrying capacity for the subject site by reason that, based on the low soil fertility, quality of the pasture and size of the subject site, it is estimated that cattle grazing on the subject site under existing circumstances would not be economically viable without pasture improvement. Therefore, the proposed activities will not have a significant impact on agricultural enterprise within the Narrabri Shire during the construction or operational phases of the project and no mitigation measure or offset is warranted in this instance.

With respect to agricultural support services within the region, it is expected that there will be an increase in traffic volumes on the Newell Highway during the construction phase of the project. However, these impacts will be temporary in nature and are not expected to cause significant delay or increase risks associated with the transport of agricultural products and services. The potential traffic impact associated with the construction activities will be mitigated in part by the upgrade to the Old Mill Road / Newell Highway intersection and the implementation of a Construction Traffic Management Plan.

4.1.1.1 Mitigation Measures

- Upgrade Old Mill Road / Newell Highway Intersection.
- Implementation of Construction Traffic Management Plan.

4.1.2 Employment and Economic Development

The subject site does not operate an existing agricultural enterprise and therefore, no existing jobs will be lost as a direct result of the proposed activities. Furthermore, assuming the subject site was used for grazing livestock, the carrying capacity of the subject site is not sufficient to sustain a permanent employment position. Therefore, the proposed activities will not result in a loss of agricultural employment opportunities in the Narrabri Shire region. It is noted that the construction phase of the project is likely to generate local employment opportunities and contribute to the local economy through direct and indirect spend associated with the construction activities.

4.1.2.1 Mitigation Measures

- No mitigation measures required.

4.1.3 Visual Amenity

The only publicly accessible vantage points of the subject site are from the Newell Highway and Old Mill Road. The Newell Highway is adjacent to the eastern boundary of the subject site. Old Mill Road is a State forest road that runs parallel to the southern boundary of the subject site.

During construction, impacts on visual amenity are expected however, the impact will be negligible due to the following:

- Old Mill Road is an unsealed road under the management of Forests NSW that receives low volumes of traffic as it only provides access to the subject site and the Pilliga State Forrest. Vegetation in the road reserve between Old Mill Road and the subject site is approximately 30 m deep and would restrict views of the subject site during construction;
- Views of the subject site during construction for traffic on the Newell Highway would be restricted as this highway is speed limited at 110 km/hr and intermittent screening of the subject site is provided by vegetation within the road reserve;
- The development would be concentrated in the north-west corner of the subject site, approximately 100 m west of the Newell Highway; and
- The flat terrain of the area does not offer topographic vantage points to the public to view the proposed activities.

4.1.3.1 Mitigation Measures

- A vegetated landscape buffer would be incorporated along the Newell Highway frontage to further screen the subject site following construction.

4.2 Agricultural Resource Impacts

4.2.1 Land Removed from Agricultural Use

The project has an estimated operational life of at least 25 years from the commencement of construction. During the construction phase of the project the subject site would not be utilised for agricultural purposes.

4.2.1.1 Mitigation Measures

At the end of the project life the subject site may be decommissioned and rehabilitated to a condition suitable for livestock grazing. Top soil would be stockpiled for use during site restoration works.

4.2.2 Soils

During the construction phase of the project there is potential for adverse impacts to the soil resource at the subject site due to:

- Soil erosion;
- Chemical spills (e.g. diesel spill during refuelling plant);
- Soil profile inversion;
- Soil compaction; and
- Spillage or leakage of brine or produced water during commissioning works.

However, the risk of adverse impact to the soil resource during construction is considered low with the implementation of standard construction site environmental and engineering controls which are outlined in the Review of Environmental Factors (REF) for the project.

4.2.3 Water Resources

During the construction phase of the project there is potential for adverse impacts to the quality of water resources in the local area of the subject site due to:

- Soil erosion;
- Chemical spills (e.g. diesel spill during refuelling plant); and
- Spillage or leakage of brine or produced water during commissioning works.

However, the risk of adverse impact on water quality during construction is considered low with the implementation of standard construction site environmental and engineering controls which are outlined REF for the project.

4.2.4 Weed Management

During the construction phase of the project there is the potential for the introduction of weed species to / from the subject site due to site clearance activities and the increase in vehicle and equipment traffic on-site.

4.2.4.1 Mitigation Measures

- A weed survey shall be undertaken to identify existing weed species prior to commencement of construction works;
- Existing weed populations at the subject site shall be controlled in accordance with the weed management hierarchy for existing weed populations, being eradication, containment and asset protection (DPI, 2012);
- Exposure of earth shall be minimised and limited only to areas that are required to be disturbed to facilitate construction of the proposed works;
- Vehicles or equipment to be used at the subject site that originate from a known weed infested area shall be washed down at a clean down facility prior to entering the subject site;
- On-site vehicles and equipment shall use existing driving tracks and avoid driving off-track where possible;
- Suspected weed infestations shall be reported to the Site Supervisor and a suitably qualified person (e.g. a botanist or ecologist) shall be engaged to verify the observation and recommend appropriate control and hygiene measures where necessary.

4.2.5 Pest Animals / Biosecurity

During the construction phase of the project there is the potential for the introduction of pest or invasive species due to the increase in people, vehicles and equipment movements to / from the subject site.

4.2.5.1 Mitigation Measures

- Prior to construction works commencing, advice shall be sought from Namoi CMA to identify high risk species in the locality surrounding the subject site;
- Staff and construction contractors shall be notified of the identified high risk pest / invasive species and suspected sightings shall be reported to the Site Supervisor;
- Sightings shall be reported to the relevant Invasive Species Officer at Industry and Investment NSW and an appropriate management strategy shall be employed following advice the Invasive Species Officer.

5.0 Operational Phase Impacts

5.1 Socio-Economic Impacts

5.1.1 Agricultural Enterprises and Support Services

As stated at **Section 4.1.1** the subject site will not be used for agricultural enterprise during the construction or operational phases of the project however, it is possible for the subject site may be returned to agricultural use post-operation, following removal of surface infrastructure and adequate rehabilitation. It is noted that a pasture improvement program would also be required to improve the current pasture to enable a viable beef cattle enterprise.

Accordingly, based on the existing site characteristics, the proposed activities will not have a significant impact on agricultural enterprise within the Narrabri Shire during the construction or operational phases of the project and no mitigation measure or offset is warranted in this instance.

Traffic volumes during the operational phase are not expected to be significant and, therefore, it is not predicted that there will be any impact during operation on the safety or operational efficiency of the Newell Highway. Accordingly, there will be no impact on the transport of agricultural products and services along the Newell Highway. No other impacts on regional agricultural support services as a result of the proposed activities.

5.1.1.1 Mitigation Measures

- No mitigation measures required.

5.1.2 Employment and Economic Development

As stated at **Section 4.1.2**, the activities proposed on the subject site will not result in a loss of agricultural employment opportunities in the Narrabri Shire region.

It is noted that the construction phase of the project is likely to generate local employment opportunities and contribute to the local economy through direct and indirect spend associated with the construction activities.

5.1.2.1 Mitigation Measures

- No mitigation measures required.

5.1.3 Visual Amenity

The only publicly accessible vantage points of the subject site are from the Newell Highway and Dog Fence Road. The Newell Highway is adjacent to the eastern boundary of the subject site. Dog Fence Road runs parallel to the southern boundary of the subject site.

During the operational phase, impacts on visual amenity are expected however, the impact will be negligible due to the following:

- Old Mill Road is an unsealed local road that receives low volumes of traffic as it only provides access to the subject site and the Pilliga State Forest. Vegetation in the road reserve between Old Mill Road and the subject site is approximately 30 m deep and would restrict views of the Subject site during construction;
- Views of the subject site during construction for traffic on the Newell Highway would be restricted as this highway is speed limited at 110 km/hr and intermittent screening of the subject site is provided by

vegetation within the road reserve;

- The development would be concentrated in the north-west corner of the subject site, approximately 100 m west of the Newell Highway; and
- The flat terrain of the area does not offer topographic vantage points to the public to view the proposed activities.

5.1.3.1 Mitigation Measures

- A vegetated landscape buffer would be incorporated along the Newell Highway frontage to further screen the subject site during the operational phase.

5.2 Agricultural Resource Impacts

5.2.1 Land Removed from Agricultural Use

The Project will operate for the duration of Santos' exploration activities in the Gunnedah Basin and has a design life of 25 years. During the operational phase of the project the subject site would not be utilised for agricultural purposes.

5.2.1.1 Mitigation Measures

At the end of the project life the subject site may be decommissioned and rehabilitated to a condition suitable for livestock grazing.

5.2.2 Soils

During the operational phase of the project there is potential for adverse impacts to the soil resource at the subject site due to:

- Soil erosion; and
- Spillage or leakage of brine or produced water during operations.

However, the risk of adverse impact to the soil resource during operations is considered low with the implementation of standard environmental and engineering controls which are outlined in the REF for the project.

5.2.3 Water Resources

During the operational phase of the project there is potential for adverse impacts to the quality of water resources in the local area of the subject site due to:

- Soil erosion; and
- Spillage or leakage of brine or produced water during operations.

However, the risk of adverse impact on water quality during operations is considered low with the implementation of standard construction site environmental and engineering controls which are outlined in the REF for the project.

5.2.4 Weed Management

During the operational phase of the project there is the potential for the introduction of weed species due to the movement of vehicles to / from the Subject Site.

5.2.4.1 Mitigation Measures

- Vehicles or equipment to be used at the subject site that is from a known weed infested area shall be washed down at a clean down facility prior to entering the subject site;
- Vehicles and equipment shall drive on existing tracks and avoid driving off-track where possible;
- Suspected weed infestations shall be reported to the Site Supervisor and a suitably qualified person (e.g. a botanist or ecologist) shall be engaged to verify the observation and recommend appropriate control and hygiene measures where necessary.

5.2.5 Pest Animals / Biosecurity

During the operational phase of the project there is the potential for the introduction of pest or invasive species due to the increase in people, vehicles and equipment movements to / from the subject site.

5.2.5.1 Mitigation Measures

- Operational staff are notified of the high risk pest / invasive species and suspected sightings are reported to the Site Supervisor; and
- Sightings shall be reported to the relevant Invasive Species Officer at Industry and Investment NSW and an appropriate management strategy shall be employed following advice the Invasive Species Officer.

6.0 Decommissioning Phase Impacts

6.1 Socio-Economic Impacts

6.1.1 Agricultural Enterprises and Support Services

Subsequent to on-site infrastructure being decommissioned, there is the potential for the subject site (246 ha) to be returned to agricultural grazing lands, following removal of surface infrastructure and adequate rehabilitation of disturbed areas. To create a viable cattle grazing enterprise, it is considered that a pasture improvement program would be required to improve the quality of pasture above the existing circumstances.

6.1.1.1 Mitigation Measures

No mitigation measures required.

6.1.2 Employment and Economic Development

The employment generation and economic development value associated with returning the subject site to grazing land would be dependent on a number of inputs (e.g. carrying capacity, proximity to future agricultural infrastructure, cattle value, etc). Therefore, whilst a value has not been attributed to agricultural production on the subject site post operation, it is assumed that the value would be consistent with the contribution identified at Section 4.4.1 which, without pasture improvement is negligible in terms of total agricultural production value.

6.1.2.1 Mitigation Measures

- No mitigation measures required.

6.1.3 Visual Amenity

Following removal of surface infrastructure and adequate rehabilitation to disturbed areas, the presentation of the subject site would be consistent with the existing scenario.

6.1.3.1 Mitigation Measures

- No mitigation measures required.

6.2 Agricultural Resource Impacts

6.2.1 Land Removed from Agricultural Use

At the end of the project life the subject site may be decommissioned and rehabilitated to a condition suitable for livestock grazing.

6.2.1.1 Mitigation Measures

No mitigation measures are proposed as there were no identified impacts.

6.2.2 Soils

The subject site may be decommissioned and rehabilitated to a condition suitable for livestock grazing. During the course of decommissioning works the potential for adverse impacts to the soil resource and appropriate mitigation measures are as per the construction phase of the project (Section 4.2.2).

6.2.3 Water Resources

The subject site may be decommissioned and rehabilitated to a condition suitable for livestock grazing. During the course of decommissioning works the potential for adverse impacts to water resources and appropriate mitigation measures are as per the construction phase of the project (Section 4.2.3).

6.2.4 Weed Management

During the decommissioning phase of the project there is the potential for the introduction of weed species due to the movement of vehicles to / from the Subject Site.

6.2.4.1 Mitigation Measures

- Vehicles or equipment to be used at the subject site that is from a known weed infested area shall be washed down at a clean down facility prior to entering the subject site;
- Vehicles and equipment shall drive on existing tracks and avoid driving off-track where possible;
- Suspected weed infestations shall be reported to the Site Supervisor and a suitably qualified person (e.g. a botanist or ecologist) shall be engaged to verify the observation and recommend appropriate control and hygiene measures where necessary.

6.2.5 Pest Animals / Biosecurity

During the decommissioning phase of the project there is the potential for the introduction of pest or invasive species due to the increase in people, vehicles and equipment movements to / from the Subject Site.

6.2.5.1 Mitigation Measures

- Staff are notified of the high risk pest / invasive species and suspected sightings are reported to the Site Supervisor;
- Sightings shall be reported to the relevant Invasive Species Officer at Industry and Investment NSW and an appropriate management strategy shall be employed following advice the Invasive Species Officer.

7.0 Consultation

Santos undertakes consultation activities with relevant stakeholders and community in the areas within which they work. This includes consultation with landowners and adjacent landowners, Council, Aboriginal Land Councils and relevant State agencies. Santos has also established a Community Consultation Committee in Narrabri, which meets on a regular basis to discuss Santos' activities across the broader area.

As part of the Leewood project, Santos has made contact with adjacent landowners and Forests NSW (the landowners) to inform them of certain activities. A detailed overview of existing and proposed consultation, as well as Santos' conflict resolution protocol, is provided in the REF.

8.0 Summary

- Santos proposes construct and operate produced water and brine management ponds on land formally described as Lot 1 on DP771141.
- The subject site has a total area of 246 hectares and is located on the Newell Highway, approximately 24 km south west of Narrabri township.
- The subject site and surrounds are not classified as Biophysical SAL. There are no CIC in the New England North West Region.
- Soils at the site are texture contrast soils (Sodosols) that are sodic with low fertility. In terms of agricultural use of the site, grazing is the recommended land use as long term continuous cropping is not viable due to the inherent soil attributes and potential land management problems.
- The subject site was previously used for cattle grazing. However, the subject site is not currently used for grazing and it is not proposed that the subject site would be used for agricultural purposes during the construction or operational phases of the project.
- The project will quarantine land that could otherwise be utilised for cattle grazing, albeit that cattle grazing on the subject site itself is not considered to be economically viable due to the quality of the existing unimproved pasture and property size.
- The proposed development will prohibit potential agricultural production at the subject site during the construction and operational phases of the project. However, the impact on production value is negligible in terms of the gross value of livestock production in the Narrabri Shire and therefore, the proposed development does not have an unreasonable impact on agricultural resources and production at the subject site or within the Narrabri Shire.
- The project would not preclude the site from being returned to a grazing property at the cessation of activities on the site.

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Appendix 7

Cultural Heritage Due Diligence Report

Aboriginal & Historic Heritage Due Diligence Report

Leewood - Produced Water & Brine Management Project

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Appendix 2 AHIMS Search Results
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Executive Summary

RPS has been engaged by Santos to prepare an Aboriginal and Historic Heritage Due Diligence Assessment for the Leewood Produced Water and Brine Management Project which comprises three Activity Areas in the Narrabri Local Government Area (LGA); the proposed Leewood Ponds Activity Area, located wholly within a privately owned rural property, the proposed Bibblewindi Flowline Activity Area, located wholly within the Bibblewindi State Forest, and the proposed Bohena Creek Activity Area, also located in the Bibblewindi State Forest. These Activity Areas are accessible from the Newell Highway.

Visual inspection of the property revealed two pits associated with the Sydney University Giant Air-shower Recorder array which operated in the area during the 1960s and 70s. These pits were located outside of but adjacent to the Leewood Ponds Activity Area. No further Aboriginal or historic heritage constraints were identified by this due diligence assessment

This assessment has been undertaken in accordance with the *Due Diligence Code of Practice for the Protection of Aboriginal Objects* (DECCW 2010) which requires reasonable and practicable steps be taken to: identify whether or not Aboriginal objects are, or are likely to be, present in an area; determine whether or not their activities are likely to harm Aboriginal objects (if present); and determine if an Aboriginal Heritage Impact Assessment is required (DECCW 2010: 2).

The assessment contained in this report goes beyond the requirements of the Due Diligence Code to consider any potential impact on identified historic heritage items within the Activity Area and determine if a Statement of Heritage Impact for historic heritage is required.

Investigations under the code have included the following:

- a search of the Aboriginal Heritage Information Management System (AHIMS) database, which identified that there were no Aboriginal objects or Aboriginal places in the Activity Areas;
- a search of the relevant heritage registers and databases, which identified that there were no historic heritage objects or sites within the Activity Areas;
- a consideration of archaeologically sensitive landscape features and whether or not the proposed activity will occur: within 200m of water; within dune systems; on ridge tops and headlands; immediately above or below cliff faces and/or rockshelters/caves. Although Bohena Creek is located within the Bohena Creek Activity Area, no evidence of Aboriginal objects or sites were identified in this Activity Area or along the creek line. No other sensitive landscape features were identified in the Activity Areas;
- a desktop assessment including a review of previous archaeological and heritage studies in the vicinity of the Activity Areas; and
- a visual inspection of the Activity Areas. No Aboriginal objects or sites and no historic heritage objects or sites were identified in the Activity Areas.

RECOMMENDATIONS

Recommendation 1

Two historic heritage items (a Sydney University Giant Air-shower Recorder (SUGAR) station comprising two SUGAR pits) have been identified outside of the Leewood Ponds Activity Area but within the Leewood Property. The proposed works should avoid these items. These heritage items must be flagged and a temporary visual barrier (Plate 3) erected around them prior to the commencement of works. A plan of the area showing their location and the heritage exclusion zone surrounding them should be retained on site and

all on-site personnel must be advised accordingly and remain outside of the exclusion zone; this may form part of the daily toolbox talk or a separate heritage induction. The barriers must be removed at the completion of the proposed works.

Recommendation 2

If impact on the historic heritage items cannot be avoided by the proposed works further investigation under the *Heritage Act 1977* including the preparation of a Statement of Heritage Impact is required.

Recommendation 3

All relevant Santos staff and contractors should be made aware of their statutory obligations for heritage under NSW *National Parks and Wildlife Act 1974* and the NSW *Heritage Act 1977,* which may be implemented as a heritage induction.

Recommendation 4

This due diligence report must be kept by Santos so that it can be presented, if needed, as a defence from prosecution.

Recommendation 5

If Aboriginal object/s are identified in the Activity Area during works, then all works in the immediate area must cease and the area cordoned off. The Office of Environment and Heritage must be notified by ringing the Enviroline 131 555 so that the site can be adequately assessed and managed.

Recommendation 6

In the event that skeletal remains are uncovered, work must cease immediately in that area and the area cordoned off. Santos must contact the NSW Police with no further action taken until written advice is provided by the Police. If the remains are determined to be of Aboriginal origin, the Office of Environment and Heritage must be notified by ringing the Enviroline 131 555 and a management plan prior to works re-commencing must developed in consultation with the relevant Aboriginal stakeholders.

Recommendation 7

If, during the course of development works, additional suspected historic heritage material is uncovered or existing historic heritage material is in danger of impact/harm, work should cease in that area immediately. The Heritage Branch, Office of Environment and Heritage (Enviroline 131 555) should be notified and works only recommence when an approved management strategy developed.

1.0 Introduction

RPS has been engaged by Santos (the proponent) to prepare an Aboriginal and Historic Heritage Due Diligence Report. The purpose of a due diligence report is to demonstrate that reasonable and practicable measures were taken to prevent harm to an Aboriginal object or place and has been undertaken in accordance with the *Due Diligence Code of Practice for the Protection of Aboriginal Objects in New South Wales* (2010) ("Due Diligence Code").

The assessment contained in this report goes beyond the requirements of the Due Diligence Code to demonstrate that reasonable and practicable measures were taken to prevent harm to any historic heritage items that may be present within the Activity Areas, and to determine if a Statement of Heritage Impact for historic heritage is required.

This report has considered the relevant environmental and archaeological information, landscape features, disturbances and the nature of the proposed activities in addition to formulating appropriate recommendations.

1.1 The Activity Areas

This due diligence report has been prepared for the areas subject to the proposed activities, herein referred to as the "Activity Area/s", which are located in the Narrabri LGA (Figure 1).

The Leewood Ponds Activity Area is located on a rural property known as 'Leewood', and encompasses approximately 246 hectares of land (Figure 2). It is located approximately 24 kilometres southwest of Narrabri, and situated to the immediate west of the Newell Highway.

The Bibblewindi Flowline Activity Area is located immediately adjacent to the existing Bibblewindi Water Management Facility within the Bibblewindi State Forest, and encompasses an area approximately 65 metres long and 12 metres wide (Figure 3). It is located approximately 37 kilometres southwest of Narrabri, and 15 kilometres south of the Leewood Ponds Activity Area and is accessible from Garlands Road, which leads east from X Line Road and the Newell Highway.

The Bohena Creek Activity Area is located along Bohena Creek, and encompasses an area approximately 100 metres long and 12 metres wide (Figure 4). It is located approximately 35.4 kilometres southwest of Narrabri, 12.3 kilometres south of the Leewood Ponds Activity Area and 2.4 kilometres northwest of the Bibblewindi Flowline Activity Area. It is accessible from Bohena Creek Road, to the east of X Line Road and the Newell Highway.

1.2 The Proposed Activities

The proposed Project involves the construction and operation of produced water and brine management ponds at Leewood together with associated infrastructure within PAL 2 (the proposed Project).

Specifically, the proposed Project involves the construction of one 300 mega litre (ML) brine pond and one 300ML produced water pond (collectively referred to as the Leewood Ponds) on the Santos owned 'Leewood' property (herein referred to as the 'Leewood Ponds Activity Area').

The proposed Project also involves the installation of two water flowlines, measuring approximately 16 kilometres in length, alongside an existing gas flowline. These flowlines will link the proposed Leewood Ponds to the existing Bibblewindi Water Management Facility in the Bibblewindi State Forest. The majority of the proposed water flowline route is within the previously disturbed area of the gas flowline and therefore did

not require visual inspection in accordance with the Due Diligence Code (2010: 11-12). Two areas, however, require additional disturbance and were inspected as part of this Due Diligence Assessment.

The first area is located adjacent to the Bibblewindi Water Management Facility, and is herein referred to as the 'Bibblewindi Flowline Activity Area'. This revised flowline segment is approximately 65 metres long, and has an impact area approximately 12 metres wide.

The second area is at the Bohena Creek crossing, and is herein referred to as the 'Bohena Creek Activity Area'. Installation of the existing gas flowline did not require the disturbance of the bed of Bohena Creek, as horizontal directional drilling was used to install the flowline. The proposed Project will involve ploughing through the dry creek bed, and while vehicles do currently cross the creek in this location, a precautionary approach was taken to visually inspect the area. This segment of the flowline is approximately 100 metres long, and has an impact area approximately 12 metres wide.

As part of the design phase for the proposed Project, a geotechnical investigation involving the excavation of 75 geotechnical test pits was undertaken at the Leewood Ponds Activity Area. Each of these geotechnical test pits were inspected for any evidence of Aboriginal or historic heritage cultural material prior to excavation as part of the overall Due Diligence Assessment contained in this report (refer to Appendix 4).

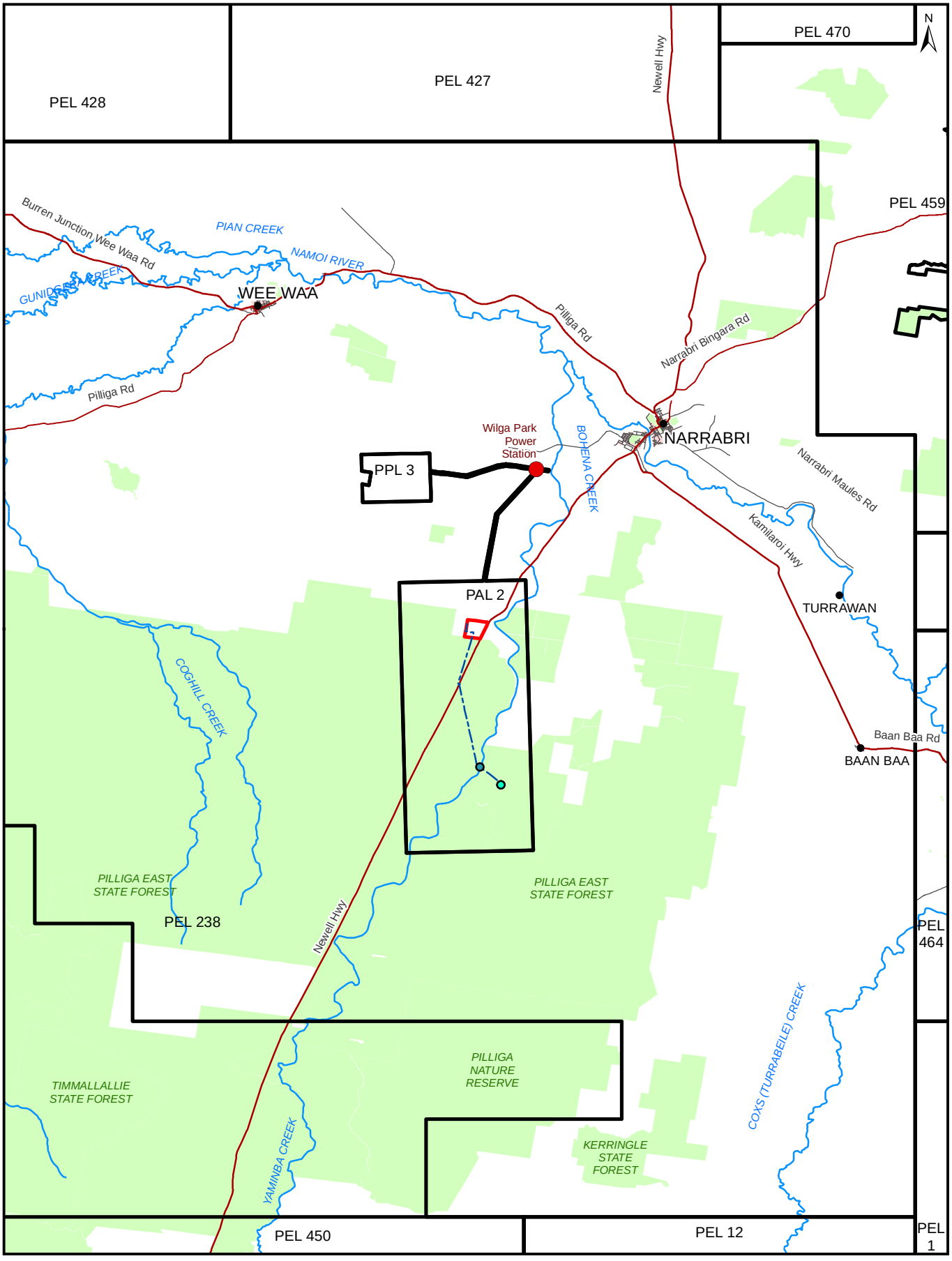
Sub-surface disturbance works, including the excavation of soil and the construction of utilities and infrastructure, will occur at both of the Activity Areas. Ground surface disturbance caused by the use and movement of heavy machinery and ancillary equipment will also be necessary. A due diligence assessment is therefore required under S1 and S2a of the Due Diligence Code (DECCW 2010:11).

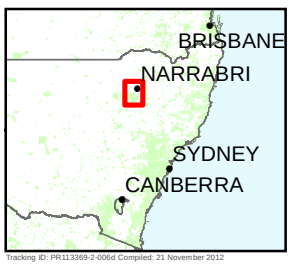
1.3 Authorship and Acknowledgements

This report was prepared by RPS Senior Archaeologist, Sarah Ward with contributions from RPS Senior Spatial Analyst Thomas Wilson, RPS Planning Manager Belinda Lewis, RPS Archaeologist Erin Williams and RPS Graduate Archaeologist Karyn Virgin. Assistance with report production was provided by Audrey Churm, RPS Business Support Manager.

The report was reviewed by RPS Technical Director Cultural Heritage, Darrell Rigby.

Fieldwork for the Leewood Ponds Activity Area was undertaken by RPS Senior Archaeologist Sarah Ward in conjunction with Golder Associates Geotechnical Engineer Matthew Skelley. Fieldwork for the Bibblewindi Flowline Activity Area was undertaken by RPS Graduate Archaeologist Karyn Virgin in conjunction with RPS Ecologist Hannah Rowan, and in the presence of Santos Project Engineer Todd Dunn. Fieldwork for the Bohena Creek Activity Area was also undertaken by RPS Graduate Archaeologist Karyn Virgin in the presence of Santos Environmental Field Compliance Advisor Greg Brennan.





Tracking ID: PR113369-2-006d Compiled: 21 November 2012

N

5 0 5 10

Kilometres

APPROX SCALE 500,000 @ A4

GDA 1994

Disclaimer: While all reasonable care has been taken to ensure the information contained on this map is up to date and accurate, no guarantee is given that the information portrayed is free from error or omission. Please verify the accuracy of all information prior to use.

DATA SOURCES

Base topographic data © Commonwealth of Australia (Geoscience Australia) 2006.

LEGEND

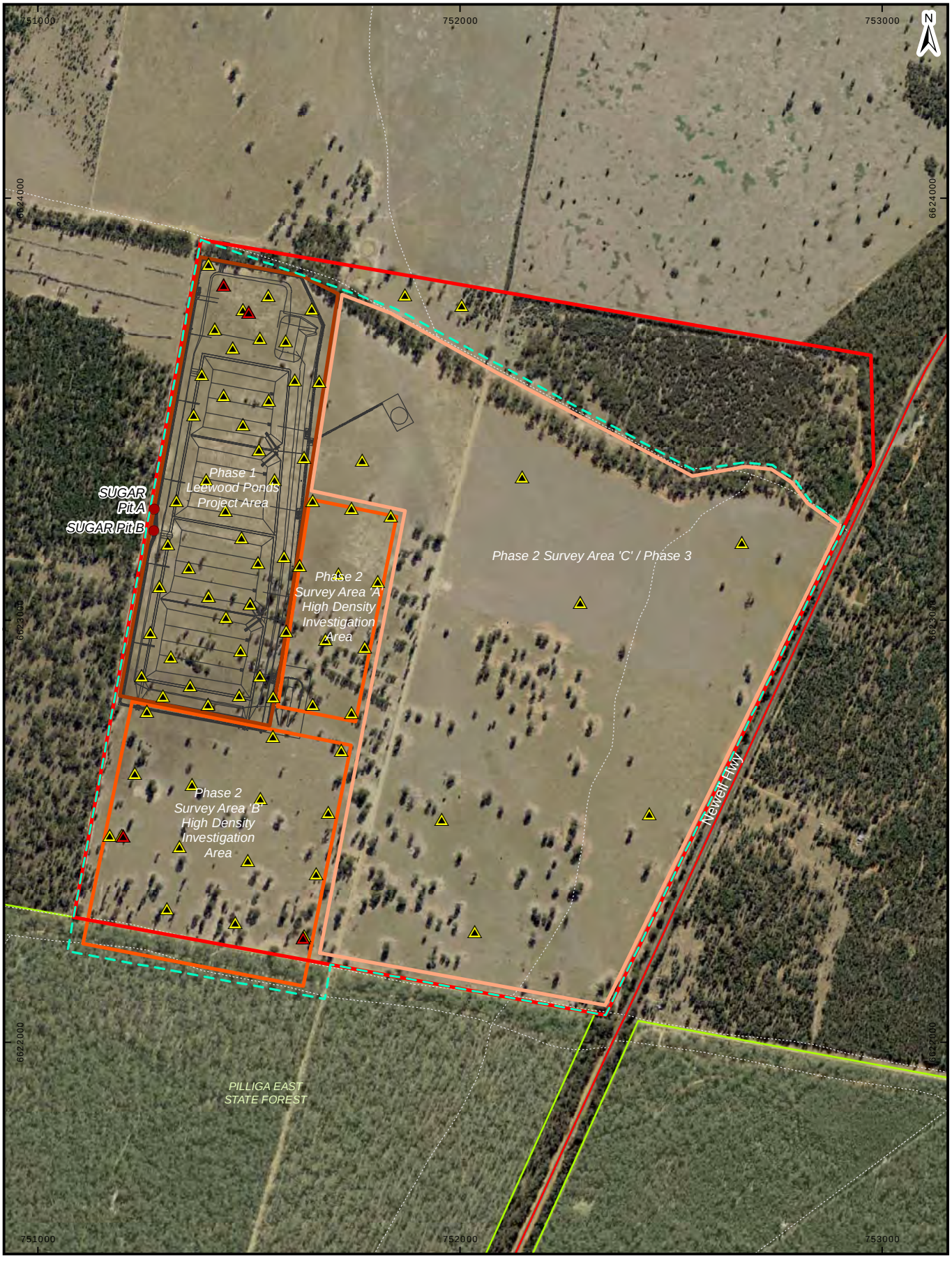
Leewood Water Treatment Facility

- Bibblewindi Activity Area
- Bohena Creek Activity Area
- Flow Line (Right of Way)
- Leewood
- Petroleum Lease
- Town / Locality
- Power Station
- Highway
- Main Road
- Local Road
- Built UpArea
- State Forest / Reserve / Park

RPS

FIGURE 1

Regional Context and Location





Tracking ID: PR113369-2-003j Compiled: 21 November 2012

N

100 0 100 200

Metres

APPROX SCALE 12,500 @ A4

GDA 1994 MGA Zone 55

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DATA SOURCES

Point features located in field by GPS.
Proposed Pond Areas derived from Aurecon drawing 7081-40-068 RevD.

LEGEND

Scouted Points

- Moved Pit
- Test Pit
- Heritage Item
- Proposed Ponds
- Leewood Ponds surveyed area
- Lot Boundary
- State Forest / Reserve / Park

Visual Inspection Survey Areas

- Phase 1
- Phase 2 Survey Area 'A' / 'B'
- Phase 2 Survey Area 'C' / Phase 3

RPS

FIGURE 2

Leewood Ponds
Activity Area





Tracking ID: PR113369-2-005g Compiled: 21 November 2012

N

50 0 50 100

Metres

APPROX SCALE 4,000 @ A4

GDA 1994 MGA Zone 55

Disclaimer: While all reasonable care has been taken to ensure the information contained on this map is up to date and accurate, no guarantee is given that the information portrayed is free from error or omission. Please verify the accuracy of all information prior to use.

DATA SOURCES

Base topographic data © Commonwealth of Australia (Geoscience Australia) 2006.
Proposed works digitised from Aurecon dwg 7081-40-067E

LEGEND

- Bibblewindi Flowline Activity Area
- W Proposed Leewood Flowline (Indicative)
- w Exsiting Flowline

Bibblewind Proposed Works

- 5ML Tank
- Concrete Bund
- Future Gas Supply
- Transfer Pumping Station

RPS

FIGURE 3

Bibblewindi Flowline Activity Area





Tracking ID: PR113369-2-007a Compiled: 21 November 2012

N

20 0 20 40

Meters

APPROX SCALE 2,500 @ A4

GDA 1994 MGA Zone 56

Disclaimer: While all reasonable care has been taken to ensure the information contained on this map is up to date and accurate, no guarantee is given that the information portrayed is free from error or omission. Please verify the accuracy of all information prior to use.

DATA SOURCES

Point features located in field by GPS.
Proposed ROW and flowline from Aurecon dwg 7081-40-067E

LEGEND

- W Proposed Leewood Flowline (Indicative)
- Right of Way (Indicative)
- Exsiting Flowline

RPS

FIGURE 4

Bohena Creek
Activity Area

2.0 Legislative Context

The following overview of the legal framework is provided solely for information purposes for the client, it should not be interpreted as legal advice. RPS will not be liable for any actions taken by any person, body or group as a result of this general overview, and recommend that specific legal advice be obtained from a qualified legal practitioner prior to any action being taken as a result of the summary below.

Although there are a number Acts protecting and managing cultural heritage in New South Wales (see Appendix 1) the primary ones which apply to this report include:

- *National Parks & Wildlife Act 1974*;
- *National Parks & Wildlife Regulation 2009; and*
- *Heritage Act 1977.*

In brief, the *National Parks & Wildlife Act 1974* protects Aboriginal heritage (places and objects) within NSW; the *National Parks and Wildlife Regulation 2009* provides a framework for undertaking activities and exercising due diligence; whilst the *Heritage Act 1977* protects historic heritage.

2.1 *National Parks & Wildlife Act 1974*

The *National Parks & Wildlife Act 1974* (NPW Act) protects Aboriginal heritage within NSW. Protection of Aboriginal heritage is outlined in s86 of the Act, as follows:

- "A person must not harm or desecrate an object that the person knows is an Aboriginal object" s86(1);
- "A person must not harm an Aboriginal object" s86(2); and
- "A person must not harm or desecrate an Aboriginal place" s86(4).

Penalties apply for harming an Aboriginal object or place. The penalty for knowingly harming an Aboriginal object (s86[1]) and/or an Aboriginal place (s86[4]) is up to $550,000 for an individual and/or imprisonment for 2 years; and in the case of a corporation the penalty is up to $1.1 million. The penalty for a strict liability offence (s86[2]) is up to $110,000 for an individual and $200,000 for a corporation.

Harm

Under the NPW Act, harm is defined as any act that: destroys defaces or damages the object; moves the object from the land on which it has been situated; and/or causes or permits the object to be harmed. However, it is a defence from prosecution if the proponent can demonstrate: 1) that harm was authorised under an Aboriginal Heritage Impact Permit (AHIP) (and the permit was properly followed); or 2) that the proponent exercised due diligence in respect to Aboriginal heritage. The **'due diligence' defence** (s87(2)), states that if a person or company has exercised due diligence to ascertain that no Aboriginal object was likely to be harmed as a result of the activities proposed for the Acitvity Area (subject area of the proposed activity); then liability from prosecution under the NPW Act will be removed or mitigated if it later transpires that an Aboriginal object was harmed.

Notification of Aboriginal Objects

Under section 89A of the NPW Act Aboriginal objects (and sites) must be reported to the Director-General (now Chief Executive) of OEH within a reasonable time (unless it has previously been recorded and submitted to AHIMS). Penalties of $11,000 for an individual and $22,000 for a corporation may apply for each object not reported.

2.2 National Parks and Wildlife Regulation 2009

The *National Parks and Wildlife Regulation 2009* ("NPW Regulation") provides a framework for undertaking activities and exercising due diligence in respect to Aboriginal heritage. The NPW Regulation 2009 outlines the recognised due diligence codes of practice which are relevant to this report, but it also outlines procedures for Aboriginal Heritage Impact Permit (AHIP) applications and Aboriginal Cultural Heritage Consultation Requirements (ACHCRs); amongst other regulatory processes.

2.3 Due Diligence and Codes of Practice

The **advantage of a Due Diligence** assessment is that:

- it assists in avoiding unintended harm to Aboriginal objects;
- provides certainty to land managers and developers about appropriate measures for them to take;
- encourages a precautionary approach;
- provides a defence against prosecution if the process is followed; and
- results in more effective conservation outcomes for Aboriginal cultural heritage.

One of the benefits of the due diligence provisions are that they provide a simplified process of investigating the Aboriginal archaeological context of an area to determine if an Aboriginal Heritage Impact Permit (AHIP) is required.

Under the s80A *National Parks & Wildlife Regulation* 2009 ("NPW Regulation") the following due diligence codes are recognised:

(a) the Due Diligence Code published by the Department of Environment, Climate Change and Water and dated 13 September 2010;

(b) the Plantations and Reafforestation Code (being the Appendix to the *Plantations & Reafforestation (Code) Regulation 2001*) as in force on 15 June 2010;

(c) the *Private Native Forestry Code of Practice for Northern New South Wales* approved by the Minister for Climate Change, Environment and Water and published in the Gazette on 8 February 2008;

(d) the *NSW Minerals Industry Due Diligence Code of Practice for the Protection of Aboriginal Objects* published by NSW Minerals Council Ltd and dated 13 September 2010;

(e) the *Aboriginal Objects Due Diligence Code for Plantation Officers Administering the Plantations and Reafforestation (Code) Regulation 2001* published by the Department of Industry and Investment and dated 13 September 2010; and

(f) the *Operational Guidelines for Aboriginal Cultural Heritage Management* published by Forests NSW and dated 13 September 2010.

This report has been written to meet the Due Diligence Code (DECCW 2010).

2.3.1 *Due Diligence Code of Practice for the Protection of Aboriginal Objects in New South Wales* (DECCW 2010)

This publication sets out a minimum benchmark for acceptable due diligence investigations to be followed. The purpose of the code is set out reasonable and practical steps in order to:

(1) identify whether or not Aboriginal objects (and places) are, or are likely to be, present in an area

(2) determine whether or not their activities are likely to harm Aboriginal objects (if present)

(3) determine whether an AHIP application is required. (DECCW 2010:2)

Investigations under the code include the following:

- a search of the Aboriginal Heritage Information Management System (AHIMS) database to identify if there are previously recorded Aboriginal objects or places in the Activity Areas;
- identification of landscape features including land within 200m of water, dune systems, ridge tops, headlands, land immediately above or below cliff faces and/or rockshelters/caves;
- desktop assessment including a review of previous archaeological and heritage studies and any other relevant material;
- visual inspection of the Activity Areas to identify if there are Aboriginal objects present; and
- assessment as to whether an AHIP is required.

This report has complied with the requirements of the code listed above. Other requirements under the code are outlined below.

Aboriginal consultation is not required for an investigation under the Due Diligence Code (DECCW 2010:3). However, if the due diligence investigation shows that the activities proposed for the area are likely to harm objects or likely objects within the landscape, then an Aboriginal Heritage Impact Permit will be required with full consultation.

A record of the due diligence procedure followed must be kept to ensure it can be used as a defence from prosecution (DECCW 2010:15).

Following a due diligence assessment (where an AHIP application was not required), such as this, an activity must proceed with caution. If any Aboriginal objects are identified during the activity, then works should cease in that area and OEH notified (DECCW 2010:13). The due diligence defence does not authorise continuing harm.

2.3.2 *Aboriginal Community Consultation*

Aboriginal community consultation is not a formal requirement of the due diligence process (DECCW 2010:3); therefore the proponent is not obliged to undertake Aboriginal community consultation.

Aboriginal community consultation was not undertaken for this due diligence report.

2.4 *Heritage Act 1977*

This Act protects the natural and historic cultural history of NSW with emphasis on non-Aboriginal 'historic' cultural heritage (such as place, building, works, relic, moveable object, precinct, historic shipwreck, or archaeological site) of State or local significance, through protection provisions and the establishment of a Heritage Council and a State Heritage Register. Additionally, Government agencies have special obligations under the *Heritage Act 1977 (*NSW). Agencies are required to compile a register of heritage assets (known as a Section 170 Heritage and Conservation Register) and look after their assets on behalf of the community.

Although Aboriginal objects and places of significance are primarily protected by the NPW Act, if an Aboriginal site, object or place is of State or local significance, it may be protected by a heritage order issued by the Minister subject to advice by the Heritage Council. Penalties of up to $1.1m are in place for breeches of the Heritage Act and its Regulations.

3.0 Environmental Context

Aboriginal cultural heritage due diligence requires that available knowledge and information is considered and forms part of the desktop assessment required under S4 of the Due Diligence Code (DECCW 2010:12-13). The purpose of reviewing the relevant environmental information is to assist in identifying whether Aboriginal objects or places are present within the Activity Areas.

3.1 Local Environment

An understanding of environmental context is important for the predictive modelling of Aboriginal sites and their interpretation. The local environment is understood to have provided natural resources for Aboriginal people, such as stone (for manufacturing stone tools), food and medicines, wood and bark (for implements such as shields, spears, canoes, bowls, shelters, amongst others), along with areas for camping and other activities. The nature of Aboriginal occupation and resource procurement is related to the local environment and it therefore needs to be considered as part of the cultural heritage assessment process. The Activity Areas are in the Pilliga sub-region of the Brigalow Belt South Bioregion (NPWS 2003: 137).

3.1.1 Geology and Soils

The Activity Areas are predominantly located on the Jurassic Pilliga Sandstone landscape. Pilliga Sandstone is a coarse textured and porous quartz sandstone with interbedded claystones, pebble beds and conglomerates (Ward 1999: 14). In areas, Pillaga Sandstone overlies the Walloon Coal Measures, which comprise claystone, shale, siltstone (Geoscience Australia 2012: Online). The landscape is characterised by stepped sandstone ridges with low cliff faces, and broad alluvial floodplains and valleys. There is a high proportion of rock outcrop and long gentle outwash slopes, which are intersected by sandy stream beds and prior stream channels, and interspersed with patches of heavy clay (Wallis 1971: 1).

Soils in the Activity Areas are typically shallow black earths and red loams on basalts. Extensive harsh texture contrast duplex soils with linear patterns of deep yellow sands and stony red broth earths are typical, as are cracking clay sub-soils. These soils are typical of those derived from the Pilliga Sandstone and are described as highly siliceous. They are characterised by the dense growth of trees and shrubs and high species diversity (Norris 1996: 1).

The geology and soils of the Activity Areas demonstrate that the landscape prior to European contact was capable of supporting Aboriginal resources suitable for habitation.

3.1.2 Topography and Hydrology

The Activity Areas are located on relatively flat land of between 240 and 250 metres Australian Height Datum (AHD) (Department of Lands 1973: Topoview Raster Viewer). The Leewood Ponds Activity Area is located on a property (‘Leewood’) currently used for agricultural purposes, while the Bibblewindi Flowline Activity Area is located within the Bibblewindi State Forest.

Several water sources, both permanent and ephemeral, are present in the vicinity of the Activity Areas. At its closest, the high order Bohena Creek is approximately 500 metres to the east of the Leewood Ponds Activity Area, approximately two kilometres to the west of the Bibblewindi Flowline Activity Area, and runs through the Bohena Creek Activity Area. A number of minor tributaries associated with Bohena Creek, which may have provided an ephemeral water source in the past, also run within one kilometre of the Activity Areas. Larger water courses in the area, such as Bohena Creek, would have provided permanent sources of water, as would Yarrie Lake, located between 15 and 32 kilometres to the northwest of the Activity Areas and the Namoi River, approximately 25 kilometres to the east at its closest point.

The topography and hydrology of the Activity Areas demonstrate that the landscape would have been habitable for past populations; the area would have provided sufficient water resources and been fertile enough to sustain human occupation.

3.1.3 Climate

During the last glacial maximum (approximately 30,000-19,000 years ago), large ice sheets covered high latitude Europe and North America and the Antarctic ice sheet was more extensive than today. Sea levels stood some 120-130 metres lower than today (Lambeck et al 2002:343) and the earth's climate was distinctly different from that of the present interglacial conditions. As the ice began to melt climatic conditions began to alter (Lambeck et al 2002:343). This affected the movement and behaviour of past populations within their environs. Sea levels started to rise, with a corresponding increase in rainfall and temperature. Short's (2000:19-21) research suggests the change in climatic conditions reached its peak about 6,000 years ago. Temperatures stabilised around 1,000 years ago and, consequently, the climate of the Activity Areas for the past 1,000 years would probably have been much the same as present day, providing a year round habitable environment. New South Wales is described as being in the temperate zone, although the climate undergoes large variations depending on proximity to the coast and mountains (OEH 2012: 46-47).

The Activity Areas are located within the eastern sub-humid region of Australia (NPWS 2000b: 3), which has erratic rainfall and no water surplus available for run-off. In the regional area, rainfall is typically well distributed geographically, however, long droughts and occasional high-intensity, short-duration storms are typical, resulting in an unreliable water source (Ward 1999: 18). Temperatures are at their highest in December (37.1^{o} Celsius) and January (37.3^{o} Celsius) with an average maximum of 28.0^{o} Celsius. The coldest month is July with the average maximum temperatures of 20.9ºCelsius (BOM 2012: Online).

3.1.4 Flora and Fauna

Although vegetation in the regional area has largely been cleared for agricultural and farming purposes, vegetation at the time of European settlement was partly dry sclerophyll forest and partly grassland (Ward 1999: 11). Remnant vegetation associated with these communities is observable in the vicinity of the Activity Areas.

In upland areas, tree species such as bimble box, white cypress pine, Blakely's red gum, white box, bull oak and wilga are typical, as are various species of wattle. Wire-grasses are also dominant in these areas, and rough speargrass and slender bamboo grass may also be present. On the alluvial plains, grassland is dominant, with typical species including curly windmill grass, nardoo, common rush, various species of roly-poly and wild turnip. A sparse tree population is also present; belah, a *Casuarina* species is prominent, though bimble box, silver-leaved ironbark, wilga, white cypress pine and bull oak are also typical. Along Galathera Creek, vegetation predominantly comprises common rush, while along the Namoi River, river red gum is common (Ward 1999: 11-12).

This vegetation community would have provided habitats for a variety of animals and would have also provided potential food and raw material sources for Aboriginal people. Full ecological assessments of the Activity Areas have been undertaken by RPS Ecology (2012).

3.1.5 Synthesis of Environmental Context

A review of environmental data indicates that, despite the landscape being highly disturbed by commercial and agricultural pursuits, prior to European occupation there would have been bountiful food, water and other resources available for exploitation by Aboriginal people and in sufficient quantities to sustain a local population. This synthesis demonstrates that there is potential for Aboriginal cultural heritage sites to be present in the vicinity of the Activity Areas.

4.0 Heritage Context

Heritage consists of those objects, sites and places that will be inherited by future generations. Australia has many rich and varied historic places and landscapes, both urban and rural. Identifying and understanding their particular qualities, and what these add to our lives, is central to our engagement with our history and culture.

4.1 Aboriginal Cultural Heritage

Aboriginal and Torres Strait Islander heritage is an important part of Australian heritage. Evidence of the occupation of Australia by Aboriginal and Torres Strait Islander peoples dates to approximately 40,000 to 60,000 years ago (Dorey 2012: Online).

4.1.1 Aboriginal Heritage Information Management System (AHIMS)

Searches were undertaken of the Aboriginal Heritage Information Management System (AHIMS) in accordance with the Due Diligence Code (DECCW 2010:11). For the Leewood Ponds Activity Area, the searches were conducted over the parcels of land described as Lot 13, Lot 15 DP 757083 and Lot 1 DP 771141 with a one kilometre buffer. This search revealed that there are **no previously recorded Aboriginal sites** and **no previously declared Aboriginal places** in, or within, one kilometre of the Leewood Ponds Activity Area.

For the Bibblewindi Flowline Activity Area, a search was conducted with a one kilometre buffer for the following area: GDA, Zone 55: Eastings 748284 – 752432 Northings 6617130 – 6620717. This search revealed that there are **no previously recorded Aboriginal sites** and **no previously declared Aboriginal places** in, or within, one kilometre of the Bibblewindi Flowline Activity Area.

For the Bohena Creek Activity Area, a search was conducted with a one kilometre buffer for the following area: GDA, Zone 55: Eastings 750421 – 753833 Northings 6608757 – 6611180. This search revealed that there are **no previously recorded Aboriginal sites** and **no previously declared Aboriginal places** in, or within, one kilometre of the Bohena Creek Activity Area.

4.1.2 National Native Title Tribunal Registers

A search was undertaken of the National Native Title Tribunal (NNTT) registers on 15 October 2012 in accordance with the *ESG2: Environmental Impact Assessment Guidelines* (NSW Trade and Investment 2012: Online). The search was conducted for the Narrabri LGA (Search Reference: 5153/12sj).

This search identified one native title claimant, being the Gomeroi People. Their claim extends over an area of 111,340 square kilometres and includes the Narrabri Shire Council area. This claim was filed with the NNTT on 20 December 2011 and the notification completed on 15 August 2012. A former claim in 2007 by the Gomeroi Narrabri People was discontinued. Under the *Native Title Act 1993* the valid grant of a freehold estate (other than certain types of Aboriginal and Torres Strait Islander land) on or before 23 December 1996 is known as a 'previous exclusive possession act', meaning that native title has been extinguished over the area. The Bibbelwindi Flowline Activity Area, being situated wholly within Crown land, can therefore be subject to a native title claim (Section 23B of the *Native Title Act 1993*). The Leewood Ponds Activity Area, being situated wholly within a freehold estate granted prior to 23 December 1996, cannot be subject to a native title claim.

4.1.1 Archaeology and Cultural Heritage Literature Review

A review of previous archaeological and heritage reports is required as part of the desktop assessment and has been undertaken in accordance with the code (DECCW 2010:13). The most relevant publications are outlined below.

Appleton, J. (2009), Narrabri Longwall Stage 2 Project: Aboriginal Heritage Assessment. Whitehaven Coal: Sydney.

This investigation was conducted pursuant to an extension to the Narrabri Coal Mine by Whitehaven Coal, located approximately 28 kilometres south of Narrabri, adjacent to the Kamilaroi Highway. The investigation entailed a desktop assessment and a survey over four main areas comprising the impact zones.

The survey identified a total of 121 sites across the four survey areas. The majority of sites were identified in the longwall panels 8-26 (69), followed by the area comprising longwall 1-7. The longwall locations were on a variety of landscapes, but mostly on the eastern slopes of the Pilliga Forest. This area is fed by numerous ephemeral and permanent watercourses, including Pine Creek and Kurrajong Creek.

Overall, the sites comprised low density artefact scatters, with scatters of higher densities being associated with confluences of water courses. A scarred tree and a hearth were also identified in the longwall 1-7 area.

Trindall, E. (2007), Narrabri Coal Seam Gas Utilisation Project: Aboriginal Heritage Assessment, Santos: Sydney.

This investigation was conducted ahead of the proposed construction of a gas gathering system, gas flow line and expansion of Wilga Park Power Station. The impact area of that project totalled approximately 36 hectares in the Pilliga East State Forest and open farmland in Narrabri Shire.

The investigation comprised a desktop assessment and a field survey to assess the impact of the proposed operations on the Aboriginal cultural heritage resource. Previous disturbances were variable, with the farmland being moderately disturbed, whilst the Pilliga Forest area had been subjected to varying levels of forestry, fires, grazing and mining exploration.

The survey identified one site, a scarred tree located between Dog Fence Road and Pilliga Forest Way. The tree was a Pilliga Box, one of less than 10 in the vicinity of the area surveyed. It was recommended that this tree be avoided by the proposed works.

Silcox, R. & Bowdler, S. (1982). An Archaeological Survey of a Proposed 132 Kv Transmission Line Route from Walgett to Narrabri Part 1. A Report to the National Parks and Wildlife Service of N.S.W. on behalf of the Electricity Commission of N.S.W. unpublished.

This investigation covered the physical examination (visual inspection) of a proposed 132 kilovolt (kv) transmission line route from Walgett to Narrabri. This report covers the first 87 kilometres of the 180 kilometre total route, which is proposed to contain an easement 45 metres wide. The second report, containing the Narrabri sector of the route was unable to be accessed.

Eight sites and seven isolated finds were identified during the course of the survey with visibility averaging 50%. The sites consisted of four scarred trees (two dead both ring barked (WN1 & WN2); two alive, standing, not ring barked (WN3 & WN4), two surface campsites and two scatters of baked clay ‘lumps’ (WN7 & WN8). The authors initially suggested that these were from hearths, however conceded later in the report that they were likely the result of European clearing and burning of timber.

4.1.2 Synthesis of Aboriginal Heritage Context

The AHIMS search conducted for the Activity Areas returned a negative result, which may be explained by the lack of archaeological studies that have been undertaken in the immediate vicinity of the Activity Areas to date; previous archaeological work in the region suggests that the broader regional area was utilised by past Aboriginal communities. This is in part due to the ready availability of food, water and other resources; the availability of water being a crucial factor in the frequency of occupation, as rivers and creeks are markers of community identity, traditional meeting places and the chosen location of settlements (NSW NPWS 2000a:36).

The literature review suggests that artefact sites, such as artefact scatters and isolated finds appear to be the most frequent site type encountered in the broader region. Appleton also observed the connection between site density/complexity and availability of reliable water which would suggest previous occupation within or near to the Activity Area; however, this cannot be confirmed. Trindall (2007: 5-11) observed the paucity of sites within the Pilliga Forest as being a direct consequence of the lack of reliable water, whilst areas outside the Pilliga and closer to permanent water contained a variety of site types. However, the potential for sites remaining must be tempered with previous land disturbance that has impacted the Activity Areas.

4.2 Historic Heritage Context

European land settlement commenced in NSW in 1788 when Governor Phillip claimed possession of the land now known as Australia for a penal colony on behalf of the British Government. The region was first visited by John Oxley, the explorer and then Surveyor General of NSW in 1817, who noted the presence of Aboriginal people and the suitability of the land for agriculture (NPWS 2000b: 133).

4.2.1 World Heritage

The World Heritage List is a register of sites considered to have outstanding universal value. A search of the World Heritage List revealed there to be 20 World Heritage listings (one listing may contain several properties) in Australia, six of which are in NSW. There are **no World Heritage** listings in the Narrabri LGA, and therefore no listings within the Activity Areas themselves.

4.2.2 National Heritage

The National Heritage List is the lead statutory document for the protection of heritage places considered to have national importance. Listed places are protected under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). A search of the Australian Heritage Database with reference to the National Heritage List on 15 October 2012 indicates that there are no heritage items in the town of Narrabri or the Narrabri LGA, on the National Heritage List, and consequently **no national heritage items** within or near to the Activity Areas.

Previously the Register of the National Estate was the primary document. While the Register of the National Estate still exists in archival form, items can no longer be registered and since February 2012 no longer has statutory status. However, the Minister is still required to considering the Register when making some decisions under the EPBC Act. A search of the Australian Heritage Database with reference to the Register of the National Estate on 15 October 2012 revealed six heritage sites within the Narrabri LGA on the Register of the National Estate. The searches revealed that **no heritage sites** on the Register of the National Estate are in, or near to, the Activity Areas.

4.2.3 Commonwealth Heritage

The Commonwealth Heritage List is a list of natural, Indigenous and historic heritage places owned or controlled by the Australian Government. A search of the Australian Heritage Database with reference to the Commonwealth Heritage List, on 15 October 2012 revealed that one site in the town of Narrabri, the Narrabri Post Office and former Telegraph Office, is listed on the Commonwealth Heritage List. The Post Office and former Telegraph Office is located in Maitland Street, Narrabri, outside of the Activity Areas. There are **no Commonwealth heritage items** in the Activity Areas.

4.2.4 State Heritage

The NSW State Heritage Inventory (SHI) database is maintained by the Heritage Branch, Office of Environment and Heritage and lists items that have been identified as of State and/or local heritage significance throughout NSW. A search of the State Heritage Register on 15 October 2012 revealed one item of State Heritage Significance listed on the NSW State Heritage Register (Narrabri Gaol and Residence, Bowen Street, Narrabri) in the Narrabri LGA. The item is outside of the Activity Areas and therefore there are **no heritage items of State Significance** in, or near to the Activity Areas.

The searches also revealed **no heritage items** in the Narrabri LGA subject to an Interim, or Authorised Interim Heritage Order, and **no heritage items** subject to a s136 order.

4.2.5 Local Heritage

Searches of the Heritage Branch, OEH State Heritage Inventory with reference to the *Narrabri Local Environmental Plan 1992* were undertaken on 15 October 2012. The searches reveal 14 local heritage items listed on the LEP. A search of the Heritage Branch, OEH State Heritage Inventory on the same day revealed a total of 37 items of local significance in the Narrabri LGA, including the 14 LEP items. Of these 37 local heritage items, **no heritage items** are in or near to the Activity Areas.

The Narrabri district has been the centre of innovative astronomy research since the early 1960s, when University of Sydney's School of Physics established the groundbreaking Narrabri Stellar Intensity Interferometer which was the first astronomical instrument to measure the diameter of a large number of stars. The area is also home to Paul Wild's Radioheliograph at Culgoora, and the Sydney University Giant Air-shower Recorder (SUGAR) array. The SUGAR station identified within the Survey Area at Leewood (comprising two pits, and located immediately adjacent to the Leewood Ponds Activity Area) is part of this array. However, the pits are currently not within the Activity Area at Leewood, and are not registered on the OEH State Heritage Inventory; nor are they listed on the Narrabri LEP.

The SUGAR array was established by the University of Sydney's School of Physics in the Pilliga Forest, and operated for over a decade between 1968 and 1979. The array consisted of 47 stations dotted around the Pilliga Forest, with each station consisting of pairs of large liquid scintillation detectors (pits filled with fluid) separated by 50 metres. The SUGAR project was developed to measure showers resulting from cosmic ray particles of the highest known energy. Each station operated in an autonomous manner with solar power units and received their timing information via radio receivers (Brownlee et al 1968: 68). At this stage it is unknown how many of these stations remain in situ in the area.

4.2.6 Synthesis of Historic Heritage Context

Although the Narrabri region has been settled for almost 200 years, the search results indicate that there are no registered locally or state significant historic heritage items within or near to the Activity Areas. However, the presence of the SUGAR station immediately adjacent to the Leewood Ponds Activity Area should be noted by the client, and impact on this feature should be minimised. In the event that the SUGAR station will

be damaged, modified or destroyed by works, further works under the *Heritage Act 1977* should be undertaken.

5.0 Visual Inspection and Field Results

A visual inspection of the Activity Area was undertaken to identify whether Aboriginal objects were present on the ground surface or were likely to be present below the ground surface. In accordance with S4 of the Due Diligence Code a qualified archaeologist undertook the visual inspection (DECCW 2010:12-13).

5.1 Visual Inspection

The visual inspection (pedestrian survey) was conducted in five phases:

- Phase 1 was the visual inspection of the 39 (TP1-TP39) geotechnical test pit sites that were originally commissioned and which formed the initial scope for the geotechnical investigation of the Leewood Ponds Activity Area;
- Phase 2 was the visual inspection of the additional 36 (TP50-TP85) geotechnical test pit sites which formed part of the extended scope of works for the Leewood Ponds Activity Area;
- Phase 3 was the overall due diligence inspection of the remaining portion of the Leewood property, outside of the Leewood Ponds Activity Area (this area is demarcated as “surveyed area” on the figures);
- Phase 4 was the visual inspection of the Bibblewindi Flowline Activity Area; and
- Phase 5 was the visual inspection of the Bohena Creek Activity Area.

5.1.1 Leewood Ponds Activity Area Methodology

The visual inspection of the Leewood Ponds Activity Areas was undertaken over seven days from Monday 30 July 2012 to Sunday 5 August 2012 by RPS Senior Archaeologist Sarah Ward in the presence of Matthew Skelly, Golder Associates Engineer who was carrying out the geotechnical investigation on behalf of the client, Santos. In addition to a general pedestrian survey of the overall Activity Area, an area of approximately 10 metres x 10 metres (100 square metres) was surveyed at each of the geotechnical test pits to ensure adequate cover for the footprint of each test pit, the digger and the scattered spoil resulting from pit backfill. The coordinates for the test pits were determined by Golder Associates (Webb 2012a; Webb 2012b) and provided to RPS by Santos. Each of the 75 geotechnical test pit locations were recorded and are described in Appendix 4.

At the commencement of the visual inspection, the geotechnical test pit locations (Tables 1 and 2) were programmed into a Garmin Oregon 450t unit. The archaeologist worked from north-west to north-east across each area, identifying and marking each test pit location. Once the locations were marked using a survey stake and flagging tape (where possible), a visual inspection (pedestrian survey) was conducted of each test pit site. This involved walking (on foot) a minimum area of approximately 10 metres x 10 metres (100 square-metres) around each test pit location. The test pit location acted as the centre point of each survey area. A description and assessment of each test pit is located in Appendix 4.

In addition to the inspection of test pits, the survey also considered the corridor of land to the west of the Leewood Ponds Activity Area, and included a cursory inspection only of the wooded area to the north east of the property. This area is not within the Leewood Ponds Activity Area and will not be affected by the proposed development works, but is defined on the figures as “surveyed area”.

5.1.2 Bibblewindi Flowline Activity Area Methodology

The visual inspection of the Bibblewindi Flowline Activity Area was undertaken on 8 October 2012 by RPS Graduate Archaeologist Karyn Virgin in conjunction with RPS Ecologist Hannah Rowan and in the presence of Santos Project Engineer Todd Dunn.

An area measuring approximately 125 metres long and 20 metres wide was surveyed to ensure that the impact footprint of the proposed water flowline route was adequately covered.

5.1.3 Bohena Creek Activity Area Methodology

The visual inspection of the Bohena Creek Activity Area was undertaken on 21 November 2012 by RPS Graduate Archaeologist Karyn Virgin in the presence of Santos Environmental Field Compliance Advisor Greg Brennan.

An area measuring approximately 100 metres long and 20 metres wide was surveyed to ensure that the impact footprint of the proposed water flowline route was adequately covered.

5.1.4 Phase 1 Survey

The Phase 1 visual inspection of the Leewood Ponds Activity Area (Figure 5) was conducted over a three day period from Monday 30 July 2012 to Wednesday 1 August 2012. Ground surface visibility varied slightly across the 39 geotechnical test pit sites. In some surveyed areas, visibility was between 0 - 5% due to thick grass cover, soggy ground and thick vegetation. In areas such as TP19 and TP15, visibility was closer to 50% with red/brown cracking clay soils evident between small tufts of grass.

The visual inspection revealed no surface Aboriginal sites or objects within either the 39 geotechnical test pit survey areas or the Leewood Ponds Activity Area. The assessed potential for subsurface objects is very low. This low – nil sensitivity assessment has subsequently been proven by the digging of all 39 geotechnical test pit sites, none of which revealed the presence of subsurface Aboriginal or historic heritage items.

Table 1 : Phase 1 Test Pit Locations (UTM)

Test Pit	Eastings	Northings	Landform	Archaeological Sensitivity
TP1	751297	6622810	Low relief disturbed landscape	Low to nil sensitivity
TP2	751404	6622789	Low relief disturbed landscape	Low to nil sensitivity
TP3	751246	6622857	Low relief disturbed landscape	Low to nil sensitivity
TP4	751362	6622834	Low relief disturbed landscape	Low to nil sensitivity
TP5	751478	6622811	Low relief disturbed landscape	Low to nil sensitivity
TP6	751316	6622903	Low relief disturbed landscape	Low to nil sensitivity
TP7	751527	6622857	Low relief disturbed landscape	Low to nil sensitivity
TP8	751267	6622960	Low relief disturbed landscape	Low to nil sensitivity
TP9	751481	6622917	Low relief disturbed landscape	Low to nil sensitivity
TP10	751446	6622997	Low relief disturbed landscape	Low to nil sensitivity
TP11	751289	6623070	Low relief disturbed landscape	Low to nil sensitivity
TP12	751405	6623047	Low relief disturbed landscape	Low to nil sensitivity
TP13	751503	6623027	Low relief disturbed landscape	Low to nil sensitivity
TP14	751358	6623113	Low relief disturbed landscape	Low to nil sensitivity
TP15	751309	6623169	Low relief disturbed landscape	Low to nil sensitivity
TP16	751522	6623125	Low relief disturbed landscape	Low to nil sensitivity
TP17	751584	6623140	Low relief disturbed landscape	Low to nil sensitivity
TP18	751483	6623184	Low relief disturbed landscape	Low to nil sensitivity
TP19	751329	6623272	Low relief disturbed landscape	Low to nil sensitivity
TP20	751445	6623249	Low relief disturbed landscape	Low to nil sensitivity
TP21	751400	6623323	Low relief disturbed landscape	Low to nil sensitivity
TP22	751562	6623323	Low relief disturbed landscape	Low to nil sensitivity
TP23	751525	6623392	Low relief disturbed landscape	Low to nil sensitivity
TP24	7551631	6623376	Low relief disturbed landscape	Low to nil sensitivity
TP25	751370	6623475	Low relief disturbed landscape	Low to nil sensitivity
TP26	751486	6623452	Low relief disturbed landscape	Low to nil sensitivity
TP27	751441	6623531	Low relief disturbed landscape	Low to nil sensitivity
TP28	751548	6623510	Low relief disturbed landscape	Low to nil sensitivity
TP29	751389	6623571	Low relief disturbed landscape	Low to nil sensitivity
TP30	751609	6623558	Low relief disturbed landscape	Low to nil sensitivity
TP31	751667	6623555	Low relief disturbed landscape	Low to nil sensitivity
TP32	751462	6623634	Low relief disturbed landscape	Low to nil sensitivity
TP33	751420	6623679	Low relief disturbed landscape	Low to nil sensitivity
TP34	751527	6623658	Low relief disturbed landscape	Low to nil sensitivity
TP35	751487	6623725	Low relief disturbed landscape	Low to nil sensitivity
TP36	751441	6623782	Low relief disturbed landscape	Low to nil sensitivity
TP37	751547	6623757	Low relief disturbed landscape	Low to nil sensitivity
TP38	751588	6623650	Low relief disturbed landscape	Low to nil sensitivity
TP39	751649	6623727	Low relief disturbed landscape	Low to nil sensitivity

Source: RPS 2012.





Tracking ID: PR113369-2-0001 Compiled: 21 November 2012

N

50 0 50 100

Meters

APPROX SCALE 5,000 @ A4

GDA 1994 MGA Zone 56

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DATA SOURCES

Point features located in field by GPS.
Proposed Pond Areas derived from Aurecon drawing 7081-40-068 RevD.

LEGEND

Scouted Points

- Moved Pit
- Test Pit
- Heritage Item
- Proposed Ponds
- Lot Boundary
- Leewood Ponds surveyed area

Visual Inspection Survey Areas

- Phase 1
- Phase 2 Survey Area 'A' / 'B'
- Phase 2 Survey Area 'C' / Phase 3

RPS

FIGURE 5

Leewood Ponds
Phase 1

5.1.5 Phase 2 Survey

The Phase 2 visual inspection of the Leewood Ponds Activity Area (Figure 6) was conducted over a two day period from Thursday 2 August 2012 to Friday 3 August 2012, and an additional half day survey of the southernmost portion of Area C was undertaken on 19 September 2012. An additional 36 geotechnical test pits were inspected (Table 3). The investigation was carried out in three stages. The stages correspond with the three areas specified in the scope of the geotechnical investigation:

- Area A refers to the rectangular 'High Density Investigation' Area (Webb 2012b) parallel and to the east of the Leewood Ponds Activity Area (TP72-TP83);
- Area B refers to the square 'High Density Investigation' Area (Web 2012b) to the south of the Leewood Ponds Activity Area (TP56-TP62 and TP64-TP71); and
- Area C refers to the remainder of the Leewood Ponds Activity Area with the exception of the wooded area along the north eastern boundary of the Leewood Ponds Activity Area (TP50-TP55, TP63 and TP84-TP85) (Web 2012b).

Area A: Ground surface visibility varied slightly and presented as less than 20% throughout the area due to thick long grass cover and small sodden boggy marshes, particularly near TP78-TP79 and TP82-83.

The visual inspection revealed no surface Aboriginal sites/objects or historic heritage items within the 12 test pit survey locations. Again the assessed potential for subsurface objects is considered to be very low. This assessment has subsequently been reinforced by the digging of these 12 test pit sites, which revealed no subsurface Aboriginal or historic heritage items.

Area B: Ground surface visibility varied slightly and presented at an average of 60-80% particularly toward the southern and eastern area boundary. As with the other survey areas, visibility in some areas was nil due to thick long grass cover, however very little of Area B presented as sodden or boggy. Dry red/brown soils were present over much of Area B.

The visual inspection revealed no surface Aboriginal sites or objects or historic heritage items within the 15 test pit survey areas. Again the assessed potential for subsurface objects is considered to be very low. This assessment has subsequently been reinforced by the digging of these 15 test pit sites, which revealed no subsurface Aboriginal or historic heritage items.

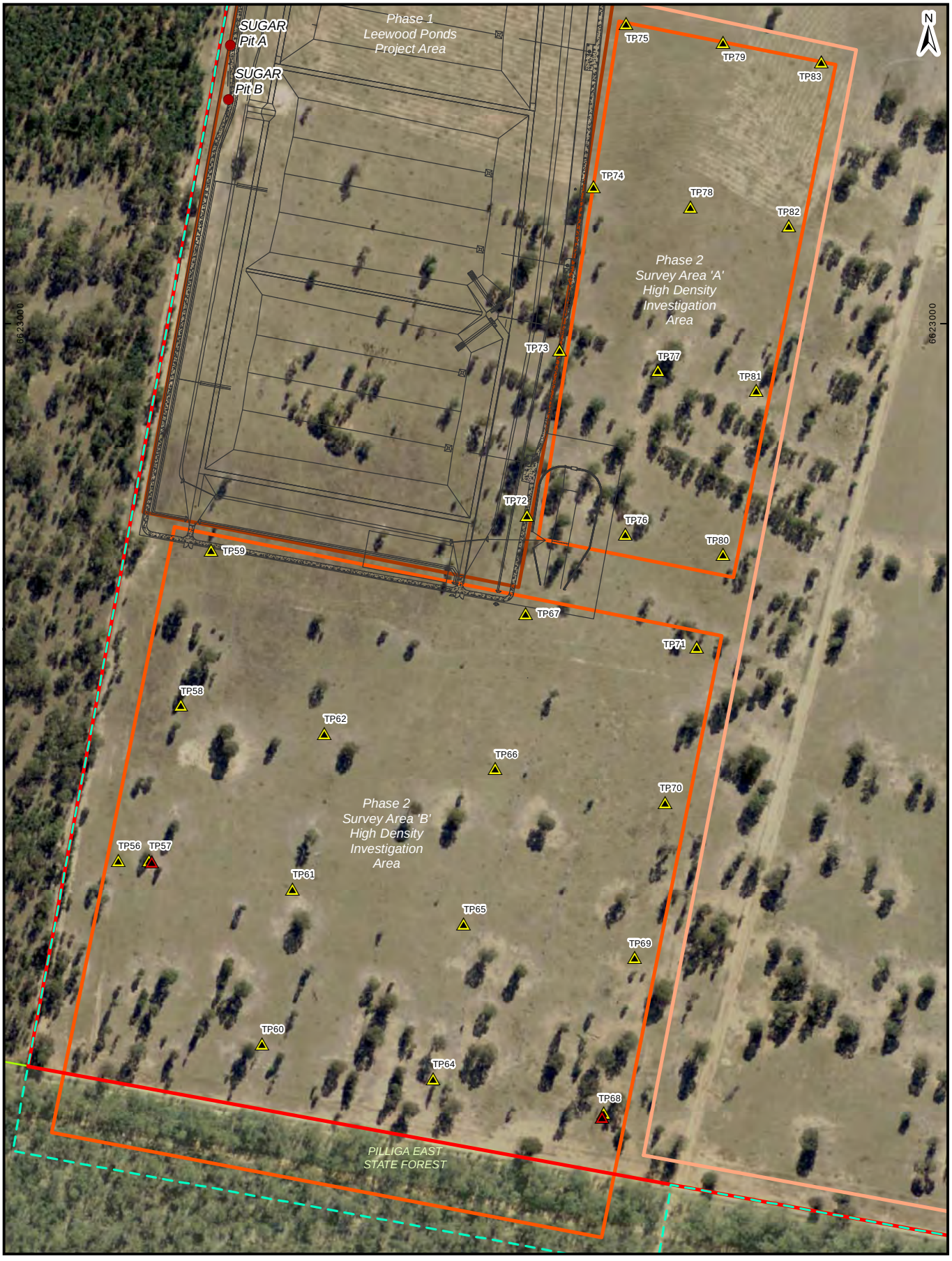
Area C: Short grasses were observed across the field containing TP51, TP53 and TP55 and visibility in these survey areas was approximately 90%. Similar visibility existed around TP50, TP52 and TP54.

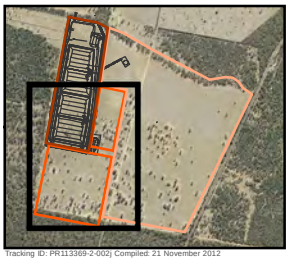
The visual inspection revealed no surface Aboriginal sites or objects or historic heritage items within the nine test pit survey areas. Again the assessed potential for subsurface objects is considered to be very low. This assessment has subsequently been reinforced by the digging of these nine geotechnical test pit sites, which revealed no subsurface Aboriginal or historic heritage items.

Table 2 : Phase 2 Area A Test Pit Locations – Expanded Scope (UTM)

Test Pit	Eastings	Northings	Landform	Archaeological Sensitivity
TP50	751957	6622518	Low relief disturbed landscape	Low to nil sensitivity
TP51	752148	6623329	Low relief disturbed landscape	Low to nil sensitivity
TP52	752035	6622252	Low relief disturbed landscape	Low to nil sensitivity
TP53	752285	6623931	Low relief disturbed landscape	Low to nil sensitivity
TP54	752449	6622531	Low relief disturbed landscape	Low to nil sensitivity
TP55	752668	6623172	Low relief disturbed landscape	Low to nil sensitivity
TP56	751171	6622333	Low relief disturbed landscape	Low to nil sensitivity
TP57	751200	6622480	Low relief disturbed landscape	Low to nil sensitivity
TP58	751230	6622627	Low relief disturbed landscape	Low to nil sensitivity
TP59	751259	6622774	Low relief disturbed landscape	Low to nil sensitivity
TP60	751307	6622306	Low relief disturbed landscape	Low to nil sensitivity
TP61	751336	6622453	Low relief disturbed landscape	Low to nil sensitivity
TP62	751366	6622600	Low relief disturbed landscape	Low to nil sensitivity
TP63	751870	6623759	Low relief disturbed landscape	Low to nil sensitivity
TP64	751469	6622273	Low relief disturbed landscape	Low to nil sensitivity
TP65	751498	6622420	Low relief disturbed landscape	Low to nil sensitivity
TP66	751528	6622567	Low relief disturbed landscape	Low to nil sensitivity
TP67	751557	6622714	Low relief disturbed landscape	Low to nil sensitivity
TP68	751631	6622241	Low relief disturbed landscape	Low to nil sensitivity
TP69	751660	6622338	Low relief disturbed landscape	Low to nil sensitivity
TP70	751689	6622535	Low relief disturbed landscape	Low to nil sensitivity
TP71	751719	6622682	Low relief disturbed landscape	Low to nil sensitivity
TP72	751558	6622807	Low relief disturbed landscape	Low to nil sensitivity
TP73	751589	6622963	Low relief disturbed landscape	Low to nil sensitivity
TP74	751621	6623118	Low relief disturbed landscape	Low to nil sensitivity
TP75	751652	6623273	Low relief disturbed landscape	Low to nil sensitivity
TP76	751651	6622789	Low relief disturbed landscape	Low to nil sensitivity
TP71	751682	6622944	Low relief disturbed landscape	Low to nil sensitivity
TP78	751713	6623099	Low relief disturbed landscape	Low to nil sensitivity
TP79	751744	6623255	Low relief disturbed landscape	Low to nil sensitivity
TP80	751744	6622770	Low relief disturbed landscape	Low to nil sensitivity
TP81	751775	6622925	Low relief disturbed landscape	Low to nil sensitivity
TP82	751806	6623081	Low relief disturbed landscape	Low to nil sensitivity
TP83	751837	6623236	Low relief disturbed landscape	Low to nil sensitivity
TP84	752005	6623735	Low relief disturbed landscape	Low to nil sensitivity
TP85	751769	2223368	Low relief disturbed landscape	Low to nil sensitivity

Source: RPS 2012.





Tracking ID: PR113369-2-002| Compiled: 21 November 2012

N

50 0 50 100

Metres

APPROX SCALE 5,000 @ A4

GDA 1994 MGA Zone 55

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DATA SOURCES

Point features located in field by GPS.
Proposed Pond Areas derived from Aurecon drawing 7081-40-068 RevD.

LEGEND

Scouted Points

- Moved Pit
- Test Pit
- Heritage Item
- Proposed Ponds
- Lot Boundary
- Leewood Ponds surveyed area
- State Forest / Reserve / Park

Visual Inspection Survey Areas

- Phase 1
- Phase 2 Survey Area 'A' / 'B'
- Phase 2 Survey Area 'C' / Phase 3

RPS

FIGURE 6

Leewood Ponds
Phase 2
Areas A & B

5.1.6 Phase 3 Survey

The Phase 3 visual inspection of the Leewood Ponds Activity Area (Figure 7) was conducted over two days from Saturday 4 August 2012 to Sunday 5 August 2012.

Ground surface visibility varied across the survey area, with an average of approximately 50%. In some survey areas, visibility was between 0%-5% due to thick grass cover, soggy ground and thick vegetation. Around TP54 however, the visibility was closer to 95%-100% with red/brown cracking clay soils evident between small tufts of grass.

The visual inspection revealed two historic heritage items outside of the Leewood Ponds Activity Area. Two deep pits lined with steel tube and fitted with a bayonet cap were noted just beyond the western boundary of the Phase 1 survey. SUGAR Pit A (Plate 8) was approximately located at position E 751271 – N 6623196 and SUGAR Pit B (Plate 9) was approximately located at E 751273 N 6623211. Research identified these as part of the former SUGAR array used for cosmic ray research from 1968-1979. The array was made up of many station dotted around the Pillaga State Forest. Each station consisted of a large steel tank filled with fluid. When a high energy particle passed through the tank the fluid would emit a flash of light that was detected by sensitive photodetectors in the tank (William Tango 2012 pers.comm.). According to William (Bill) Tango, Honorary Senior Lecturer at the School of Physics at the University of Sydney, there would have also been a small electronics cabinet next to the tank, from whence signals were transmitted from each station back to the base station which was located on university property near the Bohena Creek bridge (*ibid.*).

Aside from the SUGAR station, the visual inspection revealed no Aboriginal or historic heritage sites or objects within the Phase 3 survey area, and the assessed potential for subsurface objects beyond the above mentioned locations is very low.





Tracking ID: PR113369-2-004h Compiled: 21 November 2012

N

75 0 75 150

Metres

APPROX SCALE 7,500 @ A4

GDA 1994 MGA Zone 55

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DATA SOURCES

Point features located in field by GPS.
Proposed Pond Areas derived from Aurecon drawing 7081-40-068 RevD.

LEGEND

Scouted Points

- Test Pit
- Proposed Ponds
- Lot Boundary
- Leewood Ponds surveyed area
- State Forest / Reserve / Park

Visual Inspection Survey Areas

- Phase 1
- Phase 2 Survey Area 'A' / 'B'
- Phase 2 Survey Area 'C' / Phase 3

RPS

FIGURE 6

Leewood Ponds
Phase 2 Area C /
Phase 3

5.1.8 Phase 4 Survey

Phase 4 of the visual inspection involved the pedestrian survey of the Bibblewindi Flowline Activity Area, located to the immediate southwest of a formed unsealed vehicle track. The area appeared to be generally disturbed by vehicle movement, previous vegetation clearance and the construction of nearby infrastructure associated with the Bibblewindi Water Management Facility (Plate 10).

Vegetation appeared to be primarily regrowth, and comprised a thick heath community with sparse mature eucalypts (Plate 11). White cypress pine and she-oak trees were also present. Ground surface exposures were present (70-80%), though ground surface visibility was limited by the dense heath vegetation (50-60%) (Plate 12). No raw stone materials suitable for artefact or tool manufacture were present in the Activity Area. Soil in the Activity Area comprised loose, red-orange sand approximately 2-5 centimetres deep overlying an orange clay B horizon, which was exposed in some areas.

As clay subsoil layers are considered to be archaeologically sterile, it is not anticipated that artefacts would be contained within subsoil layers and the potential for intact archaeological deposits was assessed as low. No Aboriginal sites or objects were identified in the Activity Area and no historic heritage items or sites were identified. Additionally, no trees exhibiting evidence of cultural modification/scarring were observed and no vegetation with natural heritage significance was identified.

5.1.9 Phase 5 Survey

Phase 5 of the visual inspection involved the pedestrian survey of the Bohena Creek Activity Area located at Bohena Creek, approximately 330 metres east of Bohena Creek Road (Plate 13). The area appeared to be generally disturbed by vehicle movement, previous vegetation clearance and track grading (Plate 14).

Vegetation in the immediate impact area has been completely cleared. Surrounding vegetation was open forest, primarily comprising mature eucalypts (Plate 15). Ground surface exposure in the creek bed and along the creek banks was extensive (80-95%), and ground visibility was generally high (85%) (Plate 16). Sparse grasses on the creek banks did limit ground surface visibility slightly (60-70%). Soil in the Activity Area comprised loose, yellow sand 1-20 centimetres deep overlying orange clay B horizon soil, which was exposed in some areas (particularly along the track and on the banks of the creek) (Plate 17).

As clay subsoil layers are considered to be archaeologically sterile, it is not anticipated that artefacts would be contained within subsoil layers and the potential for intact archaeological deposits was assessed as low. No raw stone materials suitable for artefact or tool manufacture were present in the Activity Area. No Aboriginal sites or objects were identified in the Activity Area and no historic heritage items or sites were identified. Additionally, no trees exhibiting evidence of cultural modification/scarring were observed and no vegetation with natural heritage significance was identified.

5.2 Visual Inspection Field Results and Summary

The visual inspection revealed that the all geotechnical test pit locations, the Leewood Ponds Activity Area that contains them, and the surveyed area beyond, forms part of a highly disturbed landscape modified over time by intensive agricultural and domestic pursuits and as a result, appeared low in archaeological sensitivity (Tables 1 & 2) and research potential. This assessment fits with RPS understanding that the Leewood property has been farmed for over 80 years (Rodgers 2012, pers. comm.). The proposed test pit locations were all situated on slightly elevated land of low relief interspersed with access tracks and clearings. Each of the 65 geotechnical test pit locations are described in Appendix 4.

Likewise, the visual inspection of the Bibblewindi Flowline Activity Area confirmed that the area had been disturbed as a result of vehicle movement, previous vegetation clearance and the construction of nearby

infrastructure associated with the Bibblewindi Water Management Facility. The Bohena Creek Activity Area had also been disturbed by previous vegetation clearance and the installation of the existing gas flowline. RPS description of the landscape conforms with the Office of Environment and Heritage (OEH) definition of disturbed land (2010:18) as:

> *Land is disturbed land if it has been the subject of human activity that has changed the land's surface, being changes that remain clear and observable. Examples include ploughing, construction of rural infrastructure (such as dams and fences), construction of roads, trails and tracks (including fire trails and tracks and walking tracks), clearing vegetation, construction of buildings and the erection of other structures, construction or installation of utilities and other similar services (such as above or below ground electrical infrastructure, water or sewerage pipelines, stormwater drainage and other similar infrastructure), substantial grazing involving the construction of rural infrastructure, and construction of earthworks associated with anything referred to above.*

In keeping with the 2010 Due Diligence Code of Practice (2010:11-12) the landscape investigated by RPS did possess a sensitive landscape feature which may indicate the presence of Aboriginal objects. The Due Diligence Code provides examples of these higher sensitivity landscape features which occur: within 200 metres of waters; within a sand dune system; on a ridge top, ridge line or headland; within 200 metres below or above a cliff face; or within 20 metres of or in a cave, rock shelter or cave mouth; on land that is not disturbed. The high order Bohena Creek runs directly through the Bohena Creek Activity Area. This sensitive landscape feature was thoroughly inspected for evidence of Aboriginal objects or sites; none were identified. No other sensitive landscape features were identified at the Leewood Ponds, Bibblewindi Flowline or Bohena Creek Activity Areas. The RPS assessment confirms the land at the Activity Areas to be disturbed and the archaeological sensitivity and research potential to be low to nil.

Irrespective of this, the visual inspection did identify an historic site (SUGAR station) outside of the Leewood Ponds Activity Area but within the surveyed area on the Leewood property.

A SUGAR station comprising two steel lined pits was recorded just beyond the Leewood Ponds Activity Area. The proposed works must avoid these historic heritage items. They should be flagged and a temporary visual barrier (Plate 3) erected around them prior to commencement of works. A plan of the area showing the two historic heritage items and associated heritage exclusion zones should be retained on site and all on-site personnel must be advised of the location of the items and the need to remain outside of an exclusion zone; this may form part of the daily toolbox talk or a separate heritage induction. The barriers must be removed at the completion of the proposed works (see Recommendations 1-3).

6.0 Impact Assessment

6.1 Aboriginal Heritage

The purpose of a due diligence report is to identify whether Aboriginal objects are present, or likely to be present, in the Activity Areas; to determine whether proposed activities are likely to harm Aboriginal objects (if present) and to determine whether an Aboriginal Heritage Impact Permit (AHIP) is required.

The results of the AHIMS searches together with the visual inspection indicate that there are no identified Aboriginal objects or places in the Activity Areas. As **there are no identified Aboriginal objects or places in the Activity Areas it is assessed that there is no identified risk of harm to Aboriginal objects and an AHIP is not required for the proposed activity**.

6.2 Historic Heritage

The assessment contained in this report goes beyond the requirements of the Due Diligence Code to consider any potential impact on identified historic heritage items within the Activity Areas and determine if a Statement of Heritage Impact for historic heritage is required.

At this stage Santos has no intention to modify, damage or destroy the SUGAR station on the Leewood property. In the event that any part of the SUGAR station will be impacted, further investigation under the *Heritage Act 1977* should be undertaken prior to works. This may include the preparation of a Statement of Heritage Impact for the SUGAR station.

However, as **no historic heritage sites were identified within the Activity Areas, there is no identified risk of harm to historic heritage and a Statement of Heritage Impact is not required**.

7.0 Recommendations

This report has considered the available environmental and archaeological information for the Activity Areas, the land condition, as well as, the nature of the proposed activities. Recommendations 1-2 have been provided specifically for the Activity Areas. Recommendations 3-7 must also be followed for undertaking the proposed activities/works as they provide contingency procedures should unexpected Aboriginal objects, skeletal remains or suspected historic heritage material be identified during the proposed works.

No Aboriginal objects or places have been identified within the Activity Areas. **As there are no identified Aboriginal objects in the Activity Areas it is assessed that there is no identified risk of harm to Aboriginal objects and an AHIP is not required for the proposed activities.**

No historic heritage sites or objects have been identified within the Activity Areas. **As there are no identified historic heritage objects in the Activity Areas it is assessed that there is no identified risk of harm to historic heritage sites or objects and a Statement of Heritage Impact is not required for the proposed activities.**

The proposed works can proceed within the Activity Areas as planned.

RECOMMENDATIONS

Recommendation 1

Two historic heritage items (a SUGAR station comprising two SUGAR pits) have been identified outside of the Leewood Ponds Activity Area but within the surveyed area on the Leewood property. The proposed works should avoid these items. These heritage items must be flagged and a temporary visual barrier (Plate 3) erected around them prior to the commencement of works. A plan of the area showing their location and the heritage exclusion zone surrounding them should be retained on site and all on-site personnel must be advised accordingly and remain outside of the exclusion zone; this may form part of the daily toolbox talk or a separate heritage induction. The barriers must be removed at the completion of the proposed works.

Recommendation 2

If impact on the historic heritage items cannot be avoided by the proposed works further investigation under the *Heritage Act 1977* including the preparation of a Statement of Heritage Impact is required.

Recommendation 3

All relevant Santos staff and contractors should be made aware of their statutory obligations for heritage under NSW *National Parks and Wildlife Act 1974* and the NSW *Heritage Act 1977,* which may be implemented as a heritage induction.

Recommendation 4

This due diligence report must be kept by Santos so that it can be presented, if needed, as a defence from prosecution.

Recommendation 5

If Aboriginal object/s are identified in the Activity Area during works, then all works in the immediate area must cease and the area cordoned off. The Office of Environment and Heritage must be notified by ringing the Enviroline 131 555 so that the site can be adequately assessed and managed.

Recommendation 6

In the event that skeletal remains are uncovered, work must cease immediately in that area and the area cordoned off. Santos must contact the NSW Police with no further action taken until written advice is provided by the Police. If the remains are determined to be of Aboriginal origin, the Office of Environment and Heritage must be notified by ringing the Enviroline 131 555 and a management plan prior to works re-commencing must developed in consultation with the relevant Aboriginal stakeholders.

Recommendation 7

If, during the course of development works, additional suspected historic heritage material is uncovered or existing historic heritage material is in danger of impact/harm, work should cease in that area immediately. The Heritage Branch, Office of Environment and Heritage (Enviroline 131 555) should be notified and works only recommence when an approved management strategy developed.

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9.0 Plates



Plate 1 : Pilliga Box –White Cypress Pine Grassy Open Woodland on Alluvial loams observed within the Leewood Ponds Activity Area.



Plate 2 : Brigalow Woodland observed within the Leewood Ponds Activity Area.



Plate 3 : Example of temporary barrier suitable for flagging and roping off a heritage item in order to form a heritage exclusion zone to prevent it being impacted by proposed works.

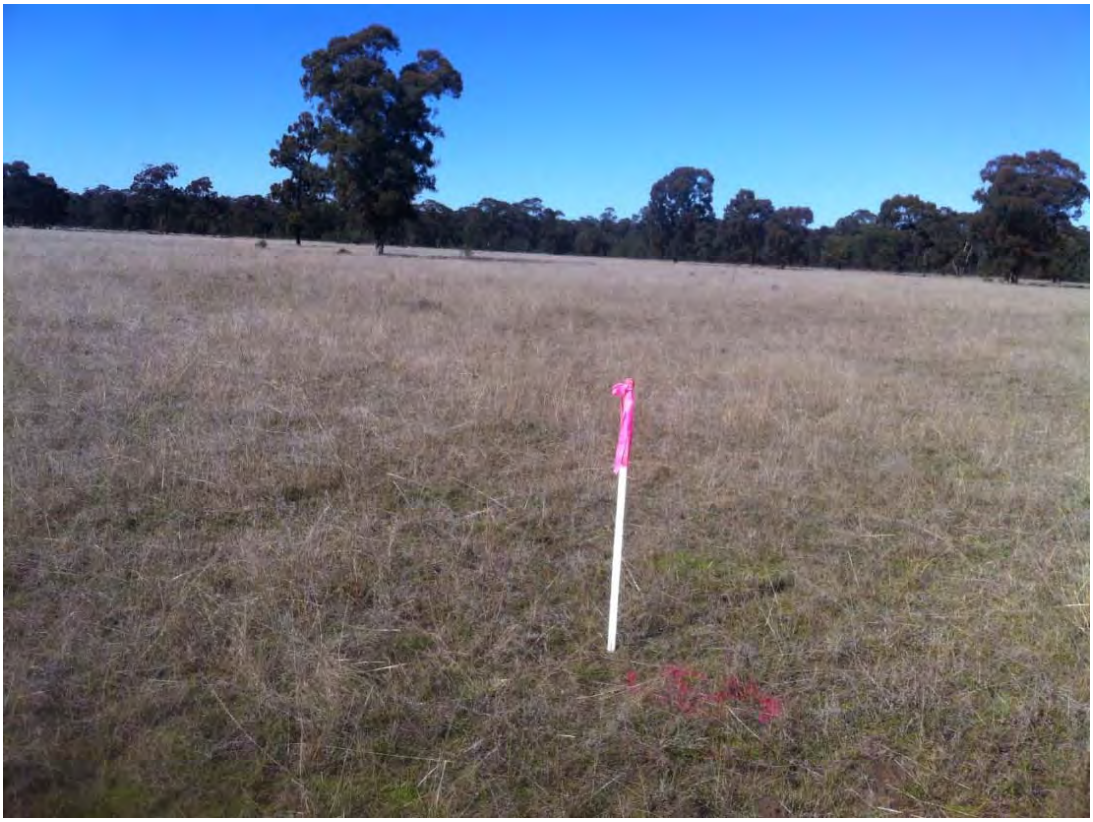


Plate 4 : Looking 164 degrees south toward the location of TP50.

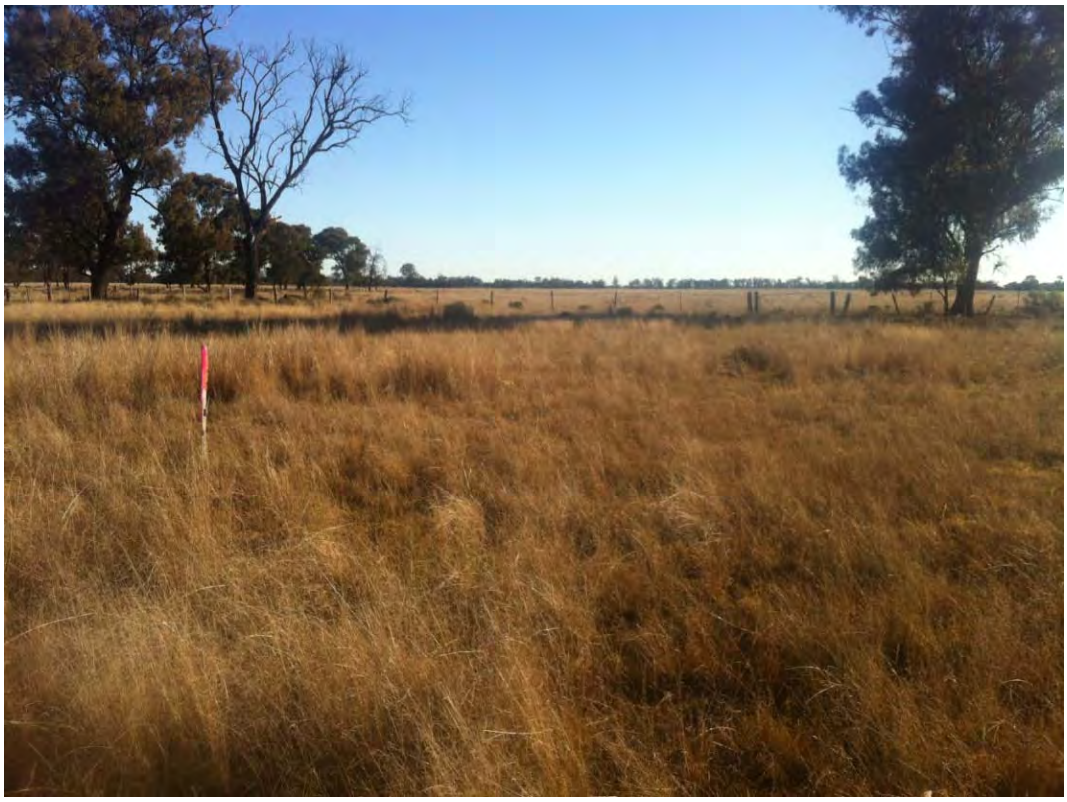


Plate 5 : Looking 359 degrees south toward the location of TP63. Note northern boundary of the Leewood property in the background.



Plate 6 : Looking 258 degrees west toward the location of TP82. Note mowed corridor/easement across centre of Test Pit location.



Plate 7 : Looking across the site of Test Pit TP77. Note the use of spray paint to mark the test pit location in the absence of available survey stakes and flagging tape.



Plate 8 : Looking toward SUGAR Pit A. When the lid was removed, the structure revealed a tunnel of approximately five metres deep which opened into a cavity at the bottom.



Plate 9 : Looking toward SUGAR Pit B. Note that the lid was unable to be removed, so the inside of the structure was unable to be examined.



Plate 10 : Disturbance adjacent to Bibblewindi Flowline Activity Area facing south east (Activity Area to the right of frame).



Plate 11 : Vegetation in the Bibblewindi Flowline Activity Area facing south east.



Plate 12 : Ground surface exposure and ground surface visibility in the Bibblewindi Flowline Activity Area.



Plate 13 : View of the Bohena Creek Activity Area facing west.



Plate 14 : Disturbance in the Bohena Creek Activity Area.



Plate 15 : Vegetation in the Bohena Creek Activity Area.



Plate 16 : Ground surface exposure and ground surface visibility in the Bohena Creek Activity Area.



Plate 17 : Ground surface exposure and ground surface visibility in the Bohena Creek Activity Area.

10.0 Terms, Definitions, and Abbreviations

Abbreviation/ Term	Meaning
Aboriginal Object	"any deposit, object or material evidence (not being a handicraft made for sale) relating to the Aboriginal habitation of the area that comprises NSW, being habitation before or concurrent with (or both) the occupation of that area by persons of non-Aboriginal extraction, and includes Aboriginal remains" (DECCW 2010:18).
Aboriginal Place	"a place declared under s.84 of the NPW Act that, in the opinion of the Minister, is or was of special significance to Aboriginal culture" (DECCW 2010:18). Aboriginal places have been gazetted by the minister.
Aboriginal Culturally Modified Tree	"means a tree that, before or concurrent with (or both) the occupation of the area in which the tree is located by persons of non-Aboriginal extraction, has been scarred, carved or modified by an Aboriginal person by: (a) the deliberate removal, by traditional methods, of bark or wood from the tree; or (b) the deliberate modification, by traditional methods, of the wood of the tree" NPW Regulation 80B (3). Culturally Modified trees are sometimes referred to as scarred trees.
Activity	A project, development, or work (this term is used in its ordinary meaning and is not restricted to an activity as defined by Part 5 EP&A Act 1979).
AHIMS	Aboriginal Heritage Information Management System
AHIP	Aboriginal Heritage Impact Permit
cal. years BP	Calibrated years before present, indicates a radiocarbon date has been calibrated using the dendrochronology curves, making the date more accurate than an uncalibrated date.
DECCW	Department of Environment, Climate Change and Water (is now the Office of Environment and Heritage – OEH)
Disturbed Land	"Land is disturbed if it has been the subject of a human activity that has changed the land's surface, being changes that remain clear and observable." (DECCW 2010:18).
Due Diligence	"taking reasonable and practical steps to determine whether a person's actions will harm an Aboriginal object and, if so, what measures can be taken to avoid that harm" (DECCW 2010:18)
EIA	Environmental Impact Assessment
EIS	Environmental Impact Statement
EP&A Act	*Environmental Planning and Assessment Act 1979 (NSW)*
GDA	Geodetic Datum Australia
GIS	Geographic Information System
Harm	"destroy, deface, damage an object, move an object from the land on which it is situated, cause or permit an object to be harmed." (DECCW 2010:18)
LALC	Local Aboriginal Land Council
LEP	Local Environment Plan
NPWS	National Parks and Wildlife Service
NPW Act	*National Parks and Wildlife Act 1974* (NSW)
NPW Regulation	*National Parks and Wildlife Regulation 2009* (NSW)
OEH	Office of Environment and Heritage (formerly DECCW)
PAD	Potential Archaeological Deposit
Project Area	Project Area is the area subject to the proposed activity
REP	Regional Environment Plan
REF	Review of Environmental Factors

Appendix 1

Legislative Requirements

Summary of Statutory Controls

The following overview of the legal framework is provided solely for information purposes for the client, it should not be interpreted as legal advice. RPS will not be liable for any actions taken by any person, body or group as a result of this general overview, and recommend that specific legal advice be obtained from a qualified legal practitioner prior to any action being taken as a result of the summary below.

COMMONWEALTH

Aboriginal & Torres Strait Islander Heritage Protection Act 1984 (ATSIHIP Act)

The purpose of this Act is to preserve and protect all heritage places of particular significance to Aboriginal and Torres Strait Islander people. This Act applies to all sites and objects across Australia and in Australian waters (s4).

It would appear that the intention of this Act is to provide national baseline protection for Aboriginal places and objects where Stage legislation is absent. It is not to exclude or limit State laws (s7(1)). Should State legislation cover a matter already covered in the Commonwealth legislation, and a person contravenes that matter, that person may be prosecuted under either Act, but not both (s7(3)).

The Act provides for the preservation and protection of all Aboriginal objects and places from injury and/or desecration. A place is construed to be injured or desecrated if it is not treated consistently with the manner of Aboriginal tradition or is or likely to be adversely affected (s3).

Australian Heritage Commission Act 1975

The *Australian Heritage Commission Act (1975)* established the Australian Heritage Commission which assesses places to be included in the National Estate and maintains a register of those places. Places maintained in the register are those which are significant in terms of their association with particular community or social groups and they may be included for social, cultural or spiritual reasons. The Act does not include specific protective clauses.

The *Australian Heritage Council Act 2003,* together with the *Environment Protection & Biodiversity Conservation Act 1999,* includes a National Heritage List of places of National heritage significance, maintains a Commonwealth Heritage List of heritage places owned or managed by the Commonwealth and ongoing management of the Register of the National Estate.

STATE

It is incumbent on any land manager to adhere to state legislative requirements that protect Aboriginal Cultural heritage. The relevant legislation is NSW includes but is not limited to the summary below.

National Parks and Wildlife Act 1974 (NPW Act)

The NPW Act provides statutory protection for all Aboriginal heritage, places and objects (not being a handicraft made for sale), with penalties levied for breaches of the Act. This legislation is overseen by the Office of Environment and Heritage (OEH), and specifically the Chief Executive (formerly the Director-General) of OEH. Part 6 of this Act is the relevant part concerned with Aboriginal objects and places, with Section 86 and Section 90 being the most pertinent. In 2010, this Act was substantially amended, particularly with respect to Aboriginal cultural heritage requirements. Relevant sections include:

Section 86

This section now lists four major offences:

(4) A person must not harm an object that the person knows is an Aboriginal object;

(5) A person must not harm and Aboriginal object;

(6) For the purposes of s86, "circumstances of aggravation" include:

(g) The offence being committed during the course of a commercial activity; or

(h) That the offence was the second or subsequent offence committed by the person;

(7) A person must not harm or desecrate an Aboriginal place.

Offences under s86 (2) and (4) are now strict liability offences, i.e., knowledge that the object or place harmed was an Aboriginal object or place needs to be proven. Penalties for all offences under Part 6 of this Act have also been substantially increased, depending on the nature and severity of the offence.

Section 87

This section now provides defences to the offences of s86. These offences chiefly consist of having an appropriate Aboriginal Heritage Impact Permit (AHIP), not contravening the conditions of the AHIP or demonstrating that due diligence was exercised prior to the alleged offence.

Section 87A & 87B

These sections provide exemptions from the operation of s86; Section 87A for authorities such as the Rural Fire Service, State Emergency Services and officers of the National Parks & Wildlife Service in the performance of their duties, and s87B for Aboriginal people performing traditional activities.

Section 89A

If a person knows of the location of an Aboriginal object or place that has not been previously registered and does not advise the Director-General (now Chief Executive) of that object or place within a reasonable period of time, then that person is guilty of an offence under this Section of the Act.

Section 90

This section authorises the Director-General (now Chief Executive) to issue and AHIP.

Section 90A-90R

These sections govern the requirements relating to applying for an AHIP. In addition to the amendments to the Act, OEH have issued three new policy documents clarifying OEH's requirements with regards to Aboriginal archaeological investigations: *Aboriginal Cultural Heritage Consultation Requirements for Proponents 2010, Due Diligence Code of Practice for the Protection of Aboriginal Objects in NSW and Code of Practice for Archaeological Investigations in NSW*. The Consultation Requirements formalise the consultation with Aboriginal community groups into four main stages, and includes details regarding the parties required to be consulted, advertisements inviting Aboriginal community groups to participate in the consultation process, requirements regarding the provision of methodologies, draft and final reports to the Aboriginal stakeholders and timetables for the four stages. The Due Diligence Code of Practice sets out the minimum requirements for investigation, with particular regard as to whether an AHIP is required. The Code

of Practice for Archaeological Investigation sets out the minimum requirements for archaeological investigation of Aboriginal sites.

Aboriginal Heritage Impact Permits (AHIP)

OEH encourages consultation with relevant Aboriginal stakeholders for all Aboriginal Heritage Assessments. However, if an Aboriginal Heritage Impact Permit (AHIP) is required for an Aboriginal site, then specific OEH guidelines are triggered for Aboriginal consultation.

Aboriginal Cultural Heritage Consultation Requirements for Proponents

In 2010, the Aboriginal Cultural Heritage Consultation Requirements for Proponents (ACHCR's) were issued by OEH (12th April 2010). These consultation requirements replace the previously issued Interim Community Consultation Requirements (ICCR) for Applicants (Dec 2004). These guidelines apply to all AHIP applications prepared after 12th April 2010; for projects commenced prior to 12th April 2010, transitional arrangements have been stipulated in a supporting document, Questions and Answers 2: Transitional Arrangements.

The ACHCR's 2010 include a four stage Aboriginal consultation process and stipulate specific timeframes for each state. Stage 1 requires that Aboriginal people who hold cultural information are identified, notified and invited to register an expression of interest in the assessment. Stage 1 includes the identification of Aboriginal people who may have an interest in the Activity Area and hold information relevant to determining the cultural significance of Aboriginal objects or places. This identification process should draw on reasonable sources of information including: the relevant OEH EPRG regional office, the relevant Local Aboriginal Land Council(s), the Registrar of Aboriginal Owners, Aboriginal Land Rights Act (1983), the Native Title Tribunal, Native Title Services Corporation Limited, the relevant local council(s), and the relevant catchment management authority. The identification process should also include an advertisement placed in a local newspaper circulating in the general location of the Activity Area. Aboriginal organisations and/or individuals identified should be notified of the project and invited to register an expression of inters (EoI) for Aboriginal consultation. Once a list of Aboriginal stakeholders has been compiled from the EoI's, they need to be consulted in accordance with ACHCR's Stages 2, 3 and 4.

Environmental Planning & Assessment Act 1979 (EP&A Act)

This Act regulates a system of environmental planning and assessment for New South Wales. Land use planning requires that environmental impacts are considered, including the impact on cultural heritage and specifically Aboriginal heritage. Within the EP&A Act, Parts 3, 4 and 5 relate to Aboriginal heritage.

Part 3 regulates the preparation of planning policies and plans. Part 4 governs the manner in which consent authorities determine development applications and outlines those that require an environmental impact statement. Part 5 regulates government agencies that act as determining authorities for activities conducted by that agency or by authority from the agency. The National Parks & Wildlife Service is a Part 5 authority under the EP&A Act.

In brief, the NPW Act provides protection for Aboriginal objects or places, while the EP&A Act ensures that Aboriginal cultural heritage is properly assessed in land use planning and development.

Heritage Act 1977

This Act protects the natural and cultural history of NSW with emphasis on non-indigenous cultural heritage through protection provisions and the establishment of a Heritage Council. Although Aboriginal heritage sites and objects are primarily protected by the *National Parks & Wildlife Act 1974*, if an Aboriginal site, object or place is of great significance, it may be protected by a heritage order issued by the Minister subject to advice by the Heritage Council.

Other legislation of relevance to Aboriginal cultural heritage in NSW includes the *NSW Local Government Act 1993*. Local planning instruments also contain provisions relating to indigenous heritage and development conditions of consent.

Appendix 2

AHIMS Search Results

AHIMS Web Services (AWS)
Search Result

Your Ref Number : 113369-2

Client Service ID : 85716

RPS Australia East Pty Ltd Sydney CBD
Level 12 92 Pitt Street
Sydney New South Wales 2000

Attention: Karyn Virgin

Email: karyn.virgin@rpsgroup.com.au

Date: 20 November 2012

Dear Sir or Madam:

AHIMS Web Service search for the following area at Datum :GDA, Zone : 55, Eastings : 750421 - 753833, Northings : 6608757 - 6611180 with a Buffer of 1000 meters. conducted by Karyn Virgin on 20 November 2012

A search of the Office of the Environment and Heritage AHIMS Web Services (Aboriginal Heritage Information Management System) has shown that:

0	**Aboriginal sites are recorded in or near the above location.**
0	**Aboriginal places have been declared in or near the above location. ***

If your search shows Aboriginal sites or places what should you do?

- You must do an extensive search if AHIMS has shown that there are Aboriginal sites or places recorded in the search area.
- If you are checking AHIMS as a part of your due diligence, refer to the next steps of the Due Diligence Code of practice.
- You can get further information about Aboriginal places by looking at the gazettal notice that declared it. Aboriginal places gazetted after 2001 are available on the NSW Government Gazette (http://www.nsw.gov.au/gazette) website. Gazettal notices published prior to 2001 can be obtained from Office of Environment and Heritage's Aboriginal Heritage Information Unit upon request

Important information about your AHIMS search

- The information derived from the AHIMS search is only to be used for the purpose for which it was requested. It is not be made available to the public.
- AHIMS records information about Aboriginal sites that have been provided to Office of Environment and Heritage and Aboriginal places that have been declared by the Minister;
- Information recorded on AHIMS may vary in its accuracy and may not be up to date .Location details are recorded as grid references and it is important to note that there may be errors or omissions in these recordings,
- Some parts of New South Wales have not been investigated in detail and there may be fewer records of Aboriginal sites in those areas. These areas may contain Aboriginal sites which are not recorded on AHIMS.
- Aboriginal objects are protected under the National Parks and Wildlife Act 1974 even if they are not recorded as a site on AHIMS.
- This search can form part of your due diligence and remains valid for 12 months.

AHIMS Web Services (AWS)
Search Result

Your Ref Number : Bibblewindi

Client Service ID : 84423

RPS Australia East Pty Ltd Sydney CBD
Level 12 92 Pitt Street
Sydney New South Wales 2000

Attention: Karyn Virgin

Email: karyn.virgin@rpsgroup.com.au

Date: 01 November 2012

Dear Sir or Madam:

AHIMS Web Service search for the following area at Datum :GDA, Zone : 55, Eastings : 751018 - 756032, Northings : 6606701 - 6609873 with a Buffer of 1000 meters. conducted by Karyn Virgin on 01 November 2012

A search of the Office of the Environment and Heritage AHIMS Web Services (Aboriginal Heritage Information Management System) has shown that:

0	**Aboriginal sites are recorded in or near the above location.**
0	**Aboriginal places have been declared in or near the above location. ***

If your search shows Aboriginal sites or places what should you do?

- You must do an extensive search if AHIMS has shown that there are Aboriginal sites or places recorded in the search area.
- If you are checking AHIMS as a part of your due diligence, refer to the next steps of the Due Diligence Code of practice.
- You can get further information about Aboriginal places by looking at the gazettal notice that declared it. Aboriginal places gazetted after 2001 are available on the NSW Government Gazette (http://www.nsw.gov.au/gazette) website. Gazettal notices published prior to 2001 can be obtained from Office of Environment and Heritage's Aboriginal Heritage Information Unit upon request

Important information about your AHIMS search

- The information derived from the AHIMS search is only to be used for the purpose for which it was requested. It is not be made available to the public.
- AHIMS records information about Aboriginal sites that have been provided to Office of Environment and Heritage and Aboriginal places that have been declared by the Minister;
- Information recorded on AHIMS may vary in its accuracy and may not be up to date .Location details are recorded as grid references and it is important to note that there may be errors or omissions in these recordings,
- Some parts of New South Wales have not been investigated in detail and there may be fewer records of Aboriginal sites in those areas. These areas may contain Aboriginal sites which are not recorded on AHIMS.
- Aboriginal objects are protected under the National Parks and Wildlife Act 1974 even if they are not recorded as a site on AHIMS.
- This search can form part of your due diligence and remains valid for 12 months.

AHIMS Web Services (AWS)
Search Result

Your Ref Number : Leewood L15 - 1km

Client Service ID : 76914

RPS Australia East Pty Ltd Sydney CBD
Level 12 92 Pitt Street
Sydney New South Wales 2000

Attention: Sarah Ward

Email: sarah.ward@rpsgroup.com.au

Date: 09 August 2012

Dear Sir or Madam:

AHIMS Web Service search for the following area at Lot : 15, DP:DP757083 with a Buffer of 1000 meters. conducted by Sarah Ward on 09 August 2012

A search of the Office of the Environment and Heritage AHIMS Web Services (Aboriginal Heritage Information Management System) has shown that:

0	**Aboriginal sites are recorded in or near the above location.**
0	**Aboriginal places have been declared in or near the above location. ***

If your search shows Aboriginal sites or places what should you do?

- You must do an extensive search if AHIMS has shown that there are Aboriginal sites or places recorded in the search area.
- If you are checking AHIMS as a part of your due diligence, refer to the next steps of the Due Diligence Code of practice.
- You can get further information about Aboriginal places by looking at the gazettal notice that declared it. Aboriginal places gazetted after 2001 are available on the NSW Government Gazette (http://www.nsw.gov.au/gazette) website. Gazettal notices published prior to 2001 can be obtained from Office of Environment and Heritage's Aboriginal Heritage Information Unit upon request

Important information about your AHIMS search

- The information derived from the AHIMS search is only to be used for the purpose for which it was requested. It is not be made available to the public.
- AHIMS records information about Aboriginal sites that have been provided to Office of Environment and Heritage and Aboriginal places that have been declared by the Minister;
- Information recorded on AHIMS may vary in its accuracy and may not be up to date .Location details are recorded as grid references and it is important to note that there may be errors or omissions in these recordings,
- Some parts of New South Wales have not been investigated in detail and there may be fewer records of Aboriginal sites in those areas. These areas may contain Aboriginal sites which are not recorded on AHIMS.
- Aboriginal objects are protected under the National Parks and Wildlife Act 1974 even if they are not recorded as a site on AHIMS.
- This search can form part of your due diligence and remains valid for 12 months.

AHIMS Web Services (AWS)
Search Result

Your Ref Number : Leewood L13 - Ikm

Client Service ID : 76913

RPS Australia East Pty Ltd Sydney CBD
Level 12 92 Pitt Street
Sydney New South Wales 2000

Attention: Sarah Ward

Email: sarah.ward@rpsgroup.com.au

Date: 09 August 2012

Dear Sir or Madam:

AHIMS Web Service search for the following area at Lot : 13, DP:DP757083 with a Buffer of 1000 meters. conducted by Sarah Ward on 09 August 2012

A search of the Office of the Environment and Heritage AHIMS Web Services (Aboriginal Heritage Information Management System) has shown that:

0	**Aboriginal sites are recorded in or near the above location.**
0	**Aboriginal places have been declared in or near the above location. ***

If your search shows Aboriginal sites or places what should you do?

- You must do an extensive search if AHIMS has shown that there are Aboriginal sites or places recorded in the search area.
- If you are checking AHIMS as a part of your due diligence, refer to the next steps of the Due Diligence Code of practice.
- You can get further information about Aboriginal places by looking at the gazettal notice that declared it. Aboriginal places gazetted after 2001 are available on the NSW Government Gazette (http://www.nsw.gov.au/gazette) website. Gazettal notices published prior to 2001 can be obtained from Office of Environment and Heritage's Aboriginal Heritage Information Unit upon request

Important information about your AHIMS search

- The information derived from the AHIMS search is only to be used for the purpose for which it was requested. It is not be made available to the public.
- AHIMS records information about Aboriginal sites that have been provided to Office of Environment and Heritage and Aboriginal places that have been declared by the Minister;
- Information recorded on AHIMS may vary in its accuracy and may not be up to date .Location details are recorded as grid references and it is important to note that there may be errors or omissions in these recordings,
- Some parts of New South Wales have not been investigated in detail and there may be fewer records of Aboriginal sites in those areas. These areas may contain Aboriginal sites which are not recorded on AHIMS.
- Aboriginal objects are protected under the National Parks and Wildlife Act 1974 even if they are not recorded as a site on AHIMS.
- This search can form part of your due diligence and remains valid for 12 months.

AHIMS Web Services (AWS)
Search Result

Your Ref Number : Leewood L1 - 1km

Client Service ID : 76910

RPS Australia East Pty Ltd Sydney CBD
Level 12 92 Pitt Street
Sydney New South Wales 2000

Attention: Sarah Ward

Email: sarah.ward@rpsgroup.com.au

Date: 09 August 2012

Dear Sir or Madam:

AHIMS Web Service search for the following area at Lot : 1, DP:DP771141 with a Buffer of 1000 meters. conducted by Sarah Ward on 09 August 2012

A search of the Office of the Environment and Heritage AHIMS Web Services (Aboriginal Heritage Information Management System) has shown that:

0	**Aboriginal sites are recorded in or near the above location.**
0	**Aboriginal places have been declared in or near the above location. ***

If your search shows Aboriginal sites or places what should you do?

- You must do an extensive search if AHIMS has shown that there are Aboriginal sites or places recorded in the search area.
- If you are checking AHIMS as a part of your due diligence, refer to the next steps of the Due Diligence Code of practice.
- You can get further information about Aboriginal places by looking at the gazettal notice that declared it. Aboriginal places gazetted after 2001 are available on the NSW Government Gazette (http://www.nsw.gov.au/gazette) website. Gazettal notices published prior to 2001 can be obtained from Office of Environment and Heritage's Aboriginal Heritage Information Unit upon request

Important information about your AHIMS search

- The information derived from the AHIMS search is only to be used for the purpose for which it was requested. It is not be made available to the public.
- AHIMS records information about Aboriginal sites that have been provided to Office of Environment and Heritage and Aboriginal places that have been declared by the Minister;
- Information recorded on AHIMS may vary in its accuracy and may not be up to date .Location details are recorded as grid references and it is important to note that there may be errors or omissions in these recordings,
- Some parts of New South Wales have not been investigated in detail and there may be fewer records of Aboriginal sites in those areas. These areas may contain Aboriginal sites which are not recorded on AHIMS.
- Aboriginal objects are protected under the National Parks and Wildlife Act 1974 even if they are not recorded as a site on AHIMS.
- This search can form part of your due diligence and remains valid for 12 months.

Appendix 3

National Native Tribunal Search Register

National Native Title Tribunal

Sydney Office, Operations East
Level 16, Law Courts Building,
Queens Square
Sydney NSW 2000
GPO Box 9973
Sydney NSW 2000
Telephone (02) 9227 4000
Facsimile (02) 9227 4030

16 October 2012

Karyn Virgin
Graduate Archaeologist
RPS Australia East Pty Ltd
Level 9, 17 York Street
SYDNEY NSW 2000

Our Reference: 5153/12sj
Your Reference: PR113359-2, PR114737-2, PR114487-2, PR114695-2

Dear Karyn

Native Title Search Results of Narrabri Shire Local Government Area

Thank you for your search request of 15 October 2012 in relation to the above area.

Search Results
The results provided are based on the information you supplied and are derived from a search of the following Tribunal databases:

Register Type	NNTT Reference Numbers
Schedule of Applications (unregistered claimant applications)	Nil.
Register of Native Title Claims	NC2011/006
National Native Title Register	Nil.
Register of Indigenous Land Use Agreements	Nil.
Notified Indigenous Land Use Agreements	Nil.

I have included a Register Extract and NNTT Registers fact sheet to help you understand the search result.

Please note that there may be a delay between a native title determination application being lodged in the Federal Court and its transfer to the Tribunal. As a result, some native title determination applications recently filed in the Federal Court may not appear on the Tribunal's databases.

The search results are based on analysis against external boundaries of applications only. Native title applications commonly contain exclusions clauses which remove areas from within the

external boundary. To determine whether the areas described are in fact subject to claim, you need to refer to "Area covered by claim" section of the relevant Register Extract or Application Summary and any maps attached.

Search results and the existence of native title

Please note that the enclosed information from the Register of Native Title Claims and/or the Schedule of Applications is **not** confirmation of the existence of native title in this area. This cannot be confirmed until the Federal Court makes a determination that native title does or does not exist in relation to the area. Such determinations are registered on the National Native Title Register.

Tribunal accepts no liability for reliance placed on enclosed information

The enclosed information has been provided in good faith. Use of this information is at your sole risk. The National Native Title Tribunal makes no representative, either express or implied, as to the accuracy or suitability of the information enclosed for any particular purpose and accepts no liability for use of the information or reliance placed on it.

If you have any further queries, please contact me on 1800 640 501.

Yours sincerely



Sylvia Jagtman | SENIOR CASE MANAGEMENT ASSISTANT
National Native Title Tribunal | Sydney Office, Operations East
Telephone (02) 9227 4013 | Facsimile (02) 9227 4030 | Email sylvia.jagtman@nntt.gov.au
Freecall 1800 640 501 | www.nntt.gov.au

Facilitating timely and effective outcomes.

NATIONAL NATIVE TITLE TRIBUNAL

Application Information and Extract from the Register of Native Title Claims

Application Information

Application numbers:	Federal Court number: NNTT number:	NSD2308/11 NC11/6
Application name:	Gomeroi People	
Registration history:	Registered from 20/01/2012.	

Register Extract (pursuant to s.186 of the *Native Title Act 1993*)

Application filed with: Federal Court of Australia

Date application filed: 20/12/2011

Date claim entered on Register: 20/01/2012

Applicants: Ms Patricia Margaret Boney, Mr Norman McGrady, Ms Susan Smith, Mr Michael Anderson, Mr William Robinson, Mr Raymond Welsh, Mr Richard Green, Mr Greg Griffiths, Ms Elaine Binge, Mr Alfred Priestley, Mr Leslie Woodbridge, Mr Craig Trindall, Mr Burrul Galigabali, Mr Bob Weatherall, Ms Elizabeth Allan, Mr Ray Tighe, Mr Anthony Munro, Ms Madeline McGrady, Mr Jason Wilson

Address for service:
NTSCORP Limited
Unit 1a Suite 2.02
44-70 Rosehill Street
REDFERN NSW 2016
Phone: (02) 9310 3188
Fax: (02) 9310 4177

Additional Information:

Not Applicable

Area covered by the claim:

The area covered by the application ('the Application Area') comprises all the land and waters within the external boundaries described in Attachment B and depicted in the map at Attachment C.

The Application Area description and map have been prepared with the assistance of the Geo-Spatial Unit of the National Native Title Tribunal. The area covered by this application does not include the areas described at point B below.

(B) Areas within the external boundaries not covered by the application

1. The area covered by the application excludes any land and waters covered by past or present freehold title or by previous valid exclusive possession acts as defined by section 23B of the Native Title Act 1993 (Cth)

2. The area covered by the application excludes any land and waters which are:
a) a Scheduled interest;
b) a freehold estate;
c) a commercial lease that is neither an agricultural lease nor a pastoral lease;
d) an exclusive agricultural lease or an exclusive pastoral lease;
e) a residential lease;
f) a community purpose lease;
g) a lease dissected from a mining lease and referred to in s 23B(2)(c)(vii) of the Native Title Act (1993) (Cth); and
h) any lease (other than a mining lease) that confers a right of exclusive possession over particular land or waters.

3. Subject to paragraphs 5 and 6, the area covered by the application excludes any land or waters covered by the valid construction or establishment of any public work, where the construction or establishment of the public work commenced on or before 23 December 1996.

4. Subject to paragraphs 5 and 6, exclusive possession is not claimed over areas which are subject to valid previous non-exclusive possession acts done by the Commonwealth, State or Territory.

5. Subject to paragraph 7 below, where the act specified in paragraphs 2, 3 and 4 falls within the provisions of:
a) s 23B(9) Exclusion of acts benefiting Aboriginal Peoples or Torres Strait Islanders;
b) s 23B(9A) Establishment of a national park or state park;
c) s 23B(9B) Acts where legislation provides for non-extinguishment;
d) s 23B(9C) Exclusion of Crown to Crown grants; and
e) s 23B(10) Exclusion by regulation;
the area covered by the act is not excluded from the application.

6. Where an act specified in paragraphs 2, 3 and 4 affects or affected land or waters referred to in:
f) s 47 Pastoral leases etc covered by claimant application;
g) s 47A Reserves covered by claimant application;
h) s 47B Vacant Crown land covered by claimant application;
the area covered by the act is not excluded from the application.

7. The area covered by the application excludes land or waters where the native title rights and interests claimed have been otherwise extinguished.

Persons claiming to hold native title:

The Gomeroi People are the native title claim group on whose behalf the Applicant makes this application. The native title claim group comprises all the descendants of the following apical ancestors:
Thomas Pitt (who was born in 1838).
Billy Barlow (who was born in Tycannah in 1835)
Peter James Cutmore (who was born in Tycannah in 1849)
James Swan (who was born in Combadello in 1825)
Harriett Wyndham (who was born in Mungie Bundie in 1863)

William Levy (who was born in Terry Hie Hie in 1867)
Sally Nerang (who was born in Terry Hie Hie circa 1840)
Eliza Barlow (who was born in Terry Hie Hie circa 1860)
Kitty Dangar (who was born in Walgett in 1837)
William Clark (who was born in Collarenebri in 1845)
Murray Ippai (who was born in Collarenebri)
Mary Ann Ippai (who was born on the Barwon River)
Edward Morgan (who was born in Dungalear in 1855)
Nancy Morgan (who was born in Dungalear in 1861)
Robert Nicholls (who was born in Collarenebri in 1842)
Frank Mundy (who was born in Collymongle in 1872)
Lena Combo (who was born in Mogil Mogil in 1876)
Jack Thunderbolt (who was born in Walgett in 1847)
Betsy Yates (also known as Polly Yates and Polly Burras) (who was born on the Barwon River circa 1860)
Jenny (who was born in Walgett circa 1840)
Dick Silk (who was born in Walgett)
Fred Parker (who was born in Gingie in 1864)
Murray Rook (who was born in Collarenebri in 1865)
Ethel Tinker (who was born in Mercadool circa 1878)
Emily McPherson (who was born in Collarenebri in 1892)
Billy Whitford (who was born in 1828)
King Robert Cobbler (who was born in Mogil Mogil in 1855)
Billy Wightman (who was born in Kunopia in 1813)
John McGrady (who was born in Moree in 1853)
William Dennison (who was born in Kunopia in 1843)
Charlie Dennison (who was born circa 1846-1866)
Alice Dennison (who was born in Moree circa 1863 -1873)
Lucy Long (who was born in Boomi circa 1850)
Minnie Lance (who was born in Boomi circa 1868), Harry Denham
Charles Cubby (who was born on the Boomi River)
Sarah Wilson (also known as Sarah Murphy and Sarah Witman) (who was born in Kunopia in 1868)
Reuben Bartman (who was born in Boomi in 1876)
Billy Dunn (who was born in Mungindi)
William Edwards (who was born in Thallon)
Queen Susan (who was born in Welltown)
Phoebe Munday-Williams (who was born in Mungindi in 1864)
George Bennett (who was born in Mungindi in 1873)
Amelia Bell (also known as Amelia Brown) (who was born in Bingara in 1862)
William Snow (who was born in Tamworth or Moonbi in 1855)
Francis Snow (who was born in Tamworth in 1858)
Matilda Wyndham (who was born in Bingara in 1842)
Thomas Duke (who was born in Bingara in 1847)
Teasie Griffen (also known as Jessie Griffen and Ellen Griffen) (who was born in Barraba in 1859)
Mary Anne Hammond (who was born in Tamworth in 1836)
Elizabeth Guest (also known as Eliza Gillan) (who was born in Liverpool Plains in 1840)
Jane Maloney (who was born in Walhallow in 1838)
Mary Ann Healy (who was born in Murrurundi in 1829)
Thomas Taylor (who was born in Coolah in 1836)
Elizabeth Loder (also known as Elizabeth Bates) (who was born in Murrurundi in 1843)
Sarah Gatehouse (who was born in Aberdeen in 1835)
William Duncomb (who was born in Muswellbrook circa 1830)
John Morris Tighe (who was born in 1852)
Susan Bishop-Young (also known as Susan Dangar) (who was born in Warialda)
Sarah Murphy (who was born in 1846)
Thomas French (who was born in Scone in 1825)
John Thomas Bates (who was born on the Mooki River in 1840)
Alexander Nean (who was born in Liverpool Plains in 1843)

David Johnson (who was born in Cassilis circa 1838-1844)
Mary Orr (also known as Nellie Orr) (who was born in Garrawilla in 1853)
Julia Campbell (who was born on the Castlereagh River circa 1833-1834)
Annie Jendis (who was born in Burbagate in 1845)
Harriet Munro (who was born in Gunnedah in 1867), Alice Eliza Natty (who was born on the Namoi River near Boggabri in 1857)
James Tighe (who was born in Coonabarabran in 1842)
William Tighe (who was born in Toorawandi in 1844)
Patrick Tighe (who was born in Coonabarabran in 1852)
Jane Tighe (who was born in 1864)
Mary Jane Griffin (also known as 'Old Ibidah')
Susan Slater (who was born in Coonabarabran in 1839)
Thomas Leslie (who was born in Kirban circa 1850-1854)
James Leslie (who was born in born Armatree in 1853)
Ellen Fuller (who was born in Rockgidgiel in 1854)
Sarah Hughes (who was born in Coonabarabran circa 1834-1859)
James Cole (who was born in NSW in 1845)
Mary Ann Hall (who was born on the Castlereagh River in 1840)
Samuel Bruce Smith (who was born in Tambar Springs circa 1860 – 1863)
Elizabeth Ann Smith (who was born in Mullaley in 1866)
William Green (also known as William Edwards) (who was born in Kings Plains near Inverell in 1853)
Angus Landsborough (who was born in Newstead in 1867)
Patrick Landsborough (who was born in Newstead in 1872)
Alec Brown (who was born in Bundarra in 1873)
Margaret King (who was born in Gummin Gummin near Gulargambone circa 1854-1858)
William James King (who was born in Coonabarabran circa 1851-1853)
Florence May Blackman (also known as Louisa Florima Blackman) (who was born in Coonamble in 1846)
Euphemia Blackman (who was born on the Castlereagh River in 1851)
Henry Arthur Yates (who was born in Coonamble in 1860)
Betsy Yates (who was born in Wingadee in 1854)
Annie Day (who was born in Bullarora Station near Coonamble circa 1871-1876)
Army Toomey (who was born in Wingadee near Coonamble in 1886)
Maria Clare Hall (who was born in Gulargambone circa 1830-1833)
Thomas Carney (who was born in Tonderburine in 1852)
Jim Duncan (who was born in Coonamble in 1854)
Thomas Reid (who was born in Cuttabri in 1840)
Thomas John Blacklock (who was born in Terembone in 1851)
Thomas Dangar (who was born in Drilldool in 1857), Harry Doolan (who was born in Pilliga in 1855)
George Green (who was born in 1851)
Lucy Barr (who was born in Boggabri in 1851)
Peggy Reid (who was born in Cuttabri in 1836)
Julia Jane Saunders (who was born in Wee Waa in 1845)
William Newman (who was born in Cuttabri in 1807)
Emma Dingwell (who was born in Bograh Station near Narrabri in 1864)
Kate Purser (who was born in Narrabri in 1863)
Mary Ann Lucas (who was born in Millie in 1840)
Frank Maybury (who was born in Killarney Station near Narrabri circa 1840)
Charlotte Hagan (also known as Charlotte Keegan) (who was born in Narrabri circa 1850-1870)
Nellie Combo (who was born in Wallah Station near Narrabri in 1850)
Mary Peake (who was born in Narrabri in 1848)
Descendants include persons who are descendants by adoption according to traditional law and custom.
See further information attached and marked 'A'.

Registered native title rights and interests:

The following Native Title Rights & Interests were entered on the Register on 20/01/2012:

1. Where exclusive native title can be recognised (such as areas where there has been no prior extinguishment of native title or where s.238 and/or ss.47, 47A and 47B apply), the Gomeroi People as defined in Schedule A of this application, claim the right to possession, occupation, use and enjoyment of the lands and waters of the application area to the exclusion of all others subject to the valid laws of the Commonwealth and the State of New South Wales.
2. Where exclusive native title cannot be recognised, the Gomeroi People as defined in Schedule A of this application, claim the following non-exclusive rights and interests including the right to conduct activities necessary to give effect to them
(a) the right to access the application area;
(b) the right to use and enjoy the application area;
(c) the right to move about the application area;
(d) the right to camp on the application area;
(e) the right to erect shelters and other structures on the application area;
(f) the right to live being to enter and remain on the application area;
(g) the right to hold meetings on the application area;
(h) the right to hunt on the application area;
(i) the right to fish in the application area;
(j) the right to have access to and use the natural water resources of the application area;
(k) the right to gather and use the natural resources of the application area (including food, medicinal plants, timber, tubers, charcoal, wax, stone, ochre and resin as well as materials for fabricating tools, hunting implements, making artwork and musical instruments);
(m) the right to share and exchange resources derived from the land and waters within the application area;
(n) the right to participate in cultural and spiritual activities on the application area;
(o) the right to maintain and protect places of importance under traditional laws, customs and practices in the application area;
(p) the right to conduct ceremonies and rituals on the application area;
(q) the right to transmit traditional knowledge to members of the native title claim group including knowledge of particular sites on the application area;
3. The native title rights and interests referred to in paragraph 2 do not confer possession, occupation, use or enjoyment of the lands and waters of the application area to the exclusion of all others.
4. The native title rights and interests are subject to and exercisable in accordance with:
(a) the laws of the State of New South Wales and the Commonwealth of Australia including the common law;
(b) the rights (past or present) conferred upon persons pursuant to the laws of the Commonwealth and the laws of the State of New South Wales; and
(c) the traditional laws and customs of the Gomeroi People for personal, domestic and communal purposes (including social, cultural, religious, spiritual and ceremonial purposes).

Register attachments:

1. Map of the area covered by the application , Attachment C of the Application, 1 page - A4 , 20/12/2011.
2. Description of area covered by the application, Attachment B of the Application, 5 pages - A4 , 20/12/2011.

Note: The Register may, in accordance with s.188 of the Native Title Act 1993, contain confidential information that will not appear on the Extract.

Searching the NNTT Registers in New South Wales

Search service
On request the National Native Title Tribunal will search its public registers for you. A search may assist you in finding out whether any native title applications (claims), determinations or agreements exist over a particular area of land or water.

In New South Wales native title cannot exist on privately owned land including family homes or farms.

What information can a search provide?
A search can confirm whether any applications, agreements or determinations are registered in a local government area. Relevant information, including register extracts and application summaries, will be provided.

In NSW because we cannot search the registers in relation to individual parcels of land we search by local government area.

Most native title applications do not identify each parcel of land claimed. They have an external boundary and then identify the areas not claimed within the boundary by reference to types of land tenure e.g., freehold, agricultural leasehold, public works.

What if the search shows no current applications?
If there is no application covering the local government area this only indicates that at the time of the search either the Federal Court had not received any claims in relation to the local government area or the Tribunal had not yet been notified of any new native title claims.

It does not mean that native title does not exist in the area.

Native title may exist over an area of land or waters whether or not a claim for native title has been made.

Where the information is found
The information you are seeking is held in three registers and on an applications database.

National Native Title Register
The National Native Title Register contains determinations of native title by the High Court, Federal Court and other courts.

Register of Native Title Claims
The Register of Native Title Claims contains applications for native title that have passed a registration test.

Registered claims attract rights, including the right to negotiate about some types of proposed developments.

Register of Indigenous Land Use Agreements
The Register of Indigenous Land Use Agreements contains agreements made with people who hold or assert native title in an area.

The register identifies development activities that have been agreed by the parties.

Application summaries
An application summary contains a description of the location, content and status of a native title claim.

This information may be different to the information on the Register of Native Title Claims, e.g., because an amendment has not yet been tested.

How do you request a search?

A search request form is available on the Tribunal's web site at:
http://www.nntt.gov.au/registers/search.html
Mail, fax or email your request to the Tribunal's Sydney registry, identifying the local government area/s you want searched.

Email: NSWEnquiries@nntt.gov.au
Fax: (02) 9227 4030
Address: GPO Box 9973, Sydney NSW 2001
Phone: (02) 9227 4000

Appendix 4

Test Pit Assessment

Test Pit 1 (TP1)

TP1 is located outside of the Leewood Ponds Activity Area to the south of the outer southern wall of the second of two proposed brine ponds. TP1 is located approximately south of both TP6 and TP14 and east of TP2 at position 751297 E – 6622810 N. TP1 is located on relatively flat, highly disturbed ground, modified by agricultural pursuits. The test pit was located in thick short to medium tufty grass with approximately 10%-20% surface visibility across the survey area. An area of approximately 10 metres x 10 metres around the test pit location was visually inspected. The visual inspection was conducted via a pedestrian (foot) survey. The test pit location was used as the centre point for the survey area. No Aboriginal objects, or historic heritage items were identified within the 100 square-metre TP1 survey area. It is therefore considered that there are no Aboriginal or historic heritage constraints to excavating this test pit and developing the site.

Test Pit 2 (TP2)

TP2 is located outside of the Leewood Ponds Activity Area to the south of the outer southern wall of the second of two proposed brine ponds. TP2 is located approximately south of both TP10 and TP18 at position 751404 E – 6622789 N. TP2 is located on relatively flat, highly disturbed ground, modified by agricultural pursuits. The test pit was located in short to medium tufty grass with approximately 30%-40% surface visibility across the survey area. An area of approximately 10 metres x 10 metres around the test pit location was visually inspected. The visual inspection was conducted via a pedestrian (foot) survey. The test pit location was used as the centre point for the survey area. No Aboriginal objects, or historic heritage items were identified within the 100 square-metre TP2 survey area. It is therefore considered that there are no Aboriginal or historic heritage constraints to excavating this test pit and developing the site.

Test Pit 3 (TP3)

TP3 is located within the Leewood Ponds Activity Area along the western edge of the outer southern wall of the second of two proposed brine ponds. TP3 is located west of both TP4 and TP5 at position 751246 E – 6622857 N. TP3 is located on relatively flat, highly disturbed dry ground, modified by agricultural pursuits. The test pit was located in short tufty grass with approximately 20%-25% surface visibility across the survey area. An area of approximately 10 metres x 10 metres around the test pit location was visually inspected. The visual inspection was conducted via a pedestrian (foot) survey. The test pit location was used as the centre point for the survey area. No Aboriginal objects, or historic heritage items were identified within the 100 square-metre TP3 survey area. It is therefore considered that there are no Aboriginal or historic heritage constraints to excavating this test pit and developing the site.

Test Pit 4 (TP4)

TP4 is located within the Leewood Ponds Activity Area in the middle of the outer southern wall of the second of two proposed brine ponds. TP4 is located between TP3 and TP5 at position 751362 E – 6622834 N. TP4 is located on relatively flat, highly disturbed ground, modified by agricultural pursuits. The test pit was located in thick medium length grass less with approximately 5%-10% surface visibility across the survey area with nil visibility in several places. An area of approximately 10 metres x 10 metres around the test pit location was visually inspected. The visual inspection was conducted via a pedestrian (foot) survey. The test pit location was used as the centre point for the survey area. No Aboriginal objects, or historic heritage items were identified within the 100 square-metre TP4 survey area. It is therefore considered that there are no Aboriginal or historic heritage constraints to excavating this test pit and developing the site.

Test Pit 5 (TP5)

TP5 is located within the Leewood Ponds Activity Area along the outer southern wall of the second of two proposed brine ponds. TP5 is located approximately east of TP4 at position 751478 E – 66228113 N. TP5 is located on relatively flat, highly disturbed ground, modified by agricultural pursuits. The test pit was located on wet ground in thick medium length grass with less than 5% surface visibility across the survey area. An area of approximately 10 metres x 10 metres around the test pit location was visually inspected. The visual inspection was conducted via a pedestrian (foot) survey. The test pit location was used as the centre point for the survey area. No Aboriginal objects, or historic heritage items were identified within the 100 square-metre TP5 survey area. It is therefore considered that there are no Aboriginal or historic heritage constraints to excavating this test pit and developing the site.

Test Pit 6 (TP6)

TP6 is located within the Leewood Ponds Activity Area in the second of two proposed brine ponds. TP6 is located approximately east of TP7 at position 751316 E – 6622903 N. TP6 is located on relatively flat, highly disturbed ground, modified by agricultural pursuits. The test pit was located on damp ground in short to medium grass with 20% surface visibility across the survey area. An area of approximately 10 metres x 10 metres around the test pit location was visually inspected. The visual inspection was conducted via a pedestrian (foot) survey. The test pit location was used as the centre point for the survey area. No Aboriginal objects, or historic heritage items were identified within the 100 square-metre TP6 survey area. It is therefore considered that there are no Aboriginal or historic heritage constraints to excavating this test pit and developing the site.

Test Pit 7 (TP7)

TP7 is located outside of the Leewood Ponds Activity Area to the east of the eastern wall of the second of two proposed brine ponds. TP7 is located approximately south and slightly east of TP17 at position 751527 E – 6622857N. TP7 is located on relatively flat, highly disturbed ground, modified by agricultural pursuits. The test pit was located on damp ground in tall thick grass with nil surface visibility across the survey area. An area of approximately 10 metres x 10 metres around the test pit location was visually inspected. The visual inspection was conducted via a pedestrian (foot) survey. The test pit location was used as the centre point for the survey area. No Aboriginal objects, or historic heritage items were identified within the 100 square-metre TP7 survey area. It is therefore considered that there are no Aboriginal or historic heritage constraints to excavating this test pit and developing the site.

Test Pit 8 (TP8)

TP8 is located within the Leewood Ponds Activity Area along the western wall of the second of two proposed brine ponds. TP8 is located approximately south of TP11 and TP15 at position 751267 E – 6622960 N. TP8 is located on relatively flat, highly disturbed ground, modified by agricultural pursuits. The test pit was located in short grass with ground surface visibility of between 40%-60% across the survey area with one very small patch with 100% visibility. An area of approximately 10 metres x 10 metres around the test pit location was visually inspected. The visual inspection was conducted via a pedestrian (foot) survey. The test pit location was used as the centre point for the survey area. No Aboriginal objects, or historic heritage items were identified within the 100 square-metre TP8 survey area. It is therefore considered that there are no Aboriginal or historic heritage constraints to excavating this test pit and developing the site.

Test Pit 9 (TP9)

TP9 is located within the Leewood Ponds Activity Area approximately centre of inner eastern wall of the second of two proposed brine ponds. TP9 is located approximately south of TP13 at position 751481 E – 6622917 N. TP9 is located on relatively flat, highly disturbed ground, modified by agricultural pursuits. The

test pit was located in medium grass with ground surface visibility of approximately 15%-20% across the survey area with two sections of nil visibility. An area of approximately 10 metres x 10 metres around the test pit location was visually inspected. The visual inspection was conducted via a pedestrian (foot) survey. The test pit location was used as the centre point for the survey area. No Aboriginal objects, or historic heritage items were identified within the 100 square-metre TP9 survey area. It is therefore considered that there are no Aboriginal or historic heritage constraints to excavating this test pit and developing the site.

Test Pit 10 (TP10)

TP10 is located within the Leewood Ponds Activity Area along the inner northern wall of the second of two proposed brine ponds. TP10 is located approximately south of TP18 at position 751446 E – 6622997 N. TP10 is located on relatively flat, highly disturbed ground, modified by agricultural pursuits. The test pit was located in medium to tall grass with ground surface visibility of approximately 5%-15% across the survey area. An area of approximately 10 metres x 10 metres around the test pit location was visually inspected. The visual inspection was conducted via a pedestrian (foot) survey. The test pit location was used as the centre point for the survey area. No Aboriginal objects, or historic heritage items were identified within the 100 square-metre TP10 survey area. It is therefore considered that there are no Aboriginal or historic heritage constraints to excavating this test pit and developing the site.

Test Pit 11 (TP11)

TP11 is located within the Leewood Ponds Activity Area along the outer western wall of the first of two proposed brine ponds. TP11is located approximately south of TP15 at position 751289 E – 6623070 N. TP12 is located on relatively flat, highly disturbed ground, modified by agricultural pursuits. The test pit was located in medium to short to medium tufty grass with ground surface visibility of between 25% and 45 %. An area of approximately 10 metres x 10 metres around the test pit location was visually inspected. The visual inspection was conducted via a pedestrian (foot) survey. The test pit location was used as the centre point for the survey area. No Aboriginal objects, or historic heritage items were identified within the 100 square-metre TP11 survey area. It is therefore considered that there are no Aboriginal or historic heritage constraints to excavating this test pit and developing the site.

Test Pit 12 (TP12)

TP12 is located within the Leewood Ponds Activity Area about the centre of the southern inner wall of the first of two proposed brine ponds. TP12 is located to the south of TP20 at position 751405 E – 6623047 N. TP12 is located on relatively flat, highly disturbed ground, modified by agricultural pursuits. The test pit was located in medium to short to medium grass with ground surface visibility of approximately 35% across the survey area. An area of approximately 10 metres x 10 metres around the test pit location was visually inspected. The visual inspection was conducted via a pedestrian (foot) survey. The test pit location was used as the centre point for the survey area. No Aboriginal objects, or historic heritage items were identified within the 100 square-metre TP12 survey area. It is therefore considered that there are no Aboriginal or historic heritage constraints to excavating this test pit and developing the site.

Test Pit 13 (TP13)

TP13 is located within the Leewood Ponds Activity Area at the corner of the southern and eastern walls of the first of two proposed brine ponds. TP13 is located to the south of TP16 at position 751503 E – 6623027 N. TP13 is located on relatively flat, highly disturbed ground, modified by agricultural pursuits. The test pit was located in medium to short grass with ground surface visibility of approximately 40% across the survey area. An area of approximately 10 metres x 10 metres around the test pit location was visually inspected. The visual inspection was conducted via a pedestrian (foot) survey. The test pit location was used as the

centre point for the survey area. No Aboriginal objects, or historic heritage items were identified within the 100 square-metre TP13 survey area. It is therefore considered that there are no Aboriginal or historic heritage constraints to excavating this test pit and developing the site.Test Pit 14 (TP14)

TP14 is located within the Leewood Ponds Activity Area along the western wall of the first of two proposed brine ponds, to the south of TP19 at position 751358 E – 6623113 N. TP14 is located on relatively flat, highly disturbed ground, modified by agricultural pursuits. The test pit was located in medium to long grass with ground surface visibility of approximately 20% across the survey area. An area of approximately 10 metres x 10 metres around the test pit location was visually inspected. The visual inspection was conducted via a pedestrian (foot) survey. The test pit location was used as the centre point for the survey area. No Aboriginal objects, or historic heritage items were identified within the 100 square-metre TP14 survey area. It is therefore considered that there are no Aboriginal or historic heritage constraints to excavating this test pit and developing the site.

Test Pit 15 (TP15)

TP15 is located within the Leewood Ponds Activity Area along the western wall of the first of two proposed brine ponds, to the south of TP19 at position 751309 E – 6623169 N. TP15 is located on relatively flat, highly disturbed ground, modified by agricultural pursuits. The test pit was located in medium grass with ground surface visibility of approximately 25%-50% across the survey area. An area of approximately 10 metres x 10 metres around the test pit location was visually inspected. The visual inspection was conducted via a pedestrian (foot) survey. The test pit location was used as the centre point for the survey area. No Aboriginal objects, or historic heritage items were identified within the 100 square-metre TP15 survey area. It is therefore considered that there are no Aboriginal or historic heritage constraints to excavating this test pit and developing the site.

Test Pit 16 (TP16)

TP16 is located within the Leewood Ponds Activity Area along the inside (eastern) wall of the first of two proposed brine ponds, to the south of TP22 at position 751522 E – 6623125 N. TP17 is located on relatively flat, highly disturbed ground, modified by agricultural pursuits. The test pit was located in short to medium grass with ground surface visibility of approximately 35% across the survey area. An area of approximately 10 metres x 10 metres around the test pit location was visually inspected. The visual inspection was conducted via a pedestrian (foot) survey. The test pit location was used as the centre point for the survey area. No Aboriginal objects, or historic heritage items were identified within the 100 square-metre TP16 survey area. It is therefore considered that there are no Aboriginal or historic heritage constraints to excavating this test pit and developing the site.

Test Pit 17 (TP17)

TP17 is located within the Leewood Ponds Activity Area to the outside (east) of the eastern boundary of the first of two proposed brine ponds, to the south of TP24 at position 751584 E – 6623149 N. TP17 is located on relatively flat, highly disturbed ground, modified by agricultural pursuits. The test pit was located in short tufty grass with ground surface visibility of approximately 45% at the test pit location and increasing to 65% in the eastern portion of the survey area. The survey area was an area of approximately 10 metres x 10 metres around the test pit location. The visual inspection was conducted via a pedestrian (foot) survey. The test pit location was used as the centre point for the survey area. No Aboriginal objects, or historic heritage items were identified within the 100 square-metre TP17 survey area. It is therefore considered that there are no Aboriginal or historic heritage constraints to excavating this test pit and developing the site.

Test Pit 18 (TP18)

TP18 is located within the Leewood Ponds Activity Area along the inner northern pond wall of the first of two proposed brine ponds. TP18 is located to the south-west of TP23 at position 751483E – 6623184 N. TP18 is located on relatively flat, highly disturbed ground, modified by agricultural pursuits. The test pit was located in short tufty grass with ground surface visibility of approximately 55%. A survey area of approximately 10 metres x 10 metres around the test pit location was visually inspected. The survey was conducted via a pedestrian (foot) survey. The test pit location was used as the centre point for the survey area. No Aboriginal objects, or historic heritage items were identified within the 100 square-metre TP18 survey area. It is therefore considered that there are no Aboriginal or historic heritage constraints to excavating this test pit and developing the site.

Test Pit 19 (TP19)

TP19 is located within the Leewood Ponds Activity Area along the western pond wall of the second of two proposed produce water ponds. TP19 is located to the south-west of TP25 at position 751329 E – 6623272 N. TP19 is located on relatively flat, highly disturbed ground, modified by agricultural pursuits. The test pit was located in short to medium grass with ground surface visibility of approximately 45-55%. A survey area of approximately 10 metres x 10 metres around the test pit location was visually inspected. The survey was conducted via a pedestrian (foot) survey. The test pit location was used as the centre point for the survey area. No Aboriginal objects, or historic heritage items were identified within the 100 square-metre TP19 survey area. It is therefore considered that there are no Aboriginal or historic heritage constraints to excavating this test pit and developing the site.

Test Pit 20 (TP20)

TP20 is located within the Leewood Ponds Activity Area along the inner southern pond wall of the second of two proposed produce water ponds. TP20 is located to the south-west of TP23 at position 751445 E – 6623249 N. TP20 is located on relatively flat, highly disturbed ground, modified by agricultural pursuits in short to medium grass. Ground surface visibility was approximately 35%. A survey area of approximately 10 metres x 10 metres around the test pit location was visually inspected. The survey was conducted via a pedestrian (foot) survey. The test pit location was used as the centre point for the survey area. No Aboriginal objects, or historic heritage items were identified within the 100 square-metre TP20 survey area. It is therefore considered that there are no Aboriginal or historic heritage constraints to excavating this test pit and developing the site.

Test Pit 21 (TP21)

TP21 is located within the Leewood Ponds Activity Area in the second of two proposed produce water ponds, to the east of an existing farm track. TP21 is located to the south of TP23 at position 751400 E – 6623323 N. TP21 is located on relatively flat, highly disturbed ground, modified by agricultural pursuits in short to medium grass with ground surface visibility of approximately 35%. A survey area of approximately 10 metres x 10 metres around the test pit location was visually inspected. The survey was conducted via a pedestrian (foot) survey. The test pit location was used as the centre point for the survey area. No Aboriginal objects, or historic heritage items were identified within the 100 square-metre TP21 survey area. It is therefore considered that there are no Aboriginal or historic heritage constraints to excavating this test pit and developing the site.

Test Pit 22 (TP22)

TP22 is located within the Leewood Ponds Activity Area along the proposed eastern pond wall of the second of two proposed produce water ponds. TP22 is located to the south of TP25 at position 751562 E – 6623323 N. TP22 is located on relatively flat, highly disturbed ground, modified by agricultural pursuits. TP22 is

located in short to medium grass with ground surface visibility of approximately 30%. A survey area of approximately 10 metres x 10 metres around the test pit location was visually inspected. The survey was conducted via a pedestrian (foot) survey. The test pit location was used as the centre point for the survey area. No Aboriginal objects, or historic heritage items were identified within the 100 square-metre TP22 survey area. It is therefore considered that there are no Aboriginal or historic heritage constraints to excavating this test pit and developing the site.

Test Pit 23 (TP23)

TP23 is located within the Leewood Ponds Activity Area along the proposed pond wall between the two proposed produce water ponds. TP23 is located to the west of TP24 at position 751525 E – 6623392 N. TP23 is located on relatively flat, highly disturbed ground, in short grass with ground surface visibility of approximately 40%. A survey area of approximately 10 metres x 10 metres around the test pit location was visually inspected. The survey was conducted via a pedestrian (foot) survey. The test pit location was used as the centre point for the survey area. No Aboriginal objects, or historic heritage items were identified within the 100 square-metre TP23 survey area. It is therefore considered that there are no Aboriginal or historic heritage constraints to excavating this test pit and developing the site.

Test Pit 24 (TP24)

TP24 is located to the outside (east) of the eastern boundary of the Leewood Ponds Activity Area to the east of the first of two proposed produce water ponds and to the east of TP23. TP24 is located position 751631 E – 6623376 N. TP24 is located on relatively flat, highly disturbed ground, in short tufty grass with ground surface visibility of approximately 35%. A survey area of approximately 10 metres x 10 metres around the test pit location was visually inspected. The survey was conducted via a pedestrian (foot) survey. The test pit location was used as the centre point for the survey area. No Aboriginal objects, or historic heritage items were identified within the 100 square-metre TP24 survey area. It is therefore considered that there are no Aboriginal or historic heritage constraints to excavating this test pit and developing the site.

Test Pit 25 (TP25)

TP25 is located along the western wall of the first of two proposed produce water ponds in the Leewood Ponds Activity Area, to the south east of TP29. TP25 is located position 751370 E – 6623475N. TP25 is located on relatively flat, highly disturbed ground, in short to medium grass with ground surface visibility of approximately 30%. A survey area of approximately 10 metres x 10 metres around the test pit location was visually inspected. The survey was conducted via a pedestrian (foot) survey. The test pit location was used as the centre point for the survey area. No Aboriginal objects, or historic heritage items were identified within the 100 square-metre TP25 survey area. It is therefore considered that there are no Aboriginal or historic heritage constraints to excavating this test pit and developing the site.

Test Pit 26 (TP26)

TP26 is located within the first of two proposed produce water ponds in the Leewood Ponds Activity Area, to the south east of TP27 and at position 751486 E – 6623452 N. TP26 is located on relatively flat, highly disturbed ground, in short to medium grass with ground surface visibility of approximately 25%. A survey area of approximately 10 metres x 10 metres around the test pit location was visually inspected. The survey was conducted via a pedestrian (foot) survey. The test pit location was used as the centre point for the survey area. No Aboriginal objects, or historic heritage items were identified within the 100 square-metre TP26 survey area. It is therefore considered that there are no Aboriginal or historic heritage constraints to excavating this test pit and developing the site.

Test Pit 27 (TP27)

TP27 is located within the first of two proposed produce water ponds in the Leewood Ponds Activity Area. TP27 is west of TP28 at position 751441 E – 6623531 N. TP27 is located on relatively flat, highly disturbed ground, in medium length grass with ground surface visibility of approximately 40%. A survey area of approximately 10 metres x 10 metres around the test pit location was visually inspected. The survey was conducted via a pedestrian (foot) survey. The test pit location was used as the centre point for the survey area. No Aboriginal objects, or historic heritage items were identified within the 100 square-metre TP27 survey area. It is therefore considered that there are no Aboriginal or historic heritage constraints to excavating this test pit and developing the site.

Test Pit 28 (TP28)

TP28 is located within the first of two proposed produce water ponds in the Leewood Ponds Activity Area. TP28 is located at position 751548 E – 6623510 N. TP28 is located on relatively flat, highly disturbed ground, in medium to long grass with ground surface visibility of approximately 20%. A survey area of approximately 10 metres x 10 metres around the test pit location was visually inspected. The survey was conducted via a pedestrian (foot) survey. The test pit location was used as the centre point for the survey area. No Aboriginal objects, or historic heritage items were identified within the 100 square-metre TP28 survey area. It is therefore considered that there are no Aboriginal or historic heritage constraints to excavating this test pit and developing the site.

Test Pit 29 (TP29)

TP29 is located along the western wall of the first of two proposed produce water ponds in the Leewood Ponds Activity Area. TP29 is located at position 751389 E – 6623571 N. TP29 is located on relatively flat, highly disturbed ground, in medium length grass with ground surface visibility of approximately 30%. A survey area of approximately 10 metres x 10 metres around the test pit location was visually inspected. The survey was conducted via a pedestrian (foot) survey. The test pit location was used as the centre point for the survey area. No Aboriginal objects, or historic heritage items were identified within the 100 square-metre TP29 survey area. It is therefore considered that there are no Aboriginal or historic heritage constraints to excavating this test pit and developing the site.

Test Pit 30 (TP30)

TP30 is located in the Leewood Pond Activity Area within the first of two proposed produce water ponds, west of TP31 at position 751609 E – 6623558 N. TP30 is located on relatively flat, highly disturbed ground, in long grass with ground surface visibility of approximately 40%. A survey area of approximately 10 metres x 10 metres around the test pit location was visually inspected. The survey was conducted via a pedestrian (foot) survey. The test pit location was used as the centre point for the survey area. No Aboriginal objects, or historic heritage items were identified within the 100 square-metre TP30 survey area. It is therefore considered that there are no Aboriginal or historic heritage constraints to excavating this test pit and developing the site.

Test Pit 31 (TP31)

TP31 is located along the north-eastern boundary of the Leewood Ponds Activity Area, to the east of the proposed produce water pond, adjacent to TP30 at position 751667 E – 6623555 N. TP31 is located on relatively flat, highly disturbed ground, in long grass with ground surface visibility of approximately 40%. A survey area of approximately 10 metres x 10 metres around the test pit location was visually inspected. The survey was conducted via a pedestrian (foot) survey. The test pit location was used as the centre point for

the survey area. No Aboriginal objects, or historic heritage items were identified within the 100 square-metre TP31 survey area. It is therefore considered that there are no Aboriginal or historic heritage constraints to excavating this test pit and developing the site.

Test Pit 32 (TP32)

TP32 is located in the north-eastern corner of the Leewood Ponds Activity Area, south of TP35 and within the second of two proposed permeate ponds at position 751462 E – 6623634 N. TP32 is located on relatively flat, highly disturbed ground, in thick grass to the south and east of two existing farm tracks. Ground surface visibility was approximately 5%. A survey area of approximately 10 metres x 10 metres around the test pit location was visually inspected. The survey was conducted via a pedestrian (foot) survey. The test pit location was used as the centre point for the survey area. No Aboriginal objects, or historic heritage items were identified within the 100 square-metre TP32 survey area. It is therefore considered that there are no Aboriginal or historic heritage constraints to excavating this test pit and developing the site.

Test Pit 33 (TP33)

TP33 is located in the north-eastern corner of the Leewood Ponds Activity Area, south of TP36 and within the second of two proposed permeate ponds at position 751420 E - 6623679N. TP34 is located on relatively flat, highly disturbed ground, in thick grass to the south and east of two existing farm tracks. Ground surface visibility was approximately 5%. A survey area of approximately 10 metres x 10 metres around the test pit location was visually inspected. The survey was conducted via a pedestrian (foot) survey. The test pit location was used as the centre point for the survey area. No Aboriginal objects, or historic heritage items were identified within the 100 square-metre TP33 survey area. It is therefore considered that there are no Aboriginal or historic heritage constraints to excavating this test pit and developing the site.

Test Pit 34 (TP34)

TP34 is located in the north-eastern corner of the Leewood Ponds Activity Area, south of TP37 and within the second of two proposed permeate ponds at position 751527 E – 6623658 N. TP34 is located on relatively flat, highly disturbed ground, in thick grass over 100 metres south of an existing farm track. Ground surface visibility was approximately 10%. An approximately 10 metre x 10 metre area around the test pit location was visually inspected via a pedestrian (foot) survey. The test pit location was used as the centre point for the survey area. No Aboriginal objects, or historic heritage items were identified within the 100 square-metre TP34 survey area. It is therefore considered that there are no Aboriginal or historic heritage constraints to excavating this test pit and developing the site.

Test Pit 35 (TP35)

TP35 is located in the north-eastern corner of the Leewood Ponds Activity Area, south-west of TP36 and within one of two proposed permeate ponds at position751487 E- 6623725 N. TP35 is located on relatively flat, highly disturbed ground, in thick grass and set back from an existing farm track. Ground surface visibility was approximately 5%. An approximately 10 metre x 10 metre area around the test pit location was visually inspected via a pedestrian (foot) survey. The test pit location was used as the centre point for the survey area. No Aboriginal objects, or historic heritage items were identified within the 100 square-metre TP35 survey area. It is therefore considered that there are no Aboriginal or historic heritage constraints to excavating this test pit and developing the site.

Test Pit 36 (TP36)

TP 36 is located in the north-west corner of the Leewood Ponds Activity Area at position 751441 E – 6623782 N. TP36 is located on highly disturbed ground, in thick grass close to the intersection of two existing

farm tracks. Ground surface visibility was approximately 5%. An approximately 10 metre x 10 metre area was visually inspected via a pedestrian (foot) survey using the test pit location as the centre point for the survey area. No Aboriginal objects, or historic heritage items were identified within the 100 square-metre TP36 survey area. It is therefore considered that there are no Aboriginal or historic heritage constraints to excavating this test pit and developing the site.

Test Pit 37 (TP37)

TP 37 is located in the north-east corner of the Leewood Ponds Activity Area and within one of two proposed permeate ponds at position 751547 E – 6623757 N (Webb 2012a). TP37 is on relatively flat highly disturbed land, in tufty grass close to the existing farm track. Ground surface visibility was approximately 15%. An approximately 10 metre x 10 metre area was visually inspected via a pedestrian (foot) survey using the test pit location as the centre point for the survey area. No Aboriginal objects, or historic heritage items were identified within the 100 square-metre TP37survey area. It is therefore considered that there are no Aboriginal or historic heritage constraints to excavating this test pit and developing the site.

Test Pit 38 (TP 38)

TP 38 is located to the west of TP34 in the north western section of the Leewood Ponds Activity Area and within the proposed sediment pond at position 751588 E – 6623650 N (Webb 2012a). TP38 is located on relatively flat highly disturbed land, in thick grass close to the existing farm track. Ground surface visibility was approximately 20%. An approximately 10 metre x 10 metre area was visually inspected via a pedestrian (foot) survey using the test pit location as the centre point for the survey area. No Aboriginal objects, or historic heritage items were identified within the 100 square-metre TP38 survey area. It is therefore considered that there are no Aboriginal or historic heritage constraints to excavating this test pit and developing the site.

Test Pit 39

TP 39 is located to the west of TP37 in the north western section of the Leewood Ponds Activity Area and within the proposed sediment pond at position 751649 E – 6623727 N (Webb 2012a). TP39 is located on relatively flat highly disturbed land, in thick grass slightly south of an existing farm track. Ground surface visibility was approximately 10%. An approximately 10 metre x 10 metre area was visually inspected via a pedestrian (foot) survey using the test pit location as the centre point for the survey area. No Aboriginal objects, or historic heritage items were identified within the 100 square-metre TP39 survey area. It is therefore considered that there are no Aboriginal or historic heritage constraints to excavating this test pit and developing the site

Test Pit 50 (TP50)

TP 50 is located to the south east of the Leewood Ponds Activity Area at position 751957 E – 6622518 N. TP50 is located on relatively flat disused paddock in short fine grass that appears to have been recently cleared. Although the land is highly disturbed ground surface visibility high at approximately 95% (Plate 5). An approximately 10 metre x 10 metre area was visually inspected via a pedestrian (foot) survey using the test pit location as the centre point for the survey area. No Aboriginal objects, or historic heritage items were identified within the 100 square-metre TP50 survey area. It is therefore considered that there are no Aboriginal or historic heritage constraints to excavating this test pit and developing the site.

Test Pit 51 (TP51)

TP 51 is located to the east of the Leewood Ponds Activity Area at position 752148 E – 6623329 N. TP51 is located on relatively flat disused paddock in short fine grass that appears to have been recently cleared. Although the land is highly disturbed ground surface visibility was high at approximately 95%-100%. An approximately 10 metre x 10 metre area was visually inspected via a pedestrian (foot) survey using the test pit location as the centre point for the survey area. No Aboriginal objects, or historic heritage items were identified within the 100 square-metre TP51 survey area. It is therefore considered that there are no Aboriginal or historic heritage constraints to excavating this test pit and developing the site.

Test Pit 52 (TP52)

TP 52 is located to the south east of the Leewood Ponds Activity Area, south east of TP 50 at position 752035 E – 6622252 N. TP52 is located on relatively flat disused paddock in short fine grass and light ground cover that appears to be recent regrowth . Although the land is highly disturbed through agricultural pursuits ground surface visibility was high at approximately 95%-100%. An approximately 10 metre x 10 metre area was visually inspected via a pedestrian (foot) survey using the test pit location as the centre point for the survey area. No Aboriginal objects, or historic heritage items were identified within the 100 square-metre TP52 survey area. It is therefore considered that there are no Aboriginal or historic heritage constraints to excavating this test pit and developing the site.

Test Pit 53 (TP53)

TP 53 is located to the east of the Leewood Ponds Activity Area, approximately north of TP 52 at position 752285 E – 6623031 N. TP53 is located on relatively flat disused paddock in short fine grass and light ground cover that appears to be recent regrowth . Although the land is highly disturbed through agricultural pursuits ground surface visibility was high at approximately 95%-100%. An approximately 10 metre x 10 metre area was visually inspected via a pedestrian (foot) survey using the test pit location as the centre point for the survey area. No Aboriginal objects, or historic heritage items were identified within the 100 square-metre TP53 survey area. It is therefore considered that there are no Aboriginal or historic heritage constraints to excavating this test pit and developing the site.

Test Pit 54 (TP54)

TP 54 is located to the south east of the Leewood Ponds Activity Area approximately east-north-east of TP50 at position 752449 E – 6622531 N. TP54 is located on relatively flat disused paddock in short fine grass and light ground cover that appears to be recent regrowth . Although the land is highly disturbed through agricultural pursuits ground surface visibility was high at approximately 95%-100%. An approximately 10 metre x 10 metre area was visually inspected via a pedestrian (foot) survey using the test pit location as the centre point for the survey area. No Aboriginal objects, or historic heritage items were identified within the 100 square-metre TP54 survey area. It is therefore considered that there are no Aboriginal or historic heritage constraints to excavating this test pit and developing the site.

Test Pit 55 (TP55)

TP 55 is located to the east of the Leewood Ponds Activity Area approximately north-east of TP54 at position 752668 E – 6623172 N. TP55 is located on relatively flat disused paddock in short fine grass and light ground cover that appears to be recent regrowth . Although the land is highly disturbed through agricultural pursuits ground surface visibility was high at approximately 95%-100%. An approximately 10 metre x 10 metre area was visually inspected via a pedestrian (foot) survey using the test pit location as the centre point

for the survey area. No Aboriginal objects, or historic heritage items were identified within the 100 square-metre TP55 survey area. It is therefore considered that there are no Aboriginal or historic heritage constraints to excavating this test pit and developing the site.

Test Pit 56 (TP56)

TP 56 is located to the south of the Leewood Ponds Activity Area in the far south western corner of the square high density investigation area that was included when the project scope was extended. TP56 is approximately south of TP57, TP58 and TP59 at position 751171 E – 6622333 N. TP56 is located on relatively flat ground in a disused paddock in short yet tufty grass and light ground cover that appears to be recent regrowth . Although the land is highly disturbed through agricultural pursuits ground surface visibility was low at approximately 5%-10%. An approximately 10 metre x 10 metre area was visually inspected via a pedestrian (foot) survey using the test pit location as the centre point for the survey area. No Aboriginal objects, or historic heritage items were identified within the 100 square-metre TP56 survey area. It is therefore considered that there are no Aboriginal or historic heritage constraints to excavating this test pit and developing the site.

Test Pit 57 (TP57)

TP 57 is located to the south of the Leewood Ponds Activity Area along the western boundary of the Leewood Property, along the western perimeter of the square high density investigation area that was included when the project scope was extended. TP57 is located to the east of an existing farm access track between TP56 to the south and TP58 to the north at position 751200 E – 6622480 N. TP57 is located on relatively flat ground in a disused paddock in short yet tufty grass and light ground cover that appears to be recent regrowth . Although the land is highly disturbed through agricultural pursuits ground surface visibility was low at approximately 5%-10%. An approximately 10 metre x 10 metre area was visually inspected via a pedestrian (foot) survey using the test pit location as the centre point for the survey area. No Aboriginal objects, or historic heritage items were identified within the 100 square-metre TP57 survey area. It is therefore considered that there are no Aboriginal or historic heritage constraints to excavating this test pit and developing the site.

Test Pit 58 (TP58)

TP 58 is located to the south of the Leewood Ponds Activity Area along the western boundary of the Leewood Property, along the western perimeter of the square high density investigation area that was included when the project scope was extended. TP58 is located to the east of an existing farm access track between TP57 to the south and TP59 to the north at position 751230 E – 6622627 N. TP58 is located on relatively flat ground in a disused paddock in short yet tufty grass and light ground cover (including leaf litter) that appears to be recent regrowth . Although the land is highly disturbed through agricultural pursuits ground surface visibility was low at approximately 25% with two small areas of 100% visibility. An approximately 10 metre x 10 metre area was visually inspected via a pedestrian (foot) survey using the test pit location as the centre point for the survey area. No Aboriginal objects, or historic heritage items were identified within the 100 square-metre TP58 survey area. It is therefore considered that there are no Aboriginal or historic heritage constraints to excavating this test pit and developing the site.

Test Pit 59 (TP59)

TP 59 is located to the south of the Leewood Ponds Activity Area along the western boundary of the Leewood Property, along the western perimeter of the square high density investigation area that was included when the project scope was extended. TP59 is located to the east of an existing farm access track to the north of TP58 at position 751259 E – 6622774 N. TP59 is located on relatively flat ground in a disused

paddock in short to medium thick yet tufty grass with substantial ground cover. Although the land is highly disturbed through agricultural pursuits ground surface visibility was low at approximately 5% visibility across the Activity Area. An approximately 10 metre x 10 metre area was visually inspected via a pedestrian (foot) survey using the test pit location as the centre point for the survey area. No Aboriginal objects, or historic heritage items were identified within the 100 square-metre TP59 survey area. It is therefore considered that there are no Aboriginal or historic heritage constraints to excavating this test pit and developing the site.

Test Pit 60 (TP60)

TP 60 is located to the south of the Leewood Ponds Activity Area along the southern boundary of the Leewood Property, along the southern perimeter of the square high density investigation area that was included when the project scope was extended. TP60 is located to the north and east of two existing farm access tracks and is located east of TP56 at position 751307 E – 6622306 N. TP60 is located on relatively flat ground in a disused paddock on red/brown exposed soil with small patches of tufty grass and patchy ground cover. Although the land is highly disturbed through agricultural pursuits ground surface visibility was low at approximately 85% visibility across the Activity Area. An approximately 10 metre x 10 metre area was visually inspected via a pedestrian (foot) survey using the test pit location as the centre point for the survey area. No Aboriginal objects, or historic heritage items were identified within the 100 square-metre TP60 survey area. It is therefore considered that there are no Aboriginal or historic heritage constraints to excavating this test pit and developing the site.

Test Pit 61 (TP61)

TP 61 is located to the south of the Leewood Ponds Activity Area in the square high density investigation area that was included when the project scope was extended. TP61 is located to the north of TP60 and east of TP57 at position 751336 E – 6622453 N. TP60 is located on relatively flat ground in a disused paddock on red/brown exposed soil with small patches of tufty grass and patchy ground cover. Although the land is highly disturbed through agricultural pursuits ground surface visibility was low at approximately 85% visibility across the Activity Area. An approximately 10 metre x 10 metre area was visually inspected via a pedestrian (foot) survey using the test pit location as the centre point for the survey area. No Aboriginal objects, or historic heritage items were identified within the 100 square-metre TP61 survey area. It is therefore considered that there are no Aboriginal or historic heritage constraints to excavating this test pit and developing the site.

Test Pit 62 (TP62)

TP 62 is located to the south of the Leewood Ponds Activity Area in the square high density investigation area that was included when the project scope was extended. TP62 is located to the north of TP61 and east of TP58 at position 751336 E – 6622600 N. TP61 is located on relatively flat ground in a disused paddock on red/brown exposed soil with small patches of tufty grass and patchy ground cover. Although the land is highly disturbed through agricultural pursuits ground surface visibility was high at approximately 80% visibility across the Activity Area. An approximately 10 metre x 10 metre area was visually inspected via a pedestrian (foot) survey using the test pit location as the centre point for the survey area. No Aboriginal objects, or historic heritage items were identified within the 100 square-metre TP62 survey area. It is therefore considered that there are no Aboriginal or historic heritage constraints to excavating this test pit and developing the site.

Test Pit 63 (TP63)

TP 63 is located to the north east of the Leewood Ponds Activity Area along the northern boundary of the Leewood Property. TP63 is located to the north of TP85 at position 751870 E – 6623759 N. TP61 is located

on relatively flat ground in short medium dense grass and leaf litter. The land is highly disturbed through agricultural pursuits ground surface visibility was low at less than 5% across the Activity Area. An approximately 10 metre x 10 metre area was visually inspected via a pedestrian (foot) survey using the test pit location as the centre point for the survey area. No Aboriginal objects, or historic heritage items were identified within the 100 square-metre TP63 survey area. It is therefore considered that there are no Aboriginal or historic heritage constraints to excavating this test pit and developing the site.

Test Pit 64 (TP64)

TP 64 is located to the south of the Leewood Ponds Activity Area along the southern boundary of the Leewood Property, along the southern perimeter of the square high density investigation area that was included when the project scope was extended. TP64 is located to the east and north of two existing farm access tracks between TP60 to the south and TP68 to the north at position 751469 E – 6622273 N. TP64 is located on relatively flat ground in a disused paddock in short yet tufty grass and light ground cover. The land is highly disturbed through agricultural pursuits ground surface visibility was low at approximately 15% with two small areas of 95% visibility. An approximately 10 metre x 10 metre area was visually inspected via a pedestrian (foot) survey using the test pit location as the centre point for the survey area. No Aboriginal objects, or historic heritage items were identified within the 100 square-metre TP64 survey area. It is therefore considered that there are no Aboriginal or historic heritage constraints to excavating this test pit and developing the site.

Test Pit 65 (TP65)

TP 65 is located to the south of the Leewood Ponds Activity Area in the square high density investigation area that was included when the project scope was extended. TP65 is located to the north of TP64 and east of TP61 at position 7514986 E – 6622273 N. TP65 is located on relatively flat ground in a disused paddock with a small amount of exposed red/brown soil (5%) soil the remainder being short to medium length tufty grass with light ground cover. The land is highly disturbed through agricultural pursuits ground surface visibility was low at approximately 15% across the Activity Area. An approximately 10 metre x 10 metre area was visually inspected via a pedestrian (foot) survey using the test pit location as the centre point for the survey area. No Aboriginal objects, or historic heritage items were identified within the 100 square-metre TP65 survey area. It is therefore considered that there are no Aboriginal or historic heritage constraints to excavating this test pit and developing the site.

Test Pit 66 (TP66)

TP 66 is located to the south of the Leewood Ponds Activity Area in the square high density investigation area that was included when the project scope was extended. TP66 is located to the north of TP65 and east of TP62 at position 751528 E – 6622567 N. TP66 is located on relatively flat ground in a disused paddock on with short to medium length tufty grass and light vegetative ground cover. The survey area was located on land that had previously been highly disturbed by agricultural practices. Ground surface visibility was low at approximately 0% to 5% across the Activity Area. An approximately 10 metre x 10 metre area was visually inspected via a pedestrian (foot) survey using the test pit location as the centre point for the survey area. No Aboriginal objects, or historic heritage items were identified within the 100 square-metre TP662 survey area. It is therefore considered that there are no Aboriginal or historic heritage constraints to excavating this test pit and developing the site.

Test Pit 67 (TP67)

TP 67 is located to the south east of the Leewood Ponds Activity Area along the northern perimeter of the square high density investigation area that was included when the project scope was extended. TP67 is

located to the north of TP66 at position 751557 E – 6622714 N. TP67is located on relatively flat ground in a disused paddock in medium length grass with substantial ground cover. The land is highly disturbed through agricultural pursuits. Ground surface visibility was low at less than 5% across the Activity Area. An approximately 10 metre x 10 metre area was visually inspected via a pedestrian (foot) survey using the test pit location as the centre point for the survey area. No Aboriginal objects, or historic heritage items were identified within the 100 square-metre TP67 survey area. It is therefore considered that there are no Aboriginal or historic heritage constraints to excavating this test pit and developing the site.

Test Pit 68 (TP 68)

TP 68 is located to the south of the Leewood Ponds Activity Area along the southern boundary of the Leewood Property and along the southern perimeter of the square high density investigation area that was included when the project scope was extended. TP68 is located to the north of an existing farm access track east of TP64 and south of TP69 at position 751631 E – 6622388 N. TP648 is located on relatively flat ground in a disused paddock, close to a tree and in short yet tufty grass with light ground cover. The land is highly disturbed through agricultural pursuits. Ground surface visibility was low at less than 5% with two small areas of 95% visibility. An approximately 10 metre x 10 metre area was visually inspected via a pedestrian (foot) survey using the test pit location as the centre point for the survey area. No Aboriginal objects, or historic heritage items were identified within the 100 square-metre TP68 survey area. It is therefore considered that there are no Aboriginal or historic heritage constraints to excavating this test pit and developing the site.

Test Pit 69 (TP69)

TP 65 is located to the south of the Leewood Ponds Activity Area in the square high density investigation area that was included when the project scope was extended. TP65 is located to the north of TP64 and east of TP61 at position 7514986 E – 6622273 N. TP65 is located on relatively flat ground in a disused paddock with a small amount of exposed red/brown soil (5%) soil the remainder being short to medium length tufty grass with light ground cover. The land is highly disturbed through agricultural pursuits ground surface visibility was low at approximately 15% across the Activity Area. An approximately 10 metre x 10 metre area was visually inspected via a pedestrian (foot) survey using the test pit location as the centre point for the survey area. No Aboriginal objects, or historic heritage items were identified within the 100 square-metre TP65 survey area. It is therefore considered that there are no Aboriginal or historic heritage constraints to excavating this test pit and developing the site.

Test Pit 70 (TP 70)

TP 70 is located to the south east of the Leewood Ponds Activity Area in the square high density investigation area that was included when the project scope was extended. TP70 is located to the north of TP69 and east of TP66 at position 7514528 E – 6622567 N. TP70 is located on relatively flat ground in a disused paddock with a short to medium thick tufty grass. The land is highly disturbed as a result of previous agricultural pursuits. Ground surface visibility was low at less than 5% across the Activity Area. An approximately 10 metre x 10 metre area was visually inspected via a pedestrian (foot) survey using the test pit location as the centre point for the survey area. No Aboriginal objects, or historic heritage items were identified within the 100 square-metre TP70 survey area. It is therefore considered that there are no Aboriginal or historic heritage constraints to excavating this test pit and developing the site.

Test Pit 71(TP71)

TP 71 is located to the south east of the Leewood Ponds Activity Area along the northern perimeter of the square high density investigation area that was included when the project scope was extended. TP71 is

located to the north of TP70 and to the east of TP67 at position 751719 E – 6622682 N. TP71is located on relatively flat ground in a disused paddock in medium length grass with substantial ground cover. The land is highly disturbed through agricultural pursuits. Ground surface visibility was low at less than 5% across the Activity Area. An approximately 10 metre x 10 metre area was visually inspected via a pedestrian (foot) survey using the test pit location as the centre point for the survey area. No Aboriginal objects, or historic heritage items were identified within the 100 square-metre TP71survey area. It is therefore considered that there are no Aboriginal or historic heritage constraints to excavating this test pit and developing the site.

Test Pit 72 (TP72)

TP72 is located outside of the Leewood Ponds Activity Area to the east of the eastern wall of the second of two proposed brine ponds. TP72 is located to the south east of TP7 at position 751558 E – 6622807 N. TP72 is located on relatively flat, highly disturbed ground, modified by agricultural pursuits. The test pit was located on damp ground in tall thick grass with nil surface visibility across the survey area. An area of approximately 10 metres x 10 metres around the test pit location was visually inspected. The visual inspection was conducted via a pedestrian (foot) survey. The test pit location was used as the centre point for the survey area. No Aboriginal objects, or historic heritage items were identified within the 100 square-metre TP72 survey area. It is therefore considered that there are no Aboriginal or historic heritage constraints to excavating this test pit and developing the site.

Test Pit 73 (TP73)

TP73 is located outside of the Leewood Ponds Activity Area to the east of the eastern wall of the second of two proposed brine ponds. TP73 is located to the south east of TP74 at position 751589 E – 6622963 N. TP73 is located on relatively flat, highly disturbed ground, modified by agricultural pursuits. The test pit was located in on sandy brown exposed soil with 95% visibility over a small area of less than one square-metre. The remainder of the Activity Area was short to medium dry grasses with heavy leaf litter and visibility of less than 5% across the survey area. An area of approximately 10 metres x 10 metres around the test pit location was visually inspected. The visual inspection was conducted via a pedestrian (foot) survey. The test pit location was used as the centre point for the survey area. No Aboriginal objects, or historic heritage items were identified within the 100 square-metre TP73 survey area. It is therefore considered that there are no Aboriginal or historic heritage constraints to excavating this test pit and developing the site.

Test Pit 74 (TP74)

TP74 is located outside of the Leewood Ponds Activity Area to the east of the eastern wall of the first of two proposed brine ponds. TP74 is located to the north of TP73 at position 751621 E – 6623118 N. TP74 is located on relatively flat, highly disturbed ground, modified by agricultural pursuits. The test pit was located on sandy brown exposed soil with 95%-100% visibility over an area of approximately two square-metres. The remainder of the Activity Area was short to medium dry tufty grasses with light leaf litter, interspersed with areas of exposed topsoil. Visibility across this part of the survey area averaged around 60%-80%. An area of approximately 10 metres x 10 metres around the test pit location was visually inspected. The visual inspection was conducted via a pedestrian (foot) survey. The test pit location was used as the centre point for the survey area. No Aboriginal objects, or historic heritage items were identified within the 100 square-metre TP74 survey area. It is therefore considered that there are no Aboriginal or historic heritage constraints to excavating this test pit and developing the site.

Test Pit 75 (TP75)

TP75 is located outside of the Leewood Ponds Activity Area to the east of the eastern wall of the second of two produce water ponds at the north-western corner of the rectangular high density investigation when the project scope was extended. TP74 is located to the west of TP79 at position 751652 E – 6623273 N. TP74 is located on relatively flat, highly disturbed ground, modified by previous agricultural activity. The test pit was located in medium to long grass consistent throughout the survey area and producing nil visibility. An area of approximately 10 metres x 10 metres around the test pit location was visually inspected. The visual inspection was conducted via a pedestrian (foot) survey. The test pit location was used as the centre point for the survey area. No Aboriginal objects, or historic heritage items were identified within the 100 square-metre TP75 survey area. It is therefore considered that there are no Aboriginal or historic heritage constraints to excavating this test pit and developing the site.

Test Pit 76 (TP76)

TP76 is located outside of the Leewood Ponds Activity Area to the east of the eastern wall of the second of two proposed brine ponds along the southern perimeter of the rectangular high density investigation when the project scope was extended. TP76 is located to the east of TP72 and to the south of TP77 at position 751682 E – 6622944 N. TP76 is located on relatively flat, highly disturbed ground, modified by agricultural pursuits. The test pit was located in tall thick grass with nil surface visibility across the survey area. An area of approximately 10 metres x 10 metres around the test pit location was visually inspected. The visual inspection was conducted via a pedestrian (foot) survey. The test pit location was used as the centre point for the survey area. No Aboriginal objects, or historic heritage items were identified within the 100 square-metre TP77 survey area. It is therefore considered that there are no Aboriginal or historic heritage constraints to excavating this test pit and developing the site.

Test Pit 77 (TP77)

TP77 is located outside of the Leewood Ponds Activity Area to the east of the eastern wall of the second of two proposed brine ponds and within the rectangular high density investigation when the project scope was extended. TP77 is located to the south of TP78 at position 751682 E – 6622944 N. TP77 is located on relatively flat, highly disturbed ground, modified by agricultural pursuits. The test pit was located in on sandy brown exposed soil with 98% visibility over a small area of less than one square-metre. The remainder of the Activity Area was very short tufty grass with very light leaf litter in places and visibility in excess of 70% across the survey area. An area of approximately 10 metres x 10 metres around the test pit location was visually inspected. The visual inspection was conducted via a pedestrian (foot) survey. The test pit location was used as the centre point for the survey area. No Aboriginal objects, or historic heritage items were identified within the 100 square-metre TP77survey area. It is therefore considered that there are no Aboriginal or historic heritage constraints to excavating this test pit and developing the site.

Test Pit 78 (TP78)

TP78 is located outside of the Leewood Ponds Activity Area to the east of the eastern wall of the first of two proposed brine ponds and within the rectangular high density investigation when the project scope was extended. TP78 is located to the south of TP79 and to the east TP74 at position 751713 E – 6623309 N. TP78 is located on relatively flat, highly disturbed ground, modified by past agricultural activities. The test pit was located on sandy red brown soil exposed through extremely short patchy grass cover with visibility of 60% at the test pit location and between 10% and 15% throughout the remainder of the survey area. An area of approximately 10 metres x 10 metres around the test pit location was visually inspected. The visual inspection was conducted via a pedestrian (foot) survey. The test pit location was used as the centre point for the survey area. No Aboriginal objects, or historic heritage items were identified within the 100 square-metre TP78 survey area. It is therefore considered that there are no Aboriginal or historic heritage constraints to excavating this test pit and developing the site.

Test Pit 79 (TP79)

TP79 is located outside of the Leewood Ponds Activity Area to the east of the eastern wall of the second of two produce water ponds and in the centre of the northern boundary of the rectangular high density investigation when the project scope was extended. TP79 is located to the east of TP75 and to the west TP83 at position 751744 E – 6623255 N. Consistent with the other test pit locations, TP79 is located on relatively flat, highly disturbed ground, modified by previous historic agricultural activity. The test pit was located in medium to long grass consistent throughout the survey area and producing nil visibility. An area of approximately 10 metres x 10 metres around the test pit location was visually inspected. The visual inspection was conducted via a pedestrian (foot) survey. The test pit location was used as the centre point for the survey area. No Aboriginal objects, or historic heritage items were identified within the 100 square-metre TP75 survey area. It is therefore considered that there are no Aboriginal or historic heritage constraints to excavating this test pit and developing the site.

Test Pit 80 (TP80)

TP80 is located outside of the Leewood Ponds Activity Area to the east of the eastern wall of the second of two proposed brine ponds. TP80 is located at the south east corner of the rectangular high density investigation area added when the project scope was extended. TP80 is located to the east of TP76 at position 751744 E – 6622770 N. TP80 is located on relatively flat, highly disturbed ground, modified by agricultural pursuits. The test pit was located in short to medium thick grass with nil surface visibility across the survey area. An area of approximately 10 metres x 10 metres around the test pit location was visually inspected. The visual inspection was conducted via a pedestrian (foot) survey. The test pit location was used as the centre point for the survey area. No Aboriginal objects, or historic heritage items were identified within the 100 square-metre TP80 survey area. It is therefore considered that there are no Aboriginal or historic heritage constraints to excavating this test pit and developing the site.

Test Pit 81(TP81)

TP81 is located outside of the Leewood Ponds Activity Area to the east of the eastern wall of the second of two proposed brine ponds. TP81 is located along the eastern boundary of the rectangular high density investigation area added when the project scope was extended. TP81 is located to the north of TP80 at position 751775 E – 6622925 N. TP81 is located on relatively flat, highly disturbed ground, modified by agricultural pursuits. The test pit was located in short to medium thick grass with nil surface visibility across the survey area. An area of approximately 10 metres x 10 metres around the test pit location was visually inspected. The visual inspection was conducted via a pedestrian (foot) survey. The test pit location was used as the centre point for the survey area. No Aboriginal objects, or historic heritage items were identified within the 100 square-metre TP81 survey area. It is therefore considered that there are no Aboriginal or historic heritage constraints to excavating this test pit and developing the site.

Test Pit 82 (TP82)

TP82 is located outside of the Leewood Ponds Activity Area to the east of the eastern wall of the first of two proposed brine ponds. TP82 is located along the eastern boundary of the rectangular high density investigation area added when the project scope was extended. TP82 is located to the north of TP81 and to the east of TP77 at position 751806E – 6623081 N. As is consistent across all test pit sites, TP82 is located on relatively flat, highly disturbed ground, modified by agricultural pursuits. The test pit was located in extremely short grass that appears to form part of a mowed easement, perhaps associated with a pipeline installed within the Leewood site. Outside of this ‘mowed’ corridor (Plate 6) vegetation returns to the thick medium length grass found elsewhere, with nil surface visibility across this portion of the survey area. An area of approximately 10 metres x 10 metres around the test pit location was visually inspected. The visual

inspection was conducted via a pedestrian (foot) survey. The test pit location was used as the centre point for the survey area. No Aboriginal objects, or historic heritage items were identified within the 100 square-metre TP82 survey area. It is therefore considered that there are no Aboriginal or historic heritage constraints to excavating this test pit and developing the site.

Test Pit 83 (TP83)

TP83 is located outside of the Leewood Ponds Activity Area to the east of the eastern wall of the second of two produce water ponds and in the north east corner of the rectangular high density investigation added when the project scope was extended. TP83 is located to the east of TP79 and to the north of TP82 at position 751837 E – 6623236 N. Consistent with the other test pit locations, TP83 is located on relatively flat, highly disturbed ground, modified by previous historic agricultural activity. The test pit was located in very wet soggy march containing medium to long grass and producing nil visibility across the survey area. An area of approximately 10 metres x 10 metres around the test pit location was visually inspected. The visual inspection was conducted via a pedestrian (foot) survey. The test pit location was used as the centre point for the survey area. No Aboriginal objects, or historic heritage items were identified within the 100 square-metre TP83 survey area. It is therefore considered that there are no Aboriginal or historic heritage constraints to excavating this test pit and developing the site.

Test Pit 84 (TP84)

TP 84 is located to the north east of the Leewood Ponds Activity Area along the northern boundary of the Leewood Property to the north of TP63 at position 752005 E – 6623735 N. TP61 is located on relatively flat ground in short medium dense grass and leaf litter. The land is highly disturbed through agricultural pursuits ground surface visibility was low at less than 5% across the Activity Area. An approximately 10 metre x 10 metre area was visually inspected via a pedestrian (foot) survey using the test pit location as the centre point for the survey area. No Aboriginal objects, or historic heritage items were identified within the 100 square-metre TP84 survey area. It is therefore considered that there are no Aboriginal or historic heritage constraints to excavating this test pit and developing the site.

Test Pit 85 (TP85)

TP85 is located to the east and outside of the Leewood Ponds Activity Area. It is one of a number of scattered test pit sites added along with the square and rectangular high density investigation area, when the project scope was extended. TP85 is located to the north of TP79 and to the east of TP 35 at position 751769 E – 6623368 N. TP 85 is located in very wet, sodden ground amongst medium to long thick grass creating nil visibility across the survey area. An approximately 10 metre x 10 metre area was visually inspected via a pedestrian (foot) survey using the test pit location as the centre point for the survey area. No Aboriginal objects, or historic heritage items were identified within the 100 square-metre TP85 survey area. It is therefore considered that there are no Aboriginal or historic heritage constraints to excavating this test pit and developing the site.

Appendix 8

AHIMS Searches – Right of Way

AHIMS Web Services (AWS)
Search Result

Your Ref Number : BW flowlines 0 - 200m

Client Service ID : 81448

RPS Australia East Pty Ltd Sydney CBD
Level 12 92 Pitt Street
Sydney New South Wales 2000

Attention: Sarah Ward

Email: sarah.ward@rpsgroup.com.au

Date: 26 September 2012

Dear Sir or Madam:

AHIMS Web Service search for the following area at Datum :GDA, Zone : 55, Eastings : 751698 - 751699, Northings : 6622177 - 6622178 with a Buffer of 200 meters. conducted by Sarah Ward on 26 September 2012

A search of the Office of the Environment and Heritage AHIMS Web Services (Aboriginal Heritage Information Management System) has shown that:

0	**Aboriginal sites are recorded in or near the above location.**
0	**Aboriginal places have been declared in or near the above location. ***

If your search shows Aboriginal sites or places what should you do?

- You must do an extensive search if AHIMS has shown that there are Aboriginal sites or places recorded in the search area.
- If you are checking AHIMS as a part of your due diligence, refer to the next steps of the Due Diligence Code of practice.
- You can get further information about Aboriginal places by looking at the gazettal notice that declared it. Aboriginal places gazetted after 2001 are available on the NSW Government Gazette (http://www.nsw.gov.au/gazette) website. Gazettal notices published prior to 2001 can be obtained from Office of Environment and Heritage's Aboriginal Heritage Information Unit upon request

Important information about your AHIMS search

- The information derived from the AHIMS search is only to be used for the purpose for which it was requested. It is not be made available to the public.
- AHIMS records information about Aboriginal sites that have been provided to Office of Environment and Heritage and Aboriginal places that have been declared by the Minister;
- Information recorded on AHIMS may vary in its accuracy and may not be up to date .Location details are recorded as grid references and it is important to note that there may be errors or omissions in these recordings,
- Some parts of New South Wales have not been investigated in detail and there may be fewer records of Aboriginal sites in those areas. These areas may contain Aboriginal sites which are not recorded on AHIMS.
- Aboriginal objects are protected under the National Parks and Wildlife Act 1974 even if they are not recorded as a site on AHIMS.
- This search can form part of your due diligence and remains valid for 12 months.

AHIMS Web Services (AWS)
Search Result

Your Ref Number : BW flowlines 0 - 1km

Client Service ID : 81450

RPS Australia East Pty Ltd Sydney CBD
Level 12 92 Pitt Street
Sydney New South Wales 2000

Attention: Sarah Ward

Email: sarah.ward@rpsgroup.com.au

Date: 26 September 2012

Dear Sir or Madam:

AHIMS Web Service search for the following area at Datum :GDA, Zone : 55, Eastings : 751698 - 751699, Northings : 6622177 - 6622178 with a Buffer of 1000 meters. conducted by Sarah Ward on 26 September 2012

A search of the Office of the Environment and Heritage AHIMS Web Services (Aboriginal Heritage Information Management System) has shown that:

0	**Aboriginal sites are recorded in or near the above location.**
0	**Aboriginal places have been declared in or near the above location. ***

If your search shows Aboriginal sites or places what should you do?

- You must do an extensive search if AHIMS has shown that there are Aboriginal sites or places recorded in the search area.
- If you are checking AHIMS as a part of your due diligence, refer to the next steps of the Due Diligence Code of practice.
- You can get further information about Aboriginal places by looking at the gazettal notice that declared it. Aboriginal places gazetted after 2001 are available on the NSW Government Gazette (http://www.nsw.gov.au/gazette) website. Gazettal notices published prior to 2001 can be obtained from Office of Environment and Heritage's Aboriginal Heritage Information Unit upon request

Important information about your AHIMS search

- The information derived from the AHIMS search is only to be used for the purpose for which it was requested. It is not be made available to the public.
- AHIMS records information about Aboriginal sites that have been provided to Office of Environment and Heritage and Aboriginal places that have been declared by the Minister;
- Information recorded on AHIMS may vary in its accuracy and may not be up to date .Location details are recorded as grid references and it is important to note that there may be errors or omissions in these recordings,
- Some parts of New South Wales have not been investigated in detail and there may be fewer records of Aboriginal sites in those areas. These areas may contain Aboriginal sites which are not recorded on AHIMS.
- Aboriginal objects are protected under the National Parks and Wildlife Act 1974 even if they are not recorded as a site on AHIMS.
- This search can form part of your due diligence and remains valid for 12 months.

AHIMS Web Services (AWS)
Search Result

Your Ref Number : BW flowlines 1 - 200m

Client Service ID : 81437

RPS Australia East Pty Ltd Sydney CBD
Level 12 92 Pitt Street
Sydney New South Wales 2000

Attention: Sarah Ward

Email: sarah.ward@rpsgroup.com.au

Date: 26 September 2012

Dear Sir or Madam:

AHIMS Web Service search for the following area at Datum :GDA, Zone : 55, Eastings : 751153 - 751154, Northings : 6614023 - 6614024 with a Buffer of 200 meters. conducted by Sarah Ward on 26 September 2012

A search of the Office of the Environment and Heritage AHIMS Web Services (Aboriginal Heritage Information Management System) has shown that:

0	**Aboriginal sites are recorded in or near the above location.**
0	**Aboriginal places have been declared in or near the above location. ***

If your search shows Aboriginal sites or places what should you do?

- You must do an extensive search if AHIMS has shown that there are Aboriginal sites or places recorded in the search area.
- If you are checking AHIMS as a part of your due diligence, refer to the next steps of the Due Diligence Code of practice.
- You can get further information about Aboriginal places by looking at the gazettal notice that declared it. Aboriginal places gazetted after 2001 are available on the NSW Government Gazette (http://www.nsw.gov.au/gazette) website. Gazettal notices published prior to 2001 can be obtained from Office of Environment and Heritage's Aboriginal Heritage Information Unit upon request

Important information about your AHIMS search

- The information derived from the AHIMS search is only to be used for the purpose for which it was requested. It is not be made available to the public.
- AHIMS records information about Aboriginal sites that have been provided to Office of Environment and Heritage and Aboriginal places that have been declared by the Minister;
- Information recorded on AHIMS may vary in its accuracy and may not be up to date .Location details are recorded as grid references and it is important to note that there may be errors or omissions in these recordings,
- Some parts of New South Wales have not been investigated in detail and there may be fewer records of Aboriginal sites in those areas. These areas may contain Aboriginal sites which are not recorded on AHIMS.
- Aboriginal objects are protected under the National Parks and Wildlife Act 1974 even if they are not recorded as a site on AHIMS.
- This search can form part of your due diligence and remains valid for 12 months.

AHIMS Web Services (AWS)
Search Result

Your Ref Number : BW Flowlines a - 200m

Client Service ID : 81423

RPS Australia East Pty Ltd Sydney CBD
Level 12 92 Pitt Street
Sydney New South Wales 2000

Attention: Sarah Ward

Email: sarah.ward@rpsgroup.com.au

Date: 26 September 2012

Dear Sir or Madam:

AHIMS Web Service search for the following area at Datum :GDA, Zone : 55, Eastings : 753652 - 753653, Northings : 6605037 - 6605038 with a Buffer of 200 meters. conducted by Sarah Ward on 26 September 2012

A search of the Office of the Environment and Heritage AHIMS Web Services (Aboriginal Heritage Information Management System) has shown that:

0	**Aboriginal sites are recorded in or near the above location.**
0	**Aboriginal places have been declared in or near the above location. ***

If your search shows Aboriginal sites or places what should you do?

- You must do an extensive search if AHIMS has shown that there are Aboriginal sites or places recorded in the search area.
- If you are checking AHIMS as a part of your due diligence, refer to the next steps of the Due Diligence Code of practice.
- You can get further information about Aboriginal places by looking at the gazettal notice that declared it. Aboriginal places gazetted after 2001 are available on the NSW Government Gazette (http://www.nsw.gov.au/gazette) website. Gazettal notices published prior to 2001 can be obtained from Office of Environment and Heritage's Aboriginal Heritage Information Unit upon request

Important information about your AHIMS search

- The information derived from the AHIMS search is only to be used for the purpose for which it was requested. It is not be made available to the public.
- AHIMS records information about Aboriginal sites that have been provided to Office of Environment and Heritage and Aboriginal places that have been declared by the Minister;
- Information recorded on AHIMS may vary in its accuracy and may not be up to date .Location details are recorded as grid references and it is important to note that there may be errors or omissions in these recordings,
- Some parts of New South Wales have not been investigated in detail and there may be fewer records of Aboriginal sites in those areas. These areas may contain Aboriginal sites which are not recorded on AHIMS.
- Aboriginal objects are protected under the National Parks and Wildlife Act 1974 even if they are not recorded as a site on AHIMS.
- This search can form part of your due diligence and remains valid for 12 months.

AHIMS Web Services (AWS)
Search Result

Your Ref Number : BW Flowlines B 200m

Client Service ID : 81425

RPS Australia East Pty Ltd Sydney CBD
Level 12 92 Pitt Street
Sydney New South Wales 2000

Attention: Sarah Ward

Email: sarah.ward@rpsgroup.com.au

Date: 26 September 2012

Dear Sir or Madam:

AHIMS Web Service search for the following area at Datum :GDA, Zone : 55, Eastings : 753746 - 753747, Northings : 6607061 - 6607062 with a Buffer of 200 meters. conducted by Sarah Ward on 26 September 2012

A search of the Office of the Environment and Heritage AHIMS Web Services (Aboriginal Heritage Information Management System) has shown that:

0	**Aboriginal sites are recorded in or near the above location.**
0	**Aboriginal places have been declared in or near the above location. ***

If your search shows Aboriginal sites or places what should you do?

- You must do an extensive search if AHIMS has shown that there are Aboriginal sites or places recorded in the search area.
- If you are checking AHIMS as a part of your due diligence, refer to the next steps of the Due Diligence Code of practice.
- You can get further information about Aboriginal places by looking at the gazettal notice that declared it. Aboriginal places gazetted after 2001 are available on the NSW Government Gazette (http://www.nsw.gov.au/gazette) website. Gazettal notices published prior to 2001 can be obtained from Office of Environment and Heritage's Aboriginal Heritage Information Unit upon request

Important information about your AHIMS search

- The information derived from the AHIMS search is only to be used for the purpose for which it was requested. It is not be made available to the public.
- AHIMS records information about Aboriginal sites that have been provided to Office of Environment and Heritage and Aboriginal places that have been declared by the Minister;
- Information recorded on AHIMS may vary in its accuracy and may not be up to date .Location details are recorded as grid references and it is important to note that there may be errors or omissions in these recordings,
- Some parts of New South Wales have not been investigated in detail and there may be fewer records of Aboriginal sites in those areas. These areas may contain Aboriginal sites which are not recorded on AHIMS.
- Aboriginal objects are protected under the National Parks and Wildlife Act 1974 even if they are not recorded as a site on AHIMS.
- This search can form part of your due diligence and remains valid for 12 months.

AHIMS Web Services (AWS)
Search Result

Your Ref Number : BW Flowline C 200m

Client Service ID : 81426

RPS Australia East Pty Ltd Sydney CBD
Level 12 92 Pitt Street
Sydney New South Wales 2000

Attention: Sarah Ward

Email: sarah.ward@rpsgroup.com.au

Date: 26 September 2012

Dear Sir or Madam:

AHIMS Web Service search for the following area at Datum :GDA, Zone : 55, Eastings : 753777 - 753778, Northings : 6607793 - 6607794 with a Buffer of 200 meters. conducted by Sarah Ward on 26 September 2012

A search of the Office of the Environment and Heritage AHIMS Web Services (Aboriginal Heritage Information Management System) has shown that:

0	**Aboriginal sites are recorded in or near the above location.**
0	**Aboriginal places have been declared in or near the above location. ***

If your search shows Aboriginal sites or places what should you do?

- You must do an extensive search if AHIMS has shown that there are Aboriginal sites or places recorded in the search area.
- If you are checking AHIMS as a part of your due diligence, refer to the next steps of the Due Diligence Code of practice.
- You can get further information about Aboriginal places by looking at the gazettal notice that declared it. Aboriginal places gazetted after 2001 are available on the NSW Government Gazette (http://www.nsw.gov.au/gazette) website. Gazettal notices published prior to 2001 can be obtained from Office of Environment and Heritage's Aboriginal Heritage Information Unit upon request

Important information about your AHIMS search

- The information derived from the AHIMS search is only to be used for the purpose for which it was requested. It is not be made available to the public.
- AHIMS records information about Aboriginal sites that have been provided to Office of Environment and Heritage and Aboriginal places that have been declared by the Minister;
- Information recorded on AHIMS may vary in its accuracy and may not be up to date .Location details are recorded as grid references and it is important to note that there may be errors or omissions in these recordings,
- Some parts of New South Wales have not been investigated in detail and there may be fewer records of Aboriginal sites in those areas. These areas may contain Aboriginal sites which are not recorded on AHIMS.
- Aboriginal objects are protected under the National Parks and Wildlife Act 1974 even if they are not recorded as a site on AHIMS.
- This search can form part of your due diligence and remains valid for 12 months.

AHIMS Web Services (AWS)
Search Result

Your Ref Number : BW Flowlines D 200m

Client Service ID : 81427

RPS Australia East Pty Ltd Sydney CBD
Level 12 92 Pitt Street
Sydney New South Wales 2000

Attention: Sarah Ward

Email: sarah.ward@rpsgroup.com.au

Date: 26 September 2012

Dear Sir or Madam:

AHIMS Web Service search for the following area at Datum :GDA, Zone : 55, Eastings : 753729 - 753730, Northings : 6608008 - 6608009 with a Buffer of 200 meters. conducted by Sarah Ward on 26 September 2012

A search of the Office of the Environment and Heritage AHIMS Web Services (Aboriginal Heritage Information Management System) has shown that:

0	**Aboriginal sites are recorded in or near the above location.**
0	**Aboriginal places have been declared in or near the above location. ***

If your search shows Aboriginal sites or places what should you do?

- You must do an extensive search if AHIMS has shown that there are Aboriginal sites or places recorded in the search area.
- If you are checking AHIMS as a part of your due diligence, refer to the next steps of the Due Diligence Code of practice.
- You can get further information about Aboriginal places by looking at the gazettal notice that declared it. Aboriginal places gazetted after 2001 are available on the NSW Government Gazette (http://www.nsw.gov.au/gazette) website. Gazettal notices published prior to 2001 can be obtained from Office of Environment and Heritage's Aboriginal Heritage Information Unit upon request

Important information about your AHIMS search

- The information derived from the AHIMS search is only to be used for the purpose for which it was requested. It is not be made available to the public.
- AHIMS records information about Aboriginal sites that have been provided to Office of Environment and Heritage and Aboriginal places that have been declared by the Minister;
- Information recorded on AHIMS may vary in its accuracy and may not be up to date .Location details are recorded as grid references and it is important to note that there may be errors or omissions in these recordings,
- Some parts of New South Wales have not been investigated in detail and there may be fewer records of Aboriginal sites in those areas. These areas may contain Aboriginal sites which are not recorded on AHIMS.
- Aboriginal objects are protected under the National Parks and Wildlife Act 1974 even if they are not recorded as a site on AHIMS.
- This search can form part of your due diligence and remains valid for 12 months.

AHIMS Web Services (AWS)
Search Result

Your Ref Number : BW Flowlines D1 200m

Client Service ID : 81429

RPS Australia East Pty Ltd Sydney CBD
Level 12 92 Pitt Street
Sydney New South Wales 2000

Attention: Sarah Ward

Email: sarah.ward@rpsgroup.com.au

Date: 26 September 2012

Dear Sir or Madam:

AHIMS Web Service search for the following area at Datum :GDA, Zone : 55, Eastings : 753811 - 753812, Northings : 6608072 - 6608073 with a Buffer of 200 meters. conducted by Sarah Ward on 26 September 2012

A search of the Office of the Environment and Heritage AHIMS Web Services (Aboriginal Heritage Information Management System) has shown that:

0	**Aboriginal sites are recorded in or near the above location.**
0	**Aboriginal places have been declared in or near the above location. ***

If your search shows Aboriginal sites or places what should you do?

- You must do an extensive search if AHIMS has shown that there are Aboriginal sites or places recorded in the search area.
- If you are checking AHIMS as a part of your due diligence, refer to the next steps of the Due Diligence Code of practice.
- You can get further information about Aboriginal places by looking at the gazettal notice that declared it. Aboriginal places gazetted after 2001 are available on the NSW Government Gazette (http://www.nsw.gov.au/gazette) website. Gazettal notices published prior to 2001 can be obtained from Office of Environment and Heritage's Aboriginal Heritage Information Unit upon request

Important information about your AHIMS search

- The information derived from the AHIMS search is only to be used for the purpose for which it was requested. It is not be made available to the public.
- AHIMS records information about Aboriginal sites that have been provided to Office of Environment and Heritage and Aboriginal places that have been declared by the Minister;
- Information recorded on AHIMS may vary in its accuracy and may not be up to date .Location details are recorded as grid references and it is important to note that there may be errors or omissions in these recordings,
- Some parts of New South Wales have not been investigated in detail and there may be fewer records of Aboriginal sites in those areas. These areas may contain Aboriginal sites which are not recorded on AHIMS.
- Aboriginal objects are protected under the National Parks and Wildlife Act 1974 even if they are not recorded as a site on AHIMS.
- This search can form part of your due diligence and remains valid for 12 months.

AHIMS Web Services (AWS)
Search Result

Your Ref Number : BW flowlines E 200m

Client Service ID : 81430

RPS Australia East Pty Ltd Sydney CBD
Level 12 92 Pitt Street
Sydney New South Wales 2000

Attention: Sarah Ward

Email: sarah.ward@rpsgroup.com.au

Date: 26 September 2012

Dear Sir or Madam:

AHIMS Web Service search for the following area at Datum :GDA, Zone : 55, Eastings : 753675 - 753676, Northings : 6608265 - 6608266 with a Buffer of 200 meters. conducted by Sarah Ward on 26 September 2012

A search of the Office of the Environment and Heritage AHIMS Web Services (Aboriginal Heritage Information Management System) has shown that:

0	**Aboriginal sites are recorded in or near the above location.**
0	**Aboriginal places have been declared in or near the above location. ***

If your search shows Aboriginal sites or places what should you do?

- You must do an extensive search if AHIMS has shown that there are Aboriginal sites or places recorded in the search area.
- If you are checking AHIMS as a part of your due diligence, refer to the next steps of the Due Diligence Code of practice.
- You can get further information about Aboriginal places by looking at the gazettal notice that declared it. Aboriginal places gazetted after 2001 are available on the NSW Government Gazette (http://www.nsw.gov.au/gazette) website. Gazettal notices published prior to 2001 can be obtained from Office of Environment and Heritage's Aboriginal Heritage Information Unit upon request

Important information about your AHIMS search

- The information derived from the AHIMS search is only to be used for the purpose for which it was requested. It is not be made available to the public.
- AHIMS records information about Aboriginal sites that have been provided to Office of Environment and Heritage and Aboriginal places that have been declared by the Minister;
- Information recorded on AHIMS may vary in its accuracy and may not be up to date .Location details are recorded as grid references and it is important to note that there may be errors or omissions in these recordings,
- Some parts of New South Wales have not been investigated in detail and there may be fewer records of Aboriginal sites in those areas. These areas may contain Aboriginal sites which are not recorded on AHIMS.
- Aboriginal objects are protected under the National Parks and Wildlife Act 1974 even if they are not recorded as a site on AHIMS.
- This search can form part of your due diligence and remains valid for 12 months.

AHIMS Web Services (AWS)
Search Result

Your Ref Number : BW flowlines E1 - 200m

Client Service ID : 81431

RPS Australia East Pty Ltd Sydney CBD
Level 12 92 Pitt Street
Sydney New South Wales 2000

Attention: Sarah Ward

Email: sarah.ward@rpsgroup.com.au

Date: 26 September 2012

Dear Sir or Madam:

AHIMS Web Service search for the following area at Datum :GDA, Zone : 55, Eastings : 753747 - 753748, Northings : 6608316 - 6608317 with a Buffer of 200 meters. conducted by Sarah Ward on 26 September 2012

A search of the Office of the Environment and Heritage AHIMS Web Services (Aboriginal Heritage Information Management System) has shown that:

0	**Aboriginal sites are recorded in or near the above location.**
0	**Aboriginal places have been declared in or near the above location. ***

If your search shows Aboriginal sites or places what should you do?

- You must do an extensive search if AHIMS has shown that there are Aboriginal sites or places recorded in the search area.
- If you are checking AHIMS as a part of your due diligence, refer to the next steps of the Due Diligence Code of practice.
- You can get further information about Aboriginal places by looking at the gazettal notice that declared it. Aboriginal places gazetted after 2001 are available on the NSW Government Gazette (http://www.nsw.gov.au/gazette) website. Gazettal notices published prior to 2001 can be obtained from Office of Environment and Heritage's Aboriginal Heritage Information Unit upon request

Important information about your AHIMS search

- The information derived from the AHIMS search is only to be used for the purpose for which it was requested. It is not be made available to the public.
- AHIMS records information about Aboriginal sites that have been provided to Office of Environment and Heritage and Aboriginal places that have been declared by the Minister;
- Information recorded on AHIMS may vary in its accuracy and may not be up to date .Location details are recorded as grid references and it is important to note that there may be errors or omissions in these recordings,
- Some parts of New South Wales have not been investigated in detail and there may be fewer records of Aboriginal sites in those areas. These areas may contain Aboriginal sites which are not recorded on AHIMS.
- Aboriginal objects are protected under the National Parks and Wildlife Act 1974 even if they are not recorded as a site on AHIMS.
- This search can form part of your due diligence and remains valid for 12 months.

AHIMS Web Services (AWS)
Search Result

Your Ref Number : BW flowlines F - 200m

Client Service ID : 81433

RPS Australia East Pty Ltd Sydney CBD
Level 12 92 Pitt Street
Sydney New South Wales 2000

Attention: Sarah Ward

Email: sarah.ward@rpsgroup.com.au

Date: 26 September 2012

Dear Sir or Madam:

AHIMS Web Service search for the following area at Datum :GDA, Zone : 55, Eastings : 753687 - 753688, Northings : 6608317 - 6608318 with a Buffer of 200 meters. conducted by Sarah Ward on 26 September 2012

A search of the Office of the Environment and Heritage AHIMS Web Services (Aboriginal Heritage Information Management System) has shown that:

0	**Aboriginal sites are recorded in or near the above location.**
0	**Aboriginal places have been declared in or near the above location. ***

If your search shows Aboriginal sites or places what should you do?

- You must do an extensive search if AHIMS has shown that there are Aboriginal sites or places recorded in the search area.
- If you are checking AHIMS as a part of your due diligence, refer to the next steps of the Due Diligence Code of practice.
- You can get further information about Aboriginal places by looking at the gazettal notice that declared it. Aboriginal places gazetted after 2001 are available on the NSW Government Gazette (http://www.nsw.gov.au/gazette) website. Gazettal notices published prior to 2001 can be obtained from Office of Environment and Heritage's Aboriginal Heritage Information Unit upon request

Important information about your AHIMS search

- The information derived from the AHIMS search is only to be used for the purpose for which it was requested. It is not be made available to the public.
- AHIMS records information about Aboriginal sites that have been provided to Office of Environment and Heritage and Aboriginal places that have been declared by the Minister;
- Information recorded on AHIMS may vary in its accuracy and may not be up to date .Location details are recorded as grid references and it is important to note that there may be errors or omissions in these recordings,
- Some parts of New South Wales have not been investigated in detail and there may be fewer records of Aboriginal sites in those areas. These areas may contain Aboriginal sites which are not recorded on AHIMS.
- Aboriginal objects are protected under the National Parks and Wildlife Act 1974 even if they are not recorded as a site on AHIMS.
- This search can form part of your due diligence and remains valid for 12 months.

AHIMS Web Services (AWS)
Search Result

Your Ref Number : BW flowlines F1 - 200m

Client Service ID : 81434

RPS Australia East Pty Ltd Sydney CBD
Level 12 92 Pitt Street
Sydney New South Wales 2000

Attention: Sarah Ward

Email: sarah.ward@rpsgroup.com.au

Date: 26 September 2012

Dear Sir or Madam:

AHIMS Web Service search for the following area at Datum :GDA, Zone : 55, Eastings : 753728 - 753729, Northings : 6608346 - 6608347 with a Buffer of 200 meters. conducted by Sarah Ward on 26 September 2012

A search of the Office of the Environment and Heritage AHIMS Web Services (Aboriginal Heritage Information Management System) has shown that:

0	**Aboriginal sites are recorded in or near the above location.**
0	**Aboriginal places have been declared in or near the above location. ***

If your search shows Aboriginal sites or places what should you do?

- You must do an extensive search if AHIMS has shown that there are Aboriginal sites or places recorded in the search area.
- If you are checking AHIMS as a part of your due diligence, refer to the next steps of the Due Diligence Code of practice.
- You can get further information about Aboriginal places by looking at the gazettal notice that declared it. Aboriginal places gazetted after 2001 are available on the NSW Government Gazette (http://www.nsw.gov.au/gazette) website. Gazettal notices published prior to 2001 can be obtained from Office of Environment and Heritage's Aboriginal Heritage Information Unit upon request

Important information about your AHIMS search

- The information derived from the AHIMS search is only to be used for the purpose for which it was requested. It is not be made available to the public.
- AHIMS records information about Aboriginal sites that have been provided to Office of Environment and Heritage and Aboriginal places that have been declared by the Minister;
- Information recorded on AHIMS may vary in its accuracy and may not be up to date .Location details are recorded as grid references and it is important to note that there may be errors or omissions in these recordings,
- Some parts of New South Wales have not been investigated in detail and there may be fewer records of Aboriginal sites in those areas. These areas may contain Aboriginal sites which are not recorded on AHIMS.
- Aboriginal objects are protected under the National Parks and Wildlife Act 1974 even if they are not recorded as a site on AHIMS.
- This search can form part of your due diligence and remains valid for 12 months.

AHIMS Web Services (AWS)
Search Result

Your Ref Number : BW flowlines G - 200m

Client Service ID : 81435

RPS Australia East Pty Ltd Sydney CBD
Level 12 92 Pitt Street
Sydney New South Wales 2000

Attention: Sarah Ward

Email: sarah.ward@rpsgroup.com.au

Date: 26 September 2012

Dear Sir or Madam:

AHIMS Web Service search for the following area at Datum :GDA, Zone : 55, Eastings : 753551 - 753552, Northings : 6608544 - 6608545 with a Buffer of 200 meters. conducted by Sarah Ward on 26 September 2012

A search of the Office of the Environment and Heritage AHIMS Web Services (Aboriginal Heritage Information Management System) has shown that:

0	**Aboriginal sites are recorded in or near the above location.**
0	**Aboriginal places have been declared in or near the above location. ***

If your search shows Aboriginal sites or places what should you do?

- You must do an extensive search if AHIMS has shown that there are Aboriginal sites or places recorded in the search area.
- If you are checking AHIMS as a part of your due diligence, refer to the next steps of the Due Diligence Code of practice.
- You can get further information about Aboriginal places by looking at the gazettal notice that declared it. Aboriginal places gazetted after 2001 are available on the NSW Government Gazette (http://www.nsw.gov.au/gazette) website. Gazettal notices published prior to 2001 can be obtained from Office of Environment and Heritage's Aboriginal Heritage Information Unit upon request

Important information about your AHIMS search

- The information derived from the AHIMS search is only to be used for the purpose for which it was requested. It is not be made available to the public.
- AHIMS records information about Aboriginal sites that have been provided to Office of Environment and Heritage and Aboriginal places that have been declared by the Minister;
- Information recorded on AHIMS may vary in its accuracy and may not be up to date .Location details are recorded as grid references and it is important to note that there may be errors or omissions in these recordings,
- Some parts of New South Wales have not been investigated in detail and there may be fewer records of Aboriginal sites in those areas. These areas may contain Aboriginal sites which are not recorded on AHIMS.
- Aboriginal objects are protected under the National Parks and Wildlife Act 1974 even if they are not recorded as a site on AHIMS.
- This search can form part of your due diligence and remains valid for 12 months.

AHIMS Web Services (AWS)
Search Result

Your Ref Number : BW flowlines H - 200m

Client Service ID : 81436

RPS Australia East Pty Ltd Sydney CBD
Level 12 92 Pitt Street
Sydney New South Wales 2000

Attention: Sarah Ward

Email: sarah.ward@rpsgroup.com.au

Date: 26 September 2012

Dear Sir or Madam:

AHIMS Web Service search for the following area at Datum :GDA, Zone : 55, Eastings : 751793 - 751794, Northings : 6610223 - 6610224 with a Buffer of 200 meters. conducted by Sarah Ward on 26 September 2012

A search of the Office of the Environment and Heritage AHIMS Web Services (Aboriginal Heritage Information Management System) has shown that:

0	**Aboriginal sites are recorded in or near the above location.**
0	**Aboriginal places have been declared in or near the above location. ***

If your search shows Aboriginal sites or places what should you do?

- You must do an extensive search if AHIMS has shown that there are Aboriginal sites or places recorded in the search area.
- If you are checking AHIMS as a part of your due diligence, refer to the next steps of the Due Diligence Code of practice.
- You can get further information about Aboriginal places by looking at the gazettal notice that declared it. Aboriginal places gazetted after 2001 are available on the NSW Government Gazette (http://www.nsw.gov.au/gazette) website. Gazettal notices published prior to 2001 can be obtained from Office of Environment and Heritage's Aboriginal Heritage Information Unit upon request

Important information about your AHIMS search

- The information derived from the AHIMS search is only to be used for the purpose for which it was requested. It is not be made available to the public.
- AHIMS records information about Aboriginal sites that have been provided to Office of Environment and Heritage and Aboriginal places that have been declared by the Minister;
- Information recorded on AHIMS may vary in its accuracy and may not be up to date .Location details are recorded as grid references and it is important to note that there may be errors or omissions in these recordings,
- Some parts of New South Wales have not been investigated in detail and there may be fewer records of Aboriginal sites in those areas. These areas may contain Aboriginal sites which are not recorded on AHIMS.
- Aboriginal objects are protected under the National Parks and Wildlife Act 1974 even if they are not recorded as a site on AHIMS.
- This search can form part of your due diligence and remains valid for 12 months.

AHIMS Web Services (AWS)
Search Result

Your Ref Number : BW flowlines J - 200m

Client Service ID : 81438

RPS Australia East Pty Ltd Sydney CBD
Level 12 92 Pitt Street
Sydney New South Wales 2000

Attention: Sarah Ward

Email: sarah.ward@rpsgroup.com.au

Date: 26 September 2012

Dear Sir or Madam:

AHIMS Web Service search for the following area at Datum :GDA, Zone : 55, Eastings : 750715 - 750716, Northings : 6616721 - 6616722 with a Buffer of 200 meters. conducted by Sarah Ward on 26 September 2012

A search of the Office of the Environment and Heritage AHIMS Web Services (Aboriginal Heritage Information Management System) has shown that:

0	**Aboriginal sites are recorded in or near the above location.**
0	**Aboriginal places have been declared in or near the above location. ***

If your search shows Aboriginal sites or places what should you do?

- You must do an extensive search if AHIMS has shown that there are Aboriginal sites or places recorded in the search area.
- If you are checking AHIMS as a part of your due diligence, refer to the next steps of the Due Diligence Code of practice.
- You can get further information about Aboriginal places by looking at the gazettal notice that declared it. Aboriginal places gazetted after 2001 are available on the NSW Government Gazette (http://www.nsw.gov.au/gazette) website. Gazettal notices published prior to 2001 can be obtained from Office of Environment and Heritage's Aboriginal Heritage Information Unit upon request

Important information about your AHIMS search

- The information derived from the AHIMS search is only to be used for the purpose for which it was requested. It is not be made available to the public.
- AHIMS records information about Aboriginal sites that have been provided to Office of Environment and Heritage and Aboriginal places that have been declared by the Minister;
- Information recorded on AHIMS may vary in its accuracy and may not be up to date .Location details are recorded as grid references and it is important to note that there may be errors or omissions in these recordings,
- Some parts of New South Wales have not been investigated in detail and there may be fewer records of Aboriginal sites in those areas. These areas may contain Aboriginal sites which are not recorded on AHIMS.
- Aboriginal objects are protected under the National Parks and Wildlife Act 1974 even if they are not recorded as a site on AHIMS.
- This search can form part of your due diligence and remains valid for 12 months.

AHIMS Web Services (AWS)
Search Result

Your Ref Number : BW flowlines K - 1km

Client Service ID : 81454

RPS Australia East Pty Ltd Sydney CBD
Level 12 92 Pitt Street
Sydney New South Wales 2000

Attention: Sarah Ward

Email: sarah.ward@rpsgroup.com.au

Date: 26 September 2012

Dear Sir or Madam:

AHIMS Web Service search for the following area at Datum :GDA, Zone : 55, Eastings : 750543 - 750544, Northings : 6617766 - 6617767 with a Buffer of 1000 meters. conducted by Sarah Ward on 26 September 2012

A search of the Office of the Environment and Heritage AHIMS Web Services (Aboriginal Heritage Information Management System) has shown that:

0	**Aboriginal sites are recorded in or near the above location.**
0	**Aboriginal places have been declared in or near the above location. ***

If your search shows Aboriginal sites or places what should you do?

- You must do an extensive search if AHIMS has shown that there are Aboriginal sites or places recorded in the search area.
- If you are checking AHIMS as a part of your due diligence, refer to the next steps of the Due Diligence Code of practice.
- You can get further information about Aboriginal places by looking at the gazettal notice that declared it. Aboriginal places gazetted after 2001 are available on the NSW Government Gazette (http://www.nsw.gov.au/gazette) website. Gazettal notices published prior to 2001 can be obtained from Office of Environment and Heritage's Aboriginal Heritage Information Unit upon request

Important information about your AHIMS search

- The information derived from the AHIMS search is only to be used for the purpose for which it was requested. It is not be made available to the public.
- AHIMS records information about Aboriginal sites that have been provided to Office of Environment and Heritage and Aboriginal places that have been declared by the Minister;
- Information recorded on AHIMS may vary in its accuracy and may not be up to date .Location details are recorded as grid references and it is important to note that there may be errors or omissions in these recordings,
- Some parts of New South Wales have not been investigated in detail and there may be fewer records of Aboriginal sites in those areas. These areas may contain Aboriginal sites which are not recorded on AHIMS.
- Aboriginal objects are protected under the National Parks and Wildlife Act 1974 even if they are not recorded as a site on AHIMS.
- This search can form part of your due diligence and remains valid for 12 months.

AHIMS Web Services (AWS)
Search Result

Your Ref Number : BW flowlines k - 200m

Client Service ID : 81439

RPS Australia East Pty Ltd Sydney CBD
Level 12 92 Pitt Street
Sydney New South Wales 2000

Attention: Sarah Ward

Email: sarah.ward@rpsgroup.com.au

Date: 26 September 2012

Dear Sir or Madam:

AHIMS Web Service search for the following area at Datum :GDA, Zone : 55, Eastings : 750743 - 750744, Northings : 6617766 - 6617767 with a Buffer of 200 meters. conducted by Sarah Ward on 26 September 2012

A search of the Office of the Environment and Heritage AHIMS Web Services (Aboriginal Heritage Information Management System) has shown that:

0	**Aboriginal sites are recorded in or near the above location.**
0	**Aboriginal places have been declared in or near the above location. ***

If your search shows Aboriginal sites or places what should you do?

- You must do an extensive search if AHIMS has shown that there are Aboriginal sites or places recorded in the search area.
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- Aboriginal objects are protected under the National Parks and Wildlife Act 1974 even if they are not recorded as a site on AHIMS.
- This search can form part of your due diligence and remains valid for 12 months.

AHIMS Web Services (AWS)
Search Result

Your Ref Number : BW flowlines L - 1 km

Client Service ID : 81453

RPS Australia East Pty Ltd Sydney CBD
Level 12 92 Pitt Street
Sydney New South Wales 2000

Attention: Sarah Ward

Email: sarah.ward@rpsgroup.com.au

Date: 26 September 2012

Dear Sir or Madam:

AHIMS Web Service search for the following area at Datum :GDA, Zone : 55, Eastings : 750447 - 750448, Northings : 6617869 - 6617870 with a Buffer of 1000 meters. conducted by Sarah Ward on 26 September 2012

A search of the Office of the Environment and Heritage AHIMS Web Services (Aboriginal Heritage Information Management System) has shown that:

0	**Aboriginal sites are recorded in or near the above location.**
0	**Aboriginal places have been declared in or near the above location. ***

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- This search can form part of your due diligence and remains valid for 12 months.

AHIMS Web Services (AWS)
Search Result

Your Ref Number : BW flowlines I - 200m

Client Service ID : 81440

RPS Australia East Pty Ltd Sydney CBD
Level 12 92 Pitt Street
Sydney New South Wales 2000

Attention: Sarah Ward

Email: sarah.ward@rpsgroup.com.au

Date: 26 September 2012

Dear Sir or Madam:

AHIMS Web Service search for the following area at Datum :GDA, Zone : 55, Eastings : 750447 - 750448, Northings : 6617869 - 6617870 with a Buffer of 200 meters. conducted by Sarah Ward on 26 September 2012

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AHIMS Web Services (AWS)
Search Result

Your Ref Number : BW flowlines M - 1km

Client Service ID : 81452

RPS Australia East Pty Ltd Sydney CBD
Level 12 92 Pitt Street
Sydney New South Wales 2000

Attention: Sarah Ward

Email: sarah.ward@rpsgroup.com.au

Date: 26 September 2012

Dear Sir or Madam:

AHIMS Web Service search for the following area at Datum :GDA, Zone : 55, Eastings : 750642 - 750643, Northings : 6618543 - 6618544 with a Buffer of 1000 meters. conducted by Sarah Ward on 26 September 2012

A search of the Office of the Environment and Heritage AHIMS Web Services (Aboriginal Heritage Information Management System) has shown that:

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- This search can form part of your due diligence and remains valid for 12 months.

AHIMS Web Services (AWS)
Search Result

Your Ref Number : BW flowlines M - 200m

Client Service ID : 81441

RPS Australia East Pty Ltd Sydney CBD
Level 12 92 Pitt Street
Sydney New South Wales 2000

Attention: Sarah Ward

Email: sarah.ward@rpsgroup.com.au

Date: 26 September 2012

Dear Sir or Madam:

AHIMS Web Service search for the following area at Datum :GDA, Zone : 55, Eastings : 750642 - 750643, Northings : 6618543 - 6618544 with a Buffer of 200 meters. conducted by Sarah Ward on 26 September 2012

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- This search can form part of your due diligence and remains valid for 12 months.

AHIMS Web Services (AWS)
Search Result

Your Ref Number : BW flowlines N - 1 km

Client Service ID : 81451

RPS Australia East Pty Ltd Sydney CBD
Level 12 92 Pitt Street
Sydney New South Wales 2000

Attention: Sarah Ward

Email: sarah.ward@rpsgroup.com.au

Date: 26 September 2012

Dear Sir or Madam:

AHIMS Web Service search for the following area at Datum :GDA, Zone : 55, Eastings : 751176 - 751177, Northings : 6620378 - 6620379 with a Buffer of 1000 meters. conducted by Sarah Ward on 26 September 2012

A search of the Office of the Environment and Heritage AHIMS Web Services (Aboriginal Heritage Information Management System) has shown that:

0	**Aboriginal sites are recorded in or near the above location.**
0	**Aboriginal places have been declared in or near the above location. ***

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- This search can form part of your due diligence and remains valid for 12 months.

AHIMS Web Services (AWS)
Search Result

Your Ref Number : BW flowlines N - 200m

Client Service ID : 81447

RPS Australia East Pty Ltd Sydney CBD
Level 12 92 Pitt Street
Sydney New South Wales 2000

Attention: Sarah Ward

Email: sarah.ward@rpsgroup.com.au

Date: 26 September 2012

Dear Sir or Madam:

AHIMS Web Service search for the following area at Datum :GDA, Zone : 55, Eastings : 751176 - 751177, Northings : 6620378 - 6620379 with a Buffer of 200 meters. conducted by Sarah Ward on 26 September 2012

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- Aboriginal objects are protected under the National Parks and Wildlife Act 1974 even if they are not recorded as a site on AHIMS.
- This search can form part of your due diligence and remains valid for 12 months.

Appendix 9

AHIMS Searches – Bibblewindi

AHIMS Web Services (AWS)
Search Result

Your Ref Number : BW Pond 3 50m

Client Service ID : 81383

RPS Australia East Pty Ltd Sydney CBD
Level 12 92 Pitt Street
Sydney New South Wales 2000

Attention: Sarah Ward

Email: sarah.ward@rpsgroup.com.au

Date: 26 September 2012

Dear Sir or Madam:

AHIMS Web Service search for the following area at Datum :GDA, Zone : 55, Eastings : 753983 - 753984, Northings : 6607986 - 6607987 with a Buffer of 50 meters. conducted by Sarah Ward on 26 September 2012

A search of the Office of the Environment and Heritage AHIMS Web Services (Aboriginal Heritage Information Management System) has shown that:

0	**Aboriginal sites are recorded in or near the above location.**
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AHIMS Web Services (AWS)
Search Result

Your Ref Number : BW Pond 3 200m

Client Service ID : 81384

RPS Australia East Pty Ltd Sydney CBD
Level 12 92 Pitt Street
Sydney New South Wales 2000

Attention: Sarah Ward

Email: sarah.ward@rpsgroup.com.au

Date: 26 September 2012

Dear Sir or Madam:

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AHIMS Web Services (AWS)
Search Result

Your Ref Number : BW Pond 3 1km

Client Service ID : 81385

RPS Australia East Pty Ltd Sydney CBD
Level 12 92 Pitt Street
Sydney New South Wales 2000

Attention: Sarah Ward

Email: sarah.ward@rpsgroup.com.au

Date: 26 September 2012

Dear Sir or Madam:

AHIMS Web Service search for the following area at Datum :GDA, Zone : 55, Eastings : 753983 - 753984, Northings : 6607986 - 6607987 with a Buffer of 1000 meters. conducted by Sarah Ward on 26 September 2012

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Appendix 10

Dam Failure Impact Assessment

5 October 2012

SANTOS NARRABRI GAS PROJECT

Dam Failure Impact Assessment - Leewood Ponds

Submitted to:
Andrew Shek
Santos Ltd
Level 16
40 Creek Street
Brisbane Q 4000

REPORT

Report Number. 127615025-023-R-Rev0

Golder Associates

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1.0 INTRODUCTION

Santos Ltd (Santos) has commissioned Golder Associates Pty Ltd (Golder) to perform a dam failure impact assessment for the proposed Coal Seam Gas (CSG) associated water ponds at the Leewood site. This dam failure impact assessment has been undertaken in accordance with the NSW Dam Safety Committee (DSC) publication *Consequence Categories for Dams DSC3A* dated June 2010 and the ANCOLD guidelines, *Guidelines on the Consequence Categories for Dams* dated April 2011. The Qld Department of Environment and Resource Management (DERM) guidelines, *Guidelines for Failure Impact Assessment of Water Dams* dated June 2010 has also been used for this assessment where detailed methodologies have not been provided in either the DSC3A or ANCOLD guidelines.

The purpose of this dam failure impact assessment is to evaluate the impacts of a dam failure on the safety of the people, environment, livestock and property downstream of the Leewood Ponds.

2.0 SITE DESCRIPTION

The proposed location of the Leewood Ponds is the north-western portion of the property known as Leewood Lot 1 DP 771141 (herein referred to as the site). The site is located off the Newell Highway approximately 20 km south west of Narrabri, NSW.

Mollee Creek flows from southeast to north through the site. Approximately 1 km upstream (southeast) of the proposed ponds, it crosses the Newell highway via two culverts. The creek is non-perennial and not well-defined at the location of the proposed ponds. It enters the Namoi River more than 30 km downstream of the site.

A number of buildings are identified downstream of the proposed ponds. Based on an assessment of aerial imagery the majority of these buildings appear to be residences for humans.

An RPS Group report[1] identifies a stand of Brigalow which is considered an area of Threatened Ecological Community (TEC) in the northeast portion of the site. The Brigalow Park Nature Reserve (BPNR), also considered to be a TEC, is located on the western bank of Mollee Creek approximately 8 km downstream of the proposed ponds.

In general, the receiving environment downstream and to the north of the proposed ponds is land used for agricultural activities, including a number of farm dams.

The site slopes are approximately 0.2% to the north toward Mollee Creek. Elevations vary between RL 247 m and RL 245 m (AHD).

A site and catchment plan is provided in Figure A1, Appendix A.

3.0 PONDS DESIGN

The concept layout of the proposed ponds includes adjacent product, brine and permeate ponds in a turkey's nest configuration. The ponds include a full perimeter embankment. A small upslope external catchment is diverted around the ponds and as a result there is effectively no upstream catchment. The ponds crest area is the ponds catchment. The inflow into the Ponds includes pumped water associated with the production of coal seam gas and direct rainfall on the Ponds surface/embankment crest.

Table 1 provides a summary of the characteristics of the Leewood Ponds.

[1] RPS Group 2012 Preliminary Ecological Advice for a Proposed RO Plant, Narrabri

Table 1: Summary of Leewood Ponds Characteristics

	Permeate Pond	Brine Pond	Product Water Pond
Purpose	Storage of RO treatment permeate	Storage of RO treatment brine	Storage of associated CSG water
Type	Turkeys nest (ring dam) comprising homogenous site won earth fill		
Compartments	Two equal sized compartments separated by an intermediate bund at Maximum Operating Water Level (MOWL)		
Storage at Maximum Operating Water Level (MOWL)	50.0 ML	300.0 ML	300.0 ML
Storage at Spillway Level	57.6 ML	392.8 ML	412.3 ML
Storage at Dam Crest	73.0 ML	443.0 ML	470.0 ML
Storage at Dam Crest and above Existing Surface Level	48.6 ML	327.8 ML	371.6 ML
Spillway Level	247.55 m	249.80 m	250.45 m
Embankment Crest Level	248.00 m	250.40 m	251.05 m
Crest Width	5 m		
External Batter	1V:4H		
Internal Batter	1V:4H		

4.0 APPROACH

This dam failure impact assessment has been undertaken in accordance with the NSW Dam Safety Committee (DSC) publication *Consequence Categories for Dams DSC3A* (herein referred to as DSC3A) dated June 2010 and the ANCOLD guidelines, *Guidelines on the Consequence Categories for Dams* dated April 2011 (herein referred to as the ANCOLD guidelines).

Neither the DSC3A nor ANCOLD guidelines provide a calculation method for establishing the dam breach hydrograph. For the assessment of the dam breach mechanism we have followed the methodology provided in the Qld DERM *Guidelines for Failure Impact Assessment of Water Dams* dated June 2010 (herein referred to as the DERM Guidelines).

The DSC3A requires that the population at risk be based on the worst case scenario for a range of failure events, which are relevant to the Leewood Ponds. Specifically, the two main failure events to be assessed are the sunny day dam failure and dam failure during a flood.

The sunny day dam failure scenario is based on the difference between the consequences of a dambreak flood and normal downstream conditions prior to the dam failure. In this analysis, the water level in the Ponds at the initiation of the dam failure is set at spillway crest level.

The failure during a flood scenario is based on the difference between the consequences of natural rainfall and flood event without dambreak and the consequences of the superimposed dambreak flood resulting from the failure of the dam during that flood event. Typically, the failure during a flood scenario is examined for a range of floods up to the probable maximum flood (PMF) to determine which event causes the most severe incremental consequences. The DSC3A recommends that if the PMF overtops the dam then assume the dam fails with the water level at the dam crest level. In this analysis of the turkey's nest configuration, the water level has been set to the dam crest with no additional inflow. Concurrent downstream floods of the 1:2 and 1:100 AEP have been analysed to provide a range of downstream flood conditions to identify the worst incremental consequences.

Given the proposed ponds location and arrangement for the purposes of a dam break scenario assessment, it is considered possible that a dam break of any of the upstream ponds into the lower ponds may cause the downstream ponds on the site to breach due to a cascade effect. As such, the dam break scenario assessment has been undertaken on the basis that all three Leewood Ponds breach simultaneously, which is the most conservative scenario.

The water volume of each pond which is stored below the minimum existing surface level adjacent to each pond will be retained below the surface level in a dam failure event and as such has been excluded from the total volume of water to flow through the breach.

The subsequent sections contained within this report are as follows:

- Hydrology – covers the calculation of the sunny day flows, concurrent flood conditions of downstream tributaries and development of dam breach hydrographs
- Hydraulics – presents the methodology and results of the hydraulic model
- Impact Assessment – assesses the population at risk (PAR), probable loss of life (PLL) and the impact on regional ecosystems

5.0 HYDROLOGY

5.1 Sunny Day "Normal" Flow Conditions

The sunny day dam failure occurs when there is no concurrent flooding. The DSC3A states the sunny day dam failure occurs during "normal" river levels, which we have interpreted as the level during median discharge. To obtain the median discharge, daily flow data was obtained from the Office of Water for Stn. 419083 Brigalow Creek at Tharlane for the period 1994 to 2012. Brigalow Creek at Tharlane is a small (172 km^2) gauged catchment just to the west of Mollee Creek. Flow percentiles for Brigalow Creek at Tharlane are provided in Table 2.

Table 2: Sunny Day Watercourse Flow Percentiles for the Brigalow Creek at Tharlane

Percentile	Flow (m^3/s)
10%	0.0
50%	0.0
90%	0.2

The median flow in Brigalow Creek is 0 m^3/s. When prorated by area, the median flow in Mollee Creek is also 0 m^3/s. Therefore, no flow was used as the sunny day background conditions downstream of the Ponds for the inundation modelling. This assumption corresponds with conditions expected in an ephemeral creek system.

5.2 Concurrent Downstream Flood Conditions

In the failure during a flood scenario, concurrent downstream flood levels are evaluated. The 1:2 and 1:100 AEP peak discharge in ungauged Mollee Creek was estimated by proration by area of a flood frequency analysis at a nearby gauged creek, Stn. 419083 Brigalow Creek at Tharlane (catchment area 172 km^2).

The 19 year record at Brigalow Creek was used to undertake a generalised extreme value (GEV) flood frequency analysis, see Figure 1.

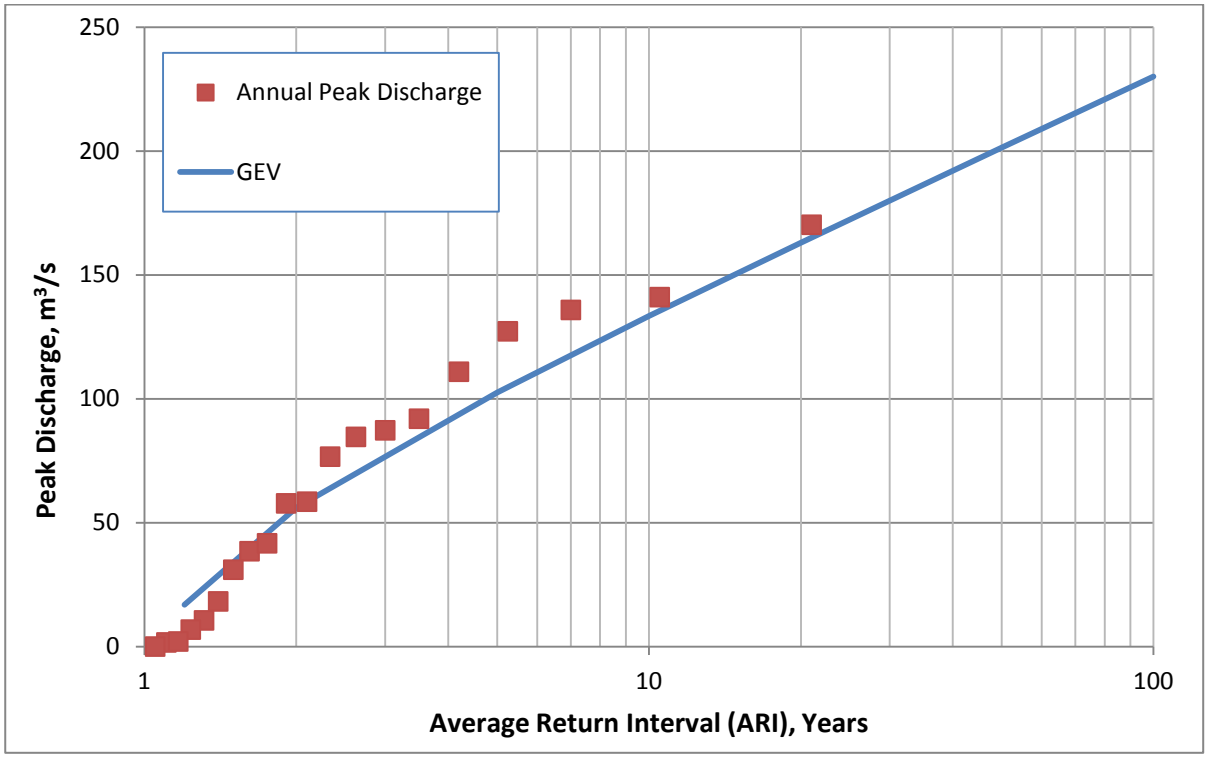


Figure 1: GEV Flood Frequency Analysis Brigalow Creek at Tharlane

Resultant peak flows for the 1:2 and 1:100 AEP flood events were then calculated by flow proration by area as described in the CRC for Catchment Hydrology 2004 publication *Hydrological Recipes Estimation Techniques for Australian Hydrology*.

$$Qc = F\,Qg$$

Where: Qc is the peak discharge of the candidate catchment

Qg is the peak discharge of the gauged catchment

$$F = (Ac/Ag)^{0.7}$$

Where: Ac is the area of the candidate catchment

Ag is the area of the gauged catchment

The resultant flow for the two catchments used for the flood day modelling are provided in Table 3.

Table 3: 1:2 AEP and 1:100 AEP Peak Discharges

Location*	Catchment Area (km^2)	1:2 AEP Peak Discharge (m^3/s)	1:100 AEP Peak Discharge (m^3/s)
1	35.6	18.6	76.4
2	76.2	31.7	130.1
3	109.8	40.9	-

*Numbers correspond to locations as shown on Figure A1 of Appendix A.

Detailed calculations are provided in Appendix B.

5.3 Dam Breach Hydrograph

The development of the dam breach hydrographs are based on the following conditions:

- initial water level at the spillway crest for the sunny day failure
- initial water level at of the dam crest for failure during a flood

The development of the dam breach hydrographs involves a two-step process.

1) The characteristics of the dam breach were estimated following methods provided in the DERM Guideline.

2) Development of a dam breach hydrograph using level-pool routing techniques based on an overtopping breach, final breach dimensions, duration, and the stage-storage relationship of the Leewood Ponds.

5.3.1 Dam Breach Characteristics

Calculation of the characteristics of the dam breach includes estimating the breach formation factor, the volume of the material eroded, the final dimensions of the breach, and lastly the breach development time. Table 4 provides the characteristics of the breach of the combined Ponds for the sunny day dam failure.

Table 4: Sunny Day Dam Breach Characteristics

Breach Parameters	Leewood Ponds
BFF, breach formation factor	2970
V_m, volume of material eroded (m^3)	1591
Zb, breach side slope	0.5
Wb, base width of breach (m)	9.5
Wt, top width of breach (m)	12.2
Wt/Wb	1.28
Wt/H	2.56
T, breach development time (hrs)	0.56

The characteristics of the combined Ponds breach for the flood day dam failure are provided in Table 5. Detailed calculations of both sunny day and flood day breach characteristics are provided in Appendix C.

Table 5: Flood Day Dam Breach Characteristics

Breach Parameters	Leewood Ponds
BFF, breach formation factor	4002
V_m, volume of material eroded (m^3)	2097
Zb, breach side slope	0.5
Wb, base width of breach (m)	12.9
Wt, top width of breach (m)	15.6
Wt/Wb	1.21
Wt/H	2.91
T, breach development time (hrs)	0.61

The DERM Guidelines state that unless special circumstances prevail (such as a very high embankment being required to store a relatively small volume of water) the breach size should be within the following range of parameters:

$1.03 < Wt/Wb < 1.74$ $0.84 < Wt/H < 10.93$

The Wt/Wb and Wt/H ratios fall within specified ranges.

5.3.2 Breach Discharge Hydrographs

The breach discharge hydrograph was developed using level-pool routing techniques based on the breach dimensions, duration, and the stage-storage relationship of the Leewood Ponds. A stage capacity relationship was developed using the design geometry of the proposed Ponds.

The peak discharge in the sunny day dam breach scenario (initial water level at spillway crest level) is 213 m^3/s, (Figure 2), and flood day dam breach scenario (initial water level at embankment crest level) is 300 m^3/s, (Figure 3).

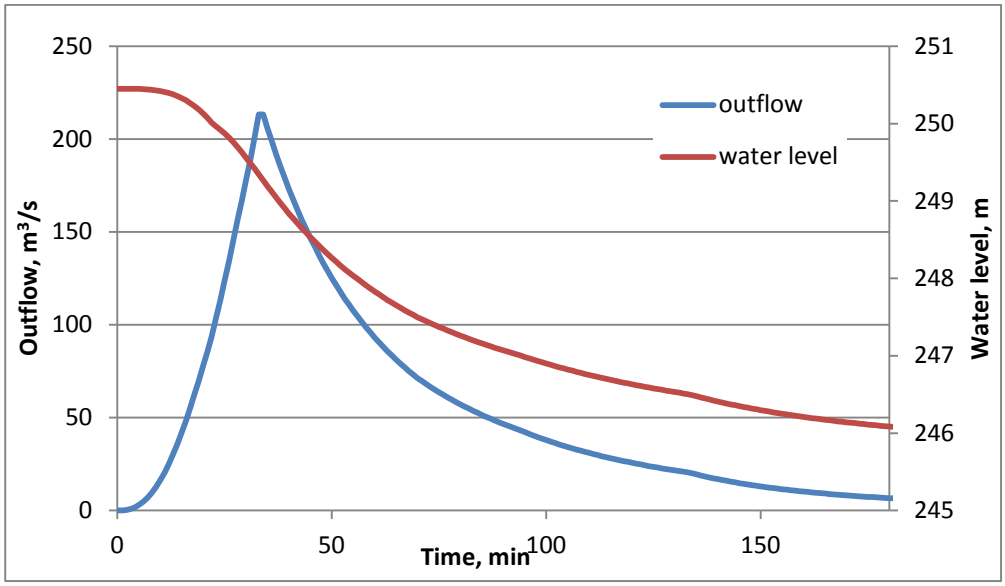


Figure 2: Leewood Ponds Sunny Day Dam Breach Discharge Hydrograph

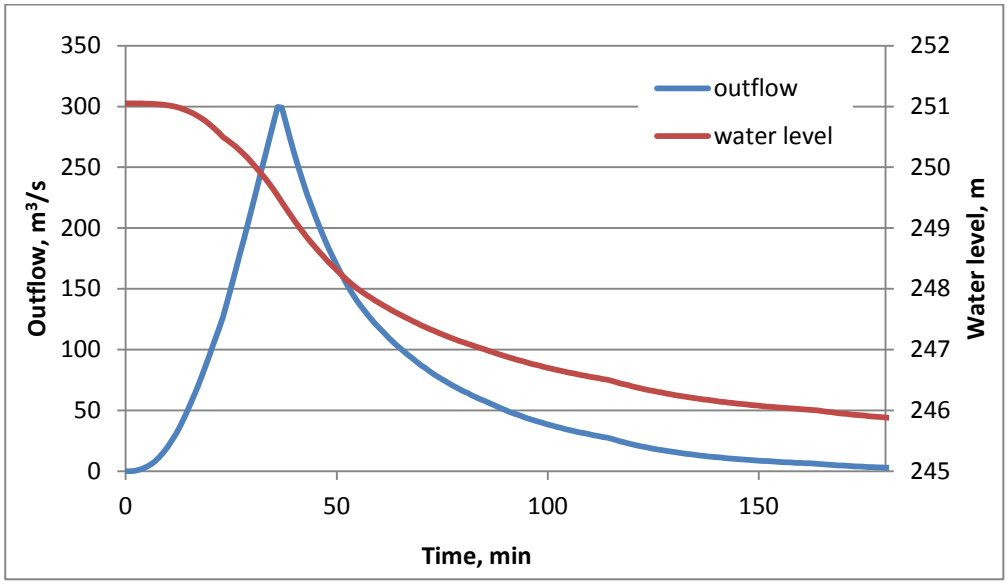


Figure 3: Leewood Ponds Flood Day Dam Breach Discharge Hydrograph

Breach discharge hydrograph calculations are provided in Appendix C.

6.0 HYDRAULICS

6.1 Model Description

Inundation modelling was undertaken using an unsteady flow 2-dimensional hydraulic model within XPSWMM. XPSWMM is a software package for dynamic modelling of storm water and river systems. It is used for both link-node (1D) and spatially distributed hydraulic models (2D). The 2D module is based on TUFLOW.

The following are components of the hydraulic model:

- Digital Terrain Model (DTM) – Photogrammetric survey data at 5 m grid, provided by Santos was used to create the model DTM.
- Model Extents – The dam break model extends from immediately upstream of the Leewood Ponds to downstream of the Brigalow Park Nature Reserve.
- Downstream Boundary Condition – The downstream boundary condition was set to shallow depth, forcing a critical depth to occur at the downstream end. We assumed that normal depth is established within the lower extent of the model. Note that the model extends past the resulting failure impact zone, see Section 6.2.1.
- Breakline – There is a protective levee (of approximately 1 m height is evident from the survey data) upstream and west of the property identified as Homestead C. Homestead C is approximately 6.5 km downstream of the proposed ponds. A breakline at RL 234.1 m has been included in the model at this location.
- Dam Breach Hydrograph – The generated breach hydrograph was incorporated into the XPSWMM model as flow boundary conditions at the active/inactive interface of the respective breach location.
- Tributary Inflows – The 1:2 AEP and 1:100 AEP flows were incorporated into the XPSWMM model as peak flow steady hydrographs. They were placed into the model as flow input nodes at the invert of the channel of Mollee Creek.

- Manning's Roughness – The Manning's value can be expected to change throughout the study reach; however, a fixed value was used for simplicity. A Manning's value of 0.05 was selected as this is considered a reasonable reflection of the average Manning's value for the dam breach area.
- 2D Grid Resolution – Grid size of 22 m was used.
- Time Step – A time step of 10 seconds was used in the XPSWMM model.
- A total of three XPSWMM cases were modelled as including.
  - Sunny Day – initial water level at spillway crest, no flow in downstream watercourses
  - Flood Day – initial water level at dam crest, concurrent downstream flood of 1:2 AEP
  - Flood Day – initial water level at dam crest, concurrent downstream flood of 1:100 AEP

6.2 Results

6.2.1 Dambreak Affected Zone

DSC3A does not provide guidance on identifying the dambreak affected zone, that is, the number of homesteads to be assessed and evaluated as those potentially at risk. The ANCOLD guideline suggests the zone may be defined by experienced judgement as an initial assessment or by inundation mapping. The DERM guideline provides a quantitative definition of failure impact zone which has been used for this assessment.

The failure impact zone ends when the:

- flood caused by the dam failure is retained within the bed and banks and no more people are at risk downstream or upstream, or
- difference between the flooding effect with dam failure and the flood effect without dam failure (that is, incremental effect of the dam failure on the impacted zone) is less than 300 mm

The dam break scenario, for both sunny day and flood day dam failures, were modelled. The failure impact zone as defined by DERM ends for the sunny day failure and the 1:100 AEP flood with dam failure, approximately 12 km downstream. Five homesteads (Homesteads A to E) are located in this vicinity. The failure impact zone for the 1:2 AEP flood ends approximately 19 km downstream of the Leewood Ponds. Twelve homesteads (Homesteads A to L) are located in this vicinity in the 1:2 AEP flood with dam failure.

Figure A2 to A4 in Appendix A provide the inundation maps for each of the dam failure cases. The outline of the maximum inundation of the 1:2 AEP and 1:100 AEP flood are overlaid in the 1:2 AEP and 1:100 AEP flood day with dam failure inundation map respectively. This is to show the incremental increase of water inundation extent due to the dam break failure in each case.

6.2.2 Dam Failure Flow Results

Discharges, water depths and velocities were output from XPSWMM at eight representative cross sections downstream from the Ponds. The sections are numbered one through to eight starting at the upstream end. The cross sections are shown in the inundation maps in Appendix A.

The sunny day failure discharge hydrographs are provided in Figure 4. It shows the attenuation in the dam failure hydrograph as it moves downstream from Cross Section 1 to Cross Section 8. The breach hydrograph attenuates from a peak of 157 m^3/s just downstream of the dam break at Cross Section 1 to 36 m^3/s at Cross Section 8.

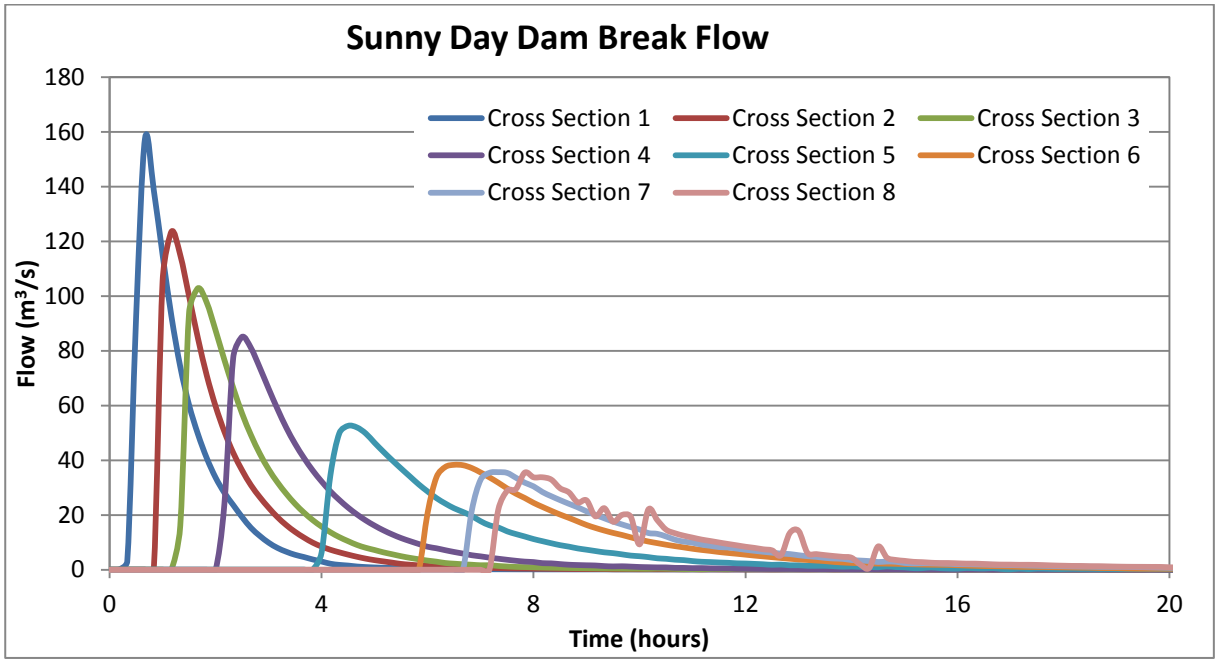


Figure 4: Sunny Day Failure, Flow Rate vs. Time

Table 6 shows the flood peak arrival times at each cross section for the sunny day dam failure scenarios once breaching has occurred.

Table 6: Flood Peak arrival times at each Section after Dam Breach

Cross Section	Distance Downstream of Dam (km)	Arrival Time of Flood Peak (hours after initial dam failure)
1	0.3	0.7
2	1.3	1.2
3	2.3	1.7
4	3.8	2.5
5	6.7	4.5
6	9.9	6.5
7	11.1	7.3
8	12.1	7.8

Refer to Appendix D for flow rates and water level at each cross section.

7.0 INUNDATION IMPACT ASSESSMENT

7.1 Population at Risk

The population at risk (PAR) is estimated based on buildings or other places of occupation that are located within the dambreak affected zone. Five homesteads are located in the proximate vicinity of the failure impact zone. Refer to flood inundation maps Figure A2, A3 and A4 in Appendix A.

Data published in NSW government websites[2] indicates that the average household size in the Narrabri region is 2.5 people. There is no observed evidence of an itinerant population in the failure impact zone. Consequently, the PAR has been assessed on a non-itinerant basis. Where a homestead is at risk a Total PAR of 2.5 people has been assigned.

The ANCOLD guideline provides a methodology for assigning the PAR in both sunny day and flood day scenarios which has been used for the following assessment. Where a levee is in place, (Homestead C), the water level reported is the level in the creek rather than the level at the homestead (behind the levee). Without more information about the structural integrity of the levee, this is the more conservative approach. The ANCOLD guidelines recommend extreme care should be taken in excluding populations that could be assumed to be protected by levees.

7.1.1 Sunny Day Population at Risk

In the sunny dam dambreak none of the homesteads can be excluded on the basis that 12 hours prior notification is possible. The maximum arrival time of the flood peak within the dambreak affected zone is 7.8 hours, (Table 6). Homestead C is the only structure that is inundated by flood water resulting from the dambreak, (Table 7). The total PAR in the sunny day failure assessment is 2.5.

Table 7: Sunny Day Failure PAR

		Dam Failure		
ID	**House Level (m AHD)**	**Water Level (m AHD)**	**Footprint of Structure Wet**	**Total PAR**
A	242.2	242.0	No	0
B	239.8	239.3	No	0
C	233.3	233.8[#]	Yes	2.5
D	227.4	226.7	No	0
E	227.4	226.7	No	0
			TOTAL	2.5

[#] *water level in creek.*

7.1.2 Flood Day Population at Risk

In the flood day dambreak, there may be extensive floodplain inundation prior to the dambreak event. PAR exposed to pre-dambreak flood waters where the product of the Depth (D) and Velocity (V) is greater than 0.6 m^2/s are discounted from the dam break PAR. In determining this value of DV, Dmax should not exceed 1.2 m or Vmax should not exceed 1.5 m/s.

The PAR in the flood day dambreak for the 1:2 AEP and 1:100 AEP flood is provided in Table 8 and Table 9.

[2] http://about.nsw.gov.au/view/census/Narrabri/BO2/

Table 8: 1:2 AEP Flood Day PAR

		Flood Only			Dam Failure during Flood		
ID	**House Level (m AHD)**	**Water Level (m AHD)**	**Footprint of Structure Wet**	**D x V (m^2/s)**	**Water Level (m AHD)**	**Footprint of Structure Wet**	**Total PAR**
A	242.2	241.7	No	N/A	242.2	No	0
B	239.8	238.9	No	N/A	239.4	No	0
C	233.3	233.5#	Yes	<0.6	233.9#	Yes	2.5
D	227.4	226.3	No	N/A	226.8	No	0
E	227.4	226.3	No	N/A	226.8	No	0
F	220.9	220.7	No	N/A	221.3	Yes	2.5
G	220.6	220.0	No	N/A	220.6	No	0
H	217.0	216.4	No	N/A	216.8	No	0
I	215.4	214.5	No	N/A	214.8	No	0
J	216.3	214.5	No	N/A	214.8	No	0
						TOTAL	5.0

water level in creek.

Table 9: 1:100 AEP Flood Day PAR

		Flood Only			Dam Failure during Flood		
ID	**House Level (m AHD)**	**Water Level (m AHD)**	**Footprint of Structure Wet**	**D x V (m^2/s)**	**Water Level (m AHD)**	**Footprint of Structure Wet**	**Total PAR**
A	242.2	241.9	No	N/A	242.3	Yes	2.5
B	239.8	239.2	No	N/A	239.5	No	0
C	233.3	233.8#	Yes	<0.6	234.0#	Yes	2.5
D	227.4	227.0	No	N/A	227.3	No	0
E	227.4	227.0	No	N/A	227.3	No	0
						TOTAL	5.0

water level in creek.

In the three scenarios the maximum PAR is 5.0.

7.2 Probable Loss of Life

The PLL assessment has been undertaken following the method of Graham, 1999[3] as required by DSC3A. The flood severity based method recommended by Graham (1999) has been used to calculate the fatality rate (the empirically derived fraction of people at risk expected to die). Flood severity, warning time and flood severity understanding are used to identify a suggested fatality rate.

7.2.1 Failure Warnings

Guidance for estimating when dam failure warnings would be initiated (Table 2 Graham, 1999) indicates for a drainage area at the dam of less than 260 km^2 (the catchment area of the Leewood Ponds is 35 km^2) and conservatively assuming no observers are present at the dam, the sunny day and flood day scenario dam failure warning is 0.25 hours after floodwater reaches populated areas during the day and 1.0 hours after floodwater reaches populated areas during the night.

However, the warning time has been conservatively assessed in this case as *no warning*. It is not clear in the assessment method what number of homesteads are needed to be considered a "populated area". As homesteads downstream of the Leewood Ponds are remote from others and this is a rural area we consider that the floodwater does not by definition reach a populated area.

7.2.2 Flood Severity

The flood severity has been identified as *low severity*. By definition low severity is to be used if most of the structures will be exposed to depths of less than 3.0 m. From the dam failure impact assessment the maximum sunny day inundation depth at a homestead was 0.5 m and maximum flood day incremental inundation depth at a homestead was 0.4 m.

7.2.3 Flood Severity Understanding

The flood severity understanding category in the event of no warning time becomes *not applicable*.

7.2.4 Estimated Probable Loss of Life

Given the failure warning and flood severity, the resultant fatality rate fraction for Leewood Ponds is 0.01 (Table 7 Graham, 1999). The resultant PLL (the fatality rate times the PAR) is 0.05. In accordance with Table 1 of DSC3A, dams with a PLL <0.1 are assigned a consequence category of Significant or lower.

7.3 Receiving Environment

Two areas considered to be Threatened Ecological Communities (TEC) have been identified in the north east of the site and the Brigalow Park Nature Reserve (BPNR) located to the west of Mollee Creek approximately 8 km downstream of the site.

The identified TECs are not impacted by the sunny day or flood day dam break scenarios as shown in Figures A2 to A4 in Appendix A.

Note, the dam failure assessment in this case considers a failure of the north eastern embankment of the Ponds (at the location of the lowest surface level). In the event that dam failure occurs through the western embankment of the Ponds it is possible that the vegetation to the west of the ponds may be impacted. We are currently awaiting the results of an ecological investigation to understand whether the area immediately to the west of the Ponds is a sensitive receiving environment. The outcome of the ecological investigation may impact on the Consequence Category of the ponds.

[3] Graham, WJ 1999 *A Procedure for Estimating Loss of Life caused by Dam Failure* U.S. Department of the Interior Dam Safety Office.

8.0 CONCLUSIONS

The Leewood Ponds have a combined capacity of 748 ML from the above ground surface level to the dam crest level. At this level (worst case circumstance), a dam failure will result in a flood wave with a peak discharge of 300 m^3/s and will last for about 2 hours.

As the flood wave moves downstream, it attenuates resulting in a dambreak affected zone extending up to approximately 19 km downstream of the Leewood Ponds. Up to twelve homesteads were identified in the vicinity of the downstream affected zone. One homestead (Homestead C) will be affected by a dam failure in all scenarios based on the criteria identified in ANCOLD guidelines. A further homestead in each of the 1:2 AEP (Homestead H) and the 1:100 AEP (Homestead A) scenarios is affected, bringing the total PAR in these cases to five persons. The resulting PLL is 0.05. In accordance with Table 1 of DSC3A, dams with a PLL <0.1 are assigned a consequence category of Significant or lower.

It is understood that Santos expect to develop the permeate pond sometime after the construction of the brine and product water ponds is complete. Given the comparatively low volume of water stored within the permeate pond it is considered that, without undertaking further analysis, the PAR and PLL for the combined ponds would likely remain unchanged.

The Consequence Category of the Leewood ponds, based on the current information, is therefore considered to be Significant.

9.0 LIMITATIONS

Your attention is drawn to the document - “Limitations”, which is included in Appendix E of this report. The statements presented in this document are intended to advise you of what your realistic expectations of this report should be, and to present you with recommendations on how to minimise the risks associated with the services provided for this project. The document is not intended to reduce the level of responsibility accepted by Golder Associates, but rather to ensure that all parties who may rely on this report are aware of the responsibilities each assumes in so doing.

Report Signature Page

GOLDER ASSOCIATES PTY LTD



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Senior Water Resources Engineer

Scott Stoneman
Principal Water Resources Engineer

MH/SS

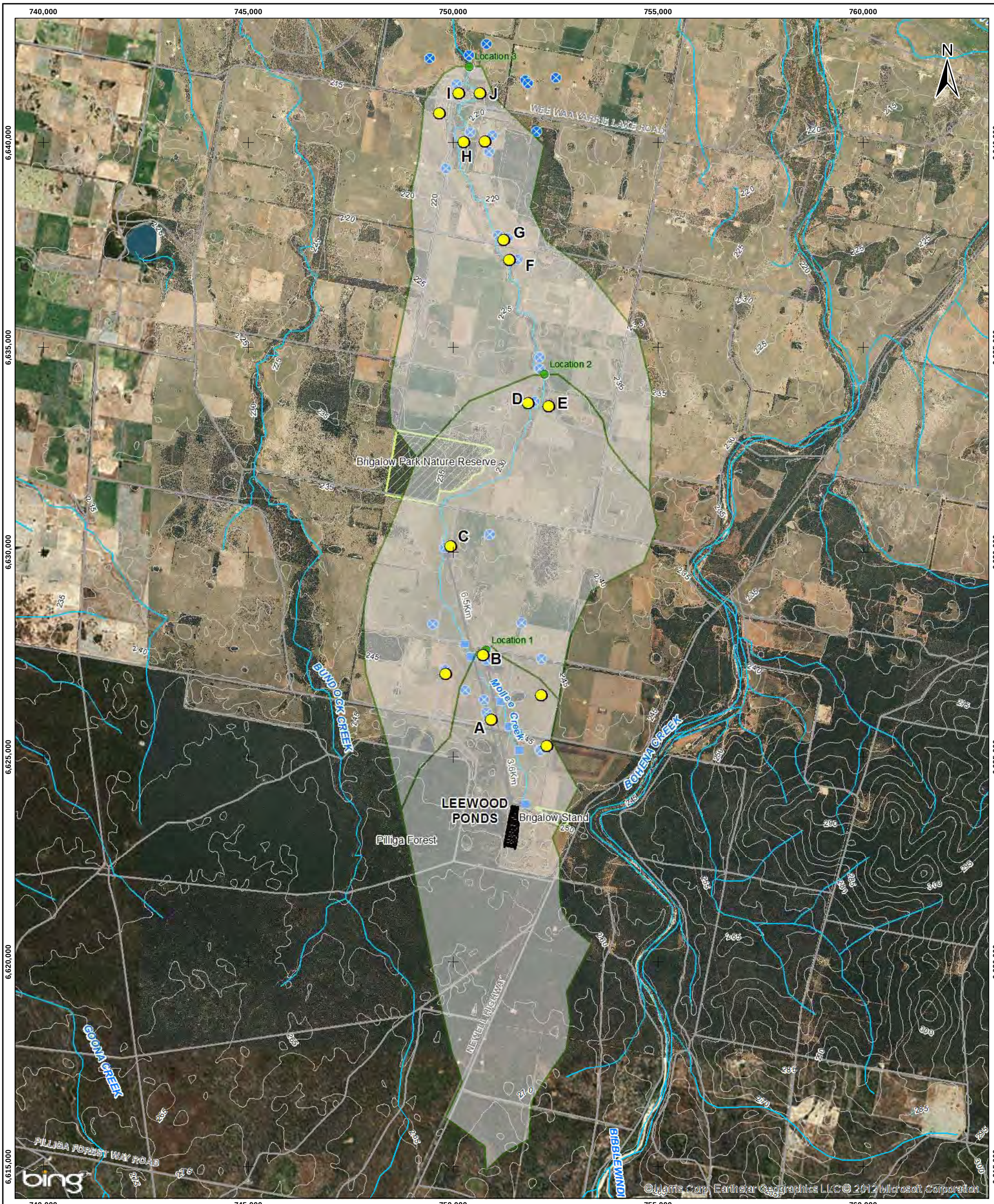
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APPENDIX A

Site Location and Flood Mapping



LEEWOOD PONDS

SANTOS

CATCHMENT MAP

LEGEND

- Homesteads
- Downstream Groundwater Boreholes
- Identified Downstream Farm Dams
- Contours - 5m Intervals
- Roads
- Watercourses
- Catchments
- Environmentally Sensitive Areas

NOTES

1. Aerial Imagery supplied by Santos.
2. Groundwater Borehole data sourced from Pinneena GW NSW Water Information.
3. Contours derived from SRTM level 1 (90m)

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PROJECT: 127615025
DATE: 19 SEP 2012
DRAWN: TPC/CRG/SL
CHECKED: MH

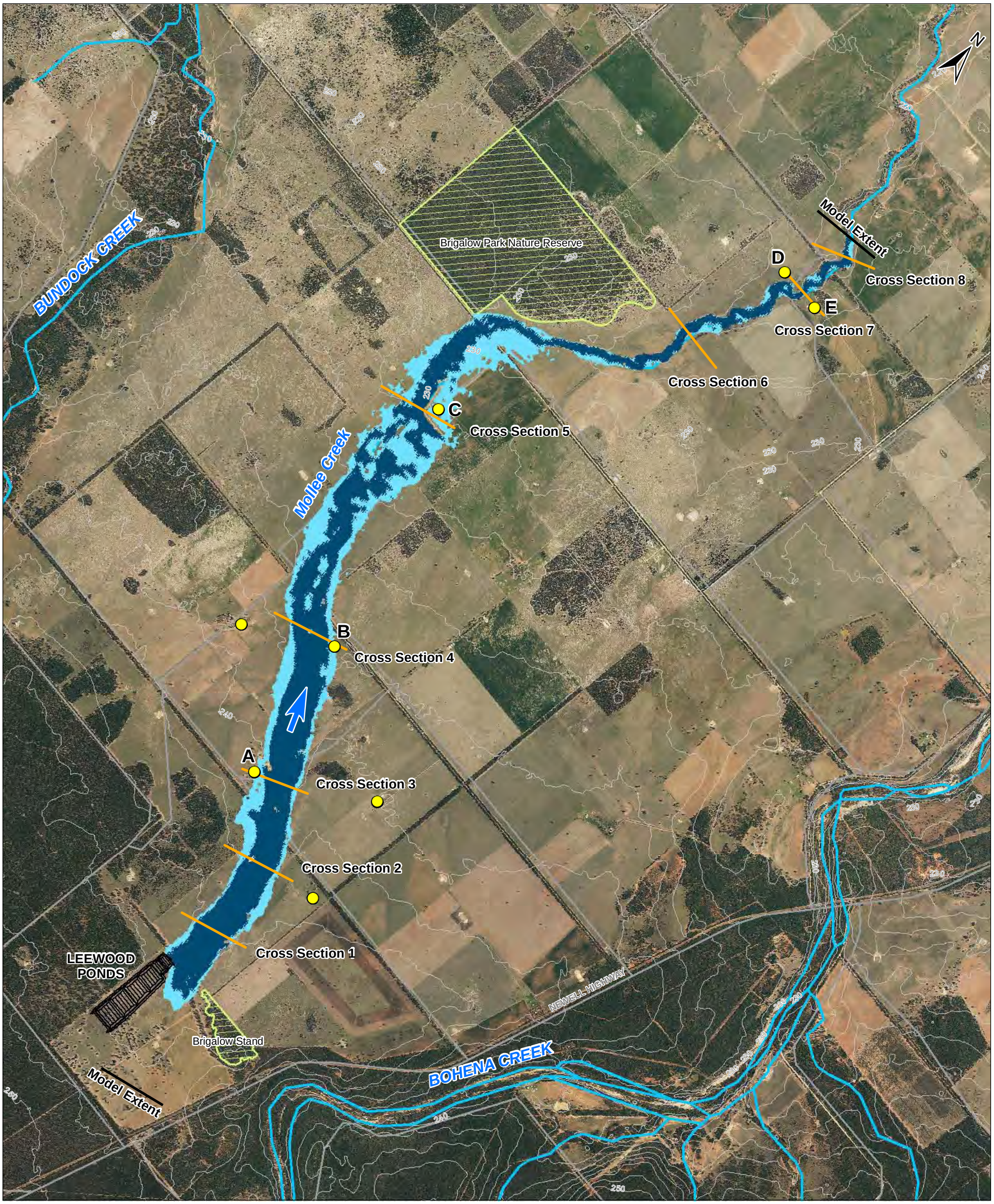
FIGURE A1

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LEEWOOD PONDS

SANTOS

SUNNY DAY INUNDATION MAP

DRAFT

LEGEND

- Flow Direction
- Homesteads
- Sunny Day Dam Failure (Depth < 0.3m)
- Sunny Day Dam Failure (Depth > 0.3m)
- Environmentally Sensitive Areas
- Watercourses
- Roads
- 2m Contour Intervals

NOTES

1. Aerial Imagery and Contours supplied by Santos.
2. Legend format indicates data layer priority.

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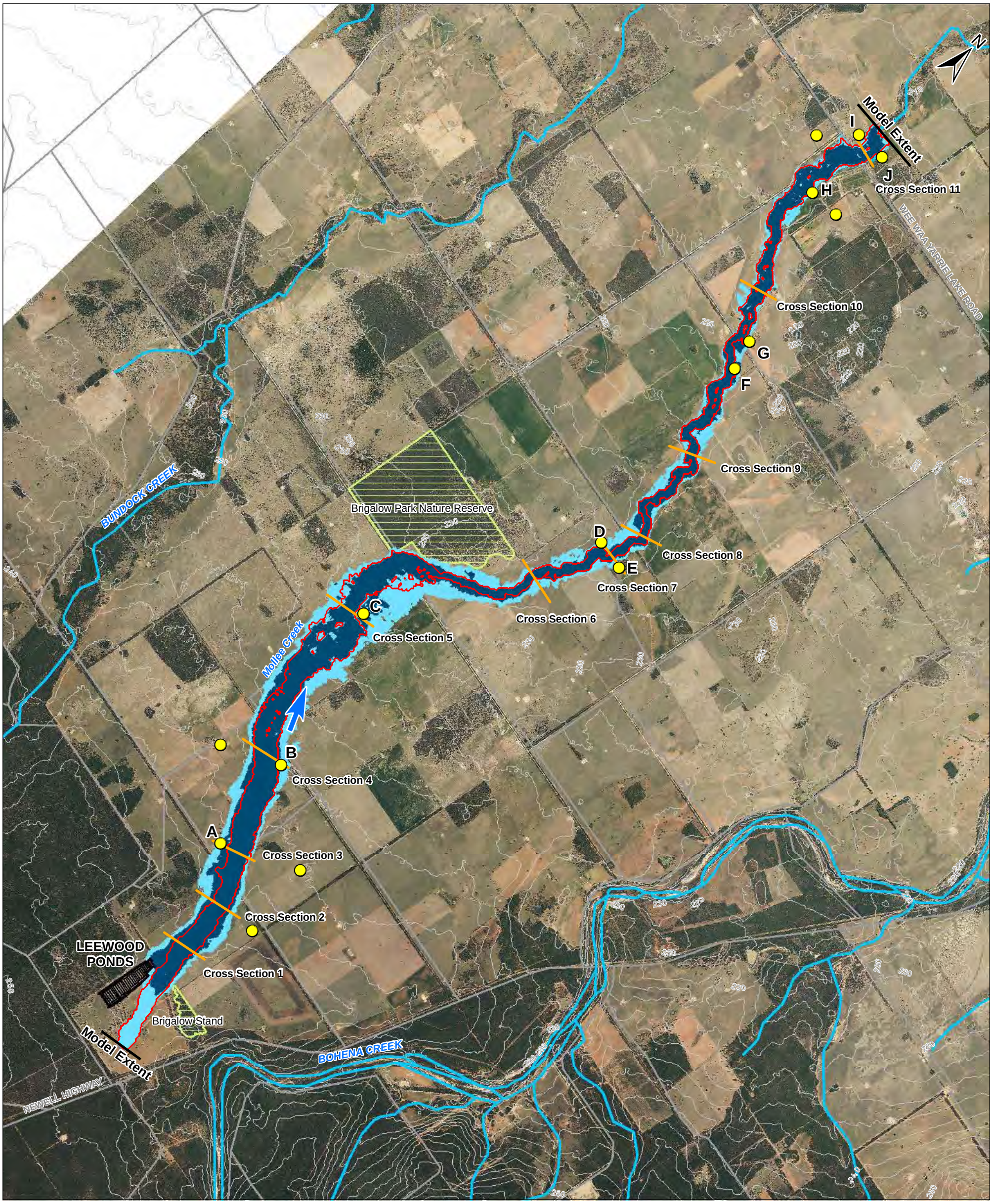
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FIGURE A2

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LEEWOOD PONDS

SANTOS

DAM FAILURE DURING FLOOD (1:2 AEP) INUNDATION MAP

DRAFT

LEGEND

- Flow Direction
- Homesteads
- 1:2 AEP Flood Limits (Without Dam Break)
- Dam Failure During 1:2 AEP Flood (Depth < 0.3m)
- Dam Failure During 1:2 AEP Flood (Depth > 0.3m)
- Environmentally Sensitive Areas
- Watercourses
- Roads
- 2m Contour Intervals

NOTES

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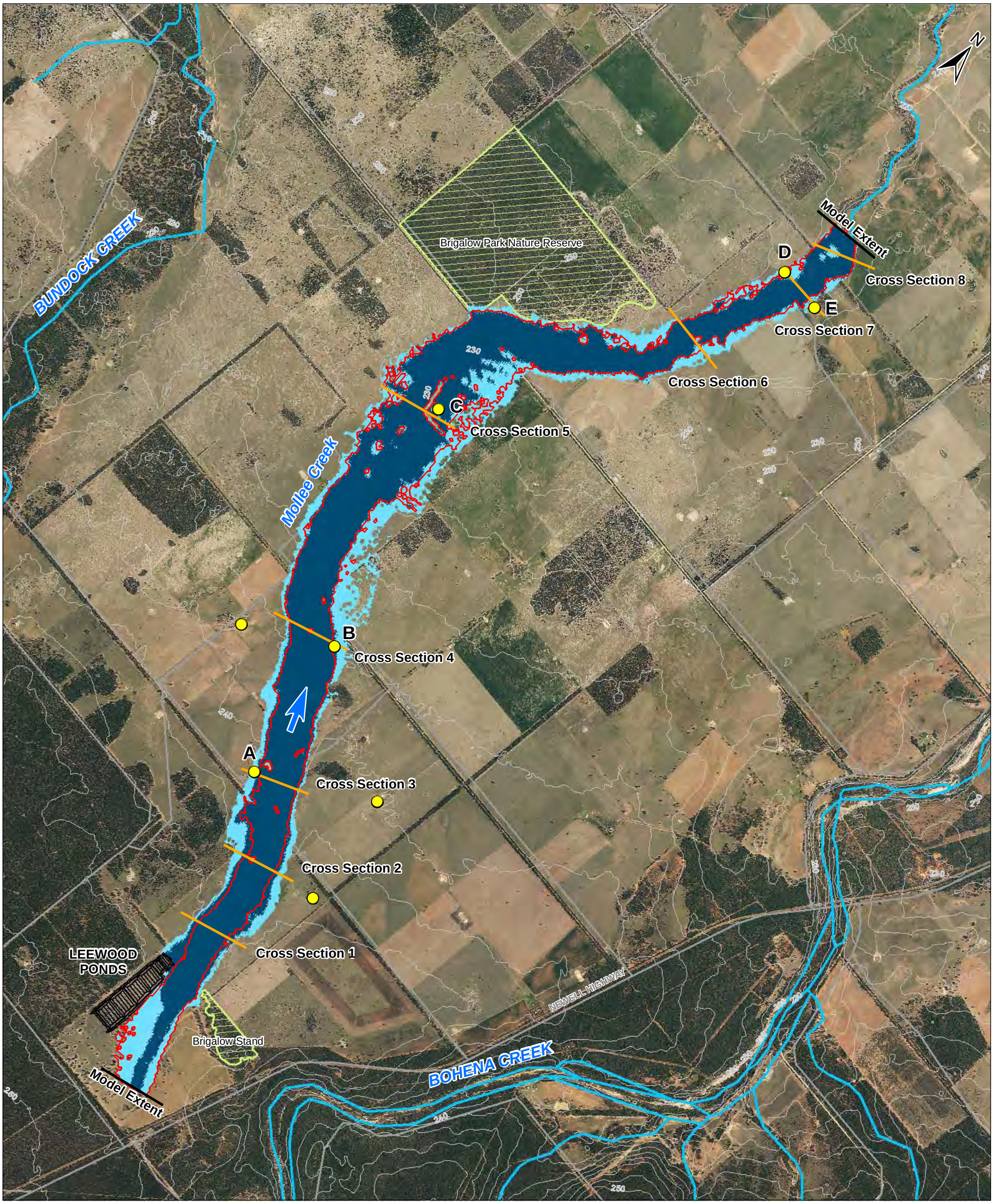
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FIGURE A3

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LEEWOOD PONDS

SANTOS

DAM FAILURE DURING FLOOD (1:100 AEP) INUNDATION MAP

DRAFT

LEGEND

- Flow Direction
- Homesteads
- 1:100 AEP Flood Limits (Without Dam Break)
- Dam Failure During 1:100 AEP Flood (Depth < 0.3m)
- Dam Failure During 1:100 AEP Flood (Depth > 0.3m)
- Environmentally Sensitive Areas
- Watercourses
- Roads
- 2m Contour Intervals

NOTES

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DATE: **19 SEP 2012**
DRAWN: **SL**
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FIGURE A4

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File Location: R:\Melbourne\Santos\127615025\Programs\ArcGIS\127615025-002-R-F0004-RevA-100.mxd

APPENDIX B

Flood Day Hydrology

Calculations flood day hydrology Leewood Ponds

Catchment ID	d/s of ponds	total catchment	d/s of ponds	total catchment
ARI (years)	100	100	2	2
A, catchment area (ha)	3560	7620	3560	7620
A, catchment area (km2)	**35.60**	**76.20**	**35.60**	**76.20**
Prorated flow Stn 419083 Brigalow Creek at Tharlane				
Stn 419083 Catchment Area (km2)	172.0	172.0	172.0	172.0
GEV	230.0	230.0	56.0	56.0
the power of b = 0.7 (Hydrological Recipes p. 84)	0.7	0.7	0.7	0.7
Q, calc'd peak discharge (m3/s)	**76.4**	**130.1**	**18.6**	**31.7**
Lost above Newell Highway (Cross Section 3 Flood Study)	9.0	9.0	5.5	5.5
Remainder this catchment	67.4	53.7	13.1	13.1

APPENDIX C

Dam Breach Calculations

Sunny Day Dam Breach Dimensions and Development Time

Method: Use QLd Gov DNRM, *Guidelines for Failure Impact Assessment of Water Dams*

Step 1 - Breach Formation Factor (BFF)

BFF = Vw*H

Dam Crest Elevation (m)	251
Water level at begin of dam failure (m)	250.45
Bottom of breach level at end of dam failure (m)	245.7
Vw, Total volume of water to flow through the breach (ML)	625
H, Height differential between crest and bottom of breach (m)	5.30
H, Height differential between begin water level and bottom of breach level (m)	4.75
BFF, Breach Formation Factor	2970

Step 2 - Determine eroded volume of breach

Vm = 10^((Log10(BFF) - 3.2553)/1.0787 + 3)

Vm, Volume of material eroded from a dam breach (m^3)	1591

Step 3 - Calculate final breach dimensions

The following geometric equation was used to estimate the width of a trapezoidal breach.

$$Wb = \frac{Vm - H^2\left(CZb + \frac{HZbZ_3}{3}\right)}{H\left(C + \frac{HZ_3}{2}\right)}$$

Z_1, Slope (Z_1:1) of upstream face of dam	4
Z_2, Slope (Z_2:1) of downstream face of dam	4
Z_3, $Z_3 = Z_1 + Z_2$	8
Zb, side slope of breach (Zb:1)	0.5
C, crest width of dam (m)	5
Wb, width of breach at base elev (m)	9.5
Wt, Wt = Wb + H*Zb, width of breach at top elev (m)	12.2

QLd Gov DNRM GFIAWD recommends that dam breach parameters are within the following:

Wt/Wb	1.28
if 1.06 < Wt/Wb < 1.74 then okay. Allow to exceed range in this case because side slope is steep and eroded material volume is small.	okay
Wt/H	2.56
if 0.84 <Wt/H < 10.93 then okay	okay

Step 4 - Calculate breach development time

T = 0.0514 * Vm^0.3231

T, breach development time (hrs)	0.556

Sunny Dam Dam Breach Routing

Method: Analyse using level-pool routing and dam breach as trapezoidal weir
Model breach as expanding in width and level linearly to time
Level Pool Routing: Inflow-Outflow = Δstorage/time
Trapezoidal Weir Equation: Q = C (2g)^0.5 (2/3*LH^1.5 + 8/15 Tan(Θ) H^2.5)

Reservoir Stage-Storage

Stage, m	Storage, ML
245.7	0.0
246	11.3
246.5	51.6
247	122.5
247.5	204.2
248	278.8
248.5	355.3
249	435.1
249.5	518.2
250	587.8
250.5	629.5
251	629.5

Breach Input

	time, min	invert level of breach, m	base width of breach, m	volume at invert level of breach, ML
start of breach	0	**250**	0	**625**
end of breach	**33.4**	**245.70**	**9.5**	**0**
				625

Breach input parameters

inflow, m3/s	0
begin water level, m	**250**
sideslope, xH:1V	**0.50**
coefficient of discharge	0.54
time step, min	1

Results

peak outflow m3/s	**213**
total routed breach volume, ML	**624**

Flood Day Dam Breach Dimensions and Development Time

Method: Use QLd Gov DNRM, *Guidelines for Failure Impact Assessment of Water Dams*

Step 1 - Breach Formation Factor (BFF)

BFF = Vw*H

Dam Crest Elevation (m)	251
Water level at begin of dam failure (m)	251
Bottom of breach level at end of dam failure (m)	245.7
Vw, Total volume of water to flow through the breach (ML)	748
H, Height differential between crest and bottom of breach (m)	5.35
H, Height differential between begin water level and bottom of breach level (m)	5.35
BFF, Breach Formation Factor	4002

Step 2 - Determine eroded volume of breach

Vm = 10^((Log10(BFF) - 3.2553)/1.0787 + 3)

Vm, Volume of material eroded from a dam breach (m^3)	2097

Step 3 - Calculate final breach dimensions

The following geometric equation was used to estimate the width of a trapezoidal breach.

$$Wb = \frac{Vm - H^2\left(CZb + \frac{HZbZ_3}{3}\right)}{H\left(C + \frac{HZ_3}{2}\right)}$$

Z_1, Slope (Z_1:1) of upstream face of dam	4
Z_2, Slope (Z_2:1) of downstream face of dam	4
Z_3, $Z_3 = Z_1 + Z_2$	8
Zb, side slope of breach (Zb:1)	0.5
C, crest width of dam (m)	5
Wb, width of breach at base elev (m)	12.9
Wt, Wt = Wb + H*Zb, width of breach at top elev (m)	15.6

QLd Gov DNRM GFIAWD recommends that dam breach parameters are within the following:

Wt/Wb	1.21
if 1.06 < Wt/Wb < 1.74 then okay. Allow to exceed range in this case because side slope is steep and eroded material volume is small.	okay
Wt/H	2.91
if 0.84 <Wt/H < 10.93 then okay	okay

Step 4 - Calculate breach development time

T = 0.0514 * Vm^0.3231

T, breach development time (hrs)	0.608

Flood Day Dam Breach Routing

Method: Analyse using level-pool routing and dam breach as trapezoidal weir
Model breach as expanding in width and level linearly to time
Level Pool Routing: Inflow-Outflow = Δstorage/time
Trapezoidal Weir Equation: Q = C (2g)^0.5 (2/3*LH^1.5 + 8/15 Tan(Θ) H^2.5)

Reservoir Stage-Storage

Stage, m	Storage, ML
245.7	0
246	11
246.5	52
247	122
247.5	204
248	290
248.5	366
249	446
249.5	529
250	615
250.5	695
251	743
251.05	748

Breach Input

	time, min	invert level of breach, m	base width of breach, m	volume at invert level of breach, ML
start of breach	0	**251**	0	**748**
end of breach	**36.5**	**245.70**	**12.9**	**0**
				748

Breach input parameters

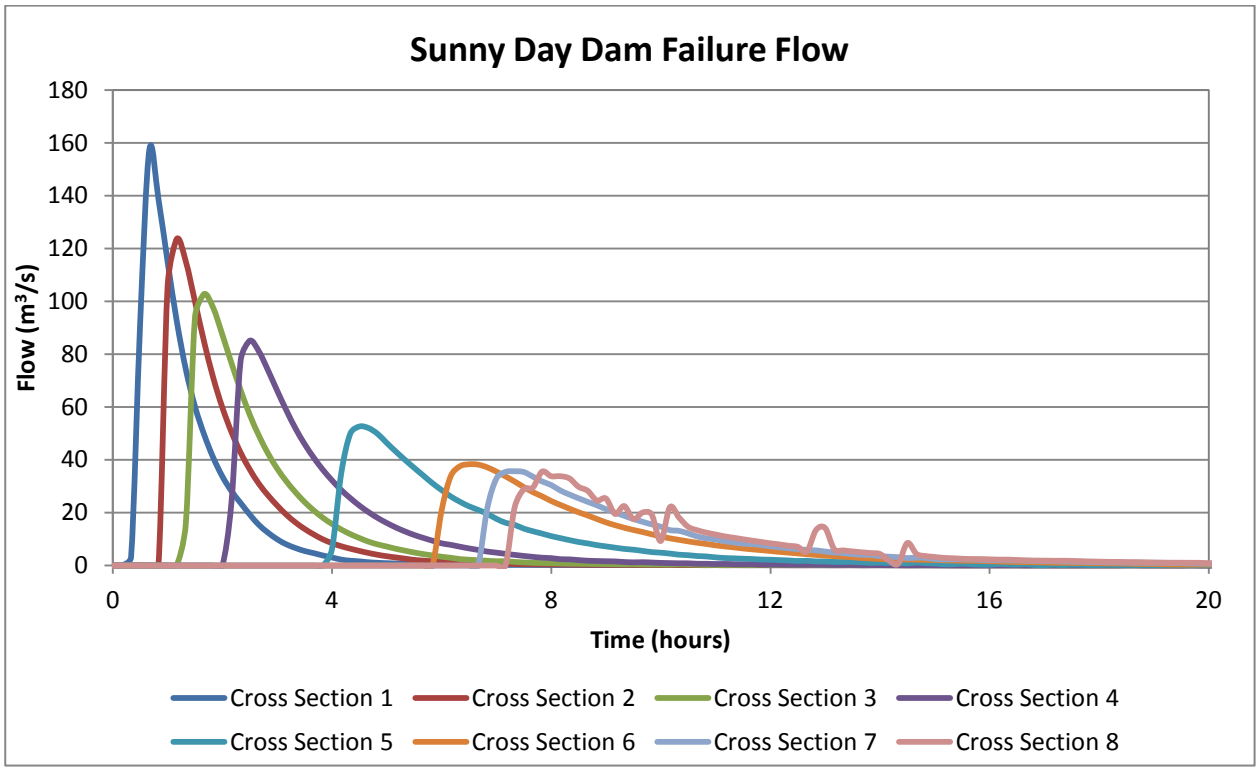
inflow, m3/s	0
begin water level, m	**251**
sideslope, xH:1V	**0.50**
coefficient of discharge	0.54
time step, min	1

Results

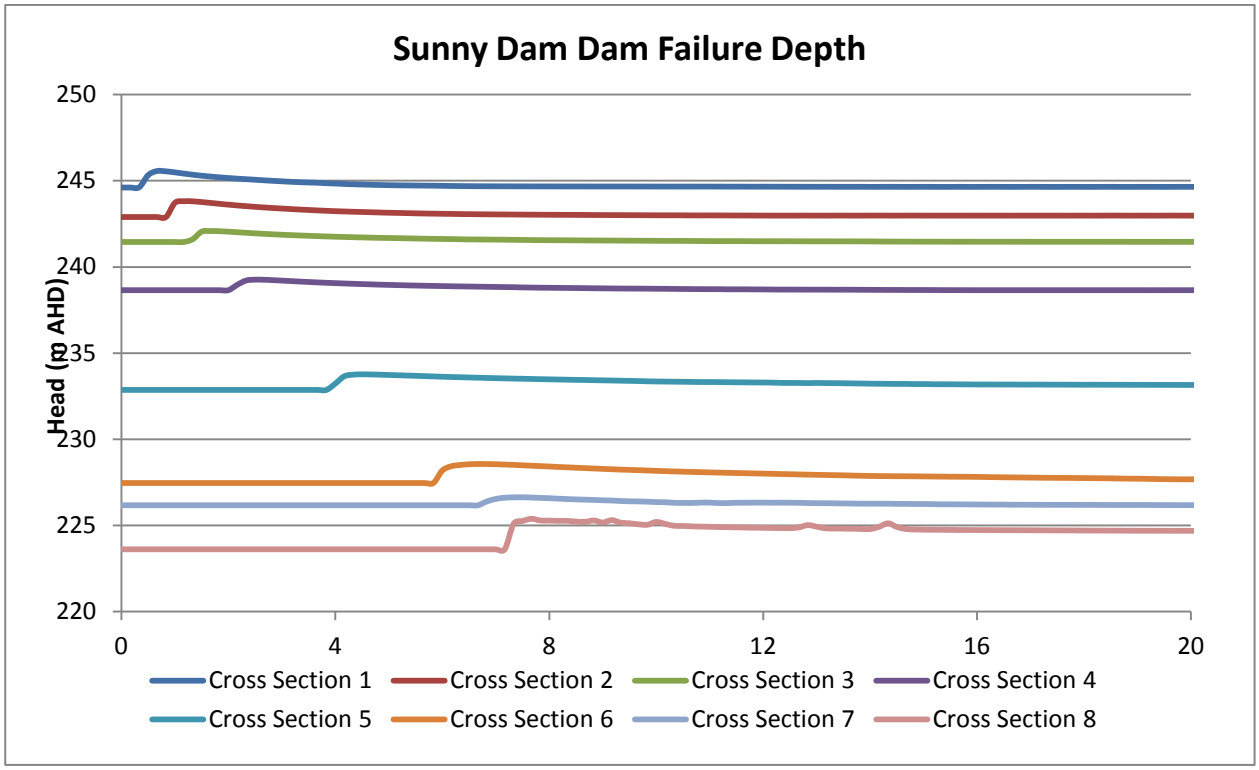
peak outflow m3/s	**300**
total routed breach volume, ML	**747**

APPENDIX D

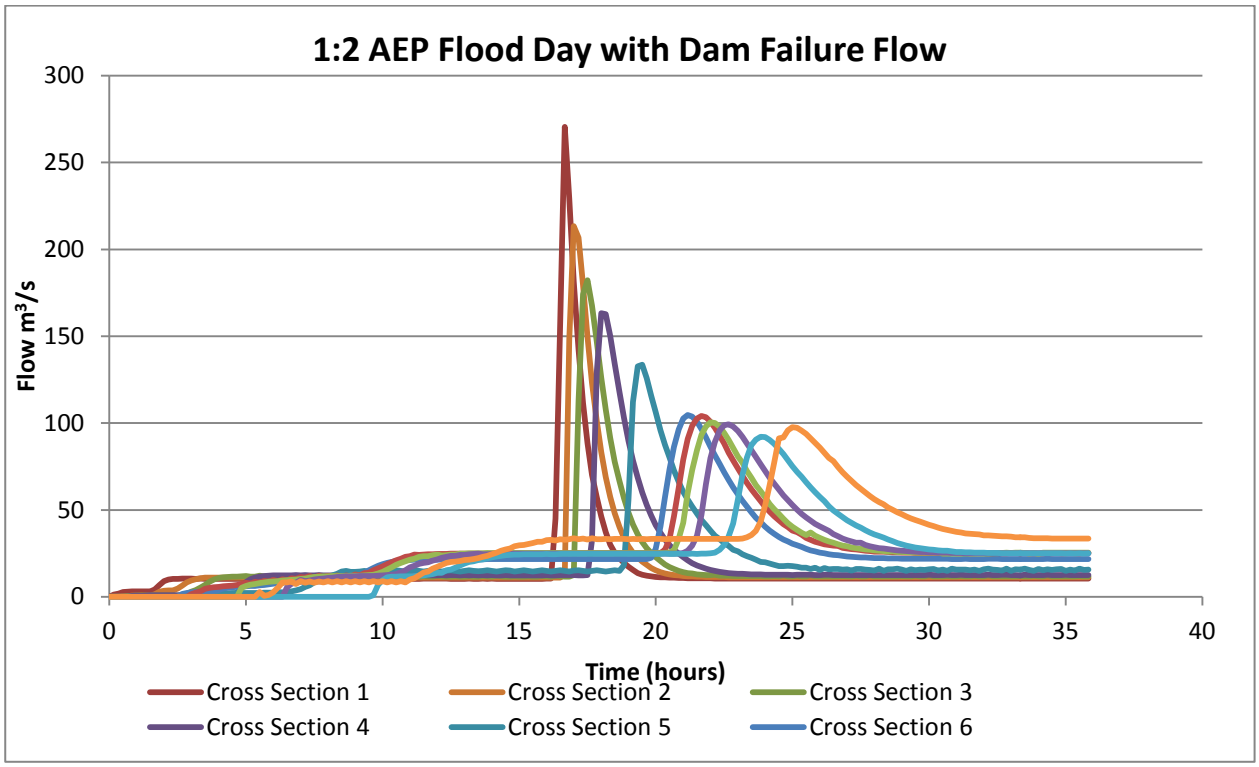
XPSWMM Flow and Water Level Results



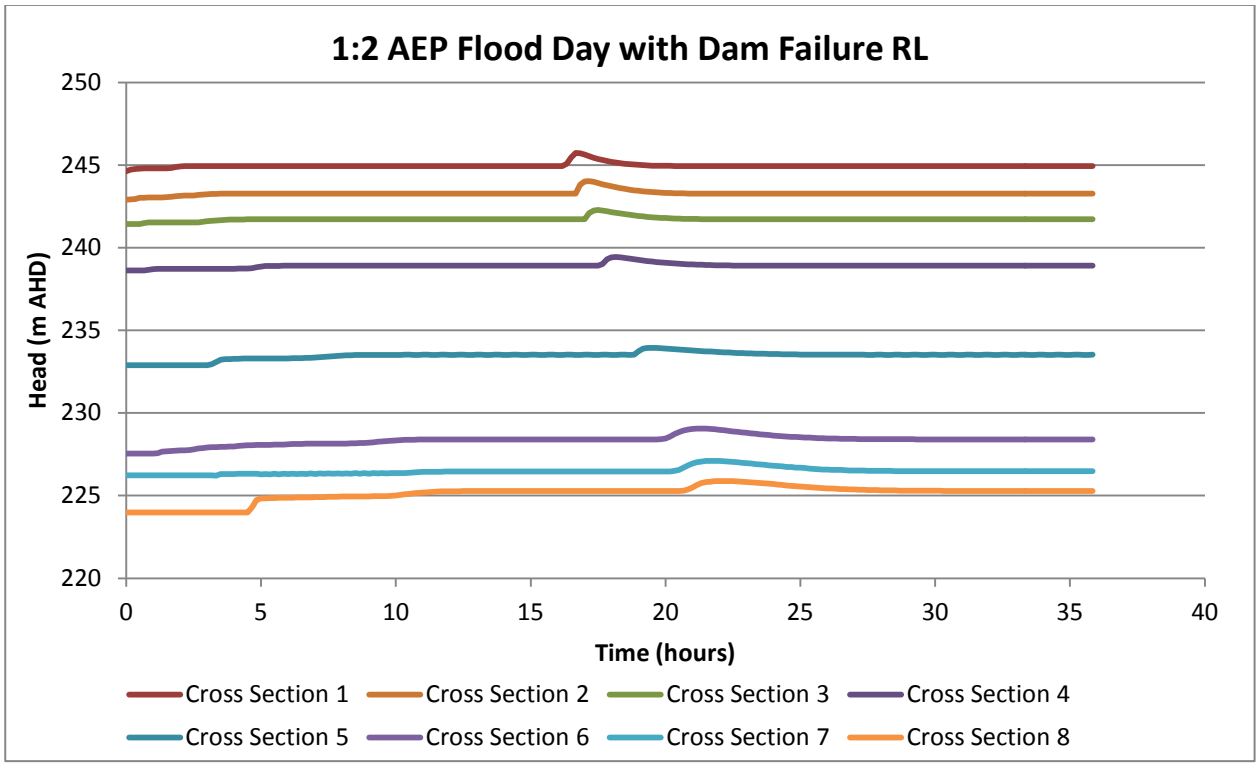
Dam Break is at time 0 hours.



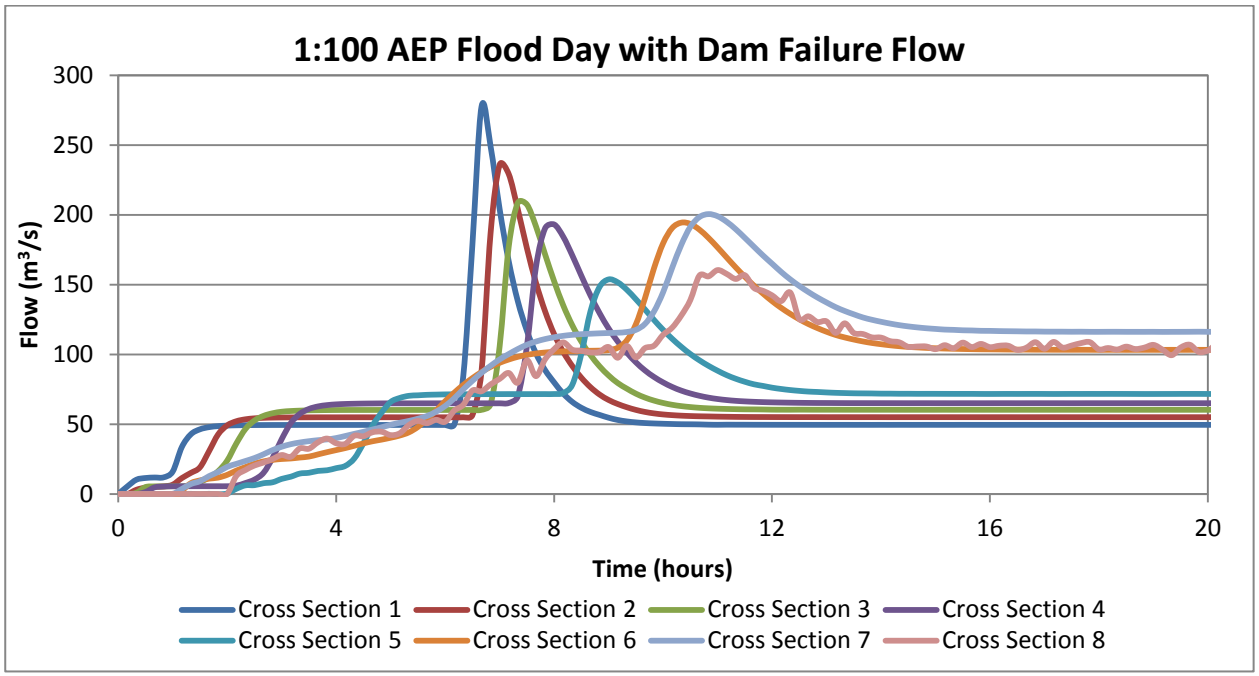
Dam Break is at time 0 hours.



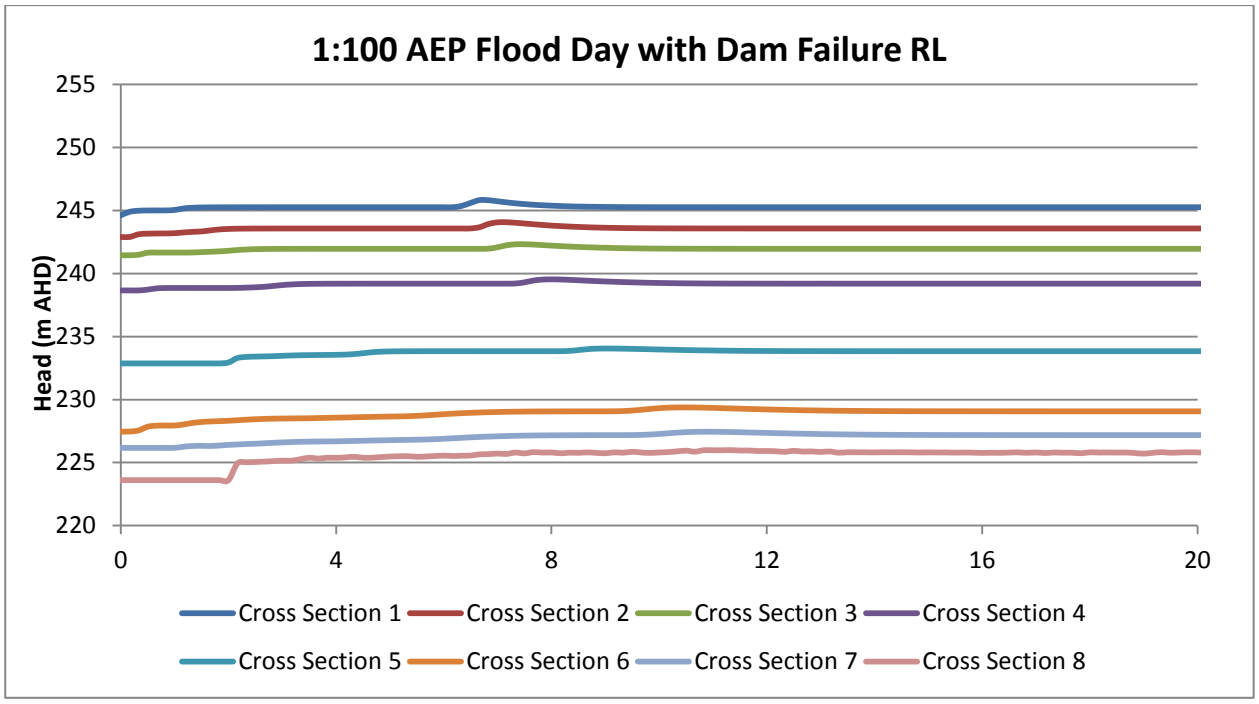
Dam Break is at time 16 hours.



Dam Break is at time 16 hours.



Dam Break is at time 6 hours.



Dam Break is at time 6 hours.

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APPENDIX E

Limitations

LIMITATIONS

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Appendix 11

Geotechnical Investigation (Leewood)

October 2012

LEEWOOD PONDS, NARRABRI GAS PROJECT, NSW

Geotechnical Investigation Stage 1 Report

Submitted to:
Santos Ltd
Level 16
40 Creek Street
Brisbane QLD 4000

REPORT

Report Number. 127615025 013 R Rev1
Distribution:
1x Santos Ltd (7081-2000-040-REP-0001)

Golder Associates

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1.0 INTRODUCTION

Santos Ltd (Santos) engaged Golder Associates Pty Ltd (Golder) to undertake a geotechnical investigation (GI) for the Leewood Ponds which form part of the proposed Narrabri Gas Project. The purpose of the GI is to assess the foundation conditions for the area of the proposed ponds and assess the suitability of site soils for construction purposes. The scope of the GI was presented in Golder proposal P27615033-001-P-Rev1 of 28 June 2012 and was commissioned under Santos contract reference 884285.

This report presents the results of the Stage 1 GI at the site of the proposed ponds, and includes comments and recommendations for the design. As discussed in Section 3.0, a Stage 2 GI report is also being prepared by Golder.

2.0 BACKGROUND

The Leewood Ponds are proposed for storage of water from coal seam gas extraction activities and subsequent reverse osmosis treatment. The nominated area for development of the ponds is in the north-west of the Leewood site, covering an area of approximately 0.3 km by 1.0 km. A plan showing the site area and the concept design layout for the ponds is presented on Figure 1.

3.0 SCOPE OF WORK

The scope of work for the GI was outlined in our proposal dated 28 June 2012 (ref: P27615033-001-P-Rev1) and also in a letter dated 25 July 2012 (Santos ref: 7081-2000-040-SOW-020 / Golder ref: 127615025 003 L Rev0) which included details of proposed test pit locations.

In summary, the GI scope of work comprised:

- Excavation of 38 test pits to a maximum depth of approximately 5 m (or refusal).
- Sampling of materials encountered within the test pits.
- Geotechnical and geochemical laboratory testing of selected soils samples.
- Reporting, including recommendations.

This report is focussed on the results of the geotechnical investigations. A technical memorandum summarising the results of the geochemical soils investigation is presented in Appendix A.

A separate “Stage 2” geotechnical investigation was undertaken by Golder at the Leewood site. Selected test pit data from the Stage 2 GI is referred to in this report. The results of the Stage 2 GI are to be reported separately (ref: 127615025 019 R) (in progress).

4.0 SITE CHARACTERISTICS

4.1 Topography

The topography of the site generally slopes towards a drainage feature which grades downwards through the site from its south east corner in a north westerly direction. Surface grades on the site are generally shallow with typical grades encountered being approximately 1 in 400.

4.2 Geology

The Narrabri 1:250 000 Geological Map (**Ref.1**) indicates the site is located on the Quaternary *Undifferentiated Cainozoic Sediments* (Cza) underlain by the Mesozoic Cretaceous *Blythesdale Group* (Klb). The Cainozoic Sediments are characterised by various silts and clays of alluvial origin. The Blythesdale Group comprise of “Sandstone, shale and minor siltstone” and residual soils.

5.0 METHOD OF GEOTECHNICAL INVESTIGATION

5.1 Site Preparation

Prior to the investigations, a layout plan of proposed test pit locations for the ponds was prepared by Golder (ref: 127615025 003 L Rev0). Santos located and cleared the pit locations based upon this plan and position co-ordinates.

5.2 Test Pit Excavation

Test pits were excavated using a Komatsu PC 220 excavator (24 tonne mass) fitted with a 0.9 m wide standard (i.e. toothed) bucket. The excavator was supplied by Specialised Civil Services Pty Ltd (SCS).

Excavation of the test pits was carried out under the direction of a Golder geotechnical engineer who logged the subsurface soil profile (including moisture condition), collected soil samples, and carried out pocket penetrometer tests on clumps of soil. Upon completion of soil logging and sample collection, the test pits were backfilled using the excavated materials and tamped using the excavator bucket.

5.3 Laboratory Testing

Laboratory testing was conducted on selected samples from within the proposed ponds footprint to assess their suitability for use in clay rich layers and embankment fill.

Test work was undertaken by South Queensland Soils (SGS), a NATA certified soils laboratory located in Brisbane. Trilab was used by SGS for remoulded permeability testing. A summary of the test methods and associated standards used is presented in Table 1

Table 1: Summary of Geotechnical Laboratory Test Methods

Laboratory Test	Standard / Method
Moisture Content	AS1289 2.1.1
Atterberg Limits	AS1289 3.1.2, 3.2.1, 3.3.1, 3.4.1
Particle Size Distribution	AS1289 3.6.1
Emerson Class	AS1289 3.8.1
Standard Compaction	AS1289 5.1.1
Permeability by Falling Head	AS1289 6.7.2, K.H. Head method **(Ref.2)**

6.0 FIELD OBSERVATIONS AND CONDITIONS

6.1 Vegetation

The site has well established dense grass and weed cover and was until recently used for cattle grazing. Trees are present at intermittent locations throughout the site with an area of dense vegetation present in the north east of the site. It is inferred that trees were previously present over the entire site but were mostly removed to provide pastureland for cattle. The general site conditions are shown in Photographs 1 and 2, in Appendix B.

6.2 Site Weather

Excavation of the test pits was undertaken between 30 July and 5 August 2012. During the test pit investigation the weather was fine, however in the preceding weeks, the site was subject to heavy rainfall.

7.0 RESULTS OF INVESTIGATIONS

7.1 Test Pits

Reports of the test pits, including photographs of the exposures are presented in Appendix C. A table summarising the position coordinates, surface elevation (inferred from site topographical data), depths and general comments is also included in Appendix C.

The following information sheets relevant to the interpretation of the test pit reports are presented in Appendix D

- Explanation of Notes, Abbreviations & Terms Used on Borehole and Test Pit Reports.
- Method of Soil Description Used on Borehole and Test Pit Reports.

The subsurface profile encountered generally comprised of a layer of topsoil, a layer of silty clay/silty sandy clay underlain by residual soils of extremely weathered sandstone. Groundwater was not encountered in any of the test pits to the excavated depths. Further detail on the subsurface interpretation is presented in Section 8.0.

7.2 Laboratory Testing

A summary table of the laboratory test results including soil sample classifications in accordance with the Unified Soil Classification System (USCS) is presented in Appendix E. Summary plasticity charts are presented in Appendix F. Laboratory test reports are presented in Appendix G, H, and I.

In addition to the test results summarised in Appendix D, a falling head permeability test was carried out on a sample retrieved from TP19 at a depth of 1.5 to 1.7 m. The sample was compacted to a target dry density of 95% of the Standard Dry Density Ratio and at Standard Optimum Moisture Content. The results indicate a coefficient of permeability value of 2.7×10^{-9} m/s.

Additional permeability testing for interpretation of the soils within the proposed pond development area is being undertaken as part of Stage 2 GI.

8.0 SUBSURFACE CONDITIONS

8.1 General

Cross sections through the proposed pond development area were produced to illustrate the subsurface conditions. The alignments for the cross sections are presented on Figure 2 and the cross sections are presented on Figure 3 and Figure 4. The general subsurface profile encountered in the test pits is described in the following sections.

8.2 Inferred Alluvial Soils

8.2.1 Topsoil

A topsoil layer was encountered across the proposed pond area. The topsoil layer variously comprised dark brown silty clay, clayey silt or sandy clayey silt with trace amounts of fine to medium grained sub rounded sand and root matter.

The topsoil consistency was typically logged as “soft” and was encountered from the surface to an average depth of 0.2 m. The topsoil thickness logged varied between 0.1 m and 0.4 m. The topsoil was generally moist to wet.

8.2.2 Sandy Clayey SILT

Sandy clayey silt was encountered beneath the topsoil layer in the northern portion of the investigation area. The thickness of this layer was generally between 0.2 m and 0.3 m. The material was typically logged as moist to wet, dark brown, containing fine to medium grained sub-rounded sand particles. Pocket

penetrometer testing indicated undrained shear strength ranging between 75 kPa to 125 kPa. The consistency of the material was generally logged as “soft” to “firm”.

8.3 Inferred Residual Soils

8.3.1 Silty CLAY/Silty Sandy CLAY

Silty clay and silty sandy clay were encountered throughout the entire proposed pond area below the sandy clayey silt layer. The material was encountered at depths between 0.2 m to about 0.5 m below the surface and extended to depths of up to 3.7 m below the surface.

These clay soils were brown in colour, incrementally changing with depth to pale gray with some iron oxide staining encountered. These materials were logged as dry to moist, high plasticity and a hard consistency. The material contained fine to medium grained sub-rounded sand particles. Pocket penetrometer testing indicated undrained shear strength in excess of 300 kPa. The sand content in the material gradually increased with depth.

8.3.2 Silty SAND/Silty Clayey SAND/ Clayey Silty SAND Layer

Silty sand, silty clayey sand and clayey silty sand were encountered beneath the silty clay/silty sandy clay layer as the sand content increased at depths of between 1.6 m and 3.7 m below ground surface.

Silty sand and silty clayey sand were pale grey yellow and pale grey orange colour respectively with iron oxide staining. These soils were logged as fine to medium grained, sub-rounded to sub-angular with a “very dense” consistency. Cementation was observed within the layer. These materials were inferred to be residual soils from completely weathered sandstone with the degree of weathering observed to gradually decrease with depth.

Practical refusal occurred in a number of test pits at depths between 2.7 m and 4.9 m. Where practical refusal was encountered the depth to refusal was generally found to decrease from the north to the south of site. Practical refusal depths in the area of the proposed Product Water Pond (where encountered) generally varied between 2.7 m and 4.0 m. It is inferred that refusal occurred on highly weathered Sandstone.

9.0 COMMENTS AND RECOMMENDATIONS

The following comments and recommendations are provided with respect to the related design and construction development of the ponds in the area of the investigation.

Site Preparation

- Limited clearing and grubbing due to predominantly grass cover across the proposed pond area.
- The topsoil across the site mainly contains grass roots. The average depth of topsoil stripping is likely to be approximately 0.2 m.

Excavation

- Excavation of the pond basins is expected to be predominantly achieved with conventional earthmoving equipment. Where excavation extends into highly weathered sandstone some dozer ripping may be required to facilitate excavation.
- The silty clay, silty sandy clay and clayey sands are generally underlain by highly weathered sandstone. Practical refusal of the Komatsu PC220 machine fitted with a 0.9 m wide standard bucket occurred where this highly weathered rock was encountered.
- The proposed ponds location is located over the north western portion of the site. The geological cross sections presented in Figures 3 and 4 indicate that the extents of the proposed excavations generally do not extend into the highly weathered sandstone however there may be some localised excavation into the highly weathered sandstone in the vicinity of TP28, TP33 and TP38.

- Where test pits are located within the pond footprint they should be re-excavated to a depth of approximately 500 mm below subgrade level and backfilled with compacted clay soil.

Clay Rich Subgrade and Embankments

- The sandy clayey silt soils underlying the topsoil in the northern portion of the investigation area have a ML classification in accordance with USCS and are not considered suitable for foundations or fill material.

- The laboratory test results indicate the silty clay and silty sandy clay generally classify as low to medium plasticity clays (CL and CI) with some high plasticity clay lenses (CH). The Emerson class tests indicate the clays are moderately to non-dispersive. On this basis, the clays are likely to be suitable for compacted fill in the embankments, and should be well compacted in response to the potentially moderate dispersive test results.

- Silty clayey sand, silty sand, clayey sand and clayey silty sand related to the completely weathered sandstone were encountered where excavations extended below the silty clay/ silty sandy clay layer over the area investigated. These soils may be selectively used for construction of the embankments, with additional testing as required. As a guide, soil with lower clay content is typically encountered with depth at the site.

- Where minor sandy lenses are encountered within the silty clay and silty sandy clay layer, the sand may be mixed with the clay by rilling with a grader. Larger pockets of sand, if encountered, should not be used for pond embankment construction unless the sand can be effectively mixed with the silty clay (maximum 15% by volume of sand to clay soils).

Moisture Conditioning

- The silty clay and silty sandy clay soils were generally dry of Standard Optimum Moisture Content at the time of the investigation, and typically excavated as clods. Breaking down of clods and moisture conditioning of soils in stockpile is required prior to their use in the pond embankments.

- Additional moisture conditioning may be required following compaction to prevent desiccation cracking prior to covering with geosynthetic liners or erosion protection.

Dispersivity

- Laboratory testing indicates that the soils on the site are moderately to non-dispersive and exhibit a moderate degree of structural stability (Emerson Class 4). On this basis, design measures are recommended to limit piping and surface erosion.

10.0 CLOSURE

This report provides a summary of the results of the Stage 1 geotechnical investigations carried out for the proposed Leewood Ponds and includes comments and recommendations for the ponds design.

11.0 LIMITATIONS

Your attention is drawn to the document - “Limitations”, which is included in Appendix J of this report. The statements presented in this document are intended to advise you of what your realistic expectations of this report should be, and to present you with recommendations on how to minimise the risks associated with the services provided for this project. The document is not intended to reduce the level of responsibility accepted by Golder Associates, but rather to ensure that all parties who may rely on this report are aware of the responsibilities each assumes in so doing.

12.0 REFERENCES

1) Narrabri 1:250 000 Geological Map. Sheet SH 55-12. Geological Survey of NSW, 1971.

2) Head, K.H. “Manual of Soil Laboratory Testing, Volume 3: Effective Stress Tests”. Wiley, 1985.

Report Signature Page

GOLDER ASSOCIATES PTY LTD





Darren Webb
Civil Engineer

Fred Gassner
Principal

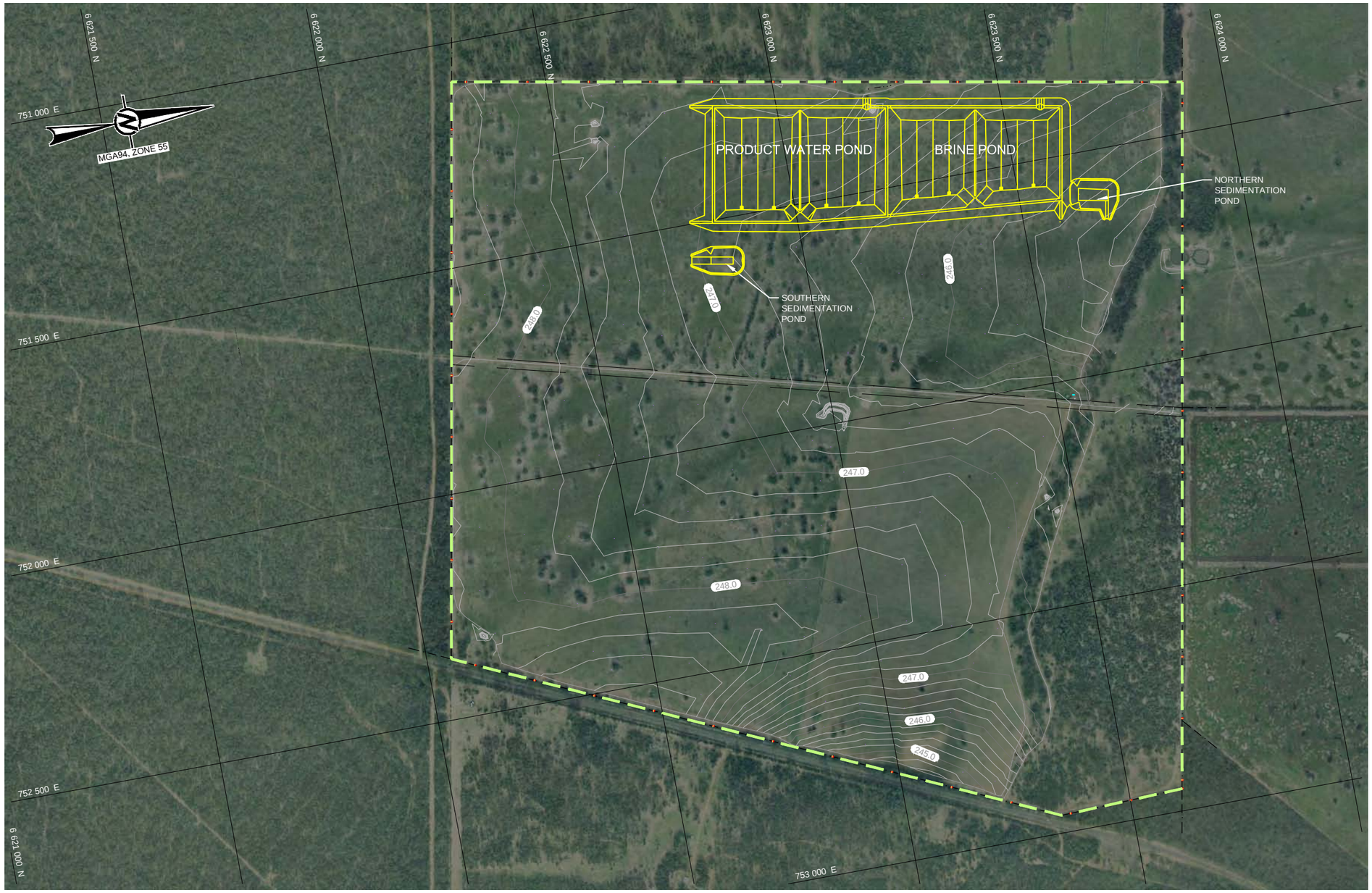
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LEGEND

- EXISTING CONTOURS AT 1m INTERVALS
- SITE BOUNDARY

0 200 400 600m

1:10,000

DRAWING TAKEN FROM GLEESON SURVEYING DRG. NO.8419_DET.DWG DATED 2ND AUGUST 2012

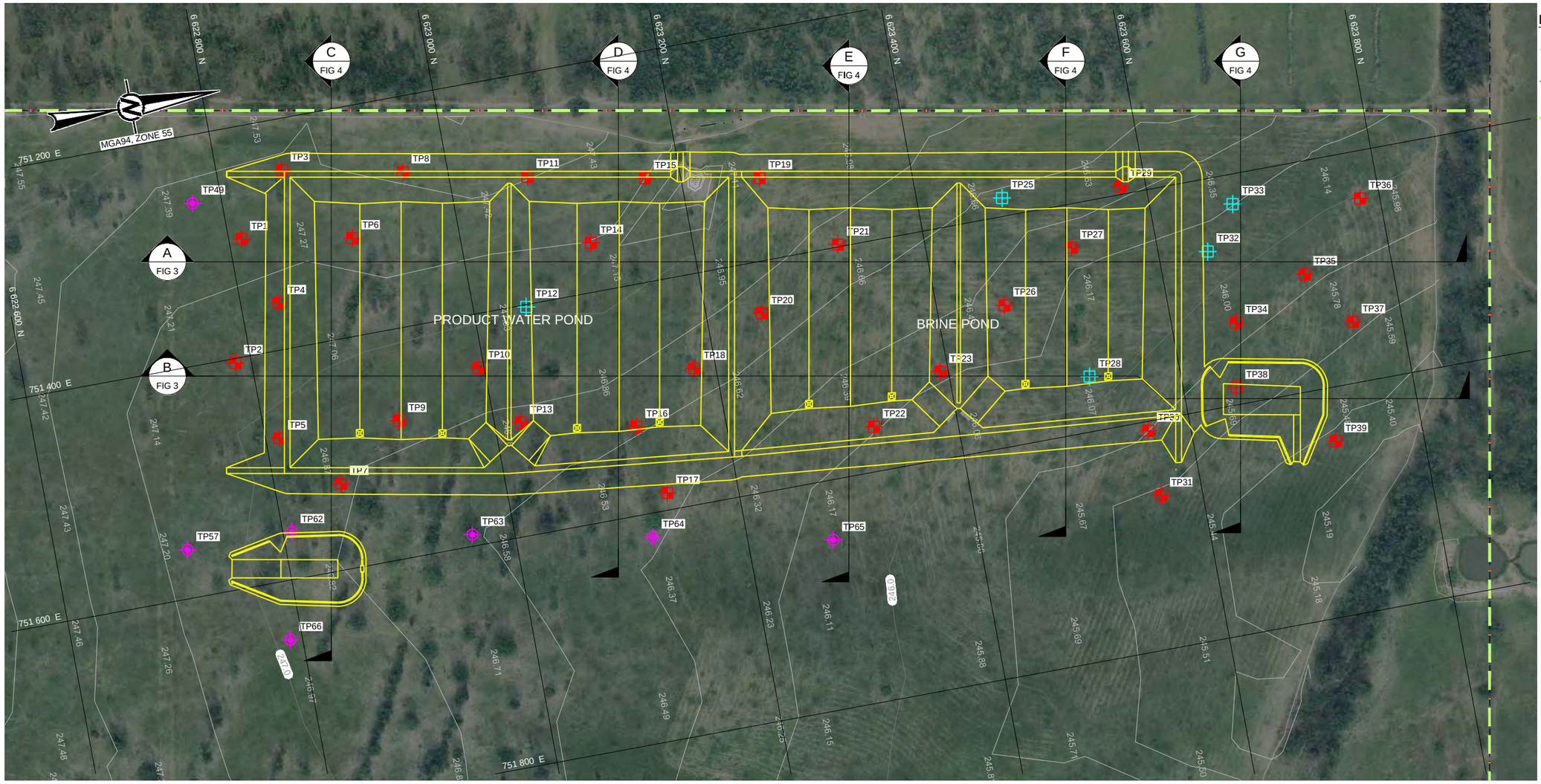
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LEGEND

- EXISTING CONTOURS AT 0.2m INTERVALS
- EXISTING FENCE
- SITE BOUNDARY
- TEST PIT LOCATIONS (GEOTECHNICAL)
- TEST PIT LOCATIONS (GEOCHEMICAL AND GEOTECHNICAL)
- SELECT TEST PIT LOCATIONS (STAGE 2 INVESTIGATION)

0 80 160 240m

1:4,000

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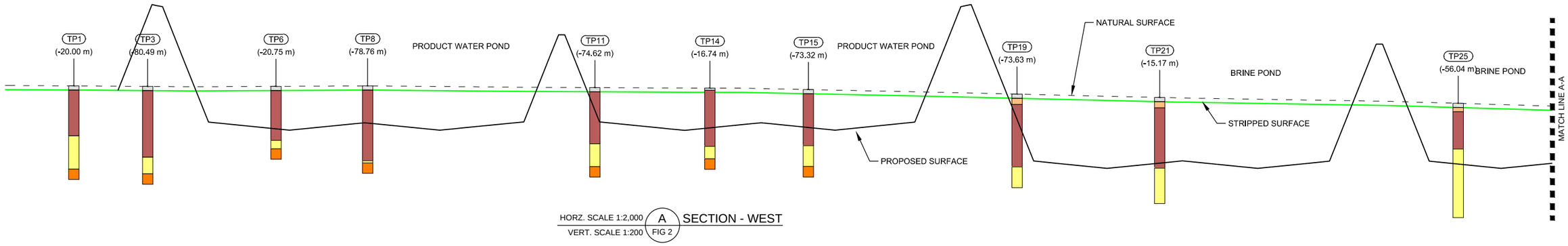
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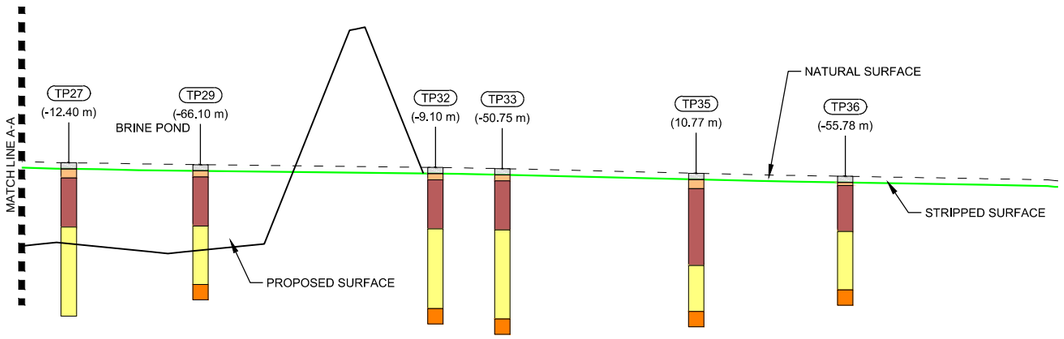
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HORZ. SCALE 1:2,000 / VERT. SCALE 1:200 — A — FIG 2

SECTION - WEST

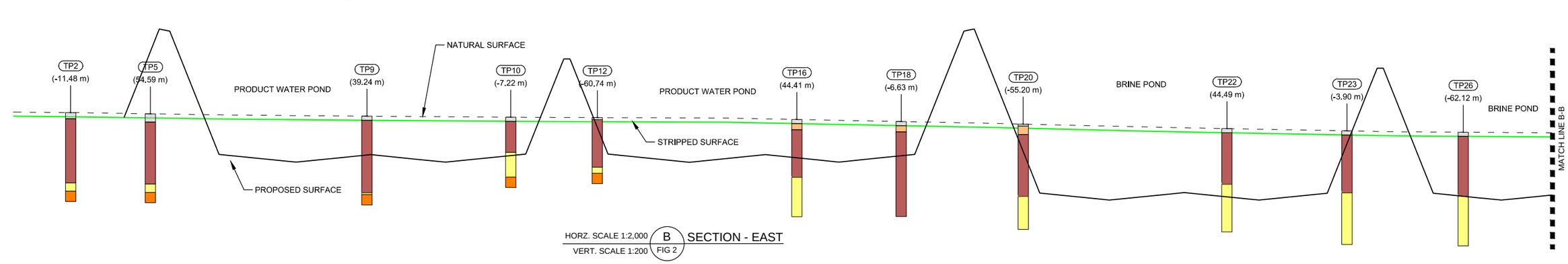


HORZ. SCALE 1:2,000 / VERT. SCALE 1:200 — A — FIG 2

SECTION - WEST CONTINUED

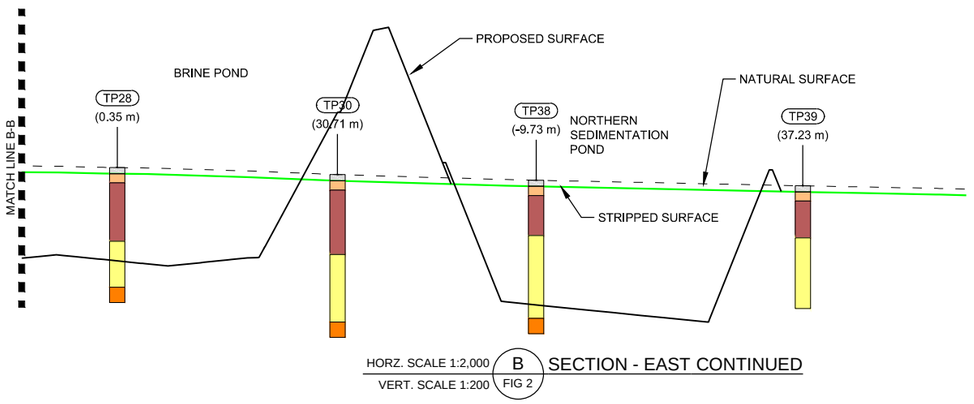
LEGEND

- TOP SOIL: Silty CLAY
- Sandy Clayey SILT
- Silty CLAY/SILTY SANDY CLAY
- Clayey SAND/Clayey Silty SAND/Silty SAND
- SANDSTONE
- (-10.00 m) PLAN OFFSET ABOVE SECTION LINE
- (10.00 m) PLAN OFFSET BELOW SECTION LINE



HORZ. SCALE 1:2,000 / VERT. SCALE 1:200 — B — FIG 2

SECTION - EAST



HORZ. SCALE 1:2,000 / VERT. SCALE 1:200 — B — FIG 2

SECTION - EAST CONTINUED

0 4 8 12m
1:200 VERT.

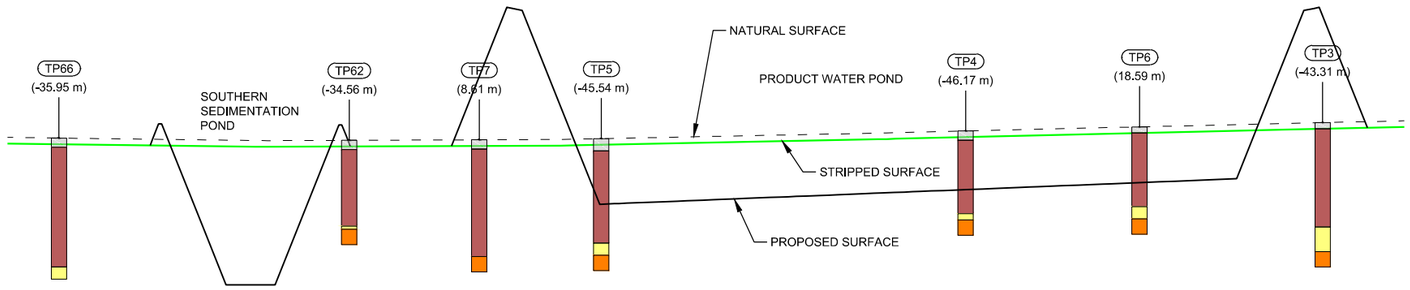
0 40 80 120m
1:2,000 HORIZ.

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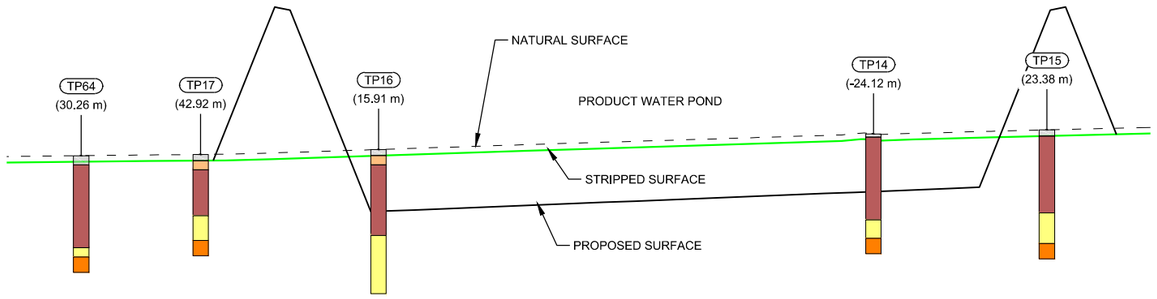
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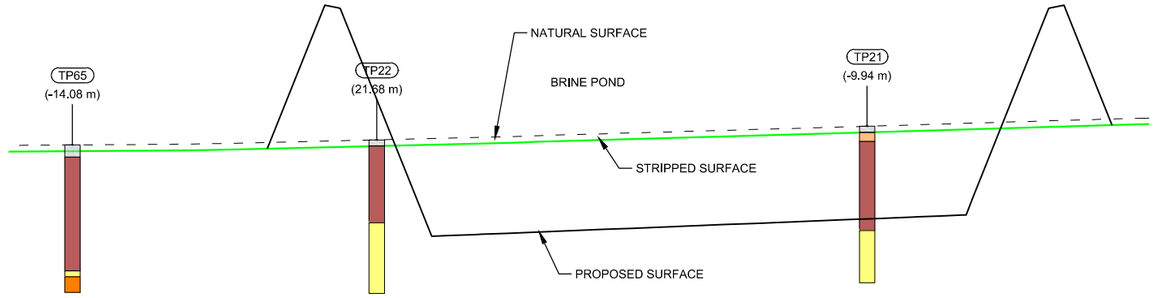
HORZ. SCALE 1:2,000 / VERT. SCALE 1:200 — C (FIG 2) — PRODUCT WATER POND SOUTH SECTION

LEGEND

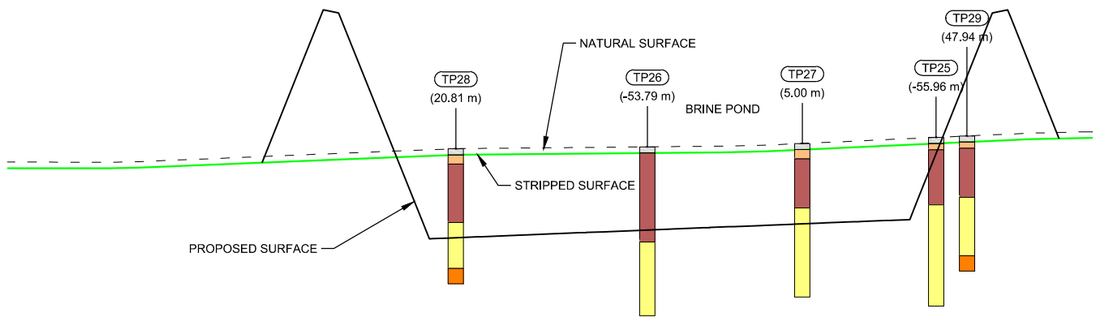
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- Sandy Clayey SILT
- Silty CLAY/SILTY SANDY CLAY
- Clayey SAND/Clayey Silty SAND/Silty SAND
- SANDSTONE
- (-10.00 m) PLAN OFFSET ABOVE SECTION LINE
- (10.00 m) PLAN OFFSET BELOW SECTION LINE



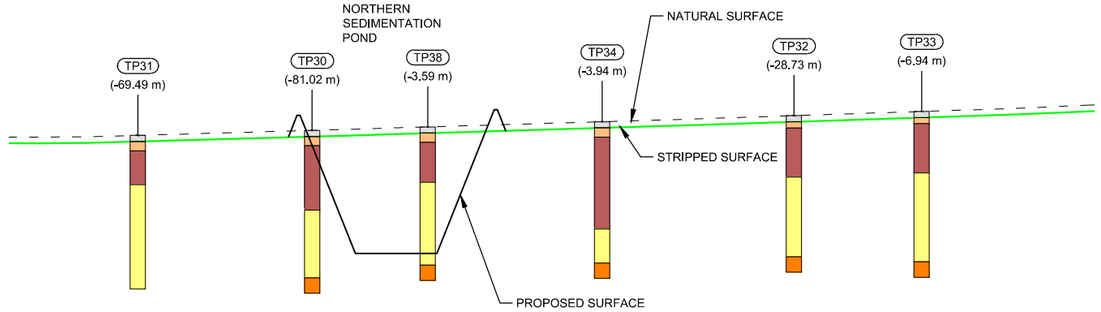
HORZ. SCALE 1:2,000 / VERT. SCALE 1:200 — D (FIG 2) — PRODUCT WATER POND NORTH SECTION



HORZ. SCALE 1:2,000 / VERT. SCALE 1:200 — E (FIG 2) — BRINE POND SOUTH SECTION



HORZ. SCALE 1:2,000 / VERT. SCALE 1:200 — F (FIG 2) — BRINE POND NORTH SECTION



HORZ. SCALE 1:2,000 / VERT. SCALE 1:200 — G (FIG 2) — NORTHERN SEDIMENTATION POND SECTION

0 4 8 12m
1:200 VERT.

0 40 80 120m
1:2,000 HORIZ.

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APPENDIX A

Geochemical Soils Investigation

TECHNICAL MEMORANDUM

DATE October 2012

REFERENCE No. 127615025 013 Appendix TM Rev1

TO Andrew Shek
Santos Ltd

CC

FROM Ian Wallace

EMAIL iwallace@golder.com.au

SANTOS LEEWOOD POND DESIGN - APPENDIX D TO GEOTECHNICAL INVESTIGATION (GEOCHEMICAL INVESTIGATION)

1.0 SCOPE OF WORK

This geochemical investigation was undertaken utilising topsoil and subsoil samples collected from six locations as part of the overall Geotechnical Investigation carried out by Golder Associates (Golder) for the design of the Leewood ponds for the Narrabri Gas Project. This Technical Memorandum should be read in association with Report No. 127615025-013-R-Rev1-Leewod Ponds Geotechnical Report Stage 1 dated October 2012.

Stabilisation of the pond embankments is desirable to reduce the risk of batter erosion. Topsoil and subsoil was sampled in order to characterise the soil across the site, to assist with the development of embankment soil management and, if required, revegetation procedures.

2.0 METHOD

During the geotechnical investigation Golder collected topsoil and subsoil samples from six of the test pits excavated across the site. The location of the test pits is shown in the Geotechnical Investigation plan (Figure 2) in the Geotechnical Investigation report. Topsoil was collected from the surface (0-0.1 m depth) at three locations (TP12, TP33 and TP38) and from 0.1 to 0.2 m depth at another location (TP25). Subsoil was collected at a depth interval of 0.2 to 0.3 m at one location (TP28) and at 0.3 to 0.4 m depth at two locations (TP12 and TP32).

All samples were tested for pH, salinity (demonstrated by electrical conductivity and soluble chloride) and exchangeable cations. Topsoil nutrients were determined on three samples (TP12 0-0.1m, TP25 0.1-0.2m and TP38 0-0.1m). Analysis undertaken was in accordance with the requirements of the Golder proposal 127615025-003-L-Rev0 of 25 July 2012 outlining the Geotechnical Investigation Scope.

Samples were submitted to Australian Laboratory Services (ALS), a NATA accredited laboratory for the required chemical tests.

Selected samples were submitted to Golder laboratory for particle size distribution (PSD) and Emerson dispersion tests. The results of these tests are reported in the Geotechnical Investigation report.

3.0 TEST RESULTS

A summary of the laboratory geochemical test results are presented in Table 1. The laboratory test reports are presented in Attachment A.

Table 1: Results of Laboratory Analysis

Sample Location	Depth	Soil Type	Laboratory Batch	Date	Moisture			Baseline Chemistry								Soil Fertility											DTPA Extractable Metals			
						pH	EC	Exchangeable Calcium	Exchangeable Magnesium	Exchangeable Potassium	Exchangeable Sodium	Exchangeable Aluminium	Cation Exchange Capacity	Exchangeable Sodium Percent	Calcium:Magnesium	Soluble Chloride	Soluble Sulfate	Soluble Calcium	Soluble Magnesium	Soluble Sodium	Soluble Potassium	Soluble Boron	NOx (Soluble N)	TKN	Total Nitrogen	Bicarbonate Extractable Phosphorus	Organic Matter	Copper	Iron	Manganese	Zinc
Units					%	pH unit	mS/cm	meq/100g						%	-	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	%	mg/kg	mg/kg	mg/kg	mg/kg
Laboratory Limits of Reporting					1.0	0.1	0	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	10	10	10	10	10	10	1	0.1	20	20	2.0	0.5	1.0	1.0	1.0	1.0
Top-soil																															
TP12	0.0-0.1m	silty clay	ES1219326	6/08/2012	12.8	5.4	0.02	1.1	3.1	<0.1	0.3	0.2	4.5	6.2	0.35	20	20	<10	10	20	20	<1	<0.1	710	710	3	0.7	<1	136	2.97	<1
TP25	0.1-0.2m	sandy clayey silt	ES1218959	31/07/2012	14.6	5.9	0.031	0.5	3.6	<0.1	0.7	<0.1	4.9	14.7	0.14	220	10	20	130	80	90	2	<1	370	370	<2	0.6	<1	48.5	<1	<1
TP33	0.0-0.1m	sandy clayey silt	ES1218958	31/07/2012	13.2	6.2	0.02	0.9	2.5	<0.1	0.4	0.1	3.9	9.9	0.36	180	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TP38	0.0-0.1m	sandy clayey silt	ES1218958	31/07/2012	13.7	5.4	0.02	0.8	1.4	<0.1	<0.1	<0.1	2.3	4.3	0.57	30	10	10	20	50	20	1	<1	160	160	<2	1.1	<1	61.8	<1	<1
Topsoil Baseline range (0-0.2m)					12.8 to 14.6	5.4 to 6.2	0.015 to 0.031	0.5 to 1.1	1.4 to 3.6	<0.1	0.1 to 0.7	0.1 to 0.2	2.3 to 4.9	4.3 to 14.7	0.14 to 0.57	20 to 220	10 to 20	10 to 20	10 to 130	20 to 80	20 to 90	<1 to 2	<1	160 to 710	160 to 710	<2 to 3	0.6 to 1.1	<1	48.5 to 136	<1 to 2.97	<1
Sub-soil																															
TP12	0.3-0.4m	silty clay	ES1219326	6/08/2012	9.5	5.6	0.21	0.3	7.9	<0.1	1.0	<0.1	9.3	11.3	0.04	500	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TP28	0.2-0.3m	sandy clayey silt	ES1218959	31/07/2012	10.8	6.3	0.042	0.4	2.7	<0.1	0.5	<0.1	3.6	12.7	0.15	180	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TP32	0.3-0.4m	sandy clayey silt	ES1218958	31/07/2012	12.3	6.2	0.11	0.6	5.0	<0.1	1.0	<0.1	6.7	14.9	0.12	320	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Subsoil Baseline range (0.2-0.5m)					9.5 to 12.3	5.6 to 6.3	0.042 to 0.212	0.3 to 0.6	2.7 to 7.9	<0.1	0.5 to 1	<0.1	3.6 to 9.3	11.3 to 14.9	0.04 to 0.15	180 to 500	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

4.0 SOIL STRATIGRAPHY

The topsoil thickness was assessed as being between 0.1 m (at BH12) and 0.2 m (at the other five locations) across the site. The topsoil texture was classified as sandy clayey silt (at most locations) and silty clay (at TP12).

The texture of the near surface subsoil, to a depth of approximately 0.5 m below ground level (bgl), consisted of silty clay at TP12, or sandy clayey silt in the other five sampled locations to a depth of between 0.4 and 0.5 m bgl overlying silty sandy clay or sandy silty clay.

The soil textures generally indicate moderately 'light' soils (i.e. soils without a high clay content) in the upper 0.5 m of the profile.

Test pit logs of the soil encountered across the site will be provided in the geotechnical report to follow.

5.0 BASELINE SOIL CHEMISTRY / SOIL FERTILITY

Topsoil pH ranged from 5.4 to 6.2, indicating moderately to slightly acidic soils. This is at the low end of the preferred topsoil pH range of pH 5.5 to 8.0 for agricultural soils. A light application of agricultural lime to the topsoil is desirable to ameliorate the soil acidity. The subsoil pH laboratory results indicate results similar to the topsoil ranging from moderately to slightly acidic. An application of lime to the subsoil is only required if subsoil is used as pond embankment cover.

Soil salinity, as represented by EC and soluble chloride, indicate relatively low levels of salinity in the topsoil at all locations tested, except for slightly higher chloride at TP25 0-0.1 m. The subsoil salinity is low to moderate. Ideally the soil EC should be below 0.35 mS/cm with the chloride content below 200 mg/kg, so TP12 0.3-0.4 m and TP32 0.3-0.4 m could be considered as slightly to moderately saline.

Soil fertility analysis was undertaken for the surface soils (topsoil). Results of the fertility testing indicate low levels of plant available nutrients below ideal concentrations for establishing most pasture species. Plant available phosphorus (extractable phosphorus), soluble sulfate and soluble cations are all low to very low. Nitrogen and organic matter levels are also low. While the plant available nutrient levels are low in most cases, these can be improved by fertiliser applications.

The DTPA extractable metal results give an indication of the availability of the important trace metals copper, iron, manganese and zinc. The results indicate low levels of these trace elements with the possible exception of plant available iron. Soluble boron is also at a low level. These trace elements can be applied in a fertiliser mix.

6.0 STRUCTURAL CHARACTERISTICS

Soil sodicity (as represented by the exchangeable sodium percentage, ESP) can compromise soil structure leading to poor soil water storage, internal drainage problems, poor soil aeration properties and soil dispersion, surface sealing and erosion issues. An ESP below 6% is considered desirable, with a value greater than 15% indicating highly sodic soil (undesirable).

The soil Emerson test results returned values that suggest that the surface and sub soils across the site are unlikely to be significantly dispersive. The Emerson results will be provided in the geotechnical report to follow.

The ESP values of the topsoil samples generally indicated low to moderate levels of sodicity in three of the four samples tested. Only at TP25 did the ESP approach a highly sodic value (14.7%).

Exchangeable calcium:magnesium ratios can also be used to assess soil structure properties. The ratios should preferably be above 0.5, and ideally above 2.5, with levels below 0.5 indicating possible soil structure problems. The Ca:Mg ratios were low in all samples tested. However, the exchangeable cation concentrations were also low in all four samples and at levels where the ESP and Ca:Mg values are not particularly reliable for interpreting the likely propensity of the soil to disperse. Given the generally low ESP values and 'light' soil types, it is anticipated that these topsoils will not be highly dispersive.

The ESPs of the three subsoils were all moderately high (up to 14.9%) and the Ca:Mg ratios were all below desirable values. This suggests that the soils will be moderately dispersive. However, similar to the topsoils, the subsoils tested returned low exchangeable cation concentrations, which indicates that the ESP value is not particularly reliable and thus these soils may not be as dispersive as the soil chemistry suggests. They may not show a marked responsive to applications of gypsum.

7.0 SOIL MANAGEMENT

These comments on soil management apply to the establishment of vegetation cover on the proposed pond embankment batters. Establishment of surface vegetation cover can offer effective erosion control if the soil preparation, species selection, soil chemical properties and maintenance programme is adequate to support the establishment and growth of plants.

Stockpiling of topsoil for extended periods (i.e. greater than 12 months) is not desirable as the soil buried within the stockpile loses, for instance, structure, biological activity, desirable chemical properties, nutrition and organic content. That is, its value as topsoil is diminished. If excavated topsoil is scheduled to be stockpiled for more than 12 months it may be beneficial to consider utilising it as general fill instead.

Two options for establishing vegetation cover on embankments. Option 1 is preferable to Option 2, as it is a more robust option. Option 1 essentially comprises placing existing topsoil on the embankment slopes, where as Option 2 comprises placing conditioned subsoil on the embankment slopes to for a layer suitable for vegetation growth.

Option 1 (Priority 1):

The topsoil on site was assessed as extending to a depth of 0.1 to 0.2m depth bgl. The subsoil was generally of similar texture and chemical properties to the topsoil; however, there was sufficient differentiation, particularly with respect to ESP..

Recommendations for the management of the soil for Option 1 include:

- Stripping of topsoil and storage separately to subsoils. The topsoil is assessed as being to an approximate depth of 0.2 m across the site. Topsoil should be stored in as shallow as possible stockpiles of less than 1.2 m depth.
- Topsoil treatment with fine good quality agricultural lime (neutralising value of at least 90) applied at a rate of approximately 1 t/ha as a blanket rate. This can be applied after reinstallation (should the embankment batter slope allow) and incorporated to the full depth of topsoil or added and incorporated through the topsoil at the time of stockpiling. The recommended rate on a volume basis is 1 kg/m^3.
- Replacement of topsoil should be to an ideally minimum depth of 0.3 m over the embankments should the stockpiled volume allow..
- Amelioration of topsoil with gypsum to reduce soil dispersion should not be required. The results of laboratory testing on topsoil samples suggest that soil dispersion of the topsoil is unlikely to be significant.

Option 2 (Priority 2):

Subsoil may be used as batter surface cover; however, this option is likely to have a less successful outcome than Option 1 due to the properties of the subsoil. Results of the cation analysis indicate that the subsoils are moderately sodic, with Exchangeable Sodium Percentage (ESP) of about 11% to 15%. These soils may be prone to dispersion and erosion if exposed or disturbed and, therefore, despite the low exchangeable cation concentrations and ‘light’ nature of the soils, an application of gypsum to the subsoil is recommended, if the subsoil is to be used as the batter surface cover .

Recommendations for the management of the subsoil as cover include:

- Treat the spoil with fine good quality agricultural lime (neutralising value of at least 90) applied at a rate of approximately 1 t/ha as a blanket rate. This can be applied after reinstallation (should the embankment batter slope allow) and incorporated to the full depth of capping soil or added and

incorporated through the subsoil at the time of stockpiling. The recommended rate on a volume basis is 1 kg/m^3.

- Based on the exchangeable cation results, only a low rate of gypsum is indicated as being required to reduce the likelihood of soil dispersion. A rate of 1 t/ha as a blanket rate is recommended. This is best applied and incorporated through the subsoil at the time of stockpiling. Alternatively, gypsum can be applied and incorporated after re-establishment (should the embankment batter slope allow). The recommended rate on a volume basis is 1 kg/m^3.

General recommendations for the establishment of vegetation on the embankments (for Option 1 or Option 2) are:

- A pre-planting application of fertiliser at about 10g/m^2 (100 kg/ha) nitrogen, 4g/m^2 (40 kg/ha) phosphorus and 6 g/m^2 (60 kg/ha) potassium, to be applied and worked into the top 0.15 m depth is recommended (should the embankment batter slope allow). Ideally apply one week or more before seeding.
- Trace elements (i.e. zinc, copper, manganese and boron) should be incorporated into the fertiliser mix if possible. Commercial fertilisers that include a mix of trace elements are available.
- Stockpiles should not be placed in the vicinity of waterways.
- Adequate erosion and sediment control of stockpiles is necessary, particularly of subsoils.
- Soil handling should be kept to a minimum (avoid double handling).
- Erosion and sediment control after seeding and before an adequate surface cover is established may be required near sensitive receptors such as waterways.
- Vegetation of the batters will require the reseeding with pasture species (grasses and broadleaf) based on species suited to the district.
- An adequate watering regime should be established for establishment of vegetation. Water should be applied in a manner that does not cause concentrated flow of water onto the soil surface. The following watering regime is recommended:
  - The site should be watered within 24 hours of the seed placement and kept moist for a period of one week.
  - The site should then be watered twice per week for the following two weeks.
  - The site should be watered once per week for a period of six weeks thereafter.
  - The watering listed above is not required if greater than 3 mm of rainfall has occurred in the previous three days.

7.1 Monitoring and assessment of germination

Monitoring and assessment of germination should be undertaken at two, four and eight weeks after seeding. If germination has not been successful the cause should be determined and measures taken to enable germination and establishment.

8.0 STUDY LIMITATIONS

Your attention is drawn to the limitations of this report which are outlined in Attachment B of this report. The statements presented in this document are intended to advise you of what your realistic expectations of this report should be, and to present you with recommendations on how to minimise the risks associated with the earthworks for this project. The document is not intended to reduce the level of responsibility accepted by Golder Associates, but rather to ensure that all parties who may rely on this report are aware of the responsibilities each assumes in so doing.



Ian Wallace
Senior Environmental Scientist

IMW/HEP/imw

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ATTACHMENT A

Laboratory Test Results

Environmental Division

CERTIFICATE OF ANALYSIS

Work Order	: **ES1218958**	Page	: 1 of 4
Client	: **GOLDER ASSOCIATES**	Laboratory	: Environmental Division Sydney
Contact	: MR DARREN WEBB	Contact	: Jennifer Cullen
Address	: P O BOX 6079 Building 7, 570-588 Swan St, Richmond, VIC. 3121 HAWTHORN WEST VIC, AUSTRALIA 3122	Address	: 277-289 Woodpark Road Smithfield NSW Australia 2164
E-mail	: dawebb@golder.com.au	E-mail	: jennifer.cullen@alsglobal.com
Telephone	: +61 03 8862 3500	Telephone	: +61 2 8784 8509
Facsimile	: +61 03 8862 3501	Facsimile	: +61 2 8784 8500
Project	: 127615025	QC Level	: NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Order number	: 335309		
C-O-C number	: ----	Date Samples Received	: 03-AUG-2012
Sampler	: M	Issue Date	: 17-AUG-2012
Site	: NARRABRI NSW		
		No. of samples received	: 3
Quote number	: EN/002/11	No. of samples analysed	: 3

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. All pages of this report have been checked and approved for release.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results

NATA Accredited Laboratory 825

Accredited for compliance with ISO/IEC 17025.

Signatories

This document has been electronically signed by the authorized signatories indicated below. Electronic signing has been carried out in compliance with procedures specified in 21 CFR Part 11.

Signatories	*Position*	*Accreditation Category*
Andrew Epps	Metals Production Chemist	Brisbane Inorganics
Celine Conceicao	Senior Spectroscopist	Sydney Inorganics
Evie.Sidarta	Inorganic Chemist	Sydney Inorganics
Sarah Millington	Senior Inorganic Chemist	Sydney Inorganics

General Comments

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

When sampling time information is not provided by the client, sampling dates are shown without a time component. In these instances, the time component has been assumed by the laboratory for processing purposes.

Key : CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
^ = This result is computed from individual analyte detections at or above the level of reporting

Analytical Results

Sub-Matrix: SOIL				Client sample ID	TP38_0.0-0.1M	TP32_0.3-0.4M	TP33_0.0-0.1M	----	----
				Client sampling date / time	31-JUL-2012 15:00	31-JUL-2012 15:00	31-JUL-2012 15:00	----	----
Compound	CAS Number	LOR	Unit		ES1218958-001	ES1218958-002	ES1218958-003	----	----
EA002 : pH (Soils)									
pH Value	----	0.1	pH Unit		5.4	6.2	6.2	----	----
EA010: Conductivity									
Electrical Conductivity @ 25°C	----	1	µS/cm		15	109	22	----	----
EA055: Moisture Content									
Moisture Content (dried @ 103°C)	----	1.0	%		13.7	12.3	13.2	----	----
ED008: Exchangeable Cations									
Exchangeable Calcium	----	0.1	meq/100g		0.8	0.6	0.9	----	----
Exchangeable Magnesium	----	0.1	meq/100g		1.4	5.0	2.5	----	----
Exchangeable Potassium	----	0.1	meq/100g		<0.1	<0.1	<0.1	----	----
Exchangeable Sodium	----	0.1	meq/100g		<0.1	1.0	0.4	----	----
Exchangeable Aluminium	----	0.1	meq/100g		<0.1	<0.1	0.1	----	----
Cation Exchange Capacity	----	0.1	meq/100g		2.3	6.7	3.9	----	----
Exchangeable Sodium Percent	----	0.1	%		4.3	14.9	9.9	----	----
ED040S : Soluble Sulfate by ICPAES									
Sulfate as SO4 2-	14808-79-8	10	mg/kg		10	----	----	----	----
ED045G: Chloride Discrete analyser									
Chloride	16887-00-6	10	mg/kg		30	320	180	----	----
ED092: DTPA Extractable Metals									
Copper	7440-50-8	1.00	mg/kg		<1.00	----	----	----	----
Iron	7439-89-6	1.00	mg/kg		61.8	----	----	----	----
Manganese	7439-96-5	1.00	mg/kg		<1.00	----	----	----	----
Zinc	7440-66-6	1.00	mg/kg		<1.00	----	----	----	----
ED093S: Soluble Major Cations									
Calcium	7440-70-2	10	mg/kg		10	----	----	----	----
Magnesium	7439-95-4	10	mg/kg		20	----	----	----	----
Sodium	7440-23-5	10	mg/kg		50	----	----	----	----
Potassium	7440-09-7	10	mg/kg		20	----	----	----	----
EG005S : Soluble Metals by ICPAES									
Boron	7440-42-8	1	mg/kg		1	----	----	----	----
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser									
Nitrite + Nitrate as N (Sol.)	----	0.1	mg/kg		<1.0	----	----	----	----
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser									
Total Kjeldahl Nitrogen as N	----	20	mg/kg		160	----	----	----	----
EK062: Total Nitrogen as N (TKN + NOx)									
^ Total Nitrogen as N	----	20	mg/kg		160	----	----	----	----

Environmental Division

CERTIFICATE OF ANALYSIS

Work Order	: **ES1218959**	Page	: 1 of 4
Client	: **GOLDER ASSOCIATES**	Laboratory	: Environmental Division Sydney
Contact	: MR DARREN WEBB	Contact	: Jennifer Cullen
Address	: P O BOX 6079 Building 7, 570-588 Swan St, Richmond, VIC. 3121 HAWTHORN WEST VIC, AUSTRALIA 3122	Address	: 277-289 Woodpark Road Smithfield NSW Australia 2164
E-mail	: dawebb@golder.com.au	E-mail	: jennifer.cullen@alsglobal.com
Telephone	: +61 03 8862 3500	Telephone	: +61 2 8784 8509
Facsimile	: +61 03 8862 3501	Facsimile	: +61 2 8784 8500
Project	: 127615025	QC Level	: NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Order number	: 335309		
C-O-C number	: ----	Date Samples Received	: 03-AUG-2012
Sampler	: M	Issue Date	: 17-AUG-2012
Site	: NARRABRI, NSW		
		No. of samples received	: 3
Quote number	: EN/002/11	No. of samples analysed	: 2

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. All pages of this report have been checked and approved for release.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results

NATA Accredited Laboratory 825

Accredited for compliance with ISO/IEC 17025.

Signatories

This document has been electronically signed by the authorized signatories indicated below. Electronic signing has been carried out in compliance with procedures specified in 21 CFR Part 11.

Signatories	*Position*	*Accreditation Category*
Andrew Epps	Metals Production Chemist	Brisbane Inorganics
Celine Conceicao	Senior Spectroscopist	Sydney Inorganics
Evie.Sidarta	Inorganic Chemist	Sydney Inorganics
Sarah Millington	Senior Inorganic Chemist	Sydney Inorganics

General Comments

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

When sampling time information is not provided by the client, sampling dates are shown without a time component. In these instances, the time component has been assumed by the laboratory for processing purposes.

Key : CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
^ = This result is computed from individual analyte detections at or above the level of reporting

Analytical Results

Sub-Matrix: SOIL				Client sample ID	TP25_0.1-0.2M	TP28_0.2-0.3M	----	----	----
				Client sampling date / time	31-JUL-2012 15:00	31-JUL-2012 15:00	----	----	----
Compound	CAS Number	LOR	Unit		ES1218959-002	ES1218959-003	----	----	----
EA002 : pH (Soils)									
pH Value	----	0.1	pH Unit		5.9	6.3	----	----	----
EA010: Conductivity									
Electrical Conductivity @ 25°C	----	1	µS/cm		31	42	----	----	----
EA055: Moisture Content									
Moisture Content (dried @ 103°C)	----	1.0	%		14.6	10.8	----	----	----
ED008: Exchangeable Cations									
Exchangeable Calcium	----	0.1	meq/100g		0.5	0.4	----	----	----
Exchangeable Magnesium	----	0.1	meq/100g		3.6	2.7	----	----	----
Exchangeable Potassium	----	0.1	meq/100g		<0.1	<0.1	----	----	----
Exchangeable Sodium	----	0.1	meq/100g		0.7	0.5	----	----	----
Exchangeable Aluminium	----	0.1	meq/100g		<0.1	<0.1	----	----	----
Cation Exchange Capacity	----	0.1	meq/100g		4.9	3.6	----	----	----
Exchangeable Sodium Percent	----	0.1	%		14.7	12.7	----	----	----
ED040S : Soluble Sulfate by ICPAES									
Sulfate as SO4 2-	14808-79-8	10	mg/kg		10	----	----	----	----
ED045G: Chloride Discrete analyser									
Chloride	16887-00-6	10	mg/kg		220	180	----	----	----
ED092: DTPA Extractable Metals									
Copper	7440-50-8	1.00	mg/kg		<1.00	----	----	----	----
Iron	7439-89-6	1.00	mg/kg		48.5	----	----	----	----
Manganese	7439-96-5	1.00	mg/kg		<1.00	----	----	----	----
Zinc	7440-66-6	1.00	mg/kg		<1.00	----	----	----	----
ED093S: Soluble Major Cations									
Calcium	7440-70-2	10	mg/kg		20	----	----	----	----
Magnesium	7439-95-4	10	mg/kg		130	----	----	----	----
Sodium	7440-23-5	10	mg/kg		80	----	----	----	----
Potassium	7440-09-7	10	mg/kg		90	----	----	----	----
EG005S : Soluble Metals by ICPAES									
Boron	7440-42-8	1	mg/kg		2	----	----	----	----
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser									
Nitrite + Nitrate as N (Sol.)	----	0.1	mg/kg		<1.0	----	----	----	----
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser									
Total Kjeldahl Nitrogen as N	----	20	mg/kg		370	----	----	----	----
EK062: Total Nitrogen as N (TKN + NOx)									
^ Total Nitrogen as N	----	20	mg/kg		370	----	----	----	----

Analytical Results

Sub-Matrix: SOIL				Client sample ID	TP25_0.1-0.2M	TP28_0.2-0.3M	-----	-----	-----
				Client sampling date / time	31-JUL-2012 15:00	31-JUL-2012 15:00	----	----	----
Compound	CAS Number	LOR	Unit		ES1218959-002	ES1218959-003	----	----	----
EK080: Bicarbonate Extractable Phosphorus (Colwell)									
Bicarbonate Ext. P (Colwell)	----	2	mg/kg		<2	----	----	----	----
EP004: Organic Matter									
Organic Matter	----	0.5	%		**0.6**	----	----	----	----

Analytical Results

Sub-Matrix: SOIL				Client sample ID	TP38_0.0-0.1M	TP32_0.3-0.4M	TP33_0.0-0.1M	----	----
				Client sampling date / time	31-JUL-2012 15:00	31-JUL-2012 15:00	31-JUL-2012 15:00	----	----
Compound	CAS Number	LOR	Unit		ES1218958-001	ES1218958-002	ES1218958-003	----	----
EK080: Bicarbonate Extractable Phosphorus (Colwell)									
Bicarbonate Ext. P (Colwell)	----	2	mg/kg		<2	----	----	----	----
EP004: Organic Matter									
Organic Matter	----	0.5	%		1.1	----	----	----	----

Environmental Division

CERTIFICATE OF ANALYSIS

Work Order	: **ES1219326**	Page	: 1 of 4
Client	: **GOLDER ASSOCIATES**	Laboratory	: Environmental Division Sydney
Contact	: MR DARREN WEBB	Contact	: Jennifer Cullen
Address	: P O BOX 1734 MILTON QLD, AUSTRALIA 4064	Address	: 277-289 Woodpark Road Smithfield NSW Australia 2164
E-mail	: dwebb@golder.com.au	E-mail	: jennifer.cullen@alsglobal.com
Telephone	: +61 07 3721 5400	Telephone	: +61 2 8784 8509
Facsimile	: +61 07 3721 5401	Facsimile	: +61 2 8784 8500
Project	: 127615025	QC Level	: NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Order number	: ----		
C-O-C number	: ----	Date Samples Received	: 09-AUG-2012
Sampler	: MS	Issue Date	: 22-AUG-2012
Site	: NARRABRI NSM		
		No. of samples received	: 2
Quote number	: EN/002/11	No. of samples analysed	: 2

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. All pages of this report have been checked and approved for release.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results

NATA Accredited Laboratory 825

Accredited for compliance with ISO/IEC 17025.

Signatories

This document has been electronically signed by the authorized signatories indicated below. Electronic signing has been carried out in compliance with procedures specified in 21 CFR Part 11.

Signatories	*Position*	*Accreditation Category*
Celine Conceicao	Senior Spectroscopist	Sydney Inorganics
Evie.Sidarta	Inorganic Chemist	Sydney Inorganics
Jonathon Angell	Inorganic Coordinator	Brisbane Inorganics
Sarah Millington	Senior Inorganic Chemist	Sydney Inorganics

General Comments

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Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

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Key : CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
^ = This result is computed from individual analyte detections at or above the level of reporting

Analytical Results

Sub-Matrix: SOIL				Client sample ID	TP12 0.0-0.1m	TP12 0.3-0.4m	----	----	----
				Client sampling date / time	06-AUG-2012 15:00	06-AUG-2012 15:00	----	----	----
Compound	CAS Number	LOR	Unit		ES1219326-001	ES1219326-002	----	----	----
EA002 : pH (Soils)									
pH Value	----	0.1	pH Unit		5.4	5.6	----	----	----
EA010: Conductivity									
Electrical Conductivity @ 25°C	----	1	µS/cm		16	212	----	----	----
EA055: Moisture Content									
Moisture Content (dried @ 103°C)	----	1.0	%		12.8	9.5	----	----	----
ED008: Exchangeable Cations									
Exchangeable Calcium	----	0.1	meq/100g		1.1	0.3	----	----	----
Exchangeable Magnesium	----	0.1	meq/100g		3.1	7.9	----	----	----
Exchangeable Potassium	----	0.1	meq/100g		<0.1	<0.1	----	----	----
Exchangeable Sodium	----	0.1	meq/100g		0.3	1.0	----	----	----
Exchangeable Aluminium	----	0.1	meq/100g		0.2	<0.1	----	----	----
Cation Exchange Capacity	----	0.1	meq/100g		4.5	9.3	----	----	----
Exchangeable Sodium Percent	----	0.1	%		6.2	11.3	----	----	----
ED040S : Soluble Sulfate by ICPAES									
Sulfate as SO4 2-	14808-79-8	10	mg/kg		20	----	----	----	----
ED045G: Chloride Discrete analyser									
Chloride	16887-00-6	10	mg/kg		20	500	----	----	----
ED092: DTPA Extractable Metals									
Copper	7440-50-8	1.00	mg/kg		<1.00	----	----	----	----
Iron	7439-89-6	1.00	mg/kg		136	----	----	----	----
Manganese	7439-96-5	1.00	mg/kg		2.97	----	----	----	----
Zinc	7440-66-6	1.00	mg/kg		<1.00	----	----	----	----
ED093S: Soluble Major Cations									
Calcium	7440-70-2	10	mg/kg		<10	----	----	----	----
Magnesium	7439-95-4	10	mg/kg		10	----	----	----	----
Sodium	7440-23-5	10	mg/kg		20	----	----	----	----
Potassium	7440-09-7	10	mg/kg		20	----	----	----	----
EG005S : Soluble Metals by ICPAES									
Boron	7440-42-8	1	mg/kg		<1	----	----	----	----
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser									
Nitrite + Nitrate as N (Sol.)	----	0.1	mg/kg		<0.1	----	----	----	----
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser									
Total Kjeldahl Nitrogen as N	----	20	mg/kg		710	----	----	----	----
EK062: Total Nitrogen as N (TKN + NOx)									
^ Total Nitrogen as N	----	20	mg/kg		710	----	----	----	----

Analytical Results

Sub-Matrix: SOIL				Client sample ID	TP12 0.0-0.1m	TP12 0.3-0.4m	----	----	----
				Client sampling date / time	06-AUG-2012 15:00	06-AUG-2012 15:00	----	----	----
Compound	CAS Number	LOR	Unit		ES1219326-001	ES1219326-002	----	----	----
EK080: Bicarbonate Extractable Phosphorus (Colwell)									
Bicarbonate Ext. P (Colwell)	----	2	mg/kg		**3**	----	----	----	----
EP004: Organic Matter									
Organic Matter	----	0.5	%		**0.7**	----	----	----	----

ATTACHMENT B

Study Limitations

LIMITATIONS

This Document has been provided by Golder Associates Pty Ltd ("Golder") subject to the following limitations:

This Document has been prepared for the particular purpose outlined in Golder's proposal and no responsibility is accepted for the use of this Document, in whole or in part, in other contexts or for any other purpose.

The scope and the period of Golder's Services are as described in Golder's proposal, and are subject to restrictions and limitations. Golder did not perform a complete assessment of all possible conditions or circumstances that may exist at the site referenced in the Document. If a service is not expressly indicated, do not assume it has been provided. If a matter is not addressed, do not assume that any determination has been made by Golder in regards to it.

Conditions may exist which were undetectable given the limited nature of the enquiry Golder was retained to undertake with respect to the site. Variations in conditions may occur between investigatory locations, and there may be special conditions pertaining to the site which have not been revealed by the investigation and which have not therefore been taken into account in the Document. Accordingly, additional studies and actions may be required.

In addition, it is recognised that the passage of time affects the information and assessment provided in this Document. Golder's opinions are based upon information that existed at the time of the production of the Document. It is understood that the Services provided allowed Golder to form no more than an opinion of the actual conditions of the site at the time the site was visited and cannot be used to assess the effect of any subsequent changes in the quality of the site, or its surroundings, or any laws or regulations.

Any assessments made in this Document are based on the conditions indicated from published sources and the investigation described. No warranty is included, either express or implied, that the actual conditions will conform exactly to the assessments contained in this Document.

Where data supplied by the client or other external sources, including previous site investigation data, have been used, it has been assumed that the information is correct unless otherwise stated. No responsibility is accepted by Golder for incomplete or inaccurate data supplied by others.

Golder may have retained subconsultants affiliated with Golder to provide Services for the benefit of Golder. To the maximum extent allowed by law, the Client acknowledges and agrees it will not have any direct legal recourse to, and waives any claim, demand, or cause of action against, Golder's affiliated companies, and their employees, officers and directors.

This Document is provided for sole use by the Client and is confidential to it and its professional advisers. No responsibility whatsoever for the contents of this Document will be accepted to any person other than the Client. Any use which a third party makes of this Document, or any reliance on or decisions to be made based on it, is the responsibility of such third parties. Golder accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions based on this Document.

APPENDIX B

Site Photographs

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Photograph 1-1: Site looking south



Photograph 1-2: Site looking west

Golder Associates	CLIENT	Santos		PROJECT	Leewood Ponds
	DRAWN	DRW	DATE Sep-12	Geotechnical Investigation Stage 1	
	CHECK	FWG	DATE Sep-12	Sep-12	
	SCALE	A4		PROJECT No. 127615025	PHOTOGRAPH 1



Photograph 2-1: Komatsu PC220



Photograph 2-2: Site looking North

Golder Associates	CLIENT	Santos		PROJECT	Leewood Ponds
	DRAWN	DRW	DATE Sep-12		Geotechnical Investigation Stage 1
	CHECK	FWG	DATE Sep-12		Sep-12
	SCALE		A4	PROJECT No. 127615025	PHOTOGRAPH 2

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APPENDIX C

Test Pit Reports

APPENDIX C
Summary of Test Pits

Test Pit Name	Easting (m)	Northing (m)	Surface Elevation (m AHD)	Test Pit Depth (m BGL)	Comment
TP1	751298.0	6622811.0	247.8	4.0	Refusal
TP2	751404.0	6622786.0	247.1	3.8	Refusal
TP3	751245.0	6622857.0	247.4	4.2	Refusal
TP4	751359.0	6622833.0	247.1	2.9	Refusal
TP5	751476.0	6622812.0	246.9	3.8	Refusal
TP6	751315.0	6622907.0	247.3	3.0	Refusal
TP7	751525.0	6622858.0	246.8	3.5	Refusal
TP8	751266.0	6622961.0	247.4	3.7	Refusal
TP9	751480.0	6622918.0	246.9	3.8	Refusal
TP10	751447.0	6622995.0	246.9	2.9	Refusal
TP11	751290.0	6623068.0	247.4	3.8	Refusal
TP12	751402.0	6623046.0	247.0	2.7	Refusal
TP13	751501.0	6623023.0	246.8	4.5	Reached target depth
TP14	751357.0	6623112.0	247.2	3.4	Refusal
TP15	751310.0	6623169.0	247.2	3.7	Refusal
TP16	751523.0	6623122.0	246.6	4.7	Reached target depth
TP17	751585.0	6623138.0	246.4	2.8	Refusal
TP18	751482.0	6623181.0	246.7	4.6	Reached target depth
TP19	751328.0	6623268.0	247.0	4.5	Reached target depth
TP20	751445.0	6623248.0	246.7	5.1	Machine Limit
TP21	751398.0	6623325.0	246.7	5.1	Reached target depth
TP22	751561.0	6623327.0	246.2	5.0	Machine Limit
TP23	751524.0	6623393.0	246.2	5.5	Machine Limit
TP24	751629.0	6623371.0	246.6	5.3	Machine Limit
TP25	751384.0	6623474.0	246.3	5.5	Machine Limit
TP26	751477.0	6623459.0	246.3	5.5	Machine Limit
TP27	751438.0	6623526.0	246.1	5.0	Machine Limit
TP28	751552.0	6623521.0	246.4	3.9	Refusal
TP29	751393.0	6623578.0	245.8	3.9	Refusal

TP30	751608.0	6623563.0	245.6	4.8	Refusal
TP31	751666.0	6623564.0	246.1	5.0	Machine Limit
TP32	751463.0	6623643.0	246.2	4.6	Refusal
TP33	751426.0	6623672.0	245.9	4.9	Refusal
TP34	751529.0	6623656.0	245.9	4.6	Refusal
TP35	751498.0	6623723.0	246.0	4.5	Refusal
TP36	751441.0	6623783.0	245.6	3.7	Refusal
TP37	751547.0	6623757.0	245.7	4.5	Refusal
TP38	751585.0	6623646.0	245.4	4.5	Refusal
TP39	751647.0	6623723.0	247.8	4.0	Machine Limit

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REPORT OF TEST PIT: TP01

CLIENT:	Santos Ltd	COORDS: 751298.0 m 6622811.0 m	SHEET: 1 OF 1
PROJECT:	Storage Ponds	SURFACE RL: DATUM:	MACHINE: Excavator
LOCATION:	Narrabri	DIRECTION: 000°	CONTRACTOR: Specialised Civil Services
JOB NO:	127615025	PIT DEPTH: 4.00 m	LOGGED: MS DATE: 3/8/12
		BUCKET TYPE: 900mm-Toothed	CHECKED: DAA DATE: 21/9/12

Excavation					Sampling		Field Material Description					
METHOD	EXCAVATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USCS SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
EX	L		0.0	0.20				CH	TOPSOIL: Silty CLAY high plasticity, dark brown, with some rootlets, with some fine to medium grained subrounded sand	M - W	S	Surface vegetation - dense grass/weeds
								CH	Silty CLAY high plasticity, brown, with some fine to medium grained subrounded sand, trace rootlets			
			0.5		DS 0.60-0.70 m Rec = 100/100 mm PP >=600 kPa							
	M-H		1.0							D - M	H	
			1.5									
			2.0	2.40								
	H		2.5		DS 2.50-2.60 m Rec = 100/100 mm PP >=600 kPa			SC	Silty Clayey SAND fine to coarse grained, sub-rounded to sub-angular, grey orange, trace rounded gravel 2-5mm, iron oxide staining, petrified organics observed, cementation, inferred EW Sandstone		D - VD	
			3.0									
			3.5									
			4.0						TEST PIT DISCONTINUED @ 4.00 m REFUSAL GROUNDWATER NOT ENCOUNTERED BACKFILLED			
			4.5									
			5.0									

This report of test pit must be read in conjunction with accompanying notes and abbreviations. It has been prepared for geotechnical purposes only, without attempt to assess possible contamination. Any references to potential contamination are for information only and do not necessarily indicate the presence or absence of soil or groundwater contamination.

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REPORT OF TEST PIT PHOTOGRAPHS: TP01

CLIENT:	Santos Ltd	COORDS: 751298.0 m 6622811.0 m	SHEET: 1 OF 1
PROJECT:	Storage Ponds	SURFACE RL: DATUM:	MACHINE: Excavator
LOCATION:	Narrabri	DIRECTION: 000°	CONTRACTOR: Specialised Civil Services
JOB NO:	127615025	PIT DEPTH: 4.00 m	LOGGED: MS DATE: 3/8/12
		BUCKET TYPE: 900mm-Toothed	CHECKED: DAA DATE: 21/9/12



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2.

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REPORT OF TEST PIT: TP02

CLIENT: Santos Ltd
PROJECT: Storage Ponds
LOCATION: Narrabri
JOB NO: 127615025

COORDS: 751404.0 m 6622786.0 m
SURFACE RL: DATUM:
DIRECTION: 000°
PIT DEPTH: 3.80 m
BUCKET TYPE: 900mm-Toothed

SHEET: 1 OF 1
MACHINE: Excavator
CONTRACTOR: Specialised Civil Services
LOGGED: MS DATE: 4/8/12
CHECKED: DAA DATE: 21/9/12

Excavation					Sampling		Field Material Description					
METHOD	EXCAVATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USCS SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
EX	L		0.0					CH	TOPSOIL: Silty CLAY high plasticity, dark brown, with some rootlets, with some fine to medium grained, subrounded sand	M - W	S	Surface vegetation - grass/weeds
				0.30	DS 0.20-0.30 m Rec = 100/100 mm PP = 180-200 kPa			CI	Silty CLAY high plasticity, brown, trace rootlets and organics, trace fine grained sand			
	H		0.5									
			1.0									
			1.5									
			2.0		BDS 2.00-2.30 m Rec = 300/300 mm PP >=600 kPa					D - M	H	
				2.40					pale grey, with some fine to medium grained, subrounded sand, trace organics, increasing sand content			
			2.5		DS 2.70-2.80 m Rec = 100/100 mm PP >=600 kPa							
			3.0									
				3.40				SM	Silty SAND fine to medium grained, sub-rounded, pale grey yellow, iron oxide staining, cementation, inferred EW Sandstone			
	R		3.5								D - VD	
									TEST PIT DISCONTINUED @ 3.80 m REFUSAL GROUNDWATER NOT ENCOUNTERED BACKFILLED			
			4.0									
			4.5									
			5.0									

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REPORT OF TEST PIT PHOTOGRAPHS: TP02

CLIENT:	Santos Ltd	COORDS: 751404.0 m 6622786.0 m	SHEET: 1 OF 1
PROJECT:	Storage Ponds	SURFACE RL: DATUM:	MACHINE: Excavator
LOCATION:	Narrabri	DIRECTION: 000°	CONTRACTOR: Specialised Civil Services
JOB NO:	127615025	PIT DEPTH: 3.80 m	LOGGED: MS DATE: 4/8/12
		BUCKET TYPE: 900mm-Toothed	CHECKED: DAA DATE: 21/9/12



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2.

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REPORT OF TEST PIT: TP03

CLIENT: Santos Ltd
PROJECT: Storage Ponds
LOCATION: Narrabri
JOB NO: 127615025

COORDS: 751245.0 m 6622857.0 m
SURFACE RL: DATUM:
DIRECTION: 000°
PIT DEPTH: 4.20 m
BUCKET TYPE: 900mm-Toothed

SHEET: 1 OF 1
MACHINE: Excavator
CONTRACTOR: Specialised Civil Services
LOGGED: MS DATE: 3/8/12
CHECKED: DAA DATE: 21/9/12

Excavation					Sampling		Field Material Description					
METHOD	EXCAVATION RESISTANCE	WATER	DEPTH (metres)	*DEPTH* RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USCS SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
EX	L		0.0	*0.20*	DS 0.00-0.10 m Rec = 100/100 mm PP = 50-100 kPa			CH	TOPSOIL: Silty CLAY high plasticity, dark brown, with some rootlets, with some fine to medium grained sand	M - W	S	Surface vegetation - dense grass/weeds
								CH	Silty CLAY high plasticity, brown, trace rootlets, trace fine grained sand			
	M-H		1.5		BDS 1.40-1.50 m Rec = 100/100 mm PP >=600 kPa						H	
				2.40						D - M		
	H		2.5						grey, iron oxide staining, increasing sand content, rootlets not observed			
				3.40				SM	Silty SAND pale grey yellow, iron oxide staining, cementation, inferred EW Sandstone		D - VD	
	R		4.0									
			4.5						TEST PIT DISCONTINUED @ 4.20 m REFUSAL GROUNDWATER NOT ENCOUNTERED BACKFILLED			
			5.0									

This report of test pit must be read in conjunction with accompanying notes and abbreviations. It has been prepared for geotechnical purposes only, without attempt to assess possible contamination. Any references to potential contamination are for information only and do not necessarily indicate the presence or absence of soil or groundwater contamination.

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REPORT OF TEST PIT PHOTOGRAPHS: TP03

CLIENT:	Santos Ltd	COORDS: 751245.0 m 6622857.0 m	SHEET: 1 OF 1
PROJECT:	Storage Ponds	SURFACE RL: DATUM:	MACHINE: Excavator
LOCATION:	Narrabri	DIRECTION: 000°	CONTRACTOR: Specialised Civil Services
JOB NO:	127615025	PIT DEPTH: 4.20 m	LOGGED: MS DATE: 3/8/12
		BUCKET TYPE: 900mm-Toothed	CHECKED: DAA DATE: 21/9/12



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REPORT OF TEST PIT: TP04

CLIENT:	Santos Ltd	COORDS: 751359.0 m 6622833.0 m	SHEET: 1 OF 1
PROJECT:	Storage Ponds	SURFACE RL: DATUM:	MACHINE: Excavator
LOCATION:	Narrabri	DIRECTION: 000°	CONTRACTOR: Specialised Civil Services
JOB NO:	127615025	PIT DEPTH: 2.90 m	LOGGED: MS DATE: 4/8/12
		BUCKET TYPE: 900mm-Toothed	CHECKED: DAA DATE: 21/9/12

Excavation					Sampling		Field Material Description					
METHOD	EXCAVATION RESISTANCE	WATER	DEPTH (metres)	*DEPTH* RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USCS SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
EX	L		0.0					CH	TOPSOIL: Silty CLAY high plasticity, dark brown, with some rootlets, trace fine to coarse grained, subrounded to subangular gravel	M - W	S	Surface vegetation - dense grass/weeds
				0.30				CH	Silty CLAY high plasticity, brown, trace rootlets, trace fine to coarse grained, subrounded to subangular sand			
			0.5		DS 0.40-0.50 m Rec = 100/100 mm PP = 100-150 kPa							
	M-H		1.0							D - M	H	
			1.5									
				1.80					pale grey, iron oxide staining, increasing sand content			
			2.0									
			2.5		DS 2.50-2.60 m Rec = 100/100 mm PP >=600 kPa							
	H			*2.70*	DS 2.80-2.90 m Rec = 100/100 mm			SM	Silty SAND fine to coarse grained, sub-rounded, yellow pale grey, trace rounded gravel, 2-5 mm, cementation, inferred EW Sandstone		D - VD	
			3.0						TEST PIT DISCONTINUED @ 2.90 m REFUSAL GROUNDWATER NOT ENCOUNTERED BACKFILLED			
			3.5									
			4.0									
			4.5									
			5.0									

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REPORT OF TEST PIT PHOTOGRAPHS: TP04

CLIENT:	Santos Ltd	COORDS: 751359.0 m 6622833.0 m	SHEET: 1 OF 1
PROJECT:	Storage Ponds	SURFACE RL: DATUM:	MACHINE: Excavator
LOCATION:	Narrabri	DIRECTION: 000°	CONTRACTOR: Specialised Civil Services
JOB NO:	127615025	PIT DEPTH: 2.90 m	LOGGED: MS DATE: 4/8/12
		BUCKET TYPE: 900mm-Toothed	CHECKED: DAA DATE: 21/9/12



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REPORT OF TEST PIT: TP05

CLIENT: Santos Ltd
PROJECT: Storage Ponds
LOCATION: Narrabri
JOB NO: 127615025

COORDS: 751476.0 m 6622812.0 m
SURFACE RL: DATUM:
DIRECTION: 000°
PIT DEPTH: 3.80 m
BUCKET TYPE: 900mm-Toothed

SHEET: 1 OF 1
MACHINE: Excavator
CONTRACTOR: Specialised Civil Services
LOGGED: MS DATE: 4/8/12
CHECKED: DAA DATE: 21/9/12

Excavation					Sampling		Field Material Description					
METHOD	EXCAVATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USCS SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
EX	L		0.0		DS 0.00-0.10 m Rec = 100/100 mm PP = 50-100 kPa			CH	TOPSOIL: Silty Sandy CLAY high plasticity, dark brown, fine the medium grained, subrounded sand, with some rootlets	M - W	S	Surface vegetation - dense grass/weeds
				0.40				CH	Silty CLAY high plasticity, brown, trace rootlets, trace fine to medium grained, subrounded sand			
			0.5									
			1.0		BDS 1.10-1.40 m Rec = 300/300 mm PP >=600 kPa							
			1.5									
	M-H			2.00							H	
			2.0						grey, trace subrounded gravel, 5-10mm, iron oxide staining, increasing sand content, cementation observed	D - M		
			2.5									
					DS 2.70-2.80 m Rec = 100/100 mm PP >=600 kPa							
			3.0									
				3.40								
	H		3.5					SM	Silty SAND fine to medium grained, sub-rounded to sub-angular, yellow pale grey, iron oxide staining, cementation, inferred EW Sandstone		D - VD	
									TEST PIT DISCONTINUED @ 3.80 m REFUSAL GROUNDWATER NOT ENCOUNTERED BACKFILLED			
			4.0									
			4.5									
			5.0									

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GAP 8_07 LIB.GLB Log GAP NON-CORED FULL PAGE 127615025_SET2_NEW.GPJ <<DrawingFile>> 21/09/2012 12:58 8.2.856

REPORT OF TEST PIT PHOTOGRAPHS: TP05

CLIENT: Santos Ltd
PROJECT: Storage Ponds
LOCATION: Narrabri
JOB NO: 127615025

COORDS: 751476.0 m 6622812.0 m
SURFACE RL: DATUM:
DIRECTION: 000°
PIT DEPTH: 3.80 m
BUCKET TYPE: 900mm-Toothed

SHEET: 1 OF 1
MACHINE: Excavator
CONTRACTOR: Specialised Civil Services
LOGGED: MS DATE: 4/8/12
CHECKED: DAA DATE: 21/9/12



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2.

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GAP 8_07 LIB.GLB GrfcTbl GAP TEST PIT PHOTO 2 PER PAGE 127615025_SET2_NEW.GPJ <<DrawingFile>> 21/09/2012 12:58 8.2.856

REPORT OF TEST PIT: TP06

CLIENT: Santos Ltd
PROJECT: Storage Ponds
LOCATION: Narrabri
JOB NO: 127615025

COORDS: 751315.0 m 6622907.0 m
SURFACE RL: DATUM:
DIRECTION: 000°
PIT DEPTH: 3.00 m
BUCKET TYPE: 900mm-Toothed

SHEET: 1 OF 1
MACHINE: Excavator
CONTRACTOR: Specialised Civil Services
LOGGED: MS DATE: 3/8/12
CHECKED: DAA DATE: 21/9/12

Excavation					Sampling		Field Material Description					
METHOD	EXCAVATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USCS SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
EX	L		0.0					CH	TOPSOIL: Silty CLAY high plasticity, dark brown, with some rootlets, trace fine grained sand	M - W	S	Surface vegetation - dense grass/weeds
				0.20				CH	Silty CLAY high plasticity, brown, trace rootlets, trace fine grained sand			
	H		0.5									
			1.0		BDS 1.00-1.30 m Rec = 300/300 mm PP >=600 kPa							
			1.5							D - M	H	
				1.90					grey, iron oxide staining			
			2.0									
			2.5		DS 2.50-2.60 m Rec = 100/100 mm PP >=600 kPa							
				2.60				SM	Silty SAND fine to coarse grained, rounded to sub-angular, pale grey yellow, iron oxide staining, cementation, inferred EW Sandstone			
	R		3.0						TEST PIT DISCONTINUED @ 3.00 m REFUSAL GROUNDWATER NOT ENCOUNTERED BACKFILLED		D - VD	
			3.5									
			4.0									
			4.5									
			5.0									

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REPORT OF TEST PIT PHOTOGRAPHS: TP06

CLIENT:	Santos Ltd	COORDS: 751315.0 m 6622907.0 m	SHEET: 1 OF 1
PROJECT:	Storage Ponds	SURFACE RL: DATUM:	MACHINE: Excavator
LOCATION:	Narrabri	DIRECTION: 000°	CONTRACTOR: Specialised Civil Services
JOB NO:	127615025	PIT DEPTH: 3.00 m	LOGGED: MS DATE: 3/8/12
		BUCKET TYPE: 900mm-Toothed	CHECKED: DAA DATE: 21/9/12



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2.

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GAP 8_07 LIB.GLB GrfcTbl GAP TEST PIT PHOTO 2 PER PAGE 127615025_SET2_NEW.GPJ <<DrawingFile>> 21/09/2012 12:58 8.2.856

REPORT OF TEST PIT: TP07

CLIENT: Santos Ltd
PROJECT: Storage Ponds
LOCATION: Narrabri
JOB NO: 127615025

COORDS: 751525.0 m 6622858.0 m
SURFACE RL: DATUM:
DIRECTION: 000°
PIT DEPTH: 3.50 m
BUCKET TYPE: 900mm-Toothed

SHEET: 1 OF 1
MACHINE: Excavator
CONTRACTOR: Specialised Civil Services
LOGGED: MS DATE: 4/8/12
CHECKED: DAA DATE: 21/9/12

Excavation					Sampling		Field Material Description					
METHOD	EXCAVATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USCS SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
EX	L		0.0					CH	TOPSOIL: Silty Sandy CLAY high plasticity, dark brown, fine to medium grained, subangular sand, with some rootlets	M		Surface vegetation - dense grass/weeds, some trees
				0.30							S	
			0.5		DS 0.40-0.50 m Rec = 100/100 mm PP = 150 kPa			CH	Silty Sandy CLAY high plasticity, brown, fine to medium grained, subrounded sand, trace rootlets, tree roots observed			
	M-H		1.0		DS 0.90-1.00 m Rec = 100/100 mm PP >=600 kPa							
			1.5							D - M		
	H		2.0								H	
			2.5	2.50					grey brown, iron oxide staining			
	R		3.0		DS 3.20-3.30 m Rec = 100/100 mm PP >=600 kPa							
			3.5						TEST PIT DISCONTINUED @ 3.50 m REFUSAL GROUNDWATER NOT ENCOUNTERED BACKFILLED			
			4.0									
			4.5									
			5.0									

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GAP 8_07 LIB.GLB Log GAP NON-CORED FULL PAGE 127615025_SET2_NEW.GPJ <<DrawingFile>> 21/09/2012 12:58 8.2.856

REPORT OF TEST PIT PHOTOGRAPHS: TP07

CLIENT:	Santos Ltd	COORDS: 751525.0 m 6622858.0 m	SHEET: 1 OF 1
PROJECT:	Storage Ponds	SURFACE RL: DATUM:	MACHINE: Excavator
LOCATION:	Narrabri	DIRECTION: 000°	CONTRACTOR: Specialised Civil Services
JOB NO:	127615025	PIT DEPTH: 3.50 m	LOGGED: MS DATE: 4/8/12
		BUCKET TYPE: 900mm-Toothed	CHECKED: DAA DATE: 21/9/12



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GAP 8_07 LIB.GLB GrfcTbl GAP TEST PIT PHOTO 2 PER PAGE 127615025_SET2_NEW.GPJ <<DrawingFile>> 21/09/2012 12:59 8.2.856

REPORT OF TEST PIT: TP08

CLIENT: Santos Ltd
PROJECT: Storage Ponds
LOCATION: Narrabri
JOB NO: 127615025

COORDS: 751266.0 m 6622961.0 m
SURFACE RL: DATUM:
DIRECTION: 000°
PIT DEPTH: 3.70 m
BUCKET TYPE: 900mm-Toothed

SHEET: 1 OF 1
MACHINE: Excavator
CONTRACTOR: Specialised Civil Services
LOGGED: MS DATE: 3/8/12
CHECKED: DAA DATE: 21/9/12

Excavation					Sampling		Field Material Description					
METHOD	EXCAVATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USCS SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
EX	L		0.0	0.20				CH	TOPSOIL: Silty CLAY high plasticity, dark brown, with some rootlets, trace fine to medium grained, subrounded to subangular sand	M - W	S	Surface vegetation - grass/weeds, saplings
					DS 0.40-0.50 m Rec = 100/100 mm PP = 150-100 kPa			CH	Silty CLAY high plasticity, brown, trace rootlets, trace fine to medium grained, subrounded to subangular sand			
	M-H		0.5									
			1.0									
			1.5		DS 1.60-1.70 m Rec = 100/100 mm PP >=600 kPa							
				1.80				CH	Sandy Silty CLAY high plasticity, pale grey brown, fine the medium grained subrounded to subangular sand, iron oxide staining, increasing sand content, petrified organics observed	D - M	H	
	H		2.0									
			2.5									
			3.0									
			3.5	3.60	DS 3.50-3.60 m Rec = 100/100 mm PP >=600 kPa							
	R							SM	Silty SAND fine to coarse grained, sub-rounded to sub-angular, yellow pale grey, iron oxide staining, cementation, inferred EW Sandstone		D - VD	
			4.0						TEST PIT DISCONTINUED @ 3.70 m REFUSAL GROUNDWATER NOT ENCOUNTERED BACKFILLED			
			4.5									
			5.0									

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GAP 8_07 LIB.GLB Log GAP NON-CORED FULL PAGE 127615025_SET2_NEW.GPJ <<DrawingFile>> 21/09/2012 12:59 8.2.856

REPORT OF TEST PIT PHOTOGRAPHS: TP08

CLIENT:	Santos Ltd	COORDS: 751266.0 m 6622961.0 m	SHEET: 1 OF 1
PROJECT:	Storage Ponds	SURFACE RL: DATUM:	MACHINE: Excavator
LOCATION:	Narrabri	DIRECTION: 000°	CONTRACTOR: Specialised Civil Services
JOB NO:	127615025	PIT DEPTH: 3.70 m	LOGGED: MS DATE: 3/8/12
		BUCKET TYPE: 900mm-Toothed	CHECKED: DAA DATE: 21/9/12



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GAP 8_07 LIB.GLB GrfcTbl GAP TEST PIT PHOTO 2 PER PAGE 127615025_SET2_NEW.GPJ <<DrawingFile>> 21/09/2012 12:59 8.2.856

REPORT OF TEST PIT: TP09

CLIENT: Santos Ltd
PROJECT: Storage Ponds
LOCATION: Narrabri
JOB NO: 127615025

COORDS: 751480.0 m 6622918.0 m
SURFACE RL: DATUM:
DIRECTION: 000°
PIT DEPTH: 3.80 m
BUCKET TYPE: 900mm-Toothed

SHEET: 1 OF 1
MACHINE: Excavator
CONTRACTOR: Specialised Civil Services
LOGGED: MS DATE: 4/8/12
CHECKED: DAA DATE: 21/9/12

Excavation					Sampling		Field Material Description					
METHOD	EXCAVATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USCS SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
EX	L		0.0					CH	TOPSOIL: Silty CLAY high plasticity, brown, with some rootlets, trace fine grained sand	M	S	Surface vegetation - grass/weeds
				0.20	DS 0.10-0.20 m Rec = 100/100 mm PP = 100-150 kPa			CH	Silty Sandy CLAY high plasticity, brown, fine to medium grained, subrounded sand, trace rootlets			
			0.5									
			1.0									
			1.5		DS 1.50-1.60 m Rec = 100/100 mm PP >=600 kPa							
	M-H		2.0							D	H	
				2.30					pale grey pale brown, iron oxide staining			
			2.5		DS 2.60-2.70 m Rec = 100/100 mm							
			3.0									
			3.5									
				3.70								
	H							SM	Silty SAND fine to coarse grained, sub-rounded, pale grey, iron oxide staining, cementation, inferred EW Sandstone		D - VD	
			4.0						TEST PIT DISCONTINUED @ 3.80 m REFUSAL GROUNDWATER NOT ENCOUNTERED BACKFILLED			
			4.5									
			5.0									

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GAP 8_07 LIB.GLB Log GAP NON-CORED FULL PAGE 127615025_SET2_NEW.GPJ <<DrawingFile>> 21/09/2012 12:59 8.2.856

REPORT OF TEST PIT PHOTOGRAPHS: TP09

CLIENT:	Santos Ltd	COORDS: 751480.0 m 6622918.0 m	SHEET: 1 OF 1
PROJECT:	Storage Ponds	SURFACE RL: DATUM:	MACHINE: Excavator
LOCATION:	Narrabri	DIRECTION: 000°	CONTRACTOR: Specialised Civil Services
JOB NO:	127615025	PIT DEPTH: 3.80 m	LOGGED: MS DATE: 4/8/12
		BUCKET TYPE: 900mm-Toothed	CHECKED: DAA DATE: 21/9/12



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GAP 8_07 LIB.GLB GrfcTbl GAP TEST PIT PHOTO 2 PER PAGE 127615025_SET2_NEW.GPJ <<DrawingFile>> 21/09/2012 12:59 8.2.856

REPORT OF TEST PIT: TP10

CLIENT: Santos Ltd
PROJECT: Storage Ponds
LOCATION: Narrabri
JOB NO: 127615025

COORDS: 751447.0 m 6622995.0 m
SURFACE RL: DATUM:
DIRECTION: 000°
PIT DEPTH: 2.90 m
BUCKET TYPE: 900mm-Toothed

SHEET: 1 OF 1
MACHINE: Excavator
CONTRACTOR: Specialised Civil Services
LOGGED: MS DATE: 3/8/12
CHECKED: DAA DATE: 21/9/12

Excavation					Sampling		Field Material Description					
METHOD	EXCAVATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USCS SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
EX	L		0.0	0.20				CH	TOPSOIL: Sandy Silty CLAY high plasticity, brown, fine the medium grained, subrounded sand, with some rootlets and tree roots			Surface vegetation - dense grass/weeds, trees
								CH	Silty CLAY brown, with some rootlets, trace fine grained sand	M	S - F	
			0.5	0.50					trace organics			
	M-H		1.0								H	
					DS 1.30-1.40 m Rec = 100/100 mm PP >=600 kPa							
			1.5	1.50					yellow, increasing sand content			
				1.70						M - D		
	H		2.0		DS 1.90-2.00 m Rec = 100/100 mm PP >=600 kPa			SM	Silty SAND fine to coarse grained, sub-rounded to sub-angular, pale grey yellow, trace rounded quartz gravel approx. 5-10 mm, cementation, inferred EW sandstone		VD	
	R		2.5									
			3.0						TEST PIT DISCONTINUED @ 2.90 m REFUSAL GROUNDWATER NOT ENCOUNTERED BACKFILLED			
			3.5									
			4.0									
			4.5									
			5.0									

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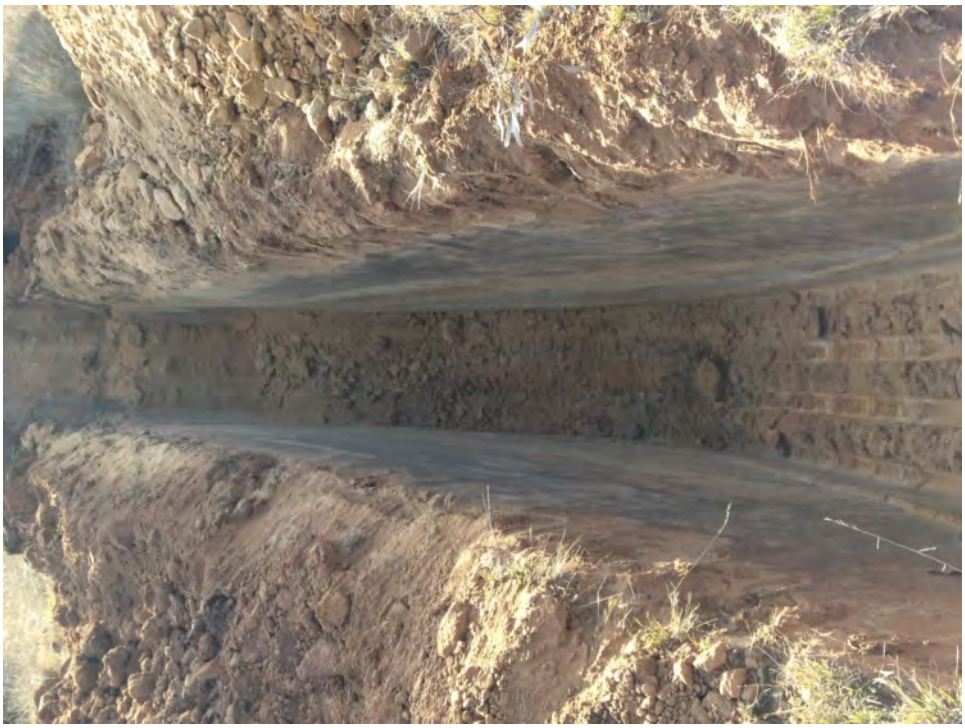
GAP 8_07 LIB.GLB Log GAP NON-CORED FULL PAGE 127615025_SET2_NEW.GPJ <<DrawingFile>> 21/09/2012 13:00 8.2.856

REPORT OF TEST PIT PHOTOGRAPHS: TP10

CLIENT:	Santos Ltd	COORDS: 751447.0 m 6622995.0 m	SHEET: 1 OF 1
PROJECT:	Storage Ponds	SURFACE RL: DATUM:	MACHINE: Excavator
LOCATION:	Narrabri	DIRECTION: 000°	CONTRACTOR: Specialised Civil Services
JOB NO:	127615025	PIT DEPTH: 2.90 m	LOGGED: MS DATE: 3/8/12
		BUCKET TYPE: 900mm-Toothed	CHECKED: DAA DATE: 21/9/12



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GAP 8_07 LIB.GLB GrfcTbl GAP TEST PIT PHOTO 2 PER PAGE 127615025_SET2_NEW.GPJ <<DrawingFile>> 21/09/2012 13:00 8.2.856

REPORT OF TEST PIT: TP11

CLIENT: Santos Ltd
PROJECT: Storage Ponds
LOCATION: Narrabri
JOB NO: 127615025

COORDS: 751290.0 m 6623068.0 m
SURFACE RL: DATUM:
DIRECTION: 000°
PIT DEPTH: 3.80 m
BUCKET TYPE: 900mm-Toothed

SHEET: 1 OF 1
MACHINE: Excavator
CONTRACTOR: Specialised Civil Services
LOGGED: MS DATE: 3/8/12
CHECKED: DAA DATE: 21/9/12

Excavation					Sampling		Field Material Description					
METHOD	EXCAVATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USCS SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
EX	L		0.0					ML	TOPSOIL: Sandy Clayey SILT low liquid limit, dark brown, fine to medium grained, subrounded sand, with some rootlets		S	Surface vegetation - grass/weeds
				0.20	DS 0.10-0.20 m Rec = 100/100 mm PP = 100 kPa BDS 0.20-0.50 m Rec = 300/300 mm PP = 300-200 kPa			CH	Silty CLAY high plasticity, brown, trace rootlets, trace fine grained sand	M - W		
			0.5									
	M-H		1.0								F - St	
			1.5									
				1.80					pale grey brown, increasing sand content, sand is fine to medium grained subangular			
			2.0									
				2.20					pale grey, iron oxide staining	D - M	H	
	H		2.5									
				2.70	DS 2.60-2.70 m Rec = 100/100 mm PP >=600 kPa			SM	Silty SAND fine to coarse grained, sub-rounded, pale grey yellow, iron oxide staining, cementation, inferred EW Sandstone		D - VD	
	R		3.5		DS 3.50-3.60 m Rec = 100/100 mm							
									TEST PIT DISCONTINUED @ 3.80 m REFUSAL GROUNDWATER NOT ENCOUNTERED BACKFILLED			
			4.0									
			4.5									
			5.0									

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GAP 8_07 LIB.GLB Log GAP NON-CORED FULL PAGE 127615025_SET2_NEW.GPJ <<DrawingFile>> 21/09/2012 13:00 8.2.856

REPORT OF TEST PIT PHOTOGRAPHS: TP11

CLIENT: Santos Ltd
PROJECT: Storage Ponds
LOCATION: Narrabri
JOB NO: 127615025

COORDS: 751290.0 m 6623068.0 m
SURFACE RL: DATUM:
DIRECTION: 000°
PIT DEPTH: 3.80 m
BUCKET TYPE: 900mm-Toothed

SHEET: 1 OF 1
MACHINE: Excavator
CONTRACTOR: Specialised Civil Services
LOGGED: MS DATE: 3/8/12
CHECKED: DAA DATE: 21/9/12



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GAP 8_07 LIB.GLB GrfcTbl GAP TEST PIT PHOTO 2 PER PAGE 127615025_SET2_NEW.GPJ <<DrawingFile>> 21/09/2012 13:00 8.2.856

REPORT OF TEST PIT: TP12

CLIENT: Santos Ltd
PROJECT: Storage Ponds
LOCATION: Narrabri
JOB NO: 127615025

COORDS: 751402.0 m 6623046.0 m
SURFACE RL: DATUM:
DIRECTION: 000°
PIT DEPTH: 2.70 m
BUCKET TYPE: 900mm-Toothed

SHEET: 1 OF 1
MACHINE: Excavator
CONTRACTOR: Specialised Civil Services
LOGGED: MS DATE: 3/8/12
CHECKED: DAA DATE: 21/9/12

Excavation					Sampling		Field Material Description					
METHOD	EXCAVATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USCS SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
EX	L		0.0	0.10				CH	TOPSOIL: Silty CLAY high plasticity, brown dark brown, with some rootlets, trace fine grained sand	M - W	S	Surface vegetation- dense grass/weeds
								CH	Silty CLAY high plasticity, brown, with some rootlets, trace fine grained sand			
			0.5	0.50	DS 0.40-0.50 m Rec = 100/100 mm PP = 50-150 kPa				trace rootlets			
	M-H		1.0		BDS 1.00-1.30 m Rec = 300/300 mm PP >=600 kPa							
				1.30					pale grey yellow, trace rounded gravel 2-5 mm, iron oxide staining, petrified organics observed, increasing sand content	D - M	H	
			1.5		DS 1.40-1.50 m Rec = 100/100 mm PP >=600 kPa							
			2.0									
				2.40								
	R		2.5					SM	Silty SAND fine to coarse grained, sub-rounded to sub-angular, yellow pale grey, trace rounded quartz gravel 2-5 mm, iron oxide staining, cementation, inferred EW Sandstone		VD	
									TEST PIT DISCONTINUED @ 2.70 m REFUSAL GROUNDWATER NOT ENCOUNTERED BACKFILLED			
			3.0									
			3.5									
			4.0									
			4.5									
			5.0									

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GAP 8_07 LIB.GLB Log GAP NON-CORED FULL PAGE 127615025_SET2_NEW.GPJ <<DrawingFile>> 21/09/2012 13:00 8.2.856

REPORT OF TEST PIT PHOTOGRAPHS: TP12

CLIENT: Santos Ltd
PROJECT: Storage Ponds
LOCATION: Narrabri
JOB NO: 127615025

COORDS: 751402.0 m 6623046.0 m
SURFACE RL: DATUM:
DIRECTION: 000°
PIT DEPTH: 2.70 m
BUCKET TYPE: 900mm-Toothed

SHEET: 1 OF 1
MACHINE: Excavator
CONTRACTOR: Specialised Civil Services
LOGGED: MS DATE: 3/8/12
CHECKED: DAA DATE: 21/9/12



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GAP 8_07 LIB.GLB GrfcTbl GAP TEST PIT PHOTO 2 PER PAGE 127615025_SET2_NEW.GPJ <<DrawingFile>> 21/09/2012 13:00 8.2.856

REPORT OF TEST PIT: TP13

CLIENT: Santos Ltd
PROJECT: Storage Ponds
LOCATION: Narrabri
JOB NO: 127615025

COORDS: 751501.0 m 6623023.0 m
SURFACE RL: DATUM:
DIRECTION: 000°
PIT DEPTH: 4.50 m
BUCKET TYPE: 900mm-Toothed

SHEET: 1 OF 1
MACHINE: Excavator
CONTRACTOR: Specialised Civil Services
LOGGED: MS DATE: 2/8/12
CHECKED: DAA DATE: 21/9/12

Excavation					Sampling		Field Material Description					
METHOD	EXCAVATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USCS SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
EX	L		0.0	0.20				CH	TOPSOIL: Silty CLAY high plasticity, brown, with some rootlets, with some fine to medium grained subrounded sand	M	S	Surface vegetation - dense grass/weeds
				0.50	DS 0.40-0.50 m Rec = 100/100 mm PP = 100-150 kPa			CH	Silty CLAY high plasticity, brown, with some rootlets, with some fine to medium grained, subrounded sand			
	M-H		0.5						trace rootlets		H	
			1.0									
			1.5	1.50					pale grey, iron oxide staining			
				1.80	DS 1.80-1.90 m Rec = 100/100 mm PP >=600 kPa			SM	Silty SAND fine to coarse grained, sub-rounded, pale grey yellow, iron oxide staining, cementation, inferred EW Sandstone	D - M	D - VD	
	H		2.0									
			2.5									
			3.0	3.20				CH	Silty CLAY high plasticity, grey, with some fine to coarse grained, subrounded to subangular sand, iron oxide staining, cementation in sand, sand content increasing			
	M-H		3.5		DS 3.30-3.40 m Rec = 100/100 mm PP >=600 kPa						H	
			4.0									
			4.5						TEST PIT DISCONTINUED @ 4.50 m TARGET DEPTH GROUNDWATER NOT ENCOUNTERED BACKFILLED			
			5.0									

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GAP 8_07 LIB.GLB Log GAP NON-CORED FULL PAGE 127615025_SET2_NEW.GPJ <<DrawingFile>> 21/09/2012 13:01 8.2.856

REPORT OF TEST PIT PHOTOGRAPHS: TP13

CLIENT:	Santos Ltd	COORDS: 751501.0 m 6623023.0 m	SHEET: 1 OF 1
PROJECT:	Storage Ponds	SURFACE RL: DATUM:	MACHINE: Excavator
LOCATION:	Narrabri	DIRECTION: 000°	CONTRACTOR: Specialised Civil Services
JOB NO:	127615025	PIT DEPTH: 4.50 m	LOGGED: MS DATE: 2/8/12
		BUCKET TYPE: 900mm-Toothed	CHECKED: DAA DATE: 21/9/12



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GAP 8_07 LIB.GLB GrfcTbl GAP TEST PIT PHOTO 2 PER PAGE 127615025_SET2_NEW.GPJ <<DrawingFile>> 21/09/2012 13:01 8.2.856

REPORT OF TEST PIT: TP14

CLIENT: Santos Ltd
PROJECT: Storage Ponds
LOCATION: Narrabri
JOB NO: 127615025

COORDS: 751357.0 m 6623112.0 m
SURFACE RL: DATUM:
DIRECTION: 000°
PIT DEPTH: 3.40 m
BUCKET TYPE: 900mm-Toothed

SHEET: 1 OF 1
MACHINE: Excavator
CONTRACTOR: Specialised Civil Services
LOGGED: MS DATE: 3/8/12
CHECKED: DAA DATE: 21/9/12

Excavation					Sampling		Field Material Description					
METHOD	EXCAVATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USCS SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
EX	L		0.0	0.10				CH	TOPSOIL: Slag And CLAY high plasticity, brown, with some rootlets, with some fine grained sand	M - W	S	Surface vegetation - dense grass/weeds
								CH	Silty CLAY high plasticity, brown, trace rootlets, trace fine grained sand			
			0.5	0.60	DS 0.50-0.60 m Rec = 100/100 mm PP = 150 kPa				grey			
	M-H		1.0								H	
			1.5	1.80					iron oxide staining, increasing sand content	D - M		
			2.0									
			2.5		DS 2.60-2.70 m Rec = 100/100 mm PP >=600 kPa							
	H			2.80				SM	Silty SAND pale grey yellow, iron oxide staining, cementation, inferred EW Sandstone			
	R		3.0								VD	
			3.5						TEST PIT DISCONTINUED @ 3.40 m REFUSAL GROUNDWATER NOT ENCOUNTERED BACKFILLED			
			4.0									
			4.5									
			5.0									

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GAP 8_07 LIB.GLB Log GAP NON-CORED FULL PAGE 127615025_SET2_NEW.GPJ <<DrawingFile>> 21/09/2012 13:01 8.2.856

REPORT OF TEST PIT PHOTOGRAPHS: TP14

CLIENT:	Santos Ltd	COORDS: 751357.0 m 6623112.0 m	SHEET: 1 OF 1
PROJECT:	Storage Ponds	SURFACE RL: DATUM:	MACHINE: Excavator
LOCATION:	Narrabri	DIRECTION: 000°	CONTRACTOR: Specialised Civil Services
JOB NO:	127615025	PIT DEPTH: 3.40 m	LOGGED: MS DATE: 3/8/12
		BUCKET TYPE: 900mm-Toothed	CHECKED: DAA DATE: 21/9/12



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GAP 8_07 LIB.GLB GrfcTbl GAP TEST PIT PHOTO 2 PER PAGE 127615025_SET2_NEW.GPJ <<DrawingFile>> 21/09/2012 13:01 8.2.856

REPORT OF TEST PIT: TP15

CLIENT: Santos Ltd
PROJECT: Storage Ponds
LOCATION: Narrabri
JOB NO: 127615025

COORDS: 751310.0 m 6623169.0 m
SURFACE RL: DATUM:
DIRECTION: 000°
PIT DEPTH: 3.70 m
BUCKET TYPE: 900mm-Toothed

SHEET: 1 OF 1
MACHINE: Excavator
CONTRACTOR: Specialised Civil Services
LOGGED: MS DATE: 3/8/12
CHECKED: DAA DATE: 21/9/12

Excavation					Sampling		Field Material Description					
METHOD	EXCAVATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USCS SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
EX	L		0.0	0.20	DS 0.00-0.10 m Rec = 100/100 mm PP = 50 kPa			ML	TOPSOIL: Clayey SILT low liquid limit, dark brown, with some rootlets, trace fine to medium grained, rounded sand	M - W	S - F	Surface vegetation - dense grass/weeds
			0.5		BDS 0.50-0.80 m Rec = 300/300 mm PP = 200 kPa			CH	Silty CLAY high plasticity, brown, trace rootlets, trace fine to medium grained, subrounded sand			
			1.0									
			1.5	1.70								
	M-H		2.0						grey, iron oxide staining.	D - M	H	
			2.5	2.70	DS 2.50-2.60 m Rec = 100/100 mm PP >=600 kPa			SM	Silty SAND fine to coarse grained, sub-rounded, yellow pale grey, iron oxide staining, cementation, inferred EW Sandstone			
	H		3.0								D - VD	
	R		3.5									
			4.0						TEST PIT DISCONTINUED @ 3.70 m REFUSAL GROUNDWATER NOT ENCOUNTERED BACKFILLED			
			4.5									
			5.0									

This report of test pit must be read in conjunction with accompanying notes and abbreviations. It has been prepared for geotechnical purposes only, without attempt to assess possible contamination. Any references to potential contamination are for information only and do not necessarily indicate the presence or absence of soil or groundwater contamination.

GAP 8_07 LIB.GLB Log GAP NON-CORED FULL PAGE 127615025_SET2_NEW.GPJ <<DrawingFile>> 21/09/2012 13:01 8.2.856

REPORT OF TEST PIT PHOTOGRAPHS: TP15

CLIENT:	Santos Ltd	COORDS: 751310.0 m 6623169.0 m	SHEET: 1 OF 1
PROJECT:	Storage Ponds	SURFACE RL: DATUM:	MACHINE: Excavator
LOCATION:	Narrabri	DIRECTION: 000°	CONTRACTOR: Specialised Civil Services
JOB NO:	127615025	PIT DEPTH: 3.70 m	LOGGED: MS DATE: 3/8/12
		BUCKET TYPE: 900mm-Toothed	CHECKED: DAA DATE: 21/9/12



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GAP 8_07 LIB.GLB GrfcTbl GAP TEST PIT PHOTO 2 PER PAGE 127615025_SET2_NEW.GPJ <<DrawingFile>> 21/09/2012 13:02 8.2.856

REPORT OF TEST PIT: TP16

CLIENT: Santos Ltd
PROJECT: Storage Ponds
LOCATION: Narrabri
JOB NO: 127615025

COORDS: 751523.0 m 6623122.0 m
SURFACE RL: DATUM:
DIRECTION: 000°
PIT DEPTH: 4.70 m
BUCKET TYPE: 900mm-Toothed

SHEET: 1 OF 1
MACHINE: Excavator
CONTRACTOR: Specialised Civil Services
LOGGED: MS DATE: 2/8/12
CHECKED: DAA DATE: 21/9/12

Excavation					Sampling		Field Material Description					
METHOD	EXCAVATION RESISTANCE	WATER	DEPTH (metres)	*DEPTH* RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USCS SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
EX	L		0.0	*0.20*				ML	TOPSOIL: Sandy Clayey SILT low liquid limit, dark brown, fine the medium grained, subrounded sand, with some rootlets	M	S	Surface vegetation - dense grass/weeds
								ML	Sandy Clayey SILT low liquid limit, dark brown, fine to medium grained, subrounded sand, trace rootlets			
			0.5	*0.50*	DS 0.40-0.50 m Rec = 100/100 mm PP = 150 kPa			CH	Silty CLAY high plasticity, pale grey, trace organics, trace fine to medium grained, subrounded sand, iron oxide staining			
	M-H		1.0								H	
			1.5									
			2.0									
			2.5		DS 2.60-2.70 m Rec = 100/100 mm PP >=600 kPa					D - M		
				2.80				SC	Clayey Silty SAND fine to medium grained, sub-rounded, pale grey, iron oxide staining, cementation, inferred EW Sandstone			
	H		3.0								D - VD	
			3.5		DS 3.60-3.70 m Rec = 100/100 mm PP >=600 kPa							
			4.0									
			4.5									
			5.0						TEST PIT DISCONTINUED @ 4.70 m TARGET DEPTH GROUNDWATER NOT ENCOUNTERED BACKFILLED			

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GAP 8_07 LIB.GLB Log GAP NON-CORED FULL PAGE 127615025_SET2_NEW.GPJ <<DrawingFile>> 21/09/2012 13:02 8.2.856

REPORT OF TEST PIT PHOTOGRAPHS: TP16

CLIENT:	Santos Ltd	COORDS: 751523.0 m 6623122.0 m	SHEET: 1 OF 1
PROJECT:	Storage Ponds	SURFACE RL: DATUM:	MACHINE: Excavator
LOCATION:	Narrabri	DIRECTION: 000°	CONTRACTOR: Specialised Civil Services
JOB NO:	127615025	PIT DEPTH: 4.70 m	LOGGED: MS DATE: 2/8/12
		BUCKET TYPE: 900mm-Toothed	CHECKED: DAA DATE: 21/9/12



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GAP 8_07 LIB.GLB GrfcTbl GAP TEST PIT PHOTO 2 PER PAGE 127615025_SET2_NEW.GPJ <<DrawingFile>> 21/09/2012 13:02 8.2.856

REPORT OF TEST PIT: TP17

Golder Associates

CLIENT: Santos Ltd
PROJECT: Storage Ponds
LOCATION: Narrabri
JOB NO: 127615025

COORDS: 751585.0 m 6623138.0 m
SURFACE RL: DATUM:
DIRECTION: 000°
PIT DEPTH: 2.80 m
BUCKET TYPE: 900mm-Toothed

SHEET: 1 OF 1
MACHINE: Excavator
CONTRACTOR: Specialised Civil Services
LOGGED: MS DATE: 2/8/12
CHECKED: DAA DATE: 21/9/12

Excavation					Sampling		Field Material Description					
METHOD	EXCAVATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USCS SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
EX	L		0.0	0.20	DS 0.20-0.30 m Rec = 100/100 mm PP = 100 kPa			ML	TOPSOIL: Clayey SILT low liquid limit, dark brown, with some rootlets, trace fine to medium grained, subrounded sand	M	S	Surface vegetation - dense grass/weeds
				0.50				ML	Clayey SILT low liquid limit, dark brown, trace rootlets, trace fine to medium grained, subrounded sand			
	M-H		0.5					CH	Silty CLAY high plasticity, pale grey, trace rootlets, trace fine the coarse grained sand, iron oxide staining, increasing sand content	D - M	H	
			1.0									
			1.5		DS 1.80-1.90 m Rec = 100/100 mm PP >=600 kPa							
			2.0	2.00				SM	Silty SAND pale grey yellow, iron oxide staining, calcareous deposits observed, cementation, inferred EW Sandstone			
	H		2.5		DS 2.30-2.40 m Rec = 100/100 mm PP >=600 kPa						D - VD	
			3.0						TEST PIT DISCONTINUED @ 2.80 m REFUSAL GROUNDWATER NOT ENCOUNTERED BACKFILLED			
			3.5									
			4.0									
			4.5									
			5.0									

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GAP 8_07 LIB.GLB Log GAP NON-CORED FULL PAGE 127615025_SET2_NEW.GPJ <<DrawingFile>> 21/09/2012 13:02 8.2.856

REPORT OF TEST PIT PHOTOGRAPHS: TP17

CLIENT:	Santos Ltd	COORDS: 751585.0 m 6623138.0 m	SHEET: 1 OF 1
PROJECT:	Storage Ponds	SURFACE RL: DATUM:	MACHINE: Excavator
LOCATION:	Narrabri	DIRECTION: 000°	CONTRACTOR: Specialised Civil Services
JOB NO:	127615025	PIT DEPTH: 2.80 m	LOGGED: MS DATE: 2/8/12
		BUCKET TYPE: 900mm-Toothed	CHECKED: DAA DATE: 21/9/12



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GAP 8_07 LIB.GLB GrfcTbl GAP TEST PIT PHOTO 2 PER PAGE 127615025_SET2_NEW.GPJ <<DrawingFile>> 21/09/2012 13:02 8.2.856

REPORT OF TEST PIT: TP18

CLIENT: Santos Ltd
PROJECT: Storage Ponds
LOCATION: Narrabri
JOB NO: 127615025

COORDS: 751482.0 m 6623181.0 m
SURFACE RL: DATUM:
DIRECTION: 000°
PIT DEPTH: 4.60 m
BUCKET TYPE: 900mm-Toothed

SHEET: 1 OF 1
MACHINE: Excavator
CONTRACTOR: Specialised Civil Services
LOGGED: MS DATE: 2/8/12
CHECKED: DAA DATE: 21/9/12

Excavation					Sampling		Field Material Description					
METHOD	EXCAVATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USCS SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
EX	L		0.0	0.20				ML	TOPSOIL: Clayey SILT low liquid limit, dark brown, with some rootlets, trace fine grained sand			Surface vegetation - dense grass/weeds
					DS 0.30-0.40 m Rec = 100/100 mm PP = 150-300 kPa			ML	Clayey SILT low liquid limit, dark brown, trace rootlets, trace fine grained sand	M	S - F	
			0.5	0.50				CH	Silty CLAY high plasticity, brown, trace organics, trace fine grained sand, sand content increasing			
	M-H				DS 0.90-1.00 m Rec = 100/100 mm PP >=600 kPa							
			1.0									
			1.5									
			2.0	2.00				CH	Silty Sandy CLAY high plasticity, grey, fine to medium grained, subrounded sand, iron oxide staining, petrified organics observed, trace cementation in sand	D - M	H	
			2.5									
	H		3.0		DS 3.20-3.30 m Rec = 100/100 mm PP >=600 kPa							
			3.5									
			4.0									
			4.5									
			5.0						TEST PIT DISCONTINUED @ 4.60 m TARGET DEPTH GROUNDWATER NOT ENCOUNTERED BACKFILLED			

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GAP gINT FN. F01e
RL3

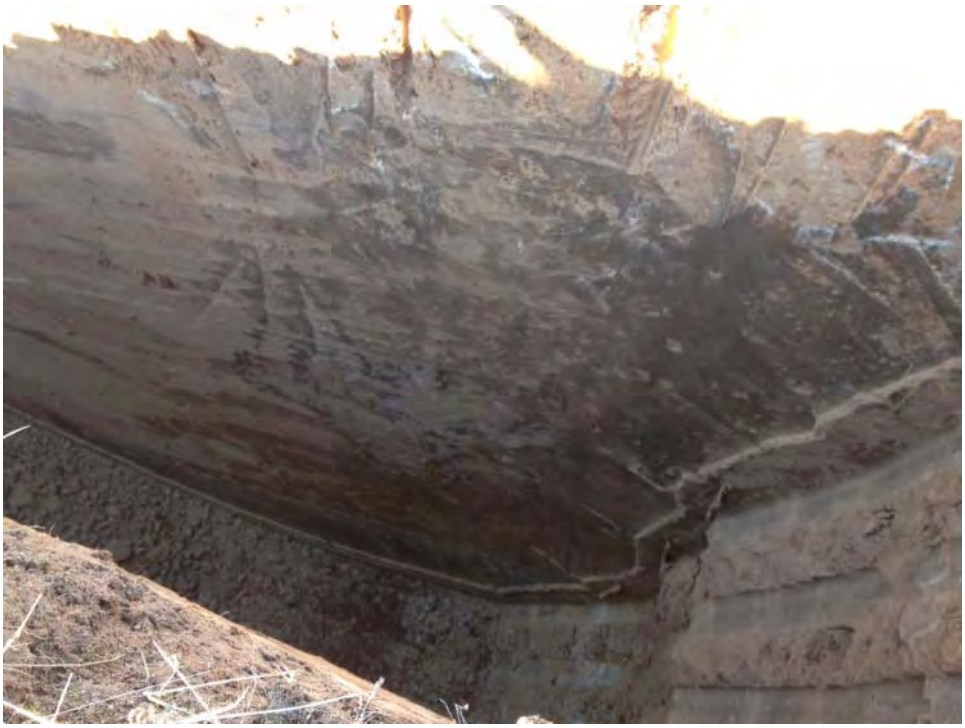
GAP 8_07 LIB.GLB Log GAP NON-CORED FULL PAGE 127615025_SET2_NEW.GPJ <<DrawingFile>> 21/09/2012 13:02 8.2.856

REPORT OF TEST PIT PHOTOGRAPHS: TP18

CLIENT:	Santos Ltd	COORDS: 751482.0 m 6623181.0 m	SHEET: 1 OF 1
PROJECT:	Storage Ponds	SURFACE RL: DATUM:	MACHINE: Excavator
LOCATION:	Narrabri	DIRECTION: 000°	CONTRACTOR: Specialised Civil Services
JOB NO:	127615025	PIT DEPTH: 4.60 m	LOGGED: MS DATE: 2/8/12
		BUCKET TYPE: 900mm-Toothed	CHECKED: DAA DATE: 21/9/12



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GAP 8_07 LIB.GLB GrfcTbl GAP TEST PIT PHOTO 2 PER PAGE 127615025_SET2_NEW.GPJ <<DrawingFile>> 21/09/2012 13:03 8.2.856

REPORT OF TEST PIT: TP19

CLIENT: Santos Ltd
PROJECT: Storage Ponds
LOCATION: Narrabri
JOB NO: 127615025

COORDS: 751328.0 m E 6623268.0 m N MGA94 56
SURFACE RL: DATUM: AHD
DIRECTION: 000°
PIT DEPTH: 4.50 m
BUCKET TYPE: 900mm-Toothed

SHEET: 1 OF 1
MACHINE: Excavator
CONTRACTOR: Specialised Civil Services
LOGGED: MS DATE: 1/8/12
CHECKED: DAA DATE: 21/8/12

Excavation					Sampling		Field Material Description					
METHOD	EXCAVATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USCS SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
EX	L	Water	0	0.20				ML	TOPSOIL: Sandy Clayey SILT high liquid limit, dark brown, fine grained sand, with some rootlets	M - W	S	Surface vegetation - dense grass/weeds;
				0.50				ML	Sandy Clayey SILT low liquid limit, dark brown, fine grained sand, trace rootlets			
			1		DS 0.70-0.80 m Rec = 100/100 mm PP >=600 kPa			CH	Sandy Silty CLAY high plasticity, brown, fine to medium grained, subrounded sand			
	M-H			1.70	BDS 1.50-1.70 m Rec = 200/200 mm PP >=600 kPa				pale grey, trace organics, iron oxide staining	D - M	H	
			2									
			3		DS 2.70-2.80 m Rec = 100/100 mm PP >=600 kPa							
				3.50				SC	Silty Clayey SAND pale grey orange, iron oxide staining, cementation, inferred EW Sandstone			
	H		4		DS 4.20-4.30 m Rec = 100/100 mm PP >=600 kPa						D - VD	
			5						TEST PIT DISCONTINUED @ 4.50 m TARGET DEPTH GROUNDWATER NOT ENCOUNTERED BACKFILLED			
			6									

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GAP 8_07 LIB.GLB Log GAP NON-CORED FULL PAGE 127615025_TP19-39.GPJ <<DrawingFile>> 21/09/2012 13:15 8.2.856

REPORT OF TEST PIT PHOTOGRAPHS: TP19

CLIENT: Santos Ltd
PROJECT: Storage Ponds
LOCATION: Narrabri
JOB NO: 127615025

COORDS: 751328.0 m E 6623268.0 m N MGA94 56
SURFACE RL: DATUM: AHD
DIRECTION: 000°
PIT DEPTH: 4.50 m
BUCKET TYPE: 900mm-Toothed

SHEET: 1 OF 1
MACHINE: Excavator
CONTRACTOR: Specialised Civil Services
LOGGED: MS DATE: 1/8/12
CHECKED: DAA DATE: 21/8/12



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GAP 8_07 LIB.GLB GrfcTbl GAP TEST PIT PHOTO 2 PER PAGE 127615025_TP19-39.GPJ <<DrawingFile>> 21/09/2012 13:15 8.2.856

REPORT OF TEST PIT: TP20

CLIENT: Santos Ltd
PROJECT: Storage Ponds
LOCATION: Narrabri
JOB NO: 127615025

COORDS: 751445.0 m E 6623248.0 m N MGA94 56
SURFACE RL: DATUM: AHD
DIRECTION: 000°
PIT DEPTH: 5.10 m
BUCKET TYPE: 900mm-Toothed

SHEET: 1 OF 1
MACHINE: Excavator
CONTRACTOR: Specialised Civil Services
LOGGED: MS DATE: 1/8/12
CHECKED: DAA DATE: 21/8/12

Excavation					Sampling		Field Material Description					
METHOD	EXCAVATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USCS SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
EX	L		0	0.10				ML	TOPSOIL: Clayey SILT low liquid limit, brown, trace fine grained sand, with some rootlets	M	S	Surface vegetation - dense grass/weeds
								ML	Clayey SILT low liquid limit, brown, trace fine grained sand, trace rootlets			
				0.50	DS 0.40-0.50 m Rec = 100/100 mm PP = 150 kPa			CH	Sandy Silty CLAY high plasticity, brown, fine grained sand			
			1		DS 1.20-1.30 m Rec = 100/100 mm PP >=600 kPa							
	M-H		2	2.00					pale grey, iron oxide staining, increasing sand content	D - M	H	
			3									
				3.50								
	H		4		DS 3.50-3.60 m Rec = 100/100 mm PP >=600 kPa			SC	Silty Clayey SAND fine to medium grained, sub-rounded, pale grey orange, iron oxide staining, cementation, inferred EW Sandstone		D - VD	
			5									
									TEST PIT DISCONTINUED @ 5.10 m MACHINE LIMIT GROUNDWATER NOT ENCOUNTERED BACKFILLED			
			6									

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REPORT OF TEST PIT PHOTOGRAPHS: TP20

CLIENT: Santos Ltd
PROJECT: Storage Ponds
LOCATION: Narrabri
JOB NO: 127615025

COORDS: 751445.0 m E 6623248.0 m N MGA94 56
SURFACE RL: DATUM: AHD
DIRECTION: 000°
PIT DEPTH: 5.10 m
BUCKET TYPE: 900mm-Toothed

SHEET: 1 OF 1
MACHINE: Excavator
CONTRACTOR: Specialised Civil Services
LOGGED: MS DATE: 1/8/12
CHECKED: DAA DATE: 21/8/12



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GAP 8_07 LIB.GLB GrfcTbl GAP TEST PIT PHOTO 2 PER PAGE 127615025_TP19-39.GPJ <<DrawingFile>> 21/09/2012 13:15 8.2.856

REPORT OF TEST PIT: TP21

CLIENT: Santos Ltd
PROJECT: Storage Ponds
LOCATION: Narrabri
JOB NO: 127615025

COORDS: 751398.0 m E 6623325.0 m N MGA94 56
SURFACE RL: DATUM: AHD
DIRECTION: 000°
PIT DEPTH: 5.10 m
BUCKET TYPE: 900mm-Toothed

SHEET: 1 OF 1
MACHINE: Excavator
CONTRACTOR: Specialised Civil Services
LOGGED: MS DATE: 1/8/12
CHECKED: DAA DATE: 21/8/12

Excavation					Sampling		Field Material Description					
METHOD	EXCAVATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USCS SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
EX	L		0	0.20				ML	TOPSOIL: Sandy Clayey SILT low liquid limit, brown, fine grained sand, with some rootlets	M - W	S	Surface vegetation - dense grass/weeds
				0.50	DS 0.40-0.50 m Rec = 100/100 mm PP = 150 kPa			ML	Sandy Clayey SILT low liquid limit, brown, fine grained sand, trace rootlets			
			1		DS 1.10-1.20 m Rec = 100/100 mm PP >=600 kPa			CH	Sandy Silty CLAY high plasticity, brown, fine grained sand			
	M-H			1.90					pale grey, iron oxide staining, increased sand content	D - M	H	
			2									
			3									
	H			3.40	DS 3.40-3.50 m Rec = 100/100 mm PP >=600 kPa			SM	Clayey Silty SAND fine to medium grained, sub-rounded, pale grey orange, iron oxide staining, cementation, inferred EW Sandstone		D - VD	
			4									
			5						TEST PIT DISCONTINUED @ 5.10 m TARGET DEPTH GROUNDWATER NOT ENCOUNTERED BACKFILLED			
			6									

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REPORT OF TEST PIT PHOTOGRAPHS: TP21

CLIENT: Santos Ltd
PROJECT: Storage Ponds
LOCATION: Narrabri
JOB NO: 127615025

COORDS: 751398.0 m E 6623325.0 m N MGA94 56
SURFACE RL: DATUM: AHD
DIRECTION: 000°
PIT DEPTH: 5.10 m
BUCKET TYPE: 900mm-Toothed

SHEET: 1 OF 1
MACHINE: Excavator
CONTRACTOR: Specialised Civil Services
LOGGED: MS DATE: 1/8/12
CHECKED: DAA DATE: 21/8/12



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GAP 8_07 LIB.GLB GrfcTbl GAP TEST PIT PHOTO 2 PER PAGE 127615025_TP19-39.GPJ <<DrawingFile>> 21/09/2012 13:16 8.2.856

REPORT OF TEST PIT: TP22

CLIENT: Santos Ltd
PROJECT: Storage Ponds
LOCATION: Narrabri
JOB NO: 127615025

COORDS: 751561.0 m E 6623327.0 m N MGA94 56
SURFACE RL: DATUM: AHD
DIRECTION: 000°
PIT DEPTH: 5.00 m
BUCKET TYPE: 900mm-Toothed

SHEET: 1 OF 1
MACHINE: Excavator
CONTRACTOR: Specialised Civil Services
LOGGED: MS DATE: 1/8/12
CHECKED: DAA DATE: 21/8/12

Excavation					Sampling		Field Material Description					
METHOD	EXCAVATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USCS SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
EX	L		0	0.20				CH	TOPSOIL: Silty CLAY high plasticity, brown, trace fine grained sound, with some rootlets	M - W	S	Surface vegetation - dense grass/weeds
					DS 0.20-0.30 m Rec = 100/100 mm PP = 100 kPa			CH	Silty CLAY high plasticity, brown, trace fine grained sand, trace rootlets, increasing sand content			
	M-H		1		DS 1.10-1.20 m Rec = 100/100 mm PP >=600 kPa						H	
			2	2.00					pale grey, rootlets not observed	D - M		
					DS 2.50-2.60 m Rec = 100/100 mm PP >=600 kPa			SC	Silty Clayey SAND fine to medium grained, sub-rounded, orange pale grey, iron oxide staining, decreasing clay and silt content cementation, EW Sandstone			
	H		3	2.70							D - VD	
			4	4.00					grey, iron oxide staining, petrified wood observed	D		
			5						TEST PIT DISCONTINUED @ 5.00 m MACHINE LIMIT GROUNDWATER NOT ENCOUNTERED BACKFILLED			
			6									

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REPORT OF TEST PIT PHOTOGRAPHS: TP22

CLIENT: Santos Ltd
PROJECT: Storage Ponds
LOCATION: Narrabri
JOB NO: 127615025

COORDS: 751561.0 m E 6623327.0 m N MGA94 56
SURFACE RL: DATUM: AHD
DIRECTION: 000°
PIT DEPTH: 5.00 m
BUCKET TYPE: 900mm-Toothed

SHEET: 1 OF 1
MACHINE: Excavator
CONTRACTOR: Specialised Civil Services
LOGGED: MS DATE: 1/8/12
CHECKED: DAA DATE: 21/8/12



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GAP gINT FN. F27 RL1

GAP 8_07 LIB.GLB GrfcTbl GAP TEST PIT PHOTO 2 PER PAGE 127615025_TP19-39.GPJ <<DrawingFile>> 21/09/2012 13:16 8.2.856

REPORT OF TEST PIT: TP23

CLIENT: Santos Ltd
PROJECT: Storage Ponds
LOCATION: Narrabri
JOB NO: 127615025

COORDS: 751524.0 m E 6623393.0 m N MGA94 56
SURFACE RL: DATUM: AHD
DIRECTION: 000°
PIT DEPTH: 5.50 m
BUCKET TYPE: 900mm-Toothed

SHEET: 1 OF 1
MACHINE: Excavator
CONTRACTOR: Specialised Civil Services
LOGGED: MS DATE: 1/8/12
CHECKED: DAA DATE: 21/8/12

Excavation					Sampling		Field Material Description					
METHOD	EXCAVATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USCS SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
EX	L		0	0.20				CH	TOPSOIL: Silty CLAY high plasticity, grey brown, fine grained , with some rootlets, trace fine grained sand	M	S	Surface vegetation - dense grass/weeds
				0.50	DS 0.40-0.50 m Rec = 100/100 mm PP = 100-90 kPa			CH	Silty CLAY high plasticity, grey brown, trace rootlets, trace fine grained sand			
			1					CH	Sandy Silty CLAY high plasticity, brown, fine grained sand, trace rootlets			
	M-H			1.80	DS 1.80-1.90 m Rec = 100/100 mm PP >=600 kPa				pale grey, iron oxide staining, rootlets not observed		H	
			2									
			3	3.00				SC	Clayey Silty SAND fine to medium grained, sub-rounded, pale grey orange, iron oxide staining, cementation, inferred EW Sandstone	D - M		
	H				DS 3.10-3.20 m Rec = 100/100 mm PP >=600 kPa						D - VD	
			4									
			5									
			6						TEST PIT DISCONTINUED @ 5.50 m MACHINE LIMIT GROUNDWATER NOT ENCOUNTERED BACKFILLED			

This report of test pit must be read in conjunction with accompanying notes and abbreviations. It has been prepared for geotechnical purposes only, without attempt to assess possible contamination. Any references to potential contamination are for information only and do not necessarily indicate the presence or absence of soil or groundwater contamination.

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REPORT OF TEST PIT PHOTOGRAPHS: TP23

CLIENT: Santos Ltd
PROJECT: Storage Ponds
LOCATION: Narrabri
JOB NO: 127615025

COORDS: 751524.0 m E 6623393.0 m N MGA94 56
SURFACE RL: DATUM: AHD
DIRECTION: 000°
PIT DEPTH: 5.50 m
BUCKET TYPE: 900mm-Toothed

SHEET: 1 OF 1
MACHINE: Excavator
CONTRACTOR: Specialised Civil Services
LOGGED: MS DATE: 1/8/12
CHECKED: DAA DATE: 21/8/12



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This report of test pit photographs must be read in conjunction with accompanying notes and abbreviations. It has been prepared for geotechnical purposes only, without attempt to assess possible contamination. Any references to potential contamination are for information only and do not necessarily indicate the presence or absence of soil or groundwater contamination.

GAP 8_07 LIB.GLB GrfcTbl GAP TEST PIT PHOTO 2 PER PAGE 127615025_TP19-39.GPJ <<DrawingFile>> 21/09/2012 13:17 8.2.856

REPORT OF TEST PIT: TP24

CLIENT: Santos Ltd
PROJECT: Storage Ponds
LOCATION: Narrabri
JOB NO: 127615025

COORDS: 751629.0 m E 6623371.0 m N MGA94 56
SURFACE RL: DATUM: AHD
DIRECTION: 000°
PIT DEPTH: 5.30 m
BUCKET TYPE: 900mm-Toothed

SHEET: 1 OF 1
MACHINE: Excavator
CONTRACTOR: Specialised Civil Services
LOGGED: MS DATE: 1/8/12
CHECKED: DAA DATE: 21/8/12

Excavation					Sampling		Field Material Description					
METHOD	EXCAVATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USCS SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
EX	L		0	0.20	DS 0.10-0.20 m Rec = 100/100 mm PP = 100-150 kPa			ML	TOPSOIL: Sandy Clayey SILT low liquid limit, dark brown, fine grained sand, with some rootlets	M - W	S	Surface vegetation - dense grass/weeds
								ML	Sandy Clayey SILT low liquid limit, dark brown, fine grained sand, trace rootlets			
				0.60				CH	Silty CLAY high plasticity, brown, trace fine grained sand, trace organics			
			1									
				1.70	DS 1.60-1.70 m Rec = 100/100 mm PP >=600 kPa			CH	Silty CLAY pale grey, trace fine grained sand, trace organics, iron oxide staining	D - M	H	
	M-H		2									
			3	3.10				SC	Silty Clayey SAND fine to medium grained, sub-rounded, dark grey orange, iron oxide staining, cementation, inferred EW sandstone			
	H		4								D - VD	
					DS 4.80-4.90 m Rec = 100/100 mm PP >=600 kPa BDS 5.00-5.30 m Rec = 300/300 mm PP >=600 kPa							
			5						TEST PIT DISCONTINUED @ 5.30 m MACHINE LIMIT GROUNDWATER NOT ENCOUNTERED BACKFILLED			
			6									

This report of test pit must be read in conjunction with accompanying notes and abbreviations. It has been prepared for geotechnical purposes only, without attempt to assess possible contamination. Any references to potential contamination are for information only and do not necessarily indicate the presence or absence of soil or groundwater contamination.

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REPORT OF TEST PIT PHOTOGRAPHS: TP24

CLIENT:	Santos Ltd	COORDS: 751629.0 m E 6623371.0 m N MGA94 56	SHEET: 1 OF 1
PROJECT:	Storage Ponds	SURFACE RL: DATUM: AHD	MACHINE: Excavator
LOCATION:	Narrabri	DIRECTION: 000°	CONTRACTOR: Specialised Civil Services
JOB NO:	127615025	PIT DEPTH: 5.30 m	LOGGED: MS DATE: 1/8/12
		BUCKET TYPE: 900mm-Toothed	CHECKED: DAA DATE: 21/8/12



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GAP 8_07 LIB.GLB GrfcTbl GAP TEST PIT PHOTO 2 PER PAGE 127615025_TP19-39.GPJ <<DrawingFile>> 21/09/2012 13:17 8.2.856

REPORT OF TEST PIT: TP25

CLIENT: Santos Ltd
PROJECT: Storage Ponds
LOCATION: Narrabri
JOB NO: 127615025

COORDS: 751384.0 m E 6623474.0 m N MGA94 56
SURFACE RL: DATUM: AHD
DIRECTION: 000°
PIT DEPTH: 5.50 m
BUCKET TYPE: 900mm-Toothed

SHEET: 1 OF 1
MACHINE: Excavator
CONTRACTOR: Specialised Civil Services
LOGGED: MS DATE: 31/7/12
CHECKED: DAA DATE: 21/8/12

Excavation					Sampling		Field Material Description					
METHOD	EXCAVATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USCS SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
EX	L		0	0.20	DS 0.10-0.20 m Rec = 100/100 mm PP = 200 kPa			ML	TOPSOIL: Sandy Clayey SILT low liquid limit, dark brown, fine grained sand, with some rootlets	M - W	S	Surface vegetation - dense grass/weeds
				0.40				ML	Sandy Clayey SILT low liquid limit, dark brown, fine grained sand, trace rootlets			
	M-H		1		DS 1.50-1.60 m Rec = 100/100 mm PP >=600 kPa			CH	Sandy Silty CLAY high plasticity, grey pale brown, fine grained sand, trace rootlets, increasing sand content		H	
			2	2.20				SC	Silty Clayey SAND fine to coarse grained, sub-rounded, grey orange, iron oxide staining, cementation, inferred EW Sandstone	D - M		
	H		3		DS 2.50-2.60 m Rec = 100/100 mm PP >=600 kPa						D - VD	
			4		DS 3.50-3.60 m Rec = 100/100 mm PP >=600 kPa							
			5						TEST PIT DISCONTINUED @ 5.50 m MACHINE LIMIT GROUNDWATER NOT ENCOUNTERED BACKFILLED			
			6									

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REPORT OF TEST PIT PHOTOGRAPHS: TP25

CLIENT:	Santos Ltd	COORDS: 751384.0 m E 6623474.0 m N MGA94 56	SHEET: 1 OF 1
PROJECT:	Storage Ponds	SURFACE RL: DATUM: AHD	MACHINE: Excavator
LOCATION:	Narrabri	DIRECTION: 000°	CONTRACTOR: Specialised Civil Services
JOB NO:	127615025	PIT DEPTH: 5.50 m	LOGGED: MS DATE: 31/7/12
		BUCKET TYPE: 900mm-Toothed	CHECKED: DAA DATE: 21/8/12



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GAP 8_07 LIB.GLB GrfcTbl GAP TEST PIT PHOTO 2 PER PAGE 127615025_TP19-39.GPJ <<DrawingFile>> 21/09/2012 13:17 8.2.856

REPORT OF TEST PIT: TP26

CLIENT: Santos Ltd
PROJECT: Storage Ponds
LOCATION: Narrabri
JOB NO: 127615025

COORDS: 751477.0 m E 6623459.0 m N MGA94 56
SURFACE RL: DATUM: AHD
DIRECTION: 000°
PIT DEPTH: 5.50 m
BUCKET TYPE: 900mm-Toothed

SHEET: 1 OF 1
MACHINE: Excavator
CONTRACTOR: Specialised Civil Services
LOGGED: MS DATE: 1/8/12
CHECKED: DAA DATE: 21/8/12

Excavation					Sampling		Field Material Description					
METHOD	EXCAVATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USCS SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
EX	L		0	0.20				CH	TOPSOIL: Sandy Silty CLAY high plasticity, dark brown, fine grained sand, with some rootlets	M - W	S	Surface vegetation - dense grass/weeds
				0.40	DS 0.30-0.40 m Rec = 100/100 mm PP = 150 kPa			CH	Silty Sandy CLAY high plasticity, dark brown grey, fine grained sand, with some rootlets brown, trace rootlets			
			1		DS 1.00-1.10 m Rec = 100/100 mm PP >=600 kPa						H	
	M-H		2							D - M		
			3	3.10	DS 3.10-3.20 m Rec = 100/100 mm PP >=600 kPa			SC	Silty Clayey SAND fine to medium grained, sub-rounded, orange pale grey, iron oxide staining, cementation, inferred EW Sandstone		D - VD	
			4									
			5									
			6						TEST PIT DISCONTINUED @ 5.50 m MACHINE LIMIT GROUNDWATER NOT ENCOUNTERED BACKFILLED			

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GAP 8_07 LIB.GLB Log GAP NON-CORED FULL PAGE 127615025_TP19-39.GPJ <<DrawingFile>> 21/09/2012 13:18 8.2.856

REPORT OF TEST PIT PHOTOGRAPHS: TP26

CLIENT: Santos Ltd
PROJECT: Storage Ponds
LOCATION: Narrabri
JOB NO: 127615025

COORDS: 751477.0 m E 6623459.0 m N MGA94 56
SURFACE RL: DATUM: AHD
DIRECTION: 000°
PIT DEPTH: 5.50 m
BUCKET TYPE: 900mm-Toothed

SHEET: 1 OF 1
MACHINE: Excavator
CONTRACTOR: Specialised Civil Services
LOGGED: MS DATE: 1/8/12
CHECKED: DAA DATE: 21/8/12



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GAP 8_07 LIB.GLB GrfcTbl GAP TEST PIT PHOTO 2 PER PAGE 127615025_TP19-39.GPJ <<DrawingFile>> 21/09/2012 13:18 8.2.856

REPORT OF TEST PIT: TP27

CLIENT: Santos Ltd
PROJECT: Storage Ponds
LOCATION: Narrabri
JOB NO: 127615025

COORDS: 751438.0 m E 6623526.0 m N MGA94 56
SURFACE RL: DATUM: AHD
DIRECTION: 000°
PIT DEPTH: 5.00 m
BUCKET TYPE: 900mm-Toothed

SHEET: 1 OF 1
MACHINE: Excavator
CONTRACTOR: Specialised Civil Services
LOGGED: MS DATE: 31/7/12
CHECKED: DAA DATE: 21/8/12

Excavation					Sampling		Field Material Description					
METHOD	EXCAVATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USCS SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
EX	L		0	0.20				ML	TOPSOIL: Sandy Clayey SILT low liquid limit, dark brown, fine grained sand, with some rootlets	M - W	S	Surface vegetation - dense grass/weeds
				0.50				ML	Sandy Clayey SILT low liquid limit, dark brown, fine grained sand, trace rootlets			
	M-H		1					CH	Silty Sandy CLAY high plasticity, grey, fine to medium grained, subrounded sand, trace rootlets, iron oxide staining		H	
			2	2.10				SC	Silty Clayey SAND fine to medium grained, sub-rounded, pale grey, iron oxide staining, cementation, inferred EW Sandstone	D - M		
	H		3		DS 2.50-2.60 m Rec = 100/100 mm PP >=600 kPa						D - VD	
			4		DS 3.50-3.60 m Rec = 100/100 mm PP >=600 kPa							
			5		DS 4.50-4.60 m Rec = 100/100 mm PP >=600 kPa				TEST PIT DISCONTINUED @ 5.00 m MACHINE LIMIT GROUNDWATER NOT ENCOUNTERED BACKFILLED			
			6									

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REPORT OF TEST PIT PHOTOGRAPHS: TP27

CLIENT:	Santos Ltd	COORDS: 751438.0 m E 6623526.0 m N MGA94 56	SHEET: 1 OF 1
PROJECT:	Storage Ponds	SURFACE RL: DATUM: AHD	MACHINE: Excavator
LOCATION:	Narrabri	DIRECTION: 000°	CONTRACTOR: Specialised Civil Services
JOB NO:	127615025	PIT DEPTH: 5.00 m	LOGGED: MS DATE: 31/7/12
		BUCKET TYPE: 900mm-Toothed	CHECKED: DAA DATE: 21/8/12



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GAP 8_07 LIB.GLB GrfcTbl GAP TEST PIT PHOTO 2 PER PAGE 127615025_TP19-39.GPJ <<DrawingFile>> 21/09/2012 13:18 8.2.856

REPORT OF TEST PIT: TP28

CLIENT: Santos Ltd
PROJECT: Storage Ponds
LOCATION: Narrabri
JOB NO: 127615025

COORDS: 751552.0 m E 6623521.0 m N MGA94 56
SURFACE RL: DATUM: AHD
DIRECTION: 000°
PIT DEPTH: 3.90 m
BUCKET TYPE: 900mm-Toothed

SHEET: 1 OF 1
MACHINE: Excavator
CONTRACTOR: Specialised Civil Services
LOGGED: MS DATE: 31/7/12
CHECKED: DAA DATE: 21/8/12

Excavation					Sampling		Field Material Description					
METHOD	EXCAVATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USCS SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
EX	L		0	0.20				ML	TOPSOIL: Sandy Clayey SILT low liquid limit, dark brown, fine grained sand, with some rootlets	M - W	S - F	Surface vegetation - dense grass/weeds
					DS 0.20-0.30 m Rec = 100/100 mm			ML	Sandy Clayey SILT low liquid limit, dark brown, fine grained sand, trace rootlets			
				0.50	DS 0.40-0.50 m Rec = 100/100 mm PP = 200-250 kPa			CH	Sandy Silty CLAY high plasticity, brown grey, fine grained sand, trace rootlets, iron oxide staining			
	M-H		1								H	
			2		DS 1.90-2.00 m Rec = 100/100 mm PP >=600 kPa BDS 2.00-2.40 m Rec = 400/400 mm PP >=600 kPa					D - M		
				2.40				SC	Silty Clayey SAND fine to medium grained, sub-rounded, grey orange, iron oxide staining, cementation, inferred EW Sandstone			
	H		3		DS 3.10-3.20 m Rec = 100/100 mm PP >=600 kPa						F - St	
			4						TEST PIT DISCONTINUED @ 3.90 m REFUSAL GROUNDWATER NOT ENCOUNTERED BACKFILLED			
			5									
			6									

This report of test pit must be read in conjunction with accompanying notes and abbreviations. It has been prepared for geotechnical purposes only, without attempt to assess possible contamination. Any references to potential contamination are for information only and do not necessarily indicate the presence or absence of soil or groundwater contamination.

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REPORT OF TEST PIT PHOTOGRAPHS: TP28

CLIENT: Santos Ltd
PROJECT: Storage Ponds
LOCATION: Narrabri
JOB NO: 127615025

COORDS: 751552.0 m E 6623521.0 m N MGA94 56
SURFACE RL: DATUM: AHD
DIRECTION: 000°
PIT DEPTH: 3.90 m
BUCKET TYPE: 900mm-Toothed

SHEET: 1 OF 1
MACHINE: Excavator
CONTRACTOR: Specialised Civil Services
LOGGED: MS DATE: 31/7/12
CHECKED: DAA DATE: 21/8/12



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GAP 8_07 LIB.GLB GrfcTbl GAP TEST PIT PHOTO 2 PER PAGE 127615025_TP19-39.GPJ <<DrawingFile>> 21/09/2012 13:18 8.2.856

REPORT OF TEST PIT: TP29

CLIENT: Santos Ltd
PROJECT: Storage Ponds
LOCATION: Narrabri
JOB NO: 127615025

COORDS: 751393.0 m E 6623578.0 m N MGA94 56
SURFACE RL: DATUM: AHD
DIRECTION: 000°
PIT DEPTH: 3.90 m
BUCKET TYPE: 900mm-Toothed

SHEET: 1 OF 1
MACHINE: Excavator
CONTRACTOR: Specialised Civil Services
LOGGED: MS DATE: 31/7/12
CHECKED: DAA DATE: 21/8/12

Excavation					Sampling		Field Material Description					
METHOD	EXCAVATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USCS SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
EX	L		0	0.20				ML	TOPSOIL: Sandy Clayey SILT low liquid limit, dark brown, fine grained sand, with some rootlets	M - W	S	Surface vegetation - dense grass/weeds
				0.40	DS 0.30-0.40 m Rec = 100/100 mm			ML	Sandy Clayey SILT low liquid limit, dark brown, fine grained sand, trace rootlets		S - F	
	M-H		1		DS 1.00-1.10 m Rec = 100/100 mm PP = 200 kPa			CH	Silty Sandy CLAY high plasticity, grey brown, fine to medium grained, subrounded sand, trace rootlets		H	
			2	2.00	DS 2.00-2.10 m Rec = 100/100 mm PP >=600 kPa			SC	Clayey Silty SAND fine to medium grained, sub-rounded, grey pale brown, iron oxide staining, cementation, inferred EW Sandstone	D - M		
	H		3		DS 3.00-3.10 m Rec = 100/100 mm PP >=600 kPa						D - VD	
			4						TEST PIT DISCONTINUED @ 3.90 m REFUSAL GROUNDWATER NOT ENCOUNTERED BACKFILLED			
			5									
			6									

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REPORT OF TEST PIT PHOTOGRAPHS: TP29

CLIENT:	Santos Ltd	COORDS: 751393.0 m E 6623578.0 m N MGA94 56	SHEET: 1 OF 1
PROJECT:	Storage Ponds	SURFACE RL: DATUM: AHD	MACHINE: Excavator
LOCATION:	Narrabri	DIRECTION: 000°	CONTRACTOR: Specialised Civil Services
JOB NO:	127615025	PIT DEPTH: 3.90 m	LOGGED: MS DATE: 31/7/12
		BUCKET TYPE: 900mm-Toothed	CHECKED: DAA DATE: 21/8/12



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GAP 8_07 LIB.GLB GrfcTbl GAP TEST PIT PHOTO 2 PER PAGE 127615025_TP19-39.GPJ <<DrawingFile>> 21/09/2012 13:19 8.2.856

REPORT OF TEST PIT: TP30

CLIENT: Santos Ltd
PROJECT: Storage Ponds
LOCATION: Narrabri
JOB NO: 127615025

COORDS: 751608.0 m E 6623563.0 m N MGA94 56
SURFACE RL: DATUM: AHD
DIRECTION: 000°
PIT DEPTH: 4.80 m
BUCKET TYPE: 900mm-Toothed

SHEET: 1 OF 1
MACHINE: Excavator
CONTRACTOR: Specialised Civil Services
LOGGED: MS DATE: 31/7/12
CHECKED: DAA DATE: 21/8/12

Excavation					Sampling		Field Material Description					
METHOD	EXCAVATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USCS SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
EX	L		0	0.20	DS 0.20-0.30 m Rec = 100/100 mm PP = 200 kPa			ML	TOPSOIL: Sandy Clayey SILT low liquid limit, dark brown, fine to medium grained, subrounded sand, with some rootlets	M - W	S	Surface vegetation - dense grass/weeds
				0.50				ML	Sandy Clayey SILT low liquid limit, grey, fine to medium grained, subrounded sand, trace rootlets			
	M-H		1					CH	Silty Sandy CLAY high plasticity, brown, fine grained, subrounded sand, trace rootlets, increasing sand content		H	
			2	2.60	DS 2.40-2.50 m Rec = 100/100 mm PP >=600 kPa			SC	Clayey Silty SAND fine to coarse grained, sub-rounded, grey, iron oxide staining, cementation, inferred EW Sandstone	D - M		
	H		3								D - VD	
			4		DS 4.70-4.80 m Rec = 100/100 mm PP >=600 kPa							
			5						TEST PIT DISCONTINUED @ 4.80 m REFUSAL GROUNDWATER NOT ENCOUNTERED BACKFILLED			
			6									

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REPORT OF TEST PIT PHOTOGRAPHS: TP30

CLIENT:	Santos Ltd	COORDS: 751608.0 m E 6623563.0 m N MGA94 56	SHEET: 1 OF 1
PROJECT:	Storage Ponds	SURFACE RL: DATUM: AHD	MACHINE: Excavator
LOCATION:	Narrabri	DIRECTION: 000°	CONTRACTOR: Specialised Civil Services
JOB NO:	127615025	PIT DEPTH: 4.80 m	LOGGED: MS DATE: 31/7/12
		BUCKET TYPE: 900mm-Toothed	CHECKED: DAA DATE: 21/8/12



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GAP 8_07 LIB.GLB GrfcTbl GAP TEST PIT PHOTO 2 PER PAGE 127615025_TP19-39.GPJ <<DrawingFile>> 21/09/2012 13:19 8.2.856

REPORT OF TEST PIT: TP31

CLIENT: Santos Ltd
PROJECT: Storage Ponds
LOCATION: Narrabri
JOB NO: 127615025

COORDS: 751666.0 m E 6623564.0 m N MGA94 56
SURFACE RL: DATUM: AHD
DIRECTION: 000°
PIT DEPTH: 5.00 m
BUCKET TYPE: 900mm-Toothed

SHEET: 1 OF 1
MACHINE: Excavator
CONTRACTOR: Specialised Civil Services
LOGGED: MS DATE: 1/8/12
CHECKED: DAA DATE: 21/8/12

Excavation					Sampling		Field Material Description					
METHOD	EXCAVATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USCS SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
EX	L		0	0.20				ML	TOPSOIL: Sandy Clayey SILT low liquid limit, dark brown, fine grained sand, with some rootlets	M - W	S	Surface vegetation - dense grass/weeds
				0.50	DS 0.40-0.50 m Rec = 100/100 mm PP = 100 kPa			ML	Sandy Clayey SILT low liquid limit, dark brown, fine grained sand, trace rootlets			
	M-H		1					CH	Silty Sandy CLAY high plasticity, brown, fine grained sand, trace rootlets		VSt - H	
				1.60	DS 1.50-1.60 m Rec = 100/100 mm PP = 500 kPa			SC	Clayey Silty SAND fine to medium grained, sub-rounded, orange, iron oxide staining, cementation	D - M		
			2									
				2.90	DS 2.80-2.90 m Rec = 100/100 mm PP >=600 kPa				pale grey, iron oxide staining, inferred EW Sandstone			
	H		3								D - VD	
			4									
			5						TEST PIT DISCONTINUED @ 5.00 m MACHINE LIMIT GROUNDWATER NOT ENCOUNTERED BACKFILLED			
			6									

This report of test pit must be read in conjunction with accompanying notes and abbreviations. It has been prepared for geotechnical purposes only, without attempt to assess possible contamination. Any references to potential contamination are for information only and do not necessarily indicate the presence or absence of soil or groundwater contamination.

GAP 8_07 LIB.GLB Log GAP NON-CORED FULL PAGE 127615025_TP19-39.GPJ <<DrawingFile>> 21/09/2012 13:19 8.2.856

REPORT OF TEST PIT PHOTOGRAPHS: TP31

CLIENT: Santos Ltd
PROJECT: Storage Ponds
LOCATION: Narrabri
JOB NO: 127615025

COORDS: 751666.0 m E 6623564.0 m N MGA94 56
SURFACE RL: DATUM: AHD
DIRECTION: 000°
PIT DEPTH: 5.00 m
BUCKET TYPE: 900mm-Toothed

SHEET: 1 OF 1
MACHINE: Excavator
CONTRACTOR: Specialised Civil Services
LOGGED: MS DATE: 1/8/12
CHECKED: DAA DATE: 21/8/12



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2.

This report of test pit photographs must be read in conjunction with accompanying notes and abbreviations. It has been prepared for geotechnical purposes only, without attempt to assess possible contamination. Any references to potential contamination are for information only and do not necessarily indicate the presence or absence of soil or groundwater contamination.

GAP 8_07 LIB.GLB GrfcTbl GAP TEST PIT PHOTO 2 PER PAGE 127615025_TP19-39.GPJ <<DrawingFile>> 21/09/2012 13:20 8.2.856

REPORT OF TEST PIT: TP32

CLIENT: Santos Ltd
PROJECT: Storage Ponds
LOCATION: Narrabri
JOB NO: 127615025

COORDS: 751463.0 m E 6623643.0 m N MGA94 56
SURFACE RL: DATUM: AHD
DIRECTION: 000°
PIT DEPTH: 4.60 m
BUCKET TYPE: 900mm-Toothed

SHEET: 1 OF 1
MACHINE: Excavator
CONTRACTOR: Specialised Civil Services
LOGGED: MS DATE: 31/7/12
CHECKED: DAA DATE: 21/8/12

Excavation					Sampling		Field Material Description					
METHOD	EXCAVATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USCS SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
EX	L		0	0.20				ML	TOPSOIL: Sandy Clayey SILT low liquid limit, dark brown, fine to medium grained, subrounded sand, with some rootlets	M - W	S - F	Surface vegetation - dense grass/weeds
				0.40	DS 0.30-0.40 m Rec = 100/100 mm PP = 200 kPa			ML	Sandy Clayey SILT low liquid limit, dark brown, fine to medium grained, subrounded sand, trace rootlets			
	M-H		1					CH	Silty Sandy CLAY high plasticity, brown orange, fine to medium grained, subrounded sand, trace rootlets		H	
					DS 1.50-1.60 m Rec = 100/100 mm PP >=600 kPa							
			2	2.00	DS 2.00-2.10 m Rec = 100/100 mm PP >=600 kPa			SC	Silty Clayey SAND fine to medium grained, sub-rounded, grey, iron oxide staining, cementation, inferred EW sandstone	D - M		
	H		3								D - VD	
			4									
									TEST PIT DISCONTINUED @ 4.60 m REFUSAL GROUNDWATER NOT ENCOUNTERED BACKFILLED			
			5									
			6									

This report of test pit must be read in conjunction with accompanying notes and abbreviations. It has been prepared for geotechnical purposes only, without attempt to assess possible contamination. Any references to potential contamination are for information only and do not necessarily indicate the presence or absence of soil or groundwater contamination.

GAP 8_07 LIB.GLB Log GAP NON-CORED FULL PAGE 127615025_TP19-39.GPJ <<DrawingFile>> 21/09/2012 13:20 8.2.856

REPORT OF TEST PIT PHOTOGRAPHS: TP32

CLIENT: Santos Ltd
PROJECT: Storage Ponds
LOCATION: Narrabri
JOB NO: 127615025

COORDS: 751463.0 m E 6623643.0 m N MGA94 56
SURFACE RL: DATUM: AHD
DIRECTION: 000°
PIT DEPTH: 4.60 m
BUCKET TYPE: 900mm-Toothed

SHEET: 1 OF 1
MACHINE: Excavator
CONTRACTOR: Specialised Civil Services
LOGGED: MS DATE: 31/7/12
CHECKED: DAA DATE: 21/8/12



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2.

This report of test pit photographs must be read in conjunction with accompanying notes and abbreviations. It has been prepared for geotechnical purposes only, without attempt to assess possible contamination. Any references to potential contamination are for information only and do not necessarily indicate the presence or absence of soil or groundwater contamination.

GAP 8_07 LIB.GLB GrfcTbl GAP TEST PIT PHOTO 2 PER PAGE 127615025_TP19-39.GPJ <<DrawingFile>> 21/09/2012 13:20 8.2.856

REPORT OF TEST PIT: TP33

CLIENT: Santos Ltd
PROJECT: Storage Ponds
LOCATION: Narrabri
JOB NO: 127615025

COORDS: 751426.0 m E 6623672.0 m N MGA94 56
SURFACE RL: DATUM: AHD
DIRECTION: 000°
PIT DEPTH: 4.90 m
BUCKET TYPE: 900mm-Toothed

SHEET: 1 OF 1
MACHINE: Excavator
CONTRACTOR: Specialised Civil Services
LOGGED: MS DATE: 31/7/12
CHECKED: DAA DATE: 21/8/12

Excavation					Sampling		Field Material Description					
METHOD	EXCAVATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USCS SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
EX	L		0	0.20	DS 0.00-0.10 m Rec = 100/100 mm			ML	TOPSOIL: Sandy Clayey SILT low liquid limit, dark brown, fine to medium grained, subrounded sand, with some rootlets	M - W	S	Surface vegetation - dense grass/weeds
				0.40	DS 0.20-0.30 m Rec = 100/100 mm PP = 50 kPa			ML	Sandy Clayey SILT low liquid limit, dark brown, fine to medium grained, subrounded sand, trace rootlets			
								CH	Silty Sandy CLAY high plasticity, brown orange, fine grained sand, trace rootlets			
	M-H		1		DS 1.20-1.30 m Rec = 100/100 mm PP >=600 kPa						H	
				2.00				SC	Clayey Silty SAND fine to coarse grained, sub-rounded, pale grey, iron oxide staining, cementation, inferred EW Sandstone	D - M		
	H		3								D - VD	
			4		DS 4.80-4.90 m Rec = 100/100 mm PP >=600 kPa							
			5						TEST PIT DISCONTINUED @ 4.90 m REFUSAL GROUNDWATER NOT ENCOUNTERED BACKFILLED			
			6									

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GAP 8_07 LIB.GLB Log GAP NON-CORED FULL PAGE 127615025_TP19-39.GPJ <<DrawingFile>> 21/09/2012 13:20 8.2.856

REPORT OF TEST PIT PHOTOGRAPHS: TP33

CLIENT: Santos Ltd
PROJECT: Storage Ponds
LOCATION: Narrabri
JOB NO: 127615025

COORDS: 751426.0 m E 6623672.0 m N MGA94 56
SURFACE RL: DATUM: AHD
DIRECTION: 000°
PIT DEPTH: 4.90 m
BUCKET TYPE: 900mm-Toothed

SHEET: 1 OF 1
MACHINE: Excavator
CONTRACTOR: Specialised Civil Services
LOGGED: MS DATE: 31/7/12
CHECKED: DAA DATE: 21/8/12



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2.

This report of test pit photographs must be read in conjunction with accompanying notes and abbreviations. It has been prepared for geotechnical purposes only, without attempt to assess possible contamination. Any references to potential contamination are for information only and do not necessarily indicate the presence or absence of soil or groundwater contamination.

GAP 8_07 LIB.GLB GrfcTbl GAP TEST PIT PHOTO 2 PER PAGE 127615025_TP19-39.GPJ <<DrawingFile>> 21/09/2012 13:20 8.2.856

REPORT OF TEST PIT: TP34

CLIENT: Santos Ltd
PROJECT: Storage Ponds
LOCATION: Narrabri
JOB NO: 127615025

COORDS: 751529.0 m E 6623656.0 m N MGA94 56
SURFACE RL: DATUM: AHD
DIRECTION: 000°
PIT DEPTH: 4.60 m
BUCKET TYPE: 900mm-Toothed

SHEET: 1 OF 1
MACHINE: Excavator
CONTRACTOR: Specialised Civil Services
LOGGED: MS DATE: 31/7/12
CHECKED: DAA DATE: 21/8/12

Excavation					Sampling		Field Material Description					
METHOD	EXCAVATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USCS SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
EX	L		0	0.20	DS 0.20-0.30 m Rec = 100/100 mm PP = 200 kPa			ML	TOPSOIL: Sandy Clayey SILT low liquid limit, dark brown, medium grained, subrounded sand, with some rootlets	M - W	VS	Surface vegetation- dense grass/weeds
				0.50				ML	Sandy Clayey SILT low liquid limit, dark brown, trace rootlets		F	
			1					CH	Sandy Silty CLAY high plasticity, brown pale grey, trace rootlets, iron oxide staining	D - M		
	M-H		2		DS 1.80-1.90 m Rec = 100/100 mm PP >=600 kPa						H	
			3	3.50				SC	Clayey Silty SAND fine to medium grained, sub-rounded, pale grey, iron oxide staining, cementation, inferred EW Sandstone			
	H		4		DS 4.20-4.30 m Rec = 100/100 mm PP >=600 kPa						D - VD	
			5						TEST PIT DISCONTINUED @ 4.60 m REFUSAL GROUNDWATER NOT ENCOUNTERED BACKFILLED			
			6									

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GAP 8_07 LIB.GLB Log GAP NON-CORED FULL PAGE 127615025_TP19-39.GPJ <<DrawingFile>> 21/09/2012 13:20 8.2.856

REPORT OF TEST PIT PHOTOGRAPHS: TP34

CLIENT: Santos Ltd
PROJECT: Storage Ponds
LOCATION: Narrabri
JOB NO: 127615025

COORDS: 751529.0 m E 6623656.0 m N MGA94 56
SURFACE RL: DATUM: AHD
DIRECTION: 000°
PIT DEPTH: 4.60 m
BUCKET TYPE: 900mm-Toothed

SHEET: 1 OF 1
MACHINE: Excavator
CONTRACTOR: Specialised Civil Services
LOGGED: MS DATE: 31/7/12
CHECKED: DAA DATE: 21/8/12



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2.

This report of test pit photographs must be read in conjunction with accompanying notes and abbreviations. It has been prepared for geotechnical purposes only, without attempt to assess possible contamination. Any references to potential contamination are for information only and do not necessarily indicate the presence or absence of soil or groundwater contamination.

GAP 8_07 LIB.GLB GrfcTbl GAP TEST PIT PHOTO 2 PER PAGE 127615025_TP19-39.GPJ <<DrawingFile>> 21/09/2012 13:21 8.2.856

REPORT OF TEST PIT: TP35

CLIENT: Santos Ltd
PROJECT: Storage Ponds
LOCATION: Narrabri
JOB NO: 127615025

COORDS: 751498.0 m E 6623723.0 m N MGA94 56
SURFACE RL: DATUM: AHD
DIRECTION: 000°
PIT DEPTH: 4.50 m
BUCKET TYPE: 900mm-Toothed

SHEET: 1 OF 1
MACHINE: Excavator
CONTRACTOR: Specialised Civil Services
LOGGED: MS DATE: 31/7/12
CHECKED: DAA DATE: 21/8/12

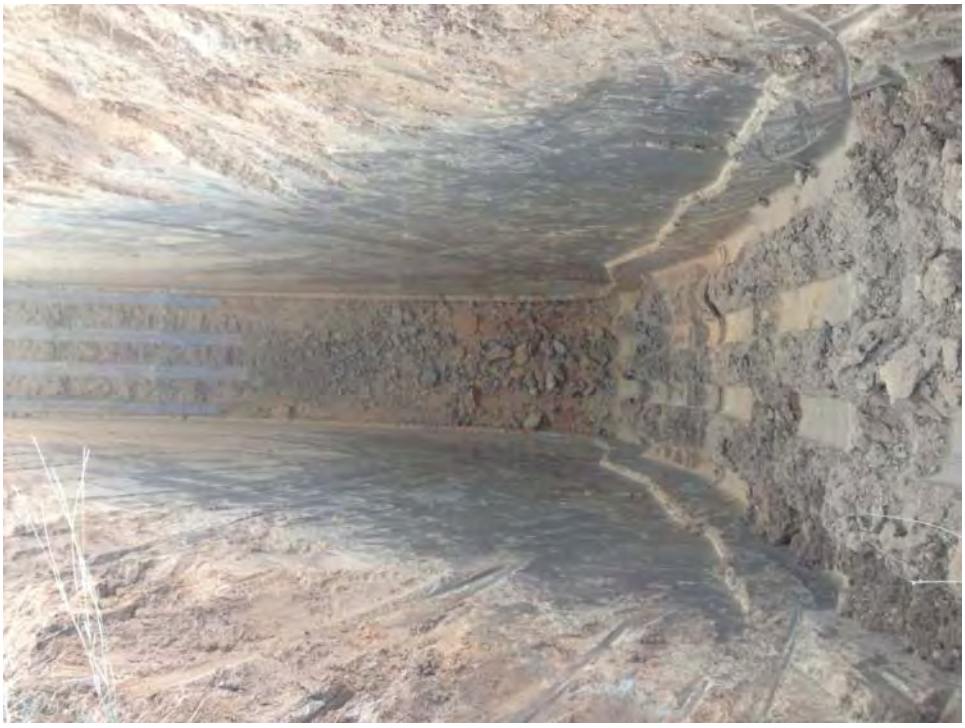
Excavation					Sampling		Field Material Description					
METHOD	EXCAVATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USCS SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
EX	L		0	0.20				ML	TOPSOIL: Sandy Clayey SILT low liquid limit, brown, with some rootlets	M - W	S - F	Surface vegetation - grass/weeds
					DS 0.30-0.40 m Rec = 100/100 mm PP = 200 kPa			ML	Sandy Clayey SILT low liquid limit, brown, trace rootlets			
				0.50				CI	Silty CLAY medium plasticity, grey brown, with iron oxide staining, increasing sand content			
	M-H		1		DS 0.70-0.80 m Rec = 100/100 mm PP >=600 kPa						H	
			2							D - M		
				3.00				SC	Clayey SAND fine to medium grained, grey, with iron oxide staining, inferred EW Sandstone			
	H		3								D - VD	
			4									
									TEST PIT DISCONTINUED @ 4.50 m REFUSAL GROUNDWATER NOT ENCOUNTERED BACKFILLED			
			5									
			6									

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GAP 8_07 LIB.GLB Log GAP NON-CORED FULL PAGE 127615025_TP19-39.GPJ <<DrawingFile>> 21/09/2012 13:21 8.2.856

REPORT OF TEST PIT PHOTOGRAPHS: TP35

CLIENT:	Santos Ltd	COORDS: 751498.0 m E 6623723.0 m N MGA94 56	SHEET: 1 OF 1
PROJECT:	Storage Ponds	SURFACE RL: DATUM: AHD	MACHINE: Excavator
LOCATION:	Narrabri	DIRECTION: 000°	CONTRACTOR: Specialised Civil Services
JOB NO:	127615025	PIT DEPTH: 4.50 m	LOGGED: MS DATE: 31/7/12
		BUCKET TYPE: 900mm-Toothed	CHECKED: DAA DATE: 21/8/12



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GAP 8_07 LIB.GLB GrfcTbl GAP TEST PIT PHOTO 2 PER PAGE 127615025_TP19-39.GPJ <<DrawingFile>> 21/09/2012 13:21 8.2.856

REPORT OF TEST PIT: TP36

CLIENT: Santos Ltd
PROJECT: Storage Ponds
LOCATION: Narrabri
JOB NO: 127615025

COORDS: 751441.0 m E 6623783.0 m N MGA94 56
SURFACE RL: DATUM: AHD
DIRECTION: 000°
PIT DEPTH: 3.70 m
BUCKET TYPE: 900mm-Toothed

SHEET: 1 OF 1
MACHINE: Excavator
CONTRACTOR: Specialised Civil Services
LOGGED: MS DATE: 30/7/12
CHECKED: DAA DATE: 21/8/12

Excavation					Sampling		Field Material Description					
METHOD	EXCAVATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USCS SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
EX	L		0	0.20				ML	Clayey SILT low liquid limit, brown, with some rootlets	M - W	VS	Surface vegetation - dense grass/weeds
				0.30				ML	Sandy Clayey SILT low liquid limit, brown, medium grained sand, trace rootlets			
					DS 0.30-0.40 m Rec = 100/100 mm PP = 150 kPa			CL-ML	Silty CLAY high plasticity, pale grey, trace rootlets, increasing sand content			
	M-H		1							D - M	VSt - H	
				1.80				SC	Clayey SAND pale grey, cementation, inferred EW Sandstone			
			2		DS 1.90-2.00 m Rec = 100/100 mm PP >=600 kPa							
	H				DS 2.70-2.80 m Rec = 100/100 mm PP >=600 kPa					D	D	
			3									
			4						TEST PIT DISCONTINUED @ 3.70 m REFUSAL GROUNDWATER NOT ENCOUNTERED BACKFILLED			
			5									
			6									

This report of test pit must be read in conjunction with accompanying notes and abbreviations. It has been prepared for geotechnical purposes only, without attempt to assess possible contamination. Any references to potential contamination are for information only and do not necessarily indicate the presence or absence of soil or groundwater contamination.

GAP 8_07 LIB.GLB Log GAP NON-CORED FULL PAGE 127615025_TP19-39.GPJ <<DrawingFile>> 21/09/2012 13:21 8.2.856

REPORT OF TEST PIT PHOTOGRAPHS: TP36

CLIENT:	Santos Ltd	COORDS: 751441.0 m E 6623783.0 m N MGA94 56	SHEET: 1 OF 1
PROJECT:	Storage Ponds	SURFACE RL: DATUM: AHD	MACHINE: Excavator
LOCATION:	Narrabri	DIRECTION: 000°	CONTRACTOR: Specialised Civil Services
JOB NO:	127615025	PIT DEPTH: 3.70 m	LOGGED: MS DATE: 30/7/12
		BUCKET TYPE: 900mm-Toothed	CHECKED: DAA DATE: 21/8/12



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GAP 8_07 LIB.GLB GrfcTbl GAP TEST PIT PHOTO 2 PER PAGE 127615025_TP19-39.GPJ <<DrawingFile>> 21/09/2012 13:21 8.2.856

REPORT OF TEST PIT: TP37

CLIENT: Santos Ltd
PROJECT: Storage Ponds
LOCATION: Narrabri
JOB NO: 127615025

COORDS: 751547.0 m E 6623757.0 m N MGA94 56
SURFACE RL: DATUM: AHD
DIRECTION: 000°
PIT DEPTH: 4.50 m
BUCKET TYPE: 900mm-Toothed

SHEET: 1 OF 1
MACHINE: Excavator
CONTRACTOR: Specialised Civil Services
LOGGED: MS DATE: 30/7/12
CHECKED: DAA DATE: 21/8/12

Excavation					Sampling		Field Material Description					
METHOD	EXCAVATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USCS SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
EX	L		0	0.20				ML	TOPSOIL: Sandy Clayey SILT low liquid limit, brown, with some rootlets	M - W	S	Surface vegetation - weed/grass
				0.50	DS 0.40-0.50 m Rec = 100/100 mm PP = 200 kPa			ML	Sandy Clayey SILT low liquid limit, brown, trace rootlets			
	M-H		1					CH	Silty CLAY high plasticity, grey, increasing sand content, petrified organics observed	D - M	H	
			2		DS 2.00-2.10 m Rec = 100/100 mm PP >=600 kPa							
			3	3.00				SC	Clayey Silty SAND fine to medium grained, sub-rounded, grey, iron oxide staining, inferred EW Siltstone			
	H		4		DS 4.00-4.10 m Rec = 100/100 mm PP >=600 kPa						D - VD	
			5						TEST PIT DISCONTINUED @ 4.50 m REFUSAL GROUNDWATER NOT ENCOUNTERED BACKFILLED			
			6									

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GAP 8_07 LIB.GLB Log GAP NON-CORED FULL PAGE 127615025_TP19-39.GPJ <<DrawingFile>> 21/09/2012 13:22 8.2.856

REPORT OF TEST PIT PHOTOGRAPHS: TP37

CLIENT:	Santos Ltd	COORDS: 751547.0 m E 6623757.0 m N MGA94 56	SHEET: 1 OF 1
PROJECT:	Storage Ponds	SURFACE RL: DATUM: AHD	MACHINE: Excavator
LOCATION:	Narrabri	DIRECTION: 000°	CONTRACTOR: Specialised Civil Services
JOB NO:	127615025	PIT DEPTH: 4.50 m	LOGGED: MS DATE: 30/7/12
		BUCKET TYPE: 900mm-Toothed	CHECKED: DAA DATE: 21/8/12



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2.

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GAP 8_07 LIB.GLB GrfcTbl GAP TEST PIT PHOTO 2 PER PAGE 127615025_TP19-39.GPJ <<DrawingFile>> 21/09/2012 13:22 8.2.856

REPORT OF TEST PIT: TP38

CLIENT: Santos Ltd
PROJECT: Storage Ponds
LOCATION: Narrabri
JOB NO: 127615025

COORDS: 751585.0 m E 6623646.0 m N MGA94 56
SURFACE RL: DATUM: AHD
DIRECTION: 000°
PIT DEPTH: 4.50 m
BUCKET TYPE: 900mm-Toothed

SHEET: 1 OF 1
MACHINE: Excavator
CONTRACTOR: Specialised Civil Services
LOGGED: MS DATE: 31/7/12
CHECKED: DAA DATE: 21/8/12

Excavation					Sampling		Field Material Description					
METHOD	EXCAVATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USCS SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
EX	L		0	0.20	DS 0.00-0.10 m Rec = 100/100 mm			ML	TOPSOIL: Sandy Clayey SILT low liquid limit, dark brown, fine to medium grained, subrounded sand, with some rootlets	M - W	S - F	Surface vegetation - dense grass/weeds
				0.50	DS 0.40-0.50 m Rec = 100/100 mm PP = 250 kPa			ML	Sandy Clayey SILT low liquid limit, dark brown, fine to medium grained, subrounded sand, trace rootlets		F	
	M-H		1		DS 0.70-0.80 m Rec = 100/100 mm PP >=600 kPa			CH	Silty Sandy CLAY high plasticity, brown pale grey, fine to medium grained, subrounded sand, trace rootlets, petrified organics observed		H	
				1.80				SC	Silty Clayey SAND fine to medium grained, sub-rounded, pale grey orange, iron oxide staining, cementation, inferred EW Sandstone	D - M		
	H		2		DS 2.20-2.30 m Rec = 100/100 mm PP >=600 kPa						D - VD	
			3									
			4									
			5						TEST PIT DISCONTINUED @ 4.50 m REFUSAL GROUNDWATER NOT ENCOUNTERED BACKFILLED			
			6									

This report of test pit must be read in conjunction with accompanying notes and abbreviations. It has been prepared for geotechnical purposes only, without attempt to assess possible contamination. Any references to potential contamination are for information only and do not necessarily indicate the presence or absence of soil or groundwater contamination.

GAP 8_07 LIB.GLB Log GAP NON-CORED FULL PAGE 127615025_TP19-39.GPJ <<DrawingFile>> 21/09/2012 13:23 8.2.856

REPORT OF TEST PIT PHOTOGRAPHS: TP38

CLIENT: Santos Ltd
PROJECT: Storage Ponds
LOCATION: Narrabri
JOB NO: 127615025

COORDS: 751585.0 m E 6623646.0 m N MGA94 56
SURFACE RL: DATUM: AHD
DIRECTION: 000°
PIT DEPTH: 4.50 m
BUCKET TYPE: 900mm-Toothed

SHEET: 1 OF 1
MACHINE: Excavator
CONTRACTOR: Specialised Civil Services
LOGGED: MS DATE: 31/7/12
CHECKED: DAA DATE: 21/8/12



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2.

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GAP 8_07 LIB.GLB GrfcTbl GAP TEST PIT PHOTO 2 PER PAGE 127615025_TP19-39.GPJ <<DrawingFile>> 21/09/2012 13:23 8.2.856

REPORT OF TEST PIT: TP39

CLIENT: Santos Ltd
PROJECT: Storage Ponds
LOCATION: Narrabri
JOB NO: 127615025

COORDS: 751647.0 m E 6623723.0 m N MGA94 56
SURFACE RL: DATUM: AHD
DIRECTION: 000°
PIT DEPTH: 4.00 m
BUCKET TYPE: 900mm-Toothed

SHEET: 1 OF 1
MACHINE: Excavator
CONTRACTOR: Specialised Civil Services
LOGGED: MS DATE: 31/7/12
CHECKED: DAA DATE: 21/8/12

Excavation					Sampling		Field Material Description					
METHOD	EXCAVATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USCS SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
EX	L		0	0.20				ML	TOPSOIL: Sandy Clayey SILT low liquid limit, dark brown, with some rootlets	M - W	F - St	Surface vegetation - desnse grass/weeds
				0.40	DS 0.30-0.40 m Rec = 100/100 mm PP = 150 kPa			ML	Sandy Clayey SILT low liquid limit, dark brown, trace rootlets			
	M-H		1					CH	Sandy Silty CLAY high plasticity, pale grey brown, fine to medium grained sand, trace rootlets			
				1.70	DS 1.50-1.60 m Rec = 100/100 mm PP >=600 kPa			SC	Silty Clayey SAND fine to medium grained, sub-rounded, orange pale grey, iron oxide staining, cementation, interred EW Sandstone	D - M	D - VD	
	H		2									
			3		DS 3.50-3.60 m Rec = 100/100 mm PP >=600 kPa							
			4						TEST PIT DISCONTINUED @ 4.00 m MACHINE LIMIT GROUNDWATER NOT ENCOUNTERED BACKFILLED			
			5									
			6									

This report of test pit must be read in conjunction with accompanying notes and abbreviations. It has been prepared for geotechnical purposes only, without attempt to assess possible contamination. Any references to potential contamination are for information only and do not necessarily indicate the presence or absence of soil or groundwater contamination.

GAP gINT FN. F01e RL3

GAP 8_07 LIB.GLB Log GAP NON-CORED FULL PAGE 127615025_TP19-39.GPJ <<DrawingFile>> 21/09/2012 13:23 8.2.856

REPORT OF TEST PIT PHOTOGRAPHS: TP39

CLIENT:	Santos Ltd	COORDS: 751647.0 m E 6623723.0 m N MGA94 56	SHEET: 1 OF 1
PROJECT:	Storage Ponds	SURFACE RL: DATUM: AHD	MACHINE: Excavator
LOCATION:	Narrabri	DIRECTION: 000°	CONTRACTOR: Specialised Civil Services
JOB NO:	127615025	PIT DEPTH: 4.00 m	LOGGED: MS DATE: 31/7/12
		BUCKET TYPE: 900mm-Toothed	CHECKED: DAA DATE: 21/8/12



1.



2.

This report of test pit photographs must be read in conjunction with accompanying notes and abbreviations. It has been prepared for geotechnical purposes only, without attempt to assess possible contamination. Any references to potential contamination are for information only and do not necessarily indicate the presence or absence of soil or groundwater contamination.

GAP 8_07 LIB.GLB GrfcTbl GAP TEST PIT PHOTO 2 PER PAGE 127615025_TP19-39.GPJ <<DrawingFile>> 21/09/2012 13:23 8.2.856

APPENDIX D

Explanation Notes and Terms, Method of Soil Description

METHOD OF SOIL DESCRIPTION USED ON BOREHOLE AND TEST PIT REPORTS


FILL


GRAVEL (GP or GW)


SAND (SP or SW)


SILT (ML or MH)


CLAY (CL, CI or CH)


ORGANIC SOILS (OL or OH or Pt)


COBBLES or BOULDERS

Combinations of these basic symbols may be used to indicate mixed materials such as sandy clay.

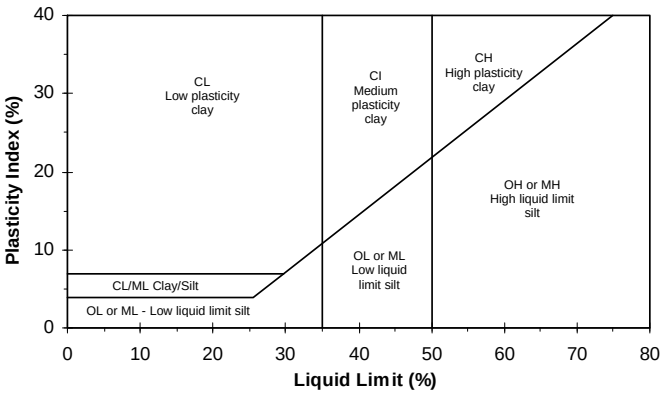
CLASSIFICATION AND INFERRED STRATIGRAPHY

Soil and Rock is classified and described in Reports of Boreholes and Test Pits using the preferred method given in AS1726 – 1993, (Amdt1 – 1994 and Amdt2 – 1994), Appendix A. The material properties are assessed in the field by visual/tactile methods.

Particle Size

Major Division	Sub Division	Particle Size
BOULDERS		> 200 mm
COBBLES		63 to 200 mm
GRAVEL	Coarse	20 to 63 mm
	Medium	6.0 to 20 mm
	Fine	2.0 to 6.0 mm
SAND	Coarse	0.6 to 2.0 mm
	Medium	0.2 to 0.6 mm
	Fine	0.075 to 0.2 mm
SILT		0.002 to 0.075 mm
CLAY		< 0.002 mm

Plasticity Properties



MOISTURE CONDITION

AS1726 - 1993

Symbol	Term	Description
D	Dry	Sands and gravels are free flowing. Clays & Silts may be brittle or friable and powdery.
M	Moist	Soils are darker than in the dry condition & may feel cool. Sands and gravels tend to cohere.
W	Wet	Soils exude free water. Sands and gravels tend to cohere.

CONSISTENCY AND DENSITY

AS1726 - 1993

Symbol	Term	Undrained Shear Strength
VS	Very Soft	0 to 12 kPa
S	Soft	12 to 25 kPa
F	Firm	25 to 50 kPa
St	Stiff	50 to 100 kPa
VSt	Very Stiff	100 to 200 kPa
H	Hard	Above 200 kPa

Symbol	Term	Density Index %	SPT "N" #
VL	Very Loose	Less than 15	0 to 4
L	Loose	15 to 35	4 to 10
MD	Medium Dense	35 to 65	10 to 30
D	Dense	65 to 85	30 to 50
VD	Very Dense	Above 85	Above 50

In the absence of test results, consistency and density may be assessed from correlations with the observed behaviour of the material.

SPT correlations are not stated in AS1726 – 1993, and may be subject to corrections for overburden pressure and equipment type.

EXPLANATION OF NOTES, ABBREVIATIONS & TERMS USED ON BOREHOLE AND TEST PIT REPORTS

DRILLING/EXCAVATION METHOD

AS*	Auger Screwing	RD	Rotary blade or drag bit	NQ	Diamond Core - 47 mm
AD*	Auger Drilling	RT	Rotary Tricone bit	NMLC	Diamond Core - 52 mm
*V	V-Bit	RAB	Rotary Air Blast	HQ	Diamond Core - 63 mm
*T	TC-Bit, e.g. ADT	RC	Reverse Circulation	HMLC	Diamond Core – 63mm
HA	Hand Auger	PT	Push Tube	BH	Tractor Mounted Backhoe
ADH	Hollow Auger	CT	Cable Tool Rig	EX	Tracked Hydraulic Excavator
DTC	Diatube Coring	JET	Jetting	EE	Existing Excavation
WB	Washbore or Bailer	NDD	Non-destructive digging	HAND	Excavated by Hand Methods

PENETRATION/EXCAVATION RESISTANCE

L **Low resistance.** Rapid penetration possible with little effort from the equipment used.

M **Medium resistance.** Excavation/possible at an acceptable rate with moderate effort from the equipment used.

H **High resistance** to penetration/excavation. Further penetration is possible at a slow rate and requires significant effort from the equipment.

R **Refusal or Practical Refusal.** No further progress possible without the risk of damage or unacceptable wear to the digging implement or machine.

These assessments are subjective and are dependent on many factors including the equipment power, weight, condition of excavation or drilling tools, and the experience of the operator.

WATER

▽	Water level at date shown	◁	Partial water loss
▷	Water inflow	◀	Complete water loss

GROUNDWATER NOT OBSERVED	The observation of groundwater, whether present or not, was not possible due to drilling water, surface seepage or cave in of the borehole/test pit.
GROUNDWATER NOT ENCOUNTERED	The borehole/test pit was dry soon after excavation. However, groundwater could be present in less permeable strata. Inflow may have been observed had the borehole/test pit been left open for a longer period.

SAMPLING AND TESTING

SPT	Standard Penetration Test to AS1289.6.3.1-2004
4,7,11 N=18	4,7,11 = Blows per 150mm. N = Blows per 300mm penetration following 150mm seating
30/80mm	Where practical refusal occurs, the blows and penetration for that interval are reported
RW	Penetration occurred under the rod weight only
HW	Penetration occurred under the hammer and rod weight only
HB	Hammer double bouncing on anvil
DS	Disturbed sample
BDS	Bulk disturbed sample
G	Gas Sample
W	Water Sample
FP	Field permeability test over section noted
FV	Field vane shear test expressed as uncorrected shear strength (s_v = peak value, s_r = residual value)
PID	Photoionisation Detector reading in ppm
PM	Pressuremeter test over section noted
PP	Pocket penetrometer test expressed as instrument reading in kPa
U63	Thin walled tube sample - number indicates nominal sample diameter in millimetres
WPT	Water pressure tests
DCP	Dynamic cone penetration test
CPT	Static cone penetration test
CPTu	Static cone penetration test with pore pressure (u) measurement

Ranking of Visually Observable Contamination and Odour (for specific soil contamination assessment projects)

R = 0	No visible evidence of contamination	R = A	No non-natural odours identified
R = 1	Slight evidence of visible contamination	R = B	Slight non-natural odours identified
R = 2	Visible contamination	R = C	Moderate non-natural odours identified
R = 3	Significant visible contamination	R = D	Strong non-natural odours identified

ROCK CORE RECOVERY

TCR = Total Core Recovery (%)

$$= \frac{\text{Length of core recovered}}{\text{Length of core run}} \times 100$$

SCR = Solid Core Recovery (%)

$$= \frac{\sum \text{Length of cylindrical core recovered}}{\text{Length of core run}} \times 100$$

RQD = Rock Quality Designation (%)

$$= \frac{\sum \text{Axial lengths of core} > 100 \text{ mm}}{\text{Length of core run}} \times 100$$

APPENDIX E

Summary of Laboratory Test Results

Table 1: Summary of laboratory test results

Test Pit No	Depth (m)	Atterberg Limits			Emerson Class Number	Natural Moisture Content (%)	Standard Compaction		Particle Size Distribution (% Passing)							Soil Description	USCS
		Liquid Limit	Plastic Limit	Plasticity Index			Standard Optimum Moisture Content (%)	MDD (t/m^3)	19 mm Sieve	9.5 mm Sieve	4.75 mm Sieve	2.36 mm Sieve	0.6 mm Sieve	0.425 mm Sieve	0.075 mm Sieve		
TP01	2.5-2.6	29	9	20		9.8										Silty Clayey SAND	SC
TP02	2-2.3	39	11	28		11.3	17	1.76	100	100	100	100	94	87	63	Silty CLAY	CI
TP03	0-0.1				4	22.6										Silty CLAY	CH
TP03	1.4-1.5	45	10	35		14.7	16	1.8								Silty CLAY	CI
TP04	0.4-0.5	37	9	28		11.6										Silty CLAY	CI
TP04	2.8-2.9	25	13	12	4	10.7			100	94	83	75	57	48	22	Silty SAND	SC
TP05	0-0.1				4	20										Silty Sandy CLAY	CI
TP05	1.1-1.4	38	10	28		12.8	15	1.78								Silty CLAY	CI
TP05	2.3-2.4	27	11	16		9.6										Silty CLAY	CL
TP06	1-1.3	35	10	25	4	10.8	14	1.83	100	100	100	100	93	85	57	Silty CLAY	CI
TP06	2.5-2.6	41	12	29		13.6			100	100	100	100	86	76	49	Silty Clayey SAND	SC
TP07	3.2-3.3	44	11	33		13.7										Silty Sandy CLAY	CI

Test Pit No	Depth (m)	Atterberg Limits			Emerson Class Number	Natural Moisture Content (%)	Standard Compaction		Particle Size Distribution (% Passing)							Soil Description	USCS
		Liquid Limit	Plastic Limit	Plasticity Index			Standard Optimum Moisture Content (%)	MDD (t/m^3)	19 mm Sieve	9.5 mm Sieve	4.75 mm Sieve	2.36 mm Sieve	0.6 mm Sieve	0.425 mm Sieve	0.075 mm Sieve		
TP09	0.1-0.2				4	13.5										Silty CLAY	CI
TP09	1.5-1.6	42	10	32	4	12.6			100	100	100	100	92	83	61	Silty Sandy CLAY	CI
TP09	2.6-2.7	40	13	27		14.4			100	100	100	99	94	89	71	Silty Sandy CLAY	CI
TP10	1.3-1.4	38	12	26		12.5			100	100	100	100	92	84	63	Silty CLAY	CI
TP10	1.9-2	18	9	9	4	5.5			100	98	95	90	76	66	38	Clayey SAND	SC
TP11	0.1-0.2				4	12.9										Sandy Clayey SILT	ML
TP11	0.2-0.5	27	10	17		9.1	12.5	1.87	100	100	100	99	87	79	52	Silty CLAY	CL
TP12	0.4-0.5	32	10	22	4	12.8			100	100	100	100	91	81	53	Silty CLAY	CL
TP12	1-1.3	35	12	23	4	11.2	16	1.73								Silty CLAY	CI
TP12	0-0.1				4	13.7										Silty CLAY	CH
TP13	1.8-1.9	21	8	13	4	8.1			100	100	100	97	63	50	33	Clayey SAND	SC
TP14	0.5-0.6	30	10	20		10.6			100	100	100	100	92	83	54	Silty CLAY	CL

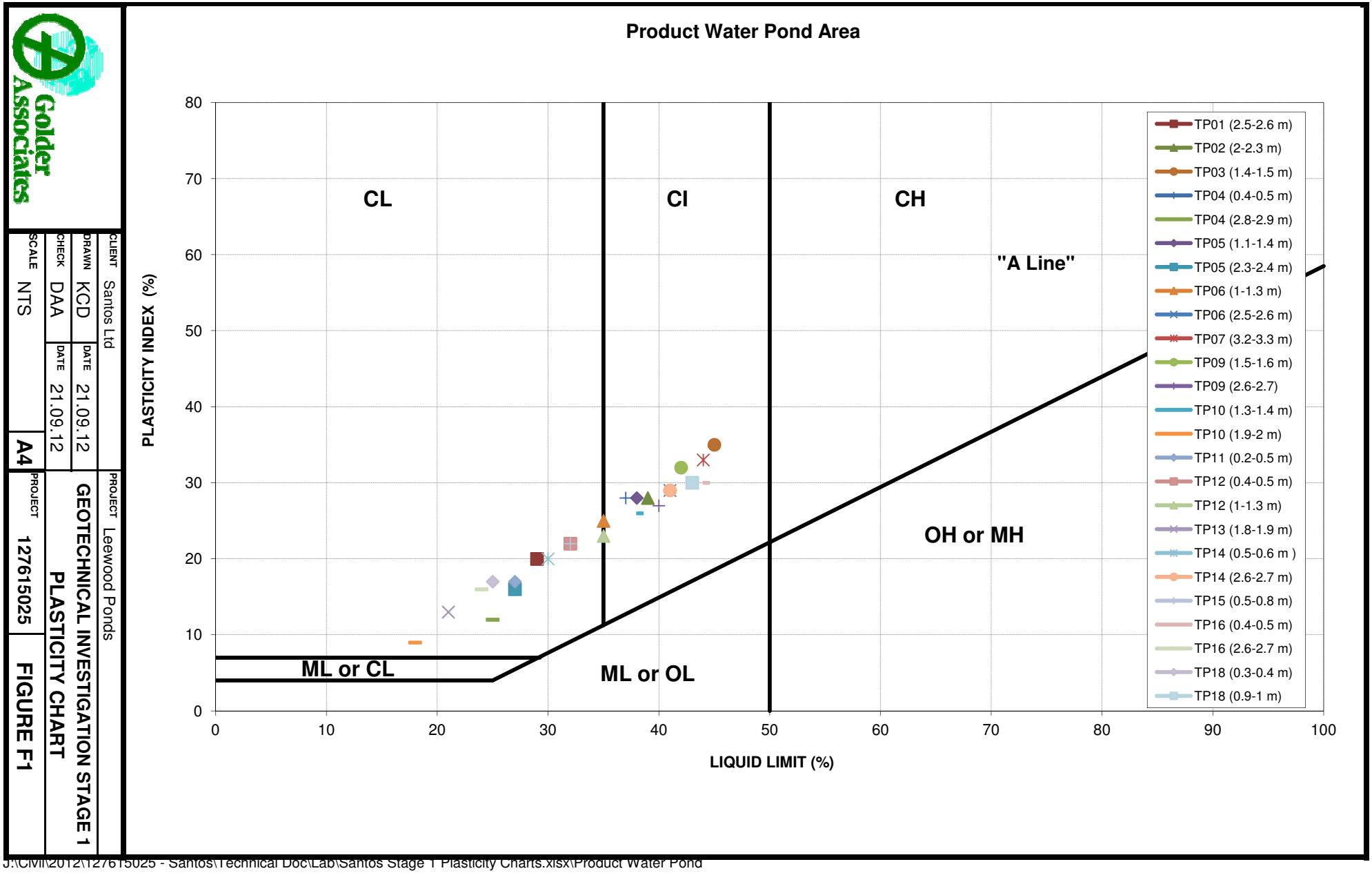
Test Pit No	Depth (m)	Atterberg Limits			Emerson Class Number	Natural Moisture Content (%)	Standard Compaction		Particle Size Distribution (% Passing)							Soil Description	USCS
		Liquid Limit	Plastic Limit	Plasticity Index			Standard Optimum Moisture Content (%)	MDD (t/m^3)	19 mm Sieve	9.5 mm Sieve	4.75 mm Sieve	2.36 mm Sieve	0.6 mm Sieve	0.425 mm Sieve	0.075 mm Sieve		
TP14	2.6-2.7	41	12	29		14.9			100	100	100	99	92	84	61	Silty CLAY	CI
TP15	0-0.1				4	13										Clayey SILT	ML
TP15	0.5-0.8	32	10	22		10.8	12.5	1.85								Silty CLAY	CL
TP16	0.4-0.5	44	14	30	4	15.6			100	100	100	100	95	91	79	Silty Sandy CLAY	CI
TP16	2.6-2.7	24	8	16		12.9										Silty CLAY	CL
TP17	0.2-0.3				4	12.1										Clayey SILT	ML
TP18	0.3-0.4	25	8	17	4	13.7			100	100	100	99	89	79	50	Clayey SAND	SC
TP18	0.9-1	43	13	30		11.8			100	100	100	99	91	84	54	Silty CLAY	CI
TP19	1.5-1.7	41	11	30	4	10.5	15	1.77	100	99	99	99	89	81	57	Sandy Silty CLAY	CI
TP20	0.4-0.5	26	9	17	4	10.7			100	100	100	100	91	82	52	Sandy Silty CLAY	CL
TP20	1.2-1.3					14.2										Sandy Silty CLAY	CI
TP21	0.4-0.5	30	11	19		11.5										Sandy Silty CLAY	CL

Test Pit No	Depth (m)	Atterberg Limits			Emerson Class Number	Natural Moisture Content (%)	Standard Compaction		Particle Size Distribution (% Passing)							Soil Description	USCS
		Liquid Limit	Plastic Limit	Plasticity Index			Standard Optimum Moisture Content (%)	MDD (t/m^3)	19 mm Sieve	9.5 mm Sieve	4.75 mm Sieve	2.36 mm Sieve	0.6 mm Sieve	0.425 mm Sieve	0.075 mm Sieve		
TP21	1.1-1.2	43	13	30		14.3			100	100	100	99	91	83	60	Sandy Silty CLAY	CI
TP22	1.1-1.2	42	10	32		13.4										Silty CLAY	CI
TP22	2.5-2.6	34	12	22	4	11.8			100	100	96	94	87	81	55	Silty CLAY	CL
TP23	1.8-1.9	45	17	28		14.3			100	100	100	100	94	86	63	Sandy Silty CLAY	CI
TP24	5-5.3	39	15	24		13.0	14.5	1.82	100	100	99	98	82	72	49	Silty Clayey SAND	SC
TP25	1.5-1.6	48	17	31		13.3										Sandy Silty CLAY	CI
TP26	0.3-0.4	28	9	19	4	13.3			100	100	100	100	91	81	54	Silty Sandy CLAY	CL
TP26	1-1.1	47	12	35		13.5										Silty Sandy CLAY	CI
TP26	3.1-3.2	32	11	21		13.3			100	100	100	100	91	81	54	Sandy CLAY	CL
TP28	2-2.4	39	10	29	4	10.6	15.5	1.8	100	100	100	100	90	81	57	Sandy Silty CLAY	CI
TP28	3.1-3.2	42	11	31	4	12.3			100	100	100	100	78	67	43	Silty Clayey SAND	SC
TP29	1-1.1	51	12	39		15.6			100	100	100	100	93	85	63	Silty Sandy CLAY	CH
TP30	0.2-0.3	17	7	10	4	12.6			100	100	100	100	87	74	36	Silty Clayey SAND	SC

Test Pit No	Depth (m)	Atterberg Limits			Emerson Class Number	Natural Moisture Content (%)	Standard Compaction		Particle Size Distribution (% Passing)							Soil Description	USCS
		Liquid Limit	Plastic Limit	Plasticity Index			Standard Optimum Moisture Content (%)	MDD (t/m^3)	19 mm Sieve	9.5 mm Sieve	4.75 mm Sieve	2.36 mm Sieve	0.6 mm Sieve	0.425 mm Sieve	0.075 mm Sieve		
TP30	2.4-2.5	37	10	27		11.6										Silty Sandy CLAY	CI
TP32	0.3-0.4	37	11	26	4	14			100	100	100	100	92	83	57	Sandy Silty CLAY	CI
TP32	1.5-1.6	48	11	37		13.7			100	97	96	94	87	79	56	Silty Sandy CLAY	CI
TP32	2-2.1	34	12	22	4	10			100	95	93	92	78	66	44	Silty Clayey SAND	SC
TP33	0.2-0.3	20	11	9		16.2			100	100	100	100	88	75	41	Silty Clayey SAND	SC
TP33	1.2-1.3	52	18	34		13.8			100	100	99	98	89	80	47	Clayey SAND	SC
TP34	0.2-0.3	29	9	20		13.4			100	100	100	100	89	78	50	Silty Clayey SAND	SC
TP34	1.8-1.9	28	13	15	4	12.8			100	100	100	100	94	86	61	Sandy Silty CLAY	CL
TP35	0.3-0.4	27	9	18	4	12.3			100	100	100	100	90	79	49	Clayey Silty SAND	SC
TP35	0.7-0.8	32	11	21		10.3			100	100	100	100	93	85	62	Silty CLAY	CL
TP36	0.3-0.4					10.3			100	100	100	100	89	80	51	Silty CLAY	CH
TP37	0.4-0.5	29	9	20		13.9										Silty Clayey SAND	SC

APPENDIX F

Plasticity Charts by Pond Area



Golder Associates

CLIENT: Santos Ltd

PROJECT: Leewood Ponds

GEOTECHNICAL INVESTIGATION STAGE 1

PLASTICITY CHART

FIGURE F1

PROJECT: 127615025

SCALE: NTS

A4

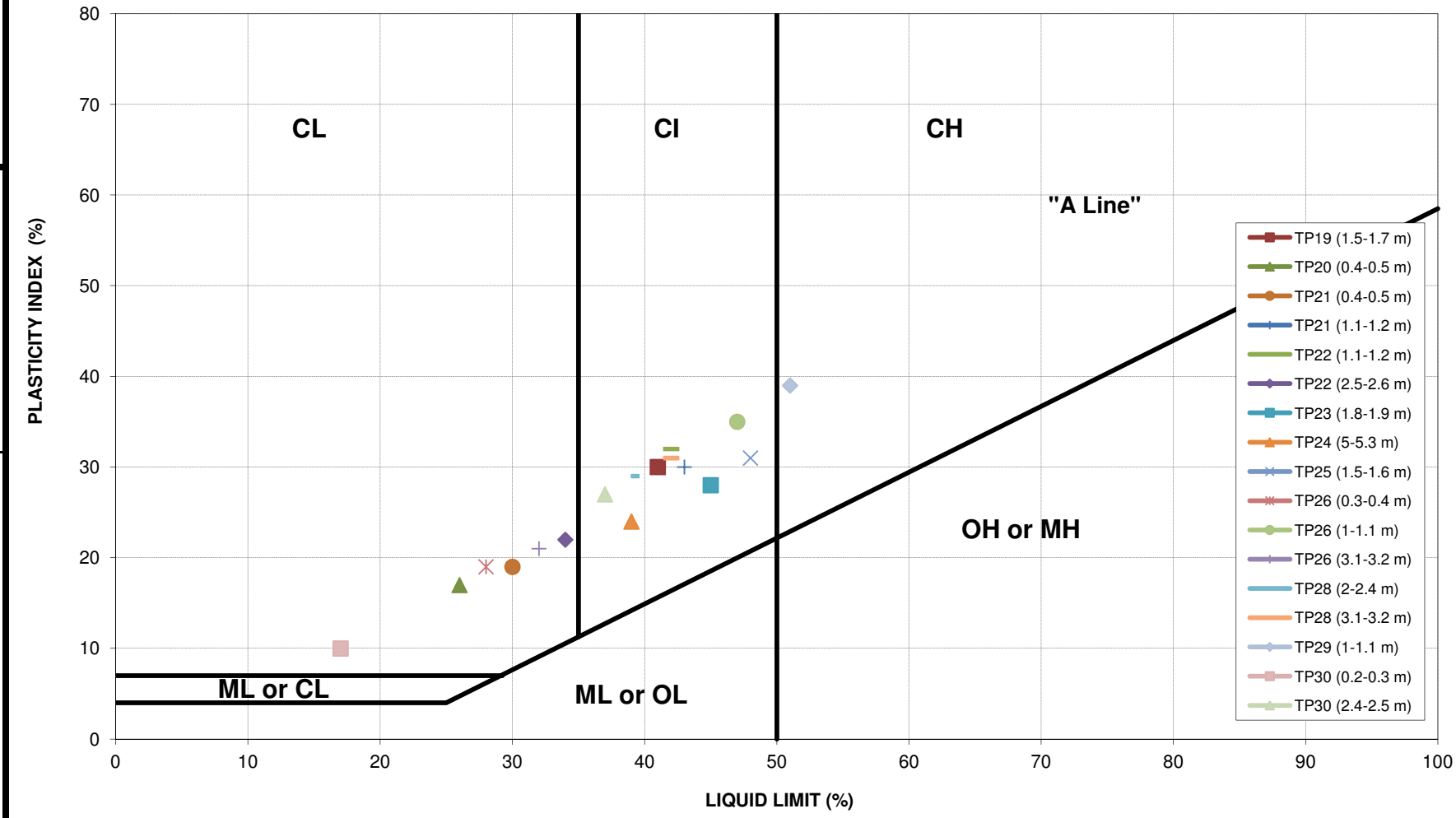
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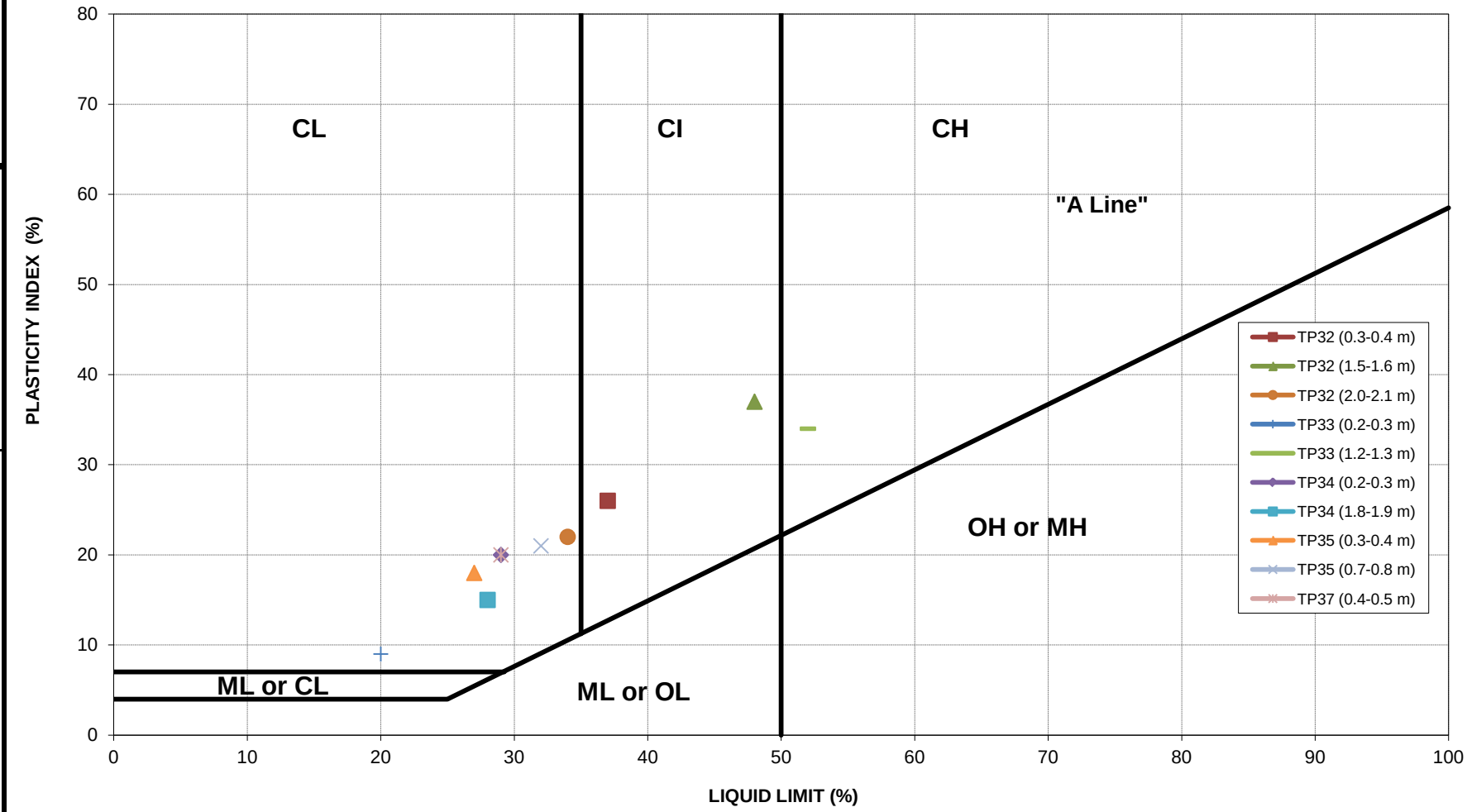
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Golder Associates

CLIENT	Santos Ltd
DRAWN	KCD
DATE	21.09.12
CHECK	DAA
DATE	21.09.12
SCALE	NTS
	A4
PROJECT	Leewood Ponds
	GEOTECHNICAL INVESTIGATION STAGE 1
	PLASTICITY CHART
PROJECT	127615025
	FIGURE F2



J:\CIVIL\2012\127615025 - Santos\Technical Doc\Lab\Santos Stage 1 Plasticity Charts.xlsx\Brine Pond



Golder Associates

CLIENT: Santos Ltd

PROJECT: Leewood Ponds

GEOTECHNICAL INVESTIGATION STAGE 1

PLASTICITY CHART

PROJECT: 127615025

FIGURE F3

SCALE	CHECK	DRAWN	DATE
NTS	DAA	KCD	21.09.12
A4	DATE 01.10.12		

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APPENDIX G

Laboratory Test Results - Moisture Content, Particle Size Distribution, Atterberg Limits and Emerson Class

SOUTH QLD SOILS PTY LTD
AS TRUSTEE FOR THE F&B TRUST
ABN 35 229 054 612
Site Investigations, Soil, Aggregate & Concrete Testing Services

BRISBANE LABORATORY
46 Grice Street Clontarf Q 4019
Phone: (07) 32848766
Fax: (07) 32844391

Report No: MAT:S122-873
Issue No: 1

Material Test Report

Client:
Golder Associates Pty Ltd
PO Box 6079
Hawthorn West VIC 3122

Project: Santos Storage Ponds "Narrabri" (127615025)

This document is issued in accordance with NATA's accreditation requirements. Accredited for compliance with ISO/IEC 17025.

Accreditation No. 2911

Approved Signatory: David Hall

Date of Issue: 21/08/2012

THIS DOCUMENT SHALL NOT BE REPRODUCED EXCEPT IN FULL

Sample Details

Sample ID:	S122-873
Client Sample:	TP01-002
Test Request No:	N/A
Sampled By:	Client
Sampling Method:	Disturbed Sample
Date Sampled:	3/08/2012
Lot No:	N/A
Source:	In-Situ
Material:	Refer to Log.
Specification:	All Purpose Grading
Location:	TP.01, Depth:2.5-2.6m

Test Results

Description	Method	Result	Limits
Moisture Content (%)	AS 1289.2.1.1	9.8	
Date Tested		13/08/2012	
Sample History	AS 1289.1.1	Oven-dried	
Preparation	AS 1289.1.1	Dry Sieved	
Linear Shrinkage (%)	AS 1289.3.4.1	N/A	
Mould Length (mm)		0	
Crumbling		No	
Curling		No	
Liquid Limit (%)	AS 1289.3.1.2	29	
Method		One Point	
Plastic Limit (%)	AS 1289.3.2.1	9	
Plasticity Index (%)	AS 1289.3.3.1	20	
Date Tested		20/08/2012	

Comments

N/A

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SOUTH QLD SOILS PTY LTD
AS TRUSTEE FOR THE F&B TRUST
ABN 35 229 054 612
Site Investigations, Soil, Aggregate & Concrete Testing Services

BRISBANE LABORATORY
46 Grice Street Clontarf Q 4019
Phone: (07) 32848766
Fax: (07) 32844391

Material Test Report

Report No: MAT:S122-849
Issue No: 1

Client:
Golder Associates Pty Ltd
PO Box 6079
Hawthorn West VIC 3122

Project: Santos Storage Ponds "Narrabri" (127615025)

NATA
Accreditation No. 2911

This document is issued in accordance with NATA's accreditation requirements. Accredited for compliance with ISO/IEC 17025.

Approved Signatory: David Hall

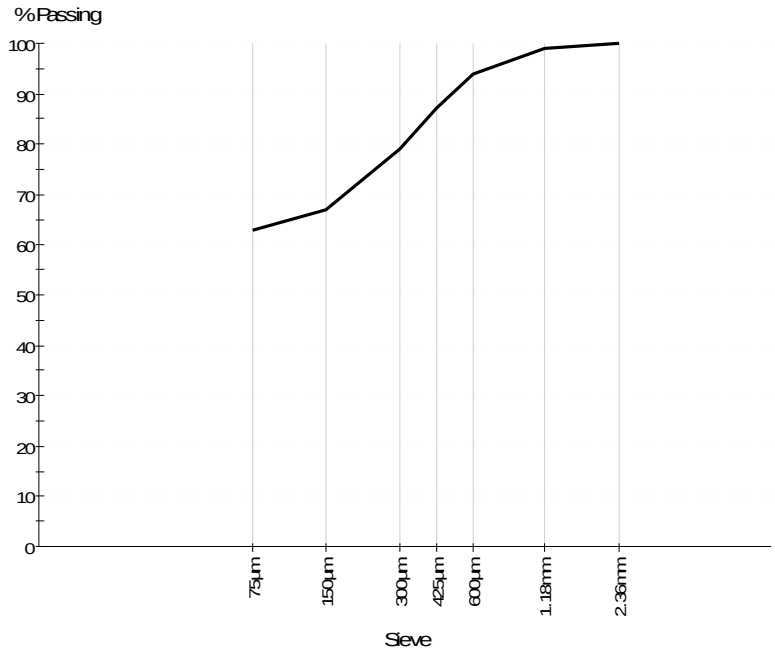
Date of Issue: 21/08/2012

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Sample Details

Sample ID:	S122-849
Client Sample:	TP02-002
Test Request No:	N/A
Sampled By:	Client
Sampling Method:	Disturbed Sample
Date Sampled:	4/08/2012
Lot No:	N/A
Source:	In-Situ
Material:	Refer to Log.
Specification:	All Purpose Grading
Location:	TP.02, Depth:2.0-2.3m

Particle Size Distribution



FINES (63.0%)		SAND			GRAVEL		COBBLES
Clay	Silt	Fine (24.0%)	Medium (12.7%)	Coarse (0.3%)	Fine (0.0%)	Coarse (0.0%)	(0.0%)

Atterberg Limit:

Liquid Limit:	39
Plastic Limit:	11
Plasticity Index:	28
Linear Shrinkage (%):	N/A

Sample Description:

Grading: AS 1289.3.6.1

Drying by: Oven
Date Tested: 16/08/2012
Note: Sample Washed

Sieve Size	% Passing	Limits
2.36mm	100	
1.18mm	99	
600µm	94	
425µm	87	
300µm	79	
150µm	67	
75µm	63	

D85: 0.3896 **D60:** 0.0446 **D50:** 0.0079
D30: 0.0002 **D15:** 0.0000 **D10:** 0.0000

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ABN 35 229 054 612
Site Investigations, Soil, Aggregate & Concrete Testing Services

BRISBANE LABORATORY
46 Grice Street Clontarf Q 4019
Phone: (07) 32848766
Fax: (07) 32844391

Material Test Report

Report No: MAT:S122-849
Issue No: 1

Client:
Golder Associates Pty Ltd
PO Box 6079
Hawthorn West VIC 3122

Project: Santos Storage Ponds "Narrabri" (127615025)

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Accreditation No. 2911

Approved Signatory: David Hall

Date of Issue: 21/08/2012

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Sample Details

Sample ID:	S122-849
Client Sample:	TP02-002
Test Request No:	N/A
Sampled By:	Client
Sampling Method:	Disturbed Sample
Date Sampled:	4/08/2012
Lot No:	N/A
Source:	In-Situ
Material:	Refer to Log.
Specification:	All Purpose Grading
Location:	TP.02, Depth:2.0-2.3m

Other Test Results

Description	Method	Result	Limits
Moisture Content (%)	AS 1289.2.1.1	11.3	
Date Tested		13/08/2012	
Sample History	AS 1289.1.1	Oven-dried	
Preparation	AS 1289.1.1	Dry Sieved	
Linear Shrinkage (%)	AS 1289.3.4.1	N/A	
Mould Length (mm)		0	
Crumbling		No	
Curling		No	
Liquid Limit (%)	AS 1289.3.1.2	39	
Method		One Point	
Plastic Limit (%)	AS 1289.3.2.1	11	
Plasticity Index (%)	AS 1289.3.3.1	28	
Date Tested		20/08/2012	
Standard Maximum Dry Density (t/m³)	AS 1289.5.1.1	1.76	
Standard Optimum Moisture Content (%)		17.0	
Retained Sieve 19mm (%)			
Date Tested		14/08/2012	

Comments

N/A

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BRISBANE LABORATORY
46 Grice Street Clontarf Q 4019
Phone: (07) 32848766
Fax: (07) 32844391

Report No: MAT:S122-874
Issue No: 1

Material Test Report

Client:
Golder Associates Pty Ltd
PO Box 6079
Hawthorn West VIC 3122

Project: Santos Storage Ponds "Narrabri" (127615025)

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Accreditation No. 2911

Approved Signatory: David Hall

Date of Issue: 21/08/2012

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Sample Details

Sample ID:	S122-874
Client Sample:	TP03-001
Test Request No:	N/A
Sampled By:	Client
Sampling Method:	Disturbed Sample
Date Sampled:	3/08/2012
Lot No:	N/A
Source:	In-Situ
Material:	Refer to Log.
Specification:	All Purpose Grading
Location:	TP.03, Depth:0.0-0.1m

Test Results

Description	Method	Result	Limits
Moisture Content (%)	AS 1289.2.1.1	22.6	
Date Tested		13/08/2012	
Emerson Class Number	AS 1289.3.8.1	4	
Soil Description		Refer to Log	
Type of Water		Distilled	
Temperature of Water (℃)		21	
Date Tested		16/08/2012	

Comments

N/A

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BRISBANE LABORATORY
46 Grice Street Clontarf Q 4019
Phone: (07) 32848766
Fax: (07) 32844391

Report No: MAT:S122-875
Issue No: 1

Material Test Report

Client:
Golder Associates Pty Ltd
PO Box 6079
Hawthorn West VIC 3122

Project: Santos Storage Ponds "Narrabri" (127615025)

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Accreditation No. 2911

Approved Signatory: David Hall

Date of Issue: 21/08/2012

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Sample Details

Sample ID: S122-875
Client Sample: TP03-002
Test Request No: N/A
Sampled By: Client
Sampling Method: Disturbed Sample
Date Sampled: 3/08/2012
Lot No: N/A
Source: In-Situ
Material: Refer to Log.
Specification: All Purpose Grading
Location: TP.03, Depth:1.4-1.5m

Test Results

Description	Method	Result	Limits
Standard Maximum Dry Density (t/m³)	AS 1289.5.1.1	1.80	
Standard Optimum Moisture Content (%)		16.0	
Retained Sieve 19mm (%)		0	
Date Tested		20/08/2012	
Sample History	AS 1289.1.1	Oven-dried	
Preparation	AS 1289.1.1	Dry Sieved	
Linear Shrinkage (%)	AS 1289.3.4.1	N/A	
Mould Length (mm)		0	
Crumbling		No	
Curling		No	
Liquid Limit (%)	AS 1289.3.1.2	45	
Method		One Point	
Plastic Limit (%)	AS 1289.3.2.1	10	
Plasticity Index (%)	AS 1289.3.3.1	35	
Date Tested		20/08/2012	
Moisture Content (%)	AS 1289.2.1.1	14.7	
Date Tested		13/08/2012	

Comments

N/A

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BRISBANE LABORATORY
46 Grice Street Clontarf Q 4019
Phone: (07) 32848766
Fax: (07) 32844391

Material Test Report

Report No: MAT:S122-858
Issue No: 1

Client:
Golder Associates Pty Ltd
PO Box 6079
Hawthorn West VIC 3122

Project: Santos Storage Ponds "Narrabri" (127615025)

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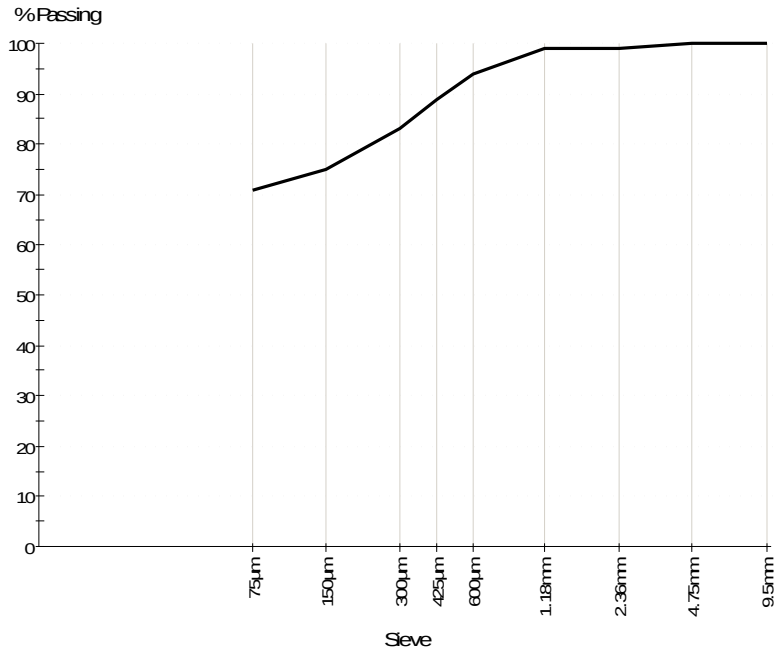
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Sample Details

Sample ID:	S122-858
Client Sample:	TP09-003
Test Request No:	N/A
Sampled By:	Client
Sampling Method:	Disturbed Sample
Date Sampled:	4/08/2012
Lot No:	N/A
Source:	In-Situ
Material:	Refer to Log.
Specification:	All Purpose Grading
Location:	TP.003, Depth:2.6-2.7m

Particle Size Distribution



FINES (71.0%)		SAND			GRAVEL		COBBLES
Clay	Silt	Fine (18.0%)	Medium (10.0%)	Coarse (1.0%)	Fine (0.0%)	Coarse (0.0%)	(0.0%)

Atterberg Limit:

Liquid Limit:	40
Plastic Limit:	13
Plasticity Index:	27
Linear Shrinkage (%):	N/A

Sample Description:

Grading: AS 1289.3.6.1

Drying by: Oven
Date Tested: 16/08/2012
Note: Sample Washed

Sieve Size	% Passing	Limits
9.5mm	100	
4.75mm	100	
2.36mm	99	
1.18mm	99	
600µm	94	
425µm	89	
300µm	83	
150µm	75	
75µm	71	

D85: 0.0000 **D60:** 0.0111 **D50:** 0.0020
D30: 0.0001 **D15:** 0.0000 **D10:** 0.0000

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BRISBANE LABORATORY
46 Grice Street Clontarf Q 4019
Phone: (07) 32848766
Fax: (07) 32844391

Report No: MAT:S122-858
Issue No: 1

Material Test Report

Client:
Golder Associates Pty Ltd
PO Box 6079
Hawthorn West VIC 3122

Project: Santos Storage Ponds "Narrabri" (127615025)

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Approved Signatory: David Hall

Date of Issue: 21/08/2012

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Sample Details

Sample ID: S122-858
Client Sample: TP09-003
Test Request No: N/A
Sampled By: Client
Sampling Method: Disturbed Sample
Date Sampled: 4/08/2012
Lot No: N/A
Source: In-Situ
Material: Refer to Log.
Specification: All Purpose Grading
Location: TP.003, Depth:2.6-2.7m

Other Test Results

Description	Method	Result	Limits
Moisture Content (%)	AS 1289.2.1.1	14.4	
Date Tested		13/08/2012	
Sample History	AS 1289.1.1	Oven-dried	
Preparation	AS 1289.1.1	Dry Sieved	
Linear Shrinkage (%)	AS 1289.3.4.1	N/A	
Mould Length (mm)		0	
Crumbling		No	
Curling		No	
Liquid Limit (%)	AS 1289.3.1.2	40	
Method		One Point	
Plastic Limit (%)	AS 1289.3.2.1	13	
Plasticity Index (%)	AS 1289.3.3.1	27	
Date Tested		20/08/2012	

Comments

N/A

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BRISBANE LABORATORY
46 Grice Street Clontarf Q 4019
Phone: (07) 32848766
Fax: (07) 32844391

Report No: MAT:S122-850
Issue No: 1

Material Test Report

Client:
Golder Associates Pty Ltd
PO Box 6079
Hawthorn West VIC 3122

Project: Santos Storage Ponds "Narrabri" (127615025)

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Date of Issue: 21/08/2012

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Sample Details

Sample ID:	S122-850
Client Sample:	TP04-001
Test Request No:	N/A
Sampled By:	Client
Sampling Method:	Disturbed Sample
Date Sampled:	4/08/2012
Lot No:	N/A
Source:	In-Situ
Material:	Refer to Log.
Specification:	All Purpose Grading
Location:	TP.04, Depth:0.4-0.5m

Test Results

Description	Method	Result	Limits
Moisture Content (%)	AS 1289.2.1.1	11.6	
Date Tested		13/08/2012	
Sample History	AS 1289.1.1	Oven-dried	
Preparation	AS 1289.1.1	Dry Sieved	
Linear Shrinkage (%)	AS 1289.3.4.1	N/A	
Mould Length (mm)		0	
Crumbling		No	
Curling		No	
Liquid Limit (%)	AS 1289.3.1.2	37	
Method		One Point	
Plastic Limit (%)	AS 1289.3.2.1	9	
Plasticity Index (%)	AS 1289.3.3.1	28	
Date Tested		20/08/2012	

Comments

N/A

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Phone: (07) 32848766
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Material Test Report

Report No: MAT:S122-851
Issue No: 1

Client:
Golder Associates Pty Ltd
PO Box 6079
Hawthorn West VIC 3122

Project: Santos Storage Ponds "Narrabri" (127615025)

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Approved Signatory: David Hall

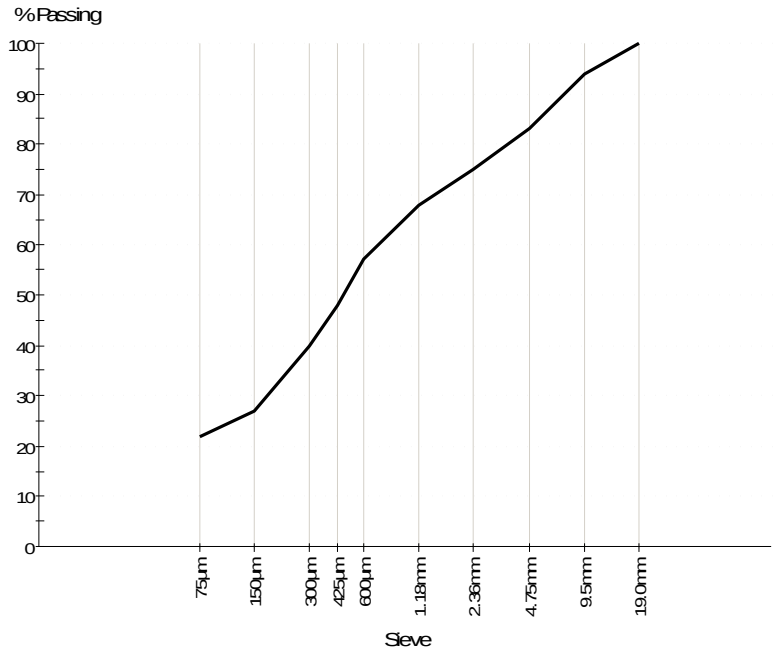
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Sample Details

Sample ID:	S122-851
Client Sample:	TP04-003
Test Request No:	N/A
Sampled By:	Client
Sampling Method:	Disturbed Sample
Date Sampled:	4/08/2012
Lot No:	N/A
Source:	In-Situ
Material:	Refer to Log.
Specification:	All Purpose Grading
Location:	TP04, Depth:2.8-2.9m

Particle Size Distribution



FINES (22.0%)		SAND			GRAVEL		COBBLES
Clay	Silt	Fine (26.0%)	Medium (24.9%)	Coarse (10.1%)	Fine (17.0%)	Coarse (0.0%)	(0.0%)

Atterberg Limit:

Liquid Limit:	25
Plastic Limit:	13
Plasticity Index:	12
Linear Shrinkage (%):	N/A

Sample Description:

Grading: AS 1289.3.6.1

Drying by: Oven
Date Tested: 1/09/2012
Note: Sample Washed

Sieve Size	% Passing	Limits
19.0mm	100	
9.5mm	94	
4.75mm	83	
2.36mm	75	
1.18mm	68	
600µm	57	
425µm	48	
300µm	40	
150µm	27	
75µm	22	

D85: 5.3880 **D60:** 0.7215 **D50:** 0.4588
D30: 0.1760 **D15:** 0.0284 **D10:** 0.0142

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46 Grice Street Clontarf Q 4019
Phone: (07) 32848766
Fax: (07) 32844391

Report No: MAT:S122-851
Issue No: 1

Material Test Report

Client:
Golder Associates Pty Ltd
PO Box 6079
Hawthorn West VIC 3122

Project: Santos Storage Ponds "Narrabri" (127615025)

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Approved Signatory: David Hall

Date of Issue: 11/09/2012

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Sample Details

Sample ID: S122-851
Client Sample: TP04-003
Test Request No: N/A
Sampled By: Client
Sampling Method: Disturbed Sample
Date Sampled: 4/08/2012
Lot No: N/A
Source: In-Situ
Material: Refer to Log.
Specification: All Purpose Grading
Location: TP04, Depth:2.8-2.9m

Other Test Results

Description	Method	Result	Limits
Sample History	AS 1289.1.1	Oven-dried	
Preparation	AS 1289.1.1	Dry Sieved	
Linear Shrinkage (%)	AS 1289.3.4.1	N/A	
Mould Length (mm)		0	
Crumbling		No	
Curling		No	
Liquid Limit (%)	AS 1289.3.1.2	25	
Method		One Point	
Plastic Limit (%)	AS 1289.3.2.1	13	
Plasticity Index (%)	AS 1289.3.3.1	12	
Date Tested		2/09/2012	
Moisture Content (%)	AS 1289.2.1.1	10.7	
Date Tested		31/08/2012	
Emerson Class Number	AS 1289.3.8.1	4	
Soil Description		Refer to Log	
Type of Water		Distilled	
Temperature of Water (℃)		23	
Date Tested		1/09/2012	

Comments

N/A

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46 Grice Street Clontarf Q 4019
Phone: (07) 32848766
Fax: (07) 32844391

Report No: MAT:S122-852
Issue No: 1

Material Test Report

Client:
Golder Associates Pty Ltd
PO Box 6079
Hawthorn West VIC 3122

Project: Santos Storage Ponds "Narrabri" (127615025)

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Approved Signatory: David Hall

Date of Issue: 11/09/2012

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Sample Details

Sample ID:	S122-852
Client Sample:	TP05-003
Test Request No:	N/A
Sampled By:	Client
Sampling Method:	Disturbed Sample
Date Sampled:	4/08/2012
Lot No:	N/A
Source:	In-Situ
Material:	Refer to Log.
Specification:	All Purpose Grading
Location:	TP05, Depth:0.0-0.1m

Test Results

Description	Method	Result	Limits
Emerson Class Number	AS 1289.3.8.1	4	
Soil Description		Refer to Log	
Type of Water		Distilled	
Temperature of Water (℃)		23	
Date Tested		30/08/2012	
Moisture Content (%)	AS 1289.2.1.1	20.0	
Date Tested		28/08/2012	

Comments

N/A

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BRISBANE LABORATORY
46 Grice Street Clontarf Q 4019
Phone: (07) 32848766
Fax: (07) 32844391

Report No: MAT:S122-853
Issue No: 1

Material Test Report

Client:
Golder Associates Pty Ltd
PO Box 6079
Hawthorn West VIC 3122

Project: Santos Storage Ponds "Narrabri" (127615025)

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Approved Signatory: David Hall

Date of Issue: 22/08/2012

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Sample Details

Sample ID: S122-853
Client Sample: TP05-001
Test Request No: N/A
Sampled By: Client
Sampling Method: Bulk Sample
Date Sampled: 4/08/2012
Lot No: N/A
Source: In-Situ
Material: Refer to Log.
Specification: All Purpose Grading
Location: TP.05, Depth:1.1-1.4m

Test Results

Description	Method	Result	Limits
Sample History	AS 1289.1.1	Oven-dried	
Preparation	AS 1289.1.1	Dry Sieved	
Linear Shrinkage (%)	AS 1289.3.4.1	N/A	
Mould Length (mm)		0	
Crumbling		No	
Curling		No	
Liquid Limit (%)	AS 1289.3.1.2	38	
Method		One Point	
Plastic Limit (%)	AS 1289.3.2.1	10	
Plasticity Index (%)	AS 1289.3.3.1	28	
Date Tested		21/08/2012	
Moisture Content (%)	AS 1289.2.1.1	12.8	
Date Tested		13/08/2012	
Standard Maximum Dry Density (t/m³)	AS 1289.5.1.1	1.78	
Standard Optimum Moisture Content (%)		15.0	
Retained Sieve 19mm (%)			
Date Tested		20/08/2012	

Comments

N/A

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Phone: (07) 32848766
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Report No: MAT:S122-854
Issue No: 1

Material Test Report

Client:
Golder Associates Pty Ltd
PO Box 6079
Hawthorn West VIC 3122

Project: Santos Storage Ponds "Narrabri" (127615025)

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Approved Signatory: David Hall

Date of Issue: 11/09/2012

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Sample Details

Sample ID: S122-854
Client Sample: TP05-003
Test Request No: N/A
Sampled By: Client
Sampling Method: Disturbed Sample
Date Sampled: 4/08/2012
Lot No: N/A
Source: In-Situ
Material: Refer to Log.
Specification: All Purpose Grading
Location: TP05, Depth:2.7-2.8m

Test Results

Description	Method	Result	Limits
Moisture Content (%)	AS 1289.2.1.1	9.6	
Date Tested		28/08/2012	
Sample History	AS 1289.1.1	Oven-dried	
Preparation	AS 1289.1.1	Dry Sieved	
Linear Shrinkage (%)	AS 1289.3.4.1	N/A	
Mould Length (mm)		0	
Crumbling		No	
Curling		No	
Liquid Limit (%)	AS 1289.3.1.2	27	
Method		One Point	
Plastic Limit (%)	AS 1289.3.2.1	11	
Plasticity Index (%)	AS 1289.3.3.1	16	
Date Tested		29/08/2012	

Comments

N/A

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BRISBANE LABORATORY
46 Grice Street Clontarf Q 4019
Phone: (07) 32848766
Fax: (07) 32844391

Material Test Report

Report No: MAT:S122-876
Issue No: 1

Client:
Golder Associates Pty Ltd
PO Box 6079
Hawthorn West VIC 3122

Project: Santos Storage Ponds "Narrabri" (127615025)

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Approved Signatory: David Hall

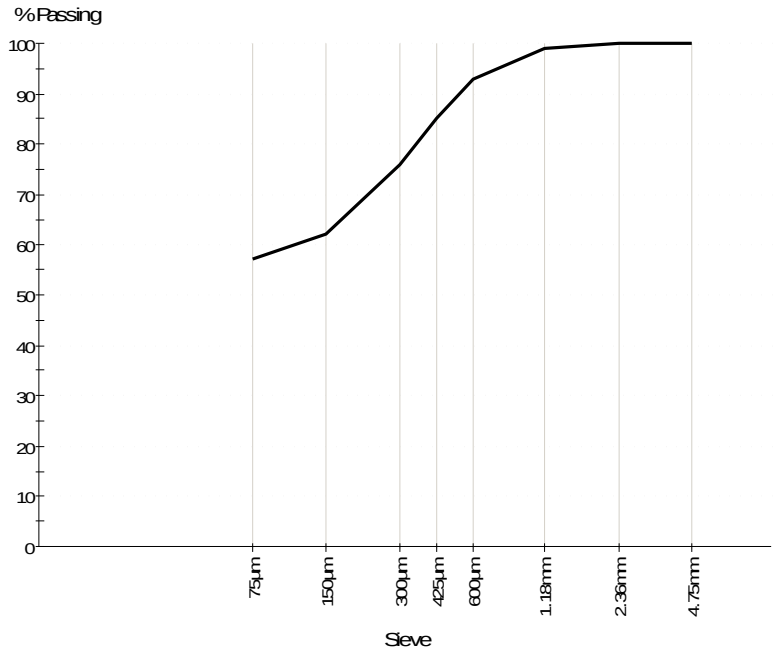
Date of Issue: 22/08/2012

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Sample Details

Sample ID:	S122-876
Client Sample:	TP06-001
Test Request No:	N/A
Sampled By:	Client
Sampling Method:	Bulk Sample
Date Sampled:	3/08/2012
Lot No:	N/A
Source:	In-Situ
Material:	Refer to Log.
Specification:	All Purpose Grading
Location:	TP.06, Depth:1.0-1.3m

Particle Size Distribution



FINES (57.0%)		SAND			GRAVEL		COBBLES
Clay	Silt	Fine (28.0%)	Medium (14.7%)	Coarse (0.3%)	Fine (0.0%)	Coarse (0.0%)	(0.0%)

Atterberg Limit:

Liquid Limit:	35
Plastic Limit:	10
Plasticity Index:	25
Linear Shrinkage (%):	N/A

Sample Description:

Grading: AS 1289.3.6.1

Drying by: Oven
Date Tested: 17/08/2012
Note: Sample Washed

Sieve Size	% Passing	Limits
4.75mm	100	
2.36mm	100	
1.18mm	99	
600µm	93	
425µm	85	
300µm	76	
150µm	62	
75µm	57	

D85: 0.4250 **D60:** 0.1137 **D50:** 0.0284
D30: 0.0018 **D15:** 0.0002 **D10:** 0.0001

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BRISBANE LABORATORY
46 Grice Street Clontarf Q 4019
Phone: (07) 32848766
Fax: (07) 32844391

Material Test Report

Report No: MAT:S122-876
Issue No: 1

Client:
Golder Associates Pty Ltd
PO Box 6079
Hawthorn West VIC 3122

Project: Santos Storage Ponds "Narrabri" (127615025)

NATA
Accreditation No. 2911

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Approved Signatory: David Hall

Date of Issue: 22/08/2012

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Sample Details

Sample ID: S122-876
Client Sample: TP06-001
Test Request No: N/A
Sampled By: Client
Sampling Method: Bulk Sample
Date Sampled: 3/08/2012
Lot No: N/A
Source: In-Situ
Material: Refer to Log.
Specification: All Purpose Grading
Location: TP.06, Depth:1.0-1.3m

Other Test Results

Description	Method	Result	Limits
Moisture Content (%)	AS 1289.2.1.1	10.8	
Date Tested		13/08/2012	
Sample History	AS 1289.1.1	Oven-dried	
Preparation	AS 1289.1.1	Dry Sieved	
Linear Shrinkage (%)	AS 1289.3.4.1	N/A	
Mould Length (mm)		0	
Crumbling		No	
Curling		No	
Liquid Limit (%)	AS 1289.3.1.2	35	
Method		One Point	
Plastic Limit (%)	AS 1289.3.2.1	10	
Plasticity Index (%)	AS 1289.3.3.1	25	
Date Tested		21/08/2012	
Emerson Class Number	AS 1289.3.8.1	4	
Soil Description		Refer to Log	
Type of Water		Distilled	
Temperature of Water (℃)		4	
Date Tested		16/08/2012	
Standard Maximum Dry Density (t/m³)	AS 1289.5.1.1	1.83	
Standard Optimum Moisture Content (%)		14.0	
Retained Sieve 19mm (%)		0	
Date Tested		20/08/2012	

Comments

N/A

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AS TRUSTEE FOR THE F&B TRUST
ABN 35 229 054 612
Site Investigations, Soil, Aggregate & Concrete Testing Services

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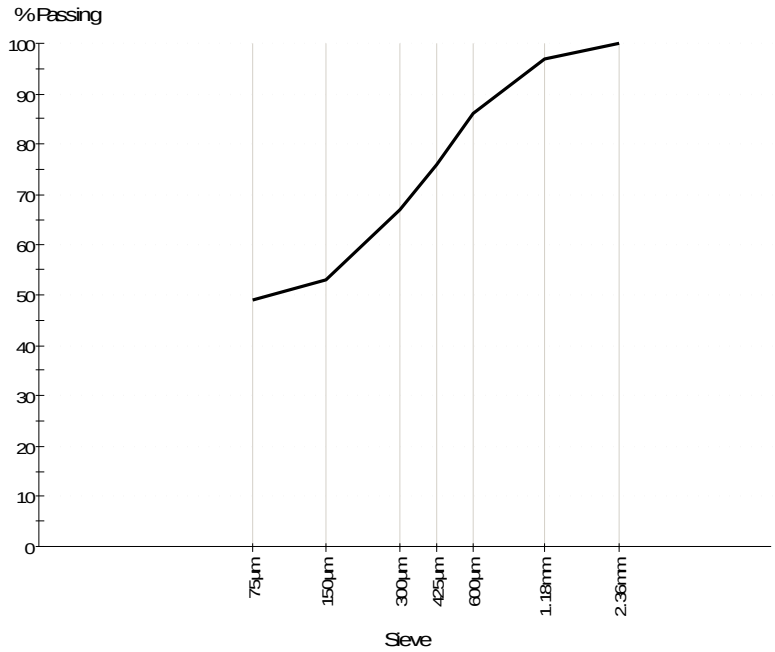
Date of Issue: 22/08/2012

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Sample Details

Sample ID:	S122-877
Client Sample:	TP06-002
Test Request No:	N/A
Sampled By:	Client
Sampling Method:	Bulk Sample
Date Sampled:	3/08/2012
Lot No:	N/A
Source:	In-Situ
Material:	Refer to Log.
Specification:	All Purpose Grading
Location:	TP.06, Depth:1.0-1.3m

Particle Size Distribution



FINES (49.0%)		SAND			GRAVEL		COBBLES
Clay	Silt	Fine (27.0%)	Medium (23.1%)	Coarse (0.9%)	Fine (0.0%)	Coarse (0.0%)	(0.0%)

Atterberg Limit:

Liquid Limit:	41
Plastic Limit:	12
Plasticity Index:	29
Linear Shrinkage (%):	N/A

Sample Description:

Grading: AS 1289.3.6.1

Drying by: Oven
Date Tested: 17/08/2012
Note: Sample Washed

Sieve Size	% Passing	Limits
2.36mm	100	
1.18mm	97	
600µm	86	
425µm	76	
300µm	67	
150µm	53	
75µm	49	

D85: 0.5797 **D60:** 0.2121 **D50:** 0.0892
D30: 0.0028 **D15:** 0.0002 **D10:** 0.0001

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Report No: MAT:S122-877
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Sample Details

Sample ID: S122-877
Client Sample: TP06-002
Test Request No: N/A
Sampled By: Client
Sampling Method: Bulk Sample
Date Sampled: 3/08/2012
Lot No: N/A
Source: In-Situ
Material: Refer to Log.
Specification: All Purpose Grading
Location: TP.06, Depth:1.0-1.3m

Other Test Results

Description	Method	Result	Limits
Moisture Content (%)	AS 1289.2.1.1	13.6	
Date Tested		13/08/2012	
Sample History	AS 1289.1.1	Oven-dried	
Preparation	AS 1289.1.1	Dry Sieved	
Linear Shrinkage (%)	AS 1289.3.4.1	N/A	
Mould Length (mm)		0	
Crumbling		No	
Curling		No	
Liquid Limit (%)	AS 1289.3.1.2	41	
Method		One Point	
Plastic Limit (%)	AS 1289.3.2.1	12	
Plasticity Index (%)	AS 1289.3.3.1	29	
Date Tested		21/08/2012	

Comments

N/A

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BRISBANE LABORATORY
46 Grice Street Clontarf Q 4019
Phone: (07) 32848766
Fax: (07) 32844391

Report No: MAT:S122-855
Issue No: 1

Material Test Report

Client:
Golder Associates Pty Ltd
PO Box 6079
Hawthorn West VIC 3122

Project: Santos Storage Ponds "Narrabri" (127615025)

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Accreditation No. 2911

Approved Signatory: David Hall

Date of Issue: 21/08/2012

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Sample Details

Sample ID: S122-855
Client Sample: TP07-003
Test Request No: N/A
Sampled By: Client
Sampling Method: Unknown
Date Sampled: 4/08/2012
Lot No: N/A
Source: In-Situ
Material: Refer to Log.
Specification: All Purpose Grading
Location: TP.07, Depth:3.2-3.3m

Test Results

Description	Method	Result	Limits
Moisture Content (%)	AS 1289.2.1.1	13.7	
Date Tested		13/08/2012	
Sample History	AS 1289.1.1	Oven-dried	
Preparation	AS 1289.1.1	Dry Sieved	
Linear Shrinkage (%)	AS 1289.3.4.1	N/A	
Mould Length (mm)		0	
Crumbling		No	
Curling		No	
Liquid Limit (%)	AS 1289.3.1.2	44	
Method		One Point	
Plastic Limit (%)	AS 1289.3.2.1	11	
Plasticity Index (%)	AS 1289.3.3.1	33	
Date Tested		20/08/2012	

Comments

N/A

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BRISBANE LABORATORY
46 Grice Street Clontarf Q 4019
Phone: (07) 32848766
Fax: (07) 32844391

Report No: MAT:S122-856
Issue No: 1

Material Test Report

Client:
Golder Associates Pty Ltd
PO Box 6079
Hawthorn West VIC 3122

Project: Santos Storage Ponds "Narrabri" (127615025)

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Approved Signatory: David Hall

Date of Issue: 21/08/2012

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Sample Details

Sample ID:	S122-856
Client Sample:	TP09-001
Test Request No:	N/A
Sampled By:	Client
Sampling Method:	Disturbed Sample
Date Sampled:	4/08/2012
Lot No:	N/A
Source:	In-Situ
Material:	Refer to Log.
Specification:	All Purpose Grading
Location:	TP.09, Depth:0.1-0.2m

Test Results

Description	Method	Result	Limits
Moisture Content (%)	AS 1289.2.1.1	13.5	
Date Tested		13/08/2012	
Emerson Class Number	AS 1289.3.8.1	4	
Soil Description		Refer to Log	
Type of Water		Distilled	
Temperature of Water (℃)		21	
Date Tested		16/08/2012	

Comments

N/A

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BRISBANE LABORATORY
46 Grice Street Clontarf Q 4019
Phone: (07) 32848766
Fax: (07) 32844391

Material Test Report

Report No: MAT:S122-857
Issue No: 1

Client:
Golder Associates Pty Ltd
PO Box 6079
Hawthorn West VIC 3122

Project: Santos Storage Ponds "Narrabri" (127615025)

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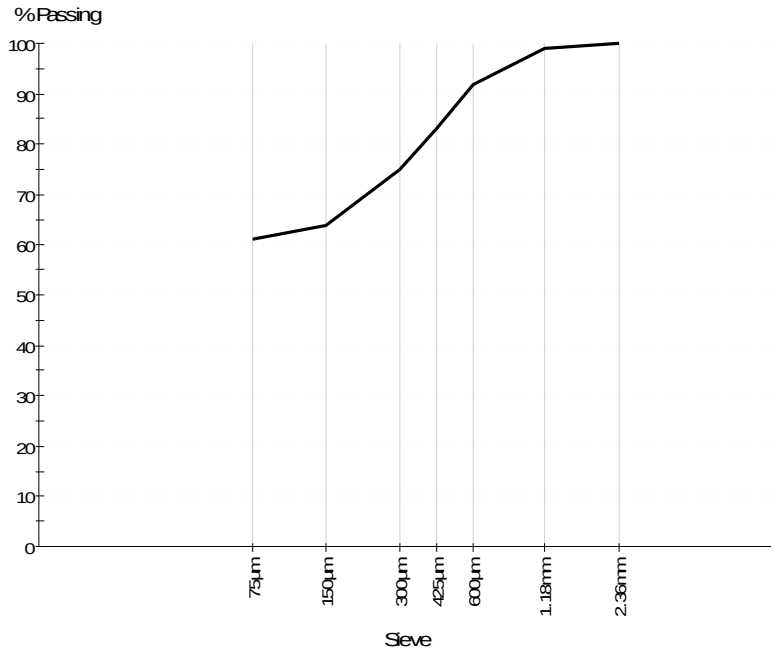
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Sample Details

Sample ID:	S122-857
Client Sample:	TP09-002
Test Request No:	N/A
Sampled By:	Client
Sampling Method:	Disturbed Sample
Date Sampled:	4/08/2012
Lot No:	N/A
Source:	In-Situ
Material:	Refer to Log.
Specification:	All Purpose Grading
Location:	TP.09, Depth:1.5-1.6m

Particle Size Distribution



FINES (61.0%)		SAND			GRAVEL		COBBLES
Clay	Silt	Fine (22.0%)	Medium (16.7%)	Coarse (0.3%)	Fine (0.0%)	Coarse (0.0%)	(0.0%)

Atterberg Limit:

Liquid Limit:	42
Plastic Limit:	10
Plasticity Index:	32
Linear Shrinkage (%):	N/A

Sample Description:

Grading: AS 1289.3.6.1

Drying by: Oven
Date Tested: 16/08/2012
Note: Sample Washed

Sieve Size	% Passing	Limits
2.36mm	100	
1.18mm	99	
600µm	92	
425µm	83	
300µm	75	
150µm	64	
75µm	61	

D85: 0.4588 **D60:** 0.0595 **D50:** 0.0059
D30: 0.0001 **D15:** 0.0000 **D10:** 0.0000

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Date of Issue: 21/08/2012

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Sample Details

Sample ID: S122-857
Client Sample: TP09-002
Test Request No: N/A
Sampled By: Client
Sampling Method: Disturbed Sample
Date Sampled: 4/08/2012
Lot No: N/A
Source: In-Situ
Material: Refer to Log.
Specification: All Purpose Grading
Location: TP.09, Depth:1.5-1.6m

Other Test Results

Description	Method	Result	Limits
Emerson Class Number	AS 1289.3.8.1	4	
Soil Description		Refer to Log	
Type of Water		Distilled	
Temperature of Water (℃)		21	
Date Tested		16/08/2012	
Sample History	AS 1289.1.1	Oven-dried	
Preparation	AS 1289.1.1	Dry Sieved	
Linear Shrinkage (%)	AS 1289.3.4.1	N/A	
Mould Length (mm)		0	
Crumbling		No	
Curling		No	
Liquid Limit (%)	AS 1289.3.1.2	42	
Method		One Point	
Plastic Limit (%)	AS 1289.3.2.1	10	
Plasticity Index (%)	AS 1289.3.3.1	32	
Date Tested		20/08/2012	
Moisture Content (%)	AS 1289.2.1.1	12.6	
Date Tested		13/08/2012	

Comments

N/A

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BRISBANE LABORATORY
46 Grice Street Clontarf Q 4019
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Material Test Report

Report No: MAT:S122-878
Issue No: 1

Client:
Golder Associates Pty Ltd
PO Box 6079
Hawthorn West VIC 3122

Project: Santos Storage Ponds "Narrabri" (127615025)

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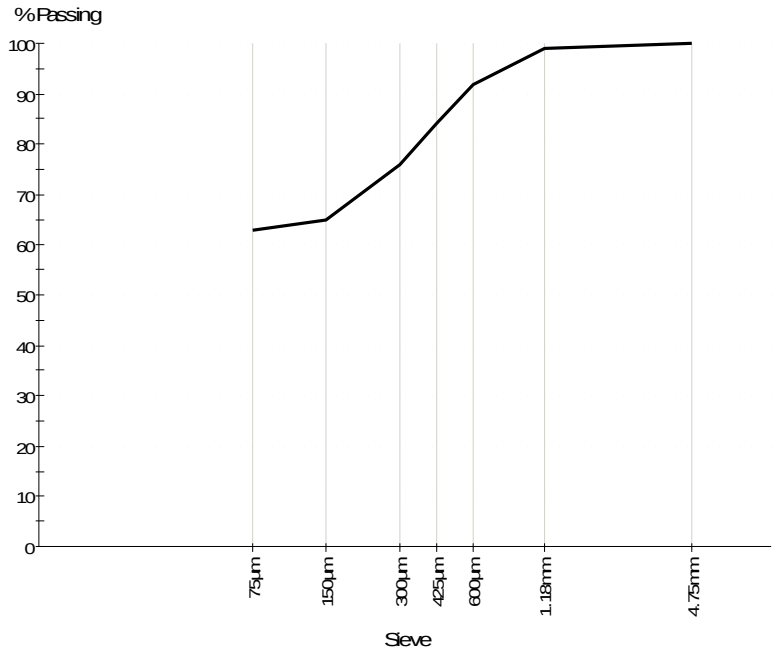
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Sample Details

Sample ID:	S122-878
Client Sample:	TP10-001
Test Request No:	N/A
Sampled By:	Client
Sampling Method:	Disturbed Sample
Date Sampled:	2/08/2012
Lot No:	N/A
Source:	In-Situ
Material:	Refer to Log.
Specification:	All Purpose Grading
Location:	TP.10, Depth:1.3-1.4m

Particle Size Distribution



FINES (63.0%)		SAND			GRAVEL		COBBLES
Clay	Silt	Fine (21.0%)	Medium (15.2%)	Coarse (0.8%)	Fine (0.0%)	Coarse (0.0%)	(0.0%)

Atterberg Limit:

Liquid Limit:	38
Plastic Limit:	12
Plasticity Index:	26
Linear Shrinkage (%):	N/A

Sample Description:

Grading: AS 1289.3.6.1

Drying by: Oven
Date Tested: 20/08/2012
Note: Sample Washed

Sieve Size	% Passing	Limits
4.75mm	100	
1.18mm	99	
600µm	92	
425µm	84	
300µm	76	
150µm	65	
75µm	63	

D85: 0.4437 **D60:** 0.0265 **D50:** 0.0008
D30: 0.0000 **D15:** 0.0000 **D10:** 0.0000

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Sample Details

Sample ID: S122-878
Client Sample: TP10-001
Test Request No: N/A
Sampled By: Client
Sampling Method: Disturbed Sample
Date Sampled: 2/08/2012
Lot No: N/A
Source: In-Situ
Material: Refer to Log.
Specification: All Purpose Grading
Location: TP.10, Depth:1.3-1.4m

Other Test Results

Description	Method	Result	Limits
Moisture Content (%)	AS 1289.2.1.1	12.5	
Date Tested		13/08/2012	
Sample History	AS 1289.1.1	Oven-dried	
Preparation	AS 1289.1.1	Dry Sieved	
Linear Shrinkage (%)	AS 1289.3.4.1	N/A	
Mould Length (mm)		0	
Crumbling		No	
Curling		No	
Liquid Limit (%)	AS 1289.3.1.2	38	
Method		One Point	
Plastic Limit (%)	AS 1289.3.2.1	12	
Plasticity Index (%)	AS 1289.3.3.1	26	
Date Tested		23/08/2012	

Comments

N/A

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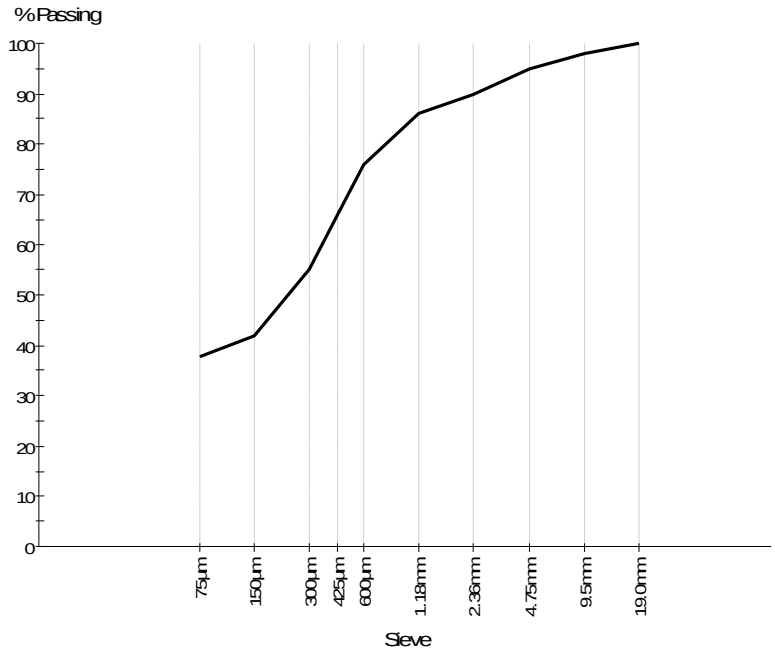
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Sample Details

Sample ID:	S122-879
Client Sample:	TP10-002
Test Request No:	N/A
Sampled By:	Client
Sampling Method:	Disturbed Sample
Date Sampled:	3/08/2012
Lot No:	N/A
Source:	In-Situ
Material:	Refer to Log.
Specification:	All Purpose Grading
Location:	TP.10, Depth:1.9-2.0m

Particle Size Distribution



FINES (38.0%)		SAND			GRAVEL		COBBLES
Clay	Silt	Fine (28.0%)	Medium (22.8%)	Coarse (6.2%)	Fine (5.0%)	Coarse (0.0%)	(0.0%)

Atterberg Limit:

Liquid Limit:	18
Plastic Limit:	9
Plasticity Index:	9
Linear Shrinkage (%):	N/A

Sample Description:

Grading: AS 1289.3.6.1

Drying by: Oven
Date Tested: 20/08/2012
Note: Sample Washed

Sieve Size	% Passing	Limits
19.0mm	100	
9.5mm	98	
4.75mm	95	
2.36mm	90	
1.18mm	86	
600µm	76	
425µm	66	
300µm	55	
150µm	42	
75µm	38	

D85: 1.1028 **D60:** 0.3515 **D50:** 0.2298
D30: 0.0187 **D15:** 0.0014 **D10:** 0.0006

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Date of Issue: 24/08/2012

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Sample Details

Sample ID: S122-879
Client Sample: TP10-002
Test Request No: N/A
Sampled By: Client
Sampling Method: Disturbed Sample
Date Sampled: 3/08/2012
Lot No: N/A
Source: In-Situ
Material: Refer to Log.
Specification: All Purpose Grading
Location: TP.10, Depth:1.9-2.0m

Other Test Results

Description	Method	Result	Limits
Moisture Content (%)	AS 1289.2.1.1	5.5	
Date Tested		13/08/2012	
Sample History	AS 1289.1.1	Oven-dried	
Preparation	AS 1289.1.1	Dry Sieved	
Linear Shrinkage (%)	AS 1289.3.4.1	N/A	
Mould Length (mm)		0	
Crumbling		No	
Curling		No	
Liquid Limit (%)	AS 1289.3.1.2	18	
Method		One Point	
Plastic Limit (%)	AS 1289.3.2.1	9	
Plasticity Index (%)	AS 1289.3.3.1	9	
Date Tested		23/08/2012	
Emerson Class Number	AS 1289.3.8.1	4	
Soil Description		Refer to Log	
Type of Water		Distilled	
Temperature of Water (℃)		21	
Date Tested		22/08/2012	

Comments

N/A

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ABN 35 229 054 612
Site Investigations, Soil, Aggregate & Concrete Testing Services

BRISBANE LABORATORY
46 Grice Street Clontarf Q 4019
Phone: (07) 32848766
Fax: (07) 32844391

Material Test Report

Report No: MAT:S122-880
Issue No: 1

Client:
Golder Associates Pty Ltd
PO Box 6079
Hawthorn West VIC 3122

Project: Santos Storage Ponds "Narrabri" (127615025)

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Accreditation No. 2911

Approved Signatory: David Hall

Date of Issue: 27/08/2012

THIS DOCUMENT SHALL NOT BE REPRODUCED EXCEPT IN FULL

Sample Details

Sample ID:	S122-880
Client Sample:	TP11-001
Test Request No:	N/A
Sampled By:	Client
Sampling Method:	Disturbed Sample
Date Sampled:	3/08/2012
Lot No:	N/A
Source:	In-Situ
Material:	Refer to Log.
Specification:	All Purpose Grading
Location:	TP.11, Depth:0.1-0.2m

Test Results

Description	Method	Result	Limits
Moisture Content (%)	AS 1289.2.1.1	12.9	
Date Tested		24/08/2012	
Emerson Class Number	AS 1289.3.8.1	4	
Soil Description		Refer to Log	
Type of Water		Distilled	
Temperature of Water (℃)		21	
Date Tested		22/08/2012	

Comments

N/A

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Material Test Report

Report No: MAT:S122-881
Issue No: 1

Client:
Golder Associates Pty Ltd
PO Box 6079
Hawthorn West VIC 3122

Project: Santos Storage Ponds "Narrabri" (127615025)

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Accreditation No. 2911

Approved Signatory: David Hall

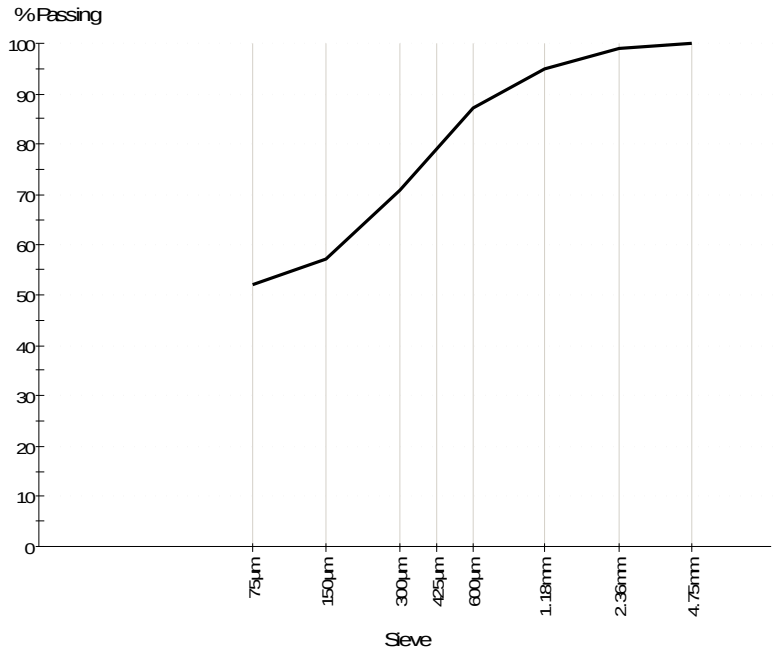
Date of Issue: 27/08/2012

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Sample Details

Sample ID:	S122-881
Client Sample:	TP11-002
Test Request No:	N/A
Sampled By:	Client
Sampling Method:	Bulk Sample
Date Sampled:	3/08/2012
Lot No:	N/A
Source:	In-Situ
Material:	Refer to Log.
Specification:	All Purpose Grading
Location:	TP.11, Depth:0.2-0.5m

Particle Size Distribution



FINES (52.0%)		SAND			GRAVEL		COBBLES
Clay	Silt	Fine (27.0%)	Medium (18.8%)	Coarse (2.2%)	Fine (0.0%)	Coarse (0.0%)	(0.0%)

Atterberg Limit:

Liquid Limit:	27
Plastic Limit:	10
Plasticity Index:	17
Linear Shrinkage (%):	N/A

Sample Description:

Grading: AS 1289.3.6.1

Drying by: Oven
Date Tested: 20/08/2012
Note: Sample Washed

Sieve Size	% Passing	Limits
4.75mm	100	
2.36mm	99	
1.18mm	95	
600µm	87	
425µm	79	
300µm	71	
150µm	57	
75µm	52	

D85: 0.5504 **D60:** 0.1740 **D50:** 0.0568
D30: 0.0036 **D15:** 0.0004 **D10:** 0.0002

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SOUTH QLD SOILS PTY LTD
AS TRUSTEE FOR THE F&B TRUST
ABN 35 229 054 612
Site Investigations, Soil, Aggregate & Concrete Testing Services

BRISBANE LABORATORY
46 Grice Street Clontarf Q 4019
Phone: (07) 32848766
Fax: (07) 32844391

Material Test Report

Report No: MAT:S122-881
Issue No: 1

Client:
Golder Associates Pty Ltd
PO Box 6079
Hawthorn West VIC 3122

Project: Santos Storage Ponds "Narrabri" (127615025)

NATA Accreditation No. 2911

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Approved Signatory: David Hall

Date of Issue: 27/08/2012

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Sample Details

Sample ID: S122-881
Client Sample: TP11-002
Test Request No: N/A
Sampled By: Client
Sampling Method: Bulk Sample
Date Sampled: 3/08/2012
Lot No: N/A
Source: In-Situ
Material: Refer to Log.
Specification: All Purpose Grading
Location: TP.11, Depth:0.2-0.5m

Other Test Results

Description	Method	Result	Limits
Moisture Content (%)	AS 1289.2.1.1	9.1	
Date Tested		13/08/2012	
Sample History	AS 1289.1.1	Oven-dried	
Preparation	AS 1289.1.1	Dry Sieved	
Linear Shrinkage (%)	AS 1289.3.4.1	N/A	
Mould Length (mm)		0	
Crumbling		No	
Curling		No	
Liquid Limit (%)	AS 1289.3.1.2	27	
Method		One Point	
Plastic Limit (%)	AS 1289.3.2.1	10	
Plasticity Index (%)	AS 1289.3.3.1	17	
Date Tested		23/08/2012	
Standard Maximum Dry Density (t/m³)	AS 1289.5.1.1	1.87	
Standard Optimum Moisture Content (%)		12.5	
Retained Sieve 19mm (%)		0	
Date Tested		21/08/2012	

Comments

N/A

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BRISBANE LABORATORY
46 Grice Street Clontarf Q 4019
Phone: (07) 32848766
Fax: (07) 32844391

Report No: MAT:S122-929
Issue No: 1

Material Test Report

Client:
Golder Associates Pty Ltd
PO Box 6079
Hawthorn West VIC 3122

Project: Santos Storage Ponds "Narrabri" (127615025)

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Approved Signatory: David Hall

Date of Issue: 11/09/2012

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Sample Details

Sample ID:	S122-929
Client Sample:	TP12-004
Test Request No:	N/A
Sampled By:	Client
Sampling Method:	Disturbed Sample
Date Sampled:	2/08/2012
Lot No:	N/A
Source:	In-Situ
Material:	Refer to Log.
Specification:	All Purpose Grading
Location:	TP12, Depth:0.1-0.2m

Test Results

Description	Method	Result	Limits
Emerson Class Number	AS 1289.3.8.1	4	
Soil Description		Refer to Log	
Type of Water		Distilled	
Temperature of Water (℃)		23	
Date Tested		28/08/2012	
Moisture Content (%)	AS 1289.2.1.1	13.7	
Date Tested		28/08/2012	

Comments

N/A

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BRISBANE LABORATORY
46 Grice Street Clontarf Q 4019
Phone: (07) 32848766
Fax: (07) 32844391

Material Test Report

Report No: MAT:S122-882
Issue No: 1

Client:
Golder Associates Pty Ltd
PO Box 6079
Hawthorn West VIC 3122

Project: Santos Storage Ponds "Narrabri" (127615025)

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Accreditation No. 2911

Approved Signatory: David Hall

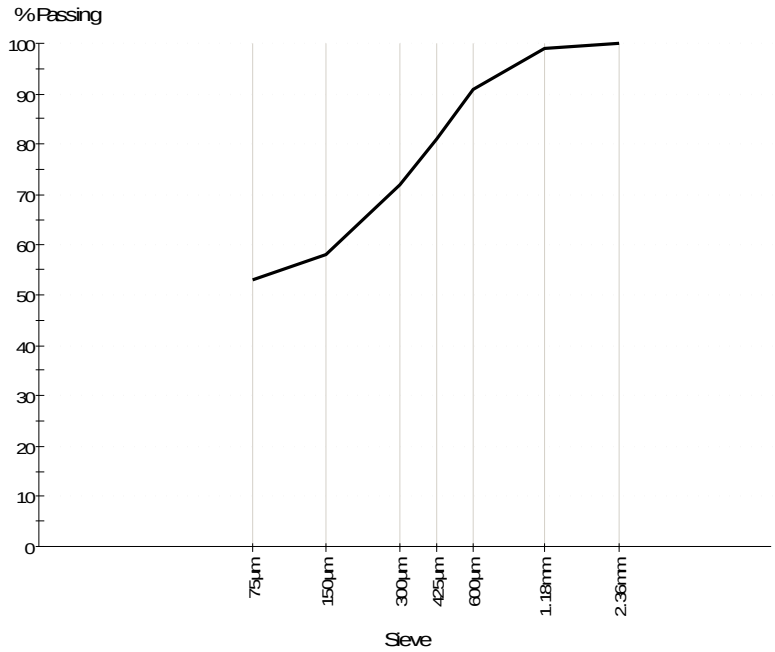
Date of Issue: 27/08/2012

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Sample Details

Sample ID:	S122-882
Client Sample:	TP12-001
Test Request No:	N/A
Sampled By:	Client
Sampling Method:	Disturbed Sample
Date Sampled:	3/08/2012
Lot No:	N/A
Source:	In-Situ
Material:	Refer to Log.
Specification:	All Purpose Grading
Location:	TP.12, Depth:0.4-0.5m

Particle Size Distribution



FINES (53.0%)		SAND			GRAVEL		COBBLES
Clay	Silt	Fine (28.0%)	Medium (18.7%)	Coarse (0.3%)	Fine (0.0%)	Coarse (0.0%)	(0.0%)

Atterberg Limit:

Liquid Limit:	32
Plastic Limit:	10
Plasticity Index:	22
Linear Shrinkage (%):	N/A

Sample Description:

Grading: AS 1289.3.6.1

Drying by: Oven
Date Tested: 20/08/2012
Note: Sample Washed

Sieve Size	% Passing	Limits
2.36mm	100	
1.18mm	99	
600µm	91	
425µm	81	
300µm	72	
150µm	58	
75µm	53	

D85: 0.4879 **D60:** 0.1656 **D50:** 0.0495
D30: 0.0031 **D15:** 0.0004 **D10:** 0.0002

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BRISBANE LABORATORY
46 Grice Street Clontarf Q 4019
Phone: (07) 32848766
Fax: (07) 32844391

Material Test Report

Report No: MAT:S122-882
Issue No: 1

Client:
Golder Associates Pty Ltd
PO Box 6079
Hawthorn West VIC 3122

Project: Santos Storage Ponds "Narrabri" (127615025)

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Approved Signatory: David Hall

Date of Issue: 27/08/2012

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Sample Details

Sample ID: S122-882
Client Sample: TP12-001
Test Request No: N/A
Sampled By: Client
Sampling Method: Disturbed Sample
Date Sampled: 3/08/2012
Lot No: N/A
Source: In-Situ
Material: Refer to Log.
Specification: All Purpose Grading
Location: TP.12, Depth:0.4-0.5m

Other Test Results

Description	Method	Result	Limits
Moisture Content (%)	AS 1289.2.1.1	12.8	
Date Tested		13/08/2012	
Emerson Class Number	AS 1289.3.8.1	4	
Soil Description		Refer to Log	
Type of Water		Distilled	
Temperature of Water (℃)		24	
Date Tested		25/08/2012	
Sample History	AS 1289.1.1	Oven-dried	
Preparation	AS 1289.1.1	Dry Sieved	
Linear Shrinkage (%)	AS 1289.3.4.1	N/A	
Mould Length (mm)		0	
Crumbling		No	
Curling		No	
Liquid Limit (%)	AS 1289.3.1.2	32	
Method		One Point	
Plastic Limit (%)	AS 1289.3.2.1	10	
Plasticity Index (%)	AS 1289.3.3.1	22	
Date Tested		24/08/2012	

Comments

N/A

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BRISBANE LABORATORY
46 Grice Street Clontarf Q 4019
Phone: (07) 32848766
Fax: (07) 32844391

Report No: MAT:S122-917
Issue No: 1

Material Test Report

Client:
Golder Associates Pty Ltd
PO Box 6079
Hawthorn West VIC 3122

Project: Santos Storage Ponds "Narrabri" (127615025)

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Approved Signatory: David Hall

Date of Issue: 27/08/2012

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Sample Details

Sample ID: S122-917
Field Sample: 139793
Test Request No: N/A
Sampled By: Client
Sampling Method: Bulk Sample
Date Sampled: 2/08/2012
Lot No: N/A
Source: In-Situ
Material: Refer to Log.
Specification: All Purpose Grading
Location: TP.12, Depth:1.0-1.3m

Test Results

Description	Method	Result	Limits
Sample History	AS 1289.1.1	Oven-dried	
Preparation	AS 1289.1.1	Dry Sieved	
Linear Shrinkage (%)	AS 1289.3.4.1	N/A	
Mould Length (mm)		0	
Crumbling		No	
Curling		No	
Liquid Limit (%)	AS 1289.3.1.2	35	
Method		One Point	
Plastic Limit (%)	AS 1289.3.2.1	12	
Plasticity Index (%)	AS 1289.3.3.1	23	
Date Tested		22/08/2012	
Emerson Class Number	AS 1289.3.8.1	4	
Soil Description		Refer to Log	
Type of Water		Distilled	
Temperature of Water (℃)		23	
Date Tested		25/08/2012	
Moisture Content (%)	AS 1289.2.1.1	11.2	
Date Tested		16/08/2012	
Standard Maximum Dry Density (t/m³)	AS 1289.5.1.1	1.73	
Standard Optimum Moisture Content (%)		16.0	
Retained Sieve 19mm (%)		0	
Date Tested		21/08/2012	

Comments

N/A

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BRISBANE LABORATORY
46 Grice Street Clontarf Q 4019
Phone: (07) 32848766
Fax: (07) 32844391

Report No: MAT:S122-918
Issue No: 1

Material Test Report

Client:
Golder Associates Pty Ltd
PO Box 6079
Hawthorn West VIC 3122

Project: Santos Storage Ponds "Narrabri" (127615025)

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Approved Signatory: David Hall

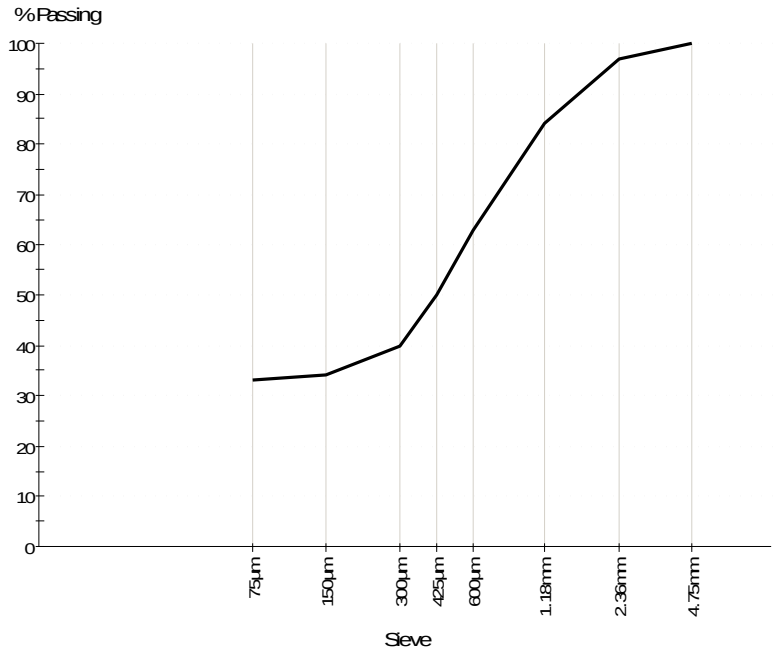
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Sample Details

Sample ID:	S122-918
Field Sample:	139794
Test Request No:	N/A
Sampled By:	Client
Sampling Method:	Disturbed Sample
Date Sampled:	2/08/2012
Lot No:	N/A
Source:	In-Situ
Material:	Refer to Log.
Specification:	All Purpose Grading
Location:	TP..13, Depth:1.8-1.9m

Particle Size Distribution



FINES (33.0%)		SAND			GRAVEL		COBBLES
Clay	Silt	Fine (17.0%)	Medium (43.0%)	Coarse (7.0%)	Fine (0.0%)	Coarse (0.0%)	(0.0%)

Atterberg Limit:

Liquid Limit:	21
Plastic Limit:	8
Plasticity Index:	13
Linear Shrinkage (%):	N/A

Sample Description:

Grading: AS 1289.3.6.1

Drying by: Oven
Date Tested: 24/08/2012
Note: Sample Washed

Sieve Size	% Passing	Limits
4.75mm	100	
2.36mm	97	
1.18mm	84	
600µm	63	
425µm	50	
300µm	40	
150µm	34	
75µm	33	

D85: 1.2446 **D60:** 0.5541 **D50:** 0.4250
D30: 0.0094 **D15:** 0.0000 **D10:** 0.0000

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BRISBANE LABORATORY
46 Grice Street Clontarf Q 4019
Phone: (07) 32848766
Fax: (07) 32844391

Material Test Report

Report No: MAT:S122-918
Issue No: 1

Client:
Golder Associates Pty Ltd
PO Box 6079
Hawthorn West VIC 3122

Project: Santos Storage Ponds "Narrabri" (127615025)

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Approved Signatory: David Hall

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Sample Details

Sample ID:	S122-918
Field Sample:	139794
Test Request No:	N/A
Sampled By:	Client
Sampling Method:	Disturbed Sample
Date Sampled:	2/08/2012
Lot No:	N/A
Source:	In-Situ
Material:	Refer to Log.
Specification:	All Purpose Grading
Location:	TP..13, Depth:1.8-1.9m

Other Test Results

Description	Method	Result	Limits
Moisture Content (%)	AS 1289.2.1.1	8.1	
Date Tested		16/08/2012	
Sample History	AS 1289.1.1	Oven-dried	
Preparation	AS 1289.1.1	Dry Sieved	
Linear Shrinkage (%)	AS 1289.3.4.1	N/A	
Mould Length (mm)		0	
Crumbling		No	
Curling		No	
Liquid Limit (%)	AS 1289.3.1.2	21	
Method		One Point	
Plastic Limit (%)	AS 1289.3.2.1	8	
Plasticity Index (%)	AS 1289.3.3.1	13	
Date Tested		23/08/2012	
Emerson Class Number	AS 1289.3.8.1	4	
Soil Description		Refer to Log	
Type of Water		Distilled	
Temperature of Water (℃)		23	
Date Tested		25/08/2012	

Comments

N/A

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BRISBANE LABORATORY
46 Grice Street Clontarf Q 4019
Phone: (07) 32848766
Fax: (07) 32844391

Material Test Report

Report No: MAT:S122-919
Issue No: 1

Client:
Golder Associates Pty Ltd
PO Box 6079
Hawthorn West VIC 3122

Project: Santos Storage Ponds "Narrabri" (127615025)

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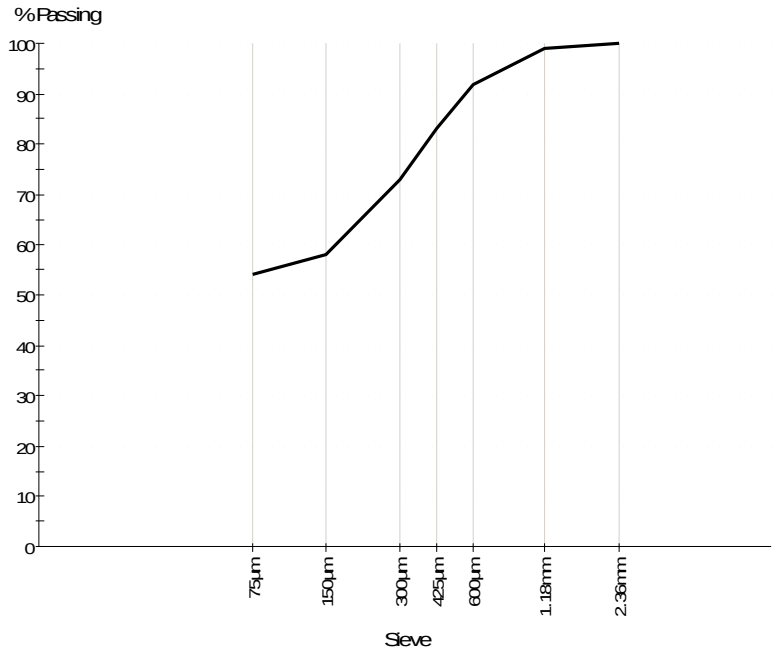
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Sample Details

Sample ID:	S122-919
Field Sample:	139795
Test Request No:	N/A
Sampled By:	Client
Sampling Method:	Disturbed Sample
Date Sampled:	2/08/2012
Lot No:	N/A
Source:	In-Situ
Material:	Refer to Log.
Specification:	All Purpose Grading
Location:	TP.14, Depth:0.5-0.6m

Particle Size Distribution



FINES (54.0%)		SAND			GRAVEL		COBBLES
Clay	Silt	Fine (29.0%)	Medium (16.7%)	Coarse (0.3%)	Fine (0.0%)	Coarse (0.0%)	(0.0%)

Atterberg Limit:

Liquid Limit:	30
Plastic Limit:	10
Plasticity Index:	20
Linear Shrinkage (%):	N/A

Sample Description:

Grading: AS 1289.3.6.1

Drying by: Oven
Date Tested: 24/08/2012
Note: Sample Washed

Sieve Size	% Passing	Limits
2.36mm	100	
1.18mm	99	
600µm	92	
425µm	83	
300µm	73	
150µm	58	
75µm	54	

D85: 0.4588 **D60:** 0.1645 **D50:** 0.0375
D30: 0.0012 **D15:** 0.0001 **D10:** 0.0000

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BRISBANE LABORATORY
46 Grice Street Clontarf Q 4019
Phone: (07) 32848766
Fax: (07) 32844391

Report No: MAT:S122-919
Issue No: 1

Material Test Report

Client:
Golder Associates Pty Ltd
PO Box 6079
Hawthorn West VIC 3122

Project: Santos Storage Ponds "Narrabri" (127615025)

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Date of Issue: 27/08/2012

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Sample Details

Sample ID: S122-919
Field Sample: 139795
Test Request No: N/A
Sampled By: Client
Sampling Method: Disturbed Sample
Date Sampled: 2/08/2012
Lot No: N/A
Source: In-Situ
Material: Refer to Log.
Specification: All Purpose Grading
Location: TP.14, Depth:0.5-0.6m

Other Test Results

Description	Method	Result	Limits
Moisture Content (%)	AS 1289.2.1.1	10.6	
Date Tested		16/08/2012	
Sample History	AS 1289.1.1	Oven-dried	
Preparation	AS 1289.1.1	Dry Sieved	
Linear Shrinkage (%)	AS 1289.3.4.1	N/A	
Mould Length (mm)		0	
Crumbling		No	
Curling		No	
Liquid Limit (%)	AS 1289.3.1.2	30	
Method		One Point	
Plastic Limit (%)	AS 1289.3.2.1	10	
Plasticity Index (%)	AS 1289.3.3.1	20	
Date Tested		22/08/2012	

Comments

N/A

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BRISBANE LABORATORY
46 Grice Street Clontarf Q 4019
Phone: (07) 32848766
Fax: (07) 32844391

Report No: MAT:S122-920
Issue No: 1

Material Test Report

Client:
Golder Associates Pty Ltd
PO Box 6079
Hawthorn West VIC 3122

Project: Santos Storage Ponds "Narrabri" (127615025)

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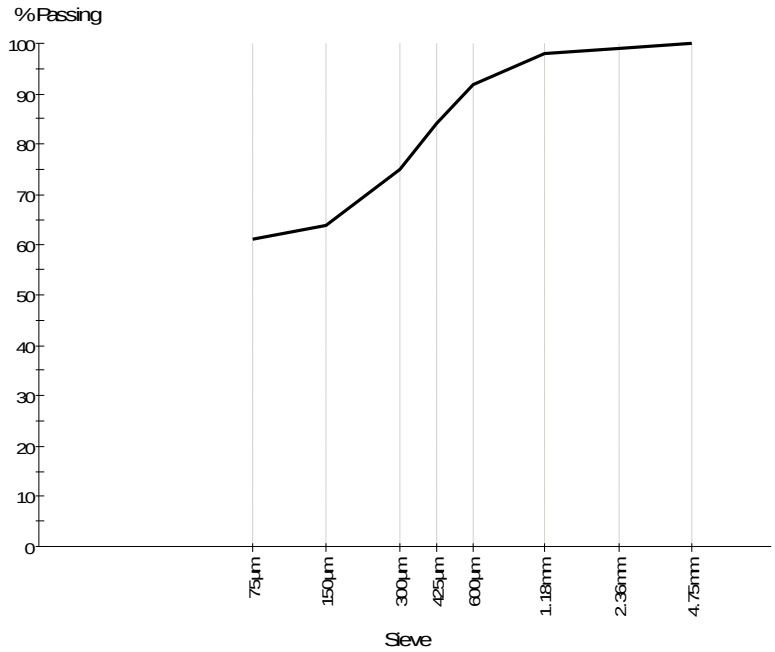
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Sample Details

Sample ID:	S122-920
Field Sample:	139796
Test Request No:	N/A
Sampled By:	Client
Sampling Method:	Disturbed Sample
Date Sampled:	2/08/2012
Lot No:	N/A
Source:	In-Situ
Material:	Refer to Log.
Specification:	All Purpose Grading
Location:	TP.14, Depth:2.6-2.7m

Particle Size Distribution



FINES (61.0%)		SAND			GRAVEL		COBBLES
Clay	Silt	Fine (23.0%)	Medium (14.7%)	Coarse (1.3%)	Fine (0.0%)	Coarse (0.0%)	(0.0%)

Atterberg Limit:

Liquid Limit:	41
Plastic Limit:	12
Plasticity Index:	29
Linear Shrinkage (%):	N/A

Sample Description:

Grading: AS 1289.3.6.1

Drying by: Oven
Date Tested: 27/08/2012
Note: Sample Washed

Sieve Size	% Passing	Limits
4.75mm	100	
2.36mm	99	
1.18mm	98	
600µm	92	
425µm	84	
300µm	75	
150µm	64	
75µm	61	

D85: 0.4437 **D60:** 0.0595 **D50:** 0.0059
D30: 0.0001 **D15:** 0.0000 **D10:** 0.0000

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46 Grice Street Clontarf Q 4019
Phone: (07) 32848766
Fax: (07) 32844391

Material Test Report

Report No: MAT:S122-920
Issue No: 1

Client:
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PO Box 6079
Hawthorn West VIC 3122

Project: Santos Storage Ponds "Narrabri" (127615025)

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Approved Signatory: David Hall

Date of Issue: 27/08/2012

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Sample Details

Sample ID: S122-920
Field Sample: 139796
Test Request No: N/A
Sampled By: Client
Sampling Method: Disturbed Sample
Date Sampled: 2/08/2012
Lot No: N/A
Source: In-Situ
Material: Refer to Log.
Specification: All Purpose Grading
Location: TP.14, Depth:2.6-2.7m

Other Test Results

Description	Method	Result	Limits
Sample History	AS 1289.1.1	Oven-dried	
Preparation	AS 1289.1.1	Dry Sieved	
Linear Shrinkage (%)	AS 1289.3.4.1	N/A	
Mould Length (mm)		0	
Crumbling		No	
Curling		No	
Liquid Limit (%)	AS 1289.3.1.2	41	
Method		One Point	
Plastic Limit (%)	AS 1289.3.2.1	12	
Plasticity Index (%)	AS 1289.3.3.1	29	
Date Tested		24/08/2012	
Moisture Content (%)	AS 1289.2.1.1	14.9	
Date Tested		16/08/2012	

Comments

N/A

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SOUTH QLD SOILS PTY LTD
AS TRUSTEE FOR THE F&B TRUST
ABN 35 229 054 612
Site Investigations, Soil, Aggregate & Concrete Testing Services

BRISBANE LABORATORY
46 Grice Street Clontarf Q 4019
Phone: (07) 32848766
Fax: (07) 32844391

Report No: MAT:S122-922
Issue No: 1

Material Test Report

Client:
Golder Associates Pty Ltd
PO Box 6079
Hawthorn West VIC 3122

Project: Santos Storage Ponds "Narrabri" (127615025)

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Accreditation No. 2911

Approved Signatory: David Hall

Date of Issue: 27/08/2012

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Sample Details

Sample ID:	S122-922
Field Sample:	139798
Test Request No:	N/A
Sampled By:	Client
Sampling Method:	Bulk Sample
Date Sampled:	2/08/2012
Lot No:	N/A
Source:	In-Situ
Material:	Refer to Log.
Specification:	All Purpose Grading
Location:	TP.15, Depth:0.5-0.8m

Test Results

Description	Method	Result	Limits
Moisture Content (%)	AS 1289.2.1.1	10.8	
Date Tested		16/08/2012	
Sample History	AS 1289.1.1	Oven-dried	
Preparation	AS 1289.1.1	Dry Sieved	
Linear Shrinkage (%)	AS 1289.3.4.1	N/A	
Mould Length (mm)		0	
Crumbling		No	
Curling		No	
Liquid Limit (%)	AS 1289.3.1.2	32	
Method		One Point	
Plastic Limit (%)	AS 1289.3.2.1	10	
Plasticity Index (%)	AS 1289.3.3.1	22	
Date Tested		22/08/2012	
Standard Maximum Dry Density (t/m³)	AS 1289.5.1.1	1.85	
Standard Optimum Moisture Content (%)		12.5	
Retained Sieve 19mm (%)			
Date Tested		20/08/2012	

Comments

N/A

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BRISBANE LABORATORY
46 Grice Street Clontarf Q 4019
Phone: (07) 32848766
Fax: (07) 32844391

Report No: MAT:S122-921
Issue No: 1

Material Test Report

Client:
Golder Associates Pty Ltd
PO Box 6079
Hawthorn West VIC 3122

Project: Santos Storage Ponds "Narrabri" (127615025)

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Accreditation No. 2911

Approved Signatory: David Hall

Date of Issue: 27/08/2012

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Sample Details

Sample ID:	S122-921
Field Sample:	139797
Test Request No:	N/A
Sampled By:	Client
Sampling Method:	Disturbed Sample
Date Sampled:	2/08/2012
Lot No:	N/A
Source:	In-Situ
Material:	Refer to Log.
Specification:	All Purpose Grading
Location:	TP.15, Depth:0.0-0.1m

Test Results

Description	Method	Result	Limits
Moisture Content (%)	AS 1289.2.1.1	13.0	
Date Tested		16/08/2012	
Emerson Class Number	AS 1289.3.8.1	4	
Soil Description		Refer to Log	
Type of Water		Distilled	
Temperature of Water (℃)		23	
Date Tested		25/08/2012	

Comments

N/A

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BRISBANE LABORATORY
46 Grice Street Clontarf Q 4019
Phone: (07) 32848766
Fax: (07) 32844391

Report No: MAT:S122-923
Issue No: 1

Material Test Report

Client:
Golder Associates Pty Ltd
PO Box 6079
Hawthorn West VIC 3122

Project: Santos Storage Ponds "Narrabri" (127615025)

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Accreditation No. 2911

Approved Signatory: David Hall

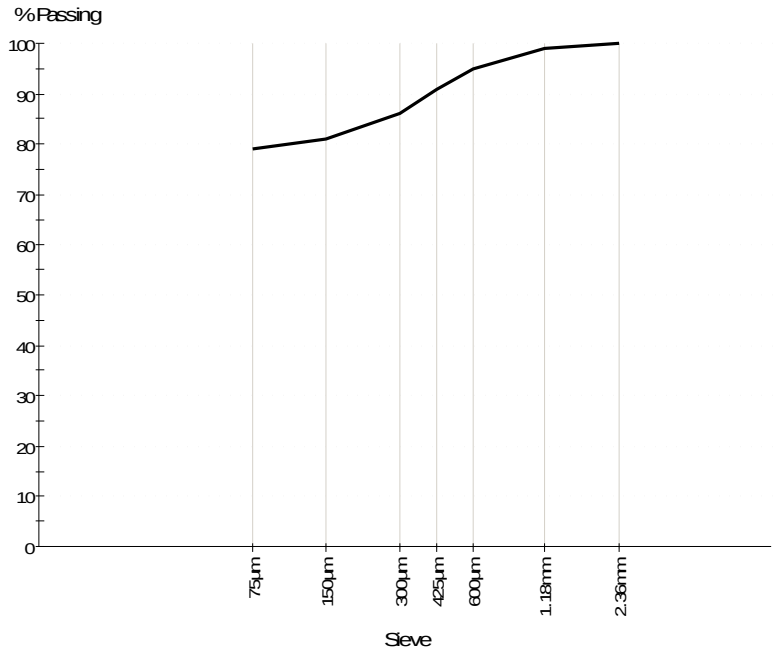
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Sample Details

Sample ID:	S122-923
Field Sample:	139799
Test Request No:	N/A
Sampled By:	Client
Sampling Method:	Disturbed Sample
Date Sampled:	2/08/2012
Lot No:	N/A
Source:	In-Situ
Material:	Refer to Log.
Specification:	All Purpose Grading
Location:	TP.16, Depth:0.4-0.6m

Particle Size Distribution



FINES (79.0%)		SAND			GRAVEL		COBBLES
Clay	Silt	Fine (12.0%)	Medium (8.7%)	Coarse (0.3%)	Fine (0.0%)	Coarse (0.0%)	(0.0%)

Atterberg Limit:

Liquid Limit:	44
Plastic Limit:	14
Plasticity Index:	30
Linear Shrinkage (%):	N/A

Sample Description:

Grading: AS 1289.3.6.1

Drying by: Oven
Date Tested: 24/08/2012
Note: Sample Washed

Sieve Size	% Passing	Limits
2.36mm	100	
1.18mm	99	
600µm	95	
425µm	91	
300µm	86	
150µm	81	
75µm	79	

D85: 0.2612 **D60:** 0.0001 **D50:** 0.0000
D30: 0.0000 **D15:** 0.0000 **D10:** 0.0000

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Material Test Report

Report No: MAT:S122-923
Issue No: 1

Client:
Golder Associates Pty Ltd
PO Box 6079
Hawthorn West VIC 3122

Project: Santos Storage Ponds "Narrabri" (127615025)

NATA
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Date of Issue: 27/08/2012

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Sample Details

Sample ID: S122-923
Field Sample: 139799
Test Request No: N/A
Sampled By: Client
Sampling Method: Disturbed Sample
Date Sampled: 2/08/2012
Lot No: N/A
Source: In-Situ
Material: Refer to Log.
Specification: All Purpose Grading
Location: TP.16, Depth:0.4-0.6m

Other Test Results

Description	Method	Result	Limits
Moisture Content (%)	AS 1289.2.1.1	15.6	
Date Tested		16/08/2012	
Sample History	AS 1289.1.1	Oven-dried	
Preparation	AS 1289.1.1	Dry Sieved	
Linear Shrinkage (%)	AS 1289.3.4.1	N/A	
Mould Length (mm)		0	
Crumbling		No	
Curling		No	
Liquid Limit (%)	AS 1289.3.1.2	44	
Method		One Point	
Plastic Limit (%)	AS 1289.3.2.1	14	
Plasticity Index (%)	AS 1289.3.3.1	30	
Date Tested		22/08/2012	
Emerson Class Number	AS 1289.3.8.1	4	
Soil Description		Refer to Log	
Type of Water		Distilled	
Temperature of Water (℃)		23	
Date Tested		25/08/2012	

Comments

N/A

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BRISBANE LABORATORY
46 Grice Street Clontarf Q 4019
Phone: (07) 32848766
Fax: (07) 32844391

Report No: MAT:S122-924
Issue No: 1

Material Test Report

Client:
Golder Associates Pty Ltd
PO Box 6079
Hawthorn West VIC 3122

Project: Santos Storage Ponds "Narrabri" (127615025)

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Sample Details

Sample ID:	S122-924
Field Sample:	139800
Test Request No:	N/A
Sampled By:	Client
Sampling Method:	Disturbed Sample
Date Sampled:	2/08/2012
Lot No:	N/A
Source:	In-Situ
Material:	Refer to Log.
Specification:	All Purpose Grading
Location:	TP.16, Depth:2.6-2.7m

Test Results

Description	Method	Result	Limits
Moisture Content (%)	AS 1289.2.1.1	12.9	
Date Tested		16/08/2012	
Sample History	AS 1289.1.1	Oven-dried	
Preparation	AS 1289.1.1	Dry Sieved	
Linear Shrinkage (%)	AS 1289.3.4.1	N/A	
Mould Length (mm)		0	
Crumbling		No	
Curling		No	
Liquid Limit (%)	AS 1289.3.1.2	24	
Method		One Point	
Plastic Limit (%)	AS 1289.3.2.1	8	
Plasticity Index (%)	AS 1289.3.3.1	16	
Date Tested		22/08/2012	

Comments

N/A

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BRISBANE LABORATORY
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Phone: (07) 32848766
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Report No: MAT:S122-925
Issue No: 1

Material Test Report

Client:
Golder Associates Pty Ltd
PO Box 6079
Hawthorn West VIC 3122

Project: Santos Storage Ponds "Narrabri" (127615025)

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Sample Details

Sample ID:	S122-925
Field Sample:	139801
Test Request No:	N/A
Sampled By:	Client
Sampling Method:	Disturbed Sample
Date Sampled:	2/08/2012
Lot No:	N/A
Source:	In-Situ
Material:	Refer to Log.
Specification:	All Purpose Grading
Location:	TP.17, Depth:0.2-0.3m

Test Results

Description	Method	Result	Limits
Moisture Content (%)	AS 1289.2.1.1	12.1	
Date Tested		16/08/2012	
Emerson Class Number	AS 1289.3.8.1	4	
Soil Description		Refer to Log	
Type of Water		Distilled	
Temperature of Water (℃)		23	
Date Tested		25/08/2012	

Comments

N/A

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Material Test Report

Report No: MAT:S122-926
Issue No: 1

Client:
Golder Associates Pty Ltd
PO Box 6079
Hawthorn West VIC 3122

Project: Santos Storage Ponds "Narrabri" (127615025)

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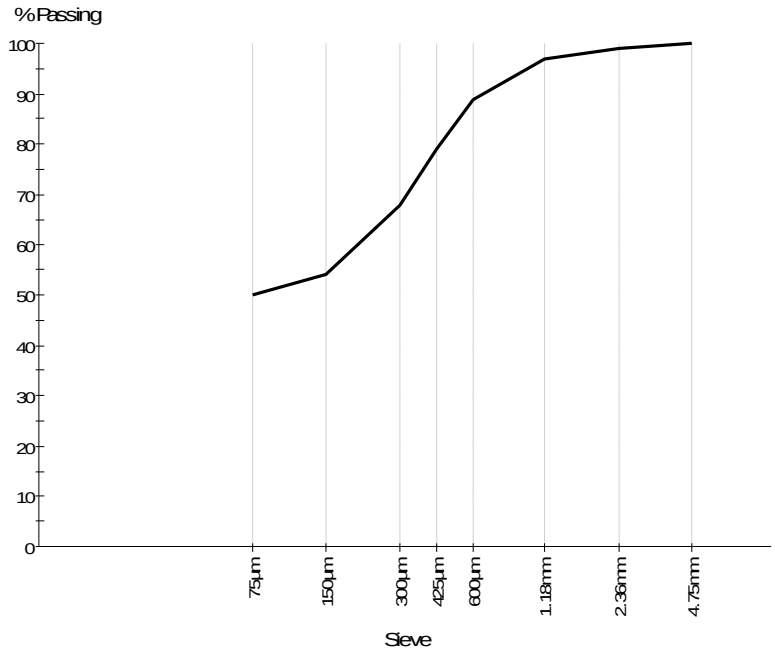
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Sample Details

Sample ID:	S122-926
Field Sample:	139802
Test Request No:	N/A
Sampled By:	Client
Sampling Method:	Disturbed Sample
Date Sampled:	2/08/2012
Lot No:	N/A
Source:	In-Situ
Material:	Refer to Log.
Specification:	All Purpose Grading
Location:	TP.18, Depth:0.3-0.4m

Particle Size Distribution



FINES (50.0%)		SAND			GRAVEL		COBBLES
Clay	**Silt**	**Fine (29.0%)**	**Medium (19.4%)**	**Coarse (1.6%)**	**Fine (0.0%)**	**Coarse (0.0%)**	**(0.0%)**

Atterberg Limit:

Liquid Limit:	25
Plastic Limit:	8
Plasticity Index:	17
Linear Shrinkage (%):	N/A

Sample Description:

Grading: AS 1289.3.6.1

Drying by: Oven
Date Tested: 24/08/2012
Note: Sample Washed

Sieve Size	% Passing	Limits
4.75mm	100	
2.36mm	99	
1.18mm	97	
600µm	89	
425µm	79	
300µm	68	
150µm	54	
75µm	50	

D85: 0.5227 **D60:** 0.2019 **D50:** 0.0750
D30: 0.0023 **D15:** 0.0002 **D10:** 0.0001

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46 Grice Street Clontarf Q 4019
Phone: (07) 32848766
Fax: (07) 32844391

Report No: MAT:S122-926
Issue No: 1

Material Test Report

Client:
Golder Associates Pty Ltd
PO Box 6079
Hawthorn West VIC 3122

Project: Santos Storage Ponds "Narrabri" (127615025)

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Sample Details

Sample ID: S122-926
Field Sample: 139802
Test Request No: N/A
Sampled By: Client
Sampling Method: Disturbed Sample
Date Sampled: 2/08/2012
Lot No: N/A
Source: In-Situ
Material: Refer to Log.
Specification: All Purpose Grading
Location: TP.18, Depth:0.3-0.4m

Other Test Results

Description	Method	Result	Limits
Sample History	AS 1289.1.1	Oven-dried	
Preparation	AS 1289.1.1	Dry Sieved	
Linear Shrinkage (%)	AS 1289.3.4.1	N/A	
Mould Length (mm)		0	
Crumbling		No	
Curling		No	
Liquid Limit (%)	AS 1289.3.1.2	25	
Method		One Point	
Plastic Limit (%)	AS 1289.3.2.1	8	
Plasticity Index (%)	AS 1289.3.3.1	17	
Date Tested		23/08/2012	
Moisture Content (%)	AS 1289.2.1.1	13.7	
Date Tested		16/08/2012	
Emerson Class Number	AS 1289.3.8.1	4	
Soil Description		Refer to Log	
Type of Water		Distilled	
Temperature of Water (℃)		23	
Date Tested		25/08/2012	

Comments

N/A

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BRISBANE LABORATORY
46 Grice Street Clontarf Q 4019
Phone: (07) 32848766
Fax: (07) 32844391

Report No: MAT:S122-927
Issue No: 1

Material Test Report

Client:
Golder Associates Pty Ltd
PO Box 6079
Hawthorn West VIC 3122

Project: Santos Storage Ponds "Narrabri" (127615025)

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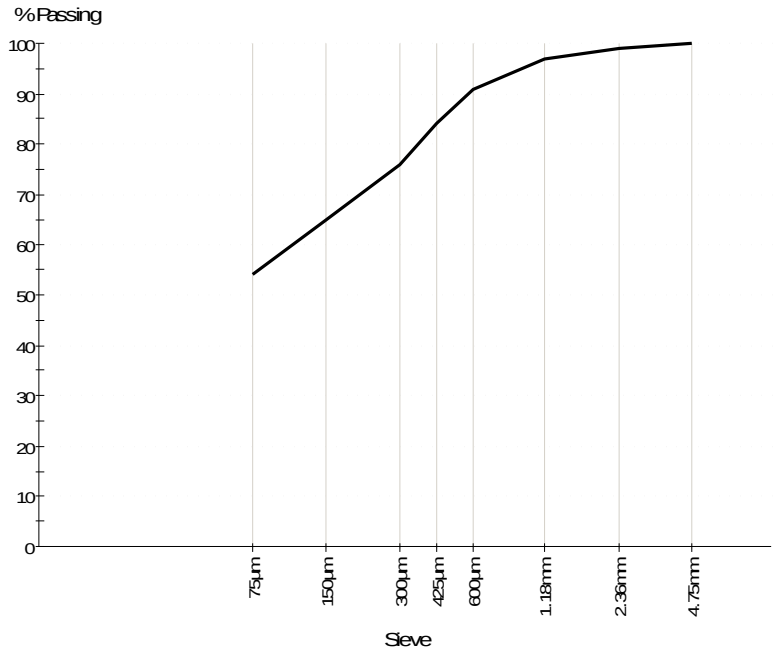
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Sample Details

Sample ID:	S122-927
Field Sample:	139803
Test Request No:	N/A
Sampled By:	Client
Sampling Method:	Disturbed Sample
Date Sampled:	2/08/2012
Lot No:	N/A
Source:	In-Situ
Material:	Refer to Log.
Specification:	All Purpose Grading
Location:	TP.18, Depth:0.9-1.0m

Particle Size Distribution



FINES (54.0%)		SAND			GRAVEL		COBBLES
Clay	Silt	Fine (30.0%)	Medium (14.4%)	Coarse (1.6%)	Fine (0.0%)	Coarse (0.0%)	(0.0%)

Atterberg Limit:

Liquid Limit:	43
Plastic Limit:	13
Plasticity Index:	30
Linear Shrinkage (%):	N/A

Sample Description:

Grading: AS 1289.3.6.1

Drying by: Oven
Date Tested: 24/08/2012
Note: Sample Washed

Sieve Size	% Passing	Limits
4.75mm	100	
2.36mm	99	
1.18mm	97	
600µm	91	
425µm	84	
300µm	76	
150µm	65	
75µm	54	

D85: 0.4465 **D60:** 0.1095 **D50:** 0.0583
D30: 0.0165 **D15:** 0.0064 **D10:** 0.0047

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46 Grice Street Clontarf Q 4019
Phone: (07) 32848766
Fax: (07) 32844391

Report No: MAT:S122-927
Issue No: 1

Material Test Report

Client:
Golder Associates Pty Ltd
PO Box 6079
Hawthorn West VIC 3122

Project: Santos Storage Ponds "Narrabri" (127615025)

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Approved Signatory: David Hall

Date of Issue: 27/08/2012

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Sample Details

Sample ID: S122-927
Field Sample: 139803
Test Request No: N/A
Sampled By: Client
Sampling Method: Disturbed Sample
Date Sampled: 2/08/2012
Lot No: N/A
Source: In-Situ
Material: Refer to Log.
Specification: All Purpose Grading
Location: TP.18, Depth:0.9-1.0m

Other Test Results

Description	Method	Result	Limits
Moisture Content (%)	AS 1289.2.1.1	11.8	
Date Tested		16/08/2012	
Sample History	AS 1289.1.1	Oven-dried	
Preparation	AS 1289.1.1	Dry Sieved	
Linear Shrinkage (%)	AS 1289.3.4.1	N/A	
Mould Length (mm)		0	
Crumbling		No	
Curling		No	
Liquid Limit (%)	AS 1289.3.1.2	43	
Method		One Point	
Plastic Limit (%)	AS 1289.3.2.1	13	
Plasticity Index (%)	AS 1289.3.3.1	30	
Date Tested		24/08/2012	

Comments

N/A

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BRISBANE LABORATORY
46 Grice Street Clontarf Q 4019
Phone: (07) 32848766
Fax: (07) 32844391

Material Test Report

Report No: MAT:S122-928
Issue No: 1

Client:
Golder Associates Pty Ltd
PO Box 6079
Hawthorn West VIC 3122

Project: Santos Storage Ponds "Narrabri" (127615025)

NATA Accreditation No. 2911

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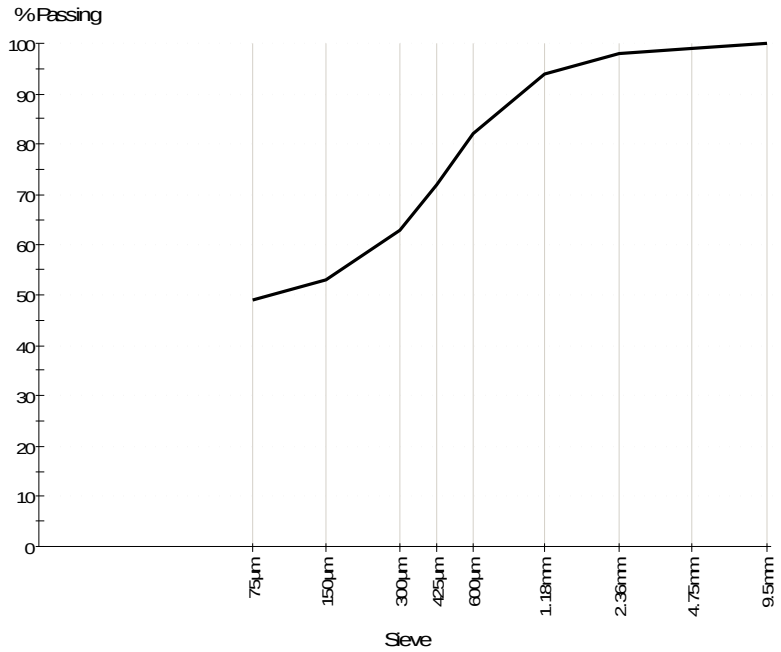
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Sample Details

Sample ID:	S122-928
Client Sample:	TP24-004
Test Request No:	N/A
Sampled By:	Client
Sampling Method:	Disturbed Sample
Date Sampled:	2/08/2012
Lot No:	N/A
Source:	In-Situ
Material:	Refer to Log.
Specification:	All Purpose Grading
Location:	TP24, Depth:5.0-5.3m

Particle Size Distribution



FINES (49.0%)		SAND			GRAVEL		COBBLES
Clay	Silt	Fine (23.0%)	Medium (24.8%)	Coarse (2.2%)	Fine (1.0%)	Coarse (0.0%)	(0.0%)

Atterberg Limit:

Liquid Limit:	39
Plastic Limit:	15
Plasticity Index:	24
Linear Shrinkage (%):	N/A

Sample Description:

Grading: AS 1289.3.6.1

Drying by: Oven
Date Tested: 1/09/2012
Note: Sample Washed

Sieve Size	% Passing	Limits
9.5mm	100	
4.75mm	99	
2.36mm	98	
1.18mm	94	
600µm	82	
425µm	72	
300µm	63	
150µm	53	
75µm	49	

D85: 0.7105 **D60:** 0.2437 **D50:** 0.0892
D30: 0.0028 **D15:** 0.0002 **D10:** 0.0001

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BRISBANE LABORATORY
46 Grice Street Clontarf Q 4019
Phone: (07) 32848766
Fax: (07) 32844391

Report No: MAT:S122-928
Issue No: 1

Material Test Report

Client:
Golder Associates Pty Ltd
PO Box 6079
Hawthorn West VIC 3122

Project: Santos Storage Ponds "Narrabri" (127615025)

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Approved Signatory: David Hall

Date of Issue: 11/09/2012

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Sample Details

Sample ID:	S122-928
Client Sample:	TP24-004
Test Request No:	N/A
Sampled By:	Client
Sampling Method:	Disturbed Sample
Date Sampled:	2/08/2012
Lot No:	N/A
Source:	In-Situ
Material:	Refer to Log.
Specification:	All Purpose Grading
Location:	TP24, Depth:5.0-5.3m

Other Test Results

Description	Method	Result	Limits
Moisture Content (%)	AS 1289.2.1.1	13.0	
Date Tested		30/08/2012	
Sample History	AS 1289.1.1	Oven-dried	
Preparation	AS 1289.1.1	Dry Sieved	
Linear Shrinkage (%)	AS 1289.3.4.1	N/A	
Mould Length (mm)		0	
Crumbling		No	
Curling		No	
Liquid Limit (%)	AS 1289.3.1.2	39	
Method		One Point	
Plastic Limit (%)	AS 1289.3.2.1	15	
Plasticity Index (%)	AS 1289.3.3.1	24	
Date Tested		1/09/2012	
Standard Maximum Dry Density (t/m³)	AS 1289.5.1.1	1.82	
Standard Optimum Moisture Content (%)		14.5	
Retained Sieve 19mm (%)		0	
Date Tested		28/08/2012	

Comments

N/A

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SOUTH QLD SOILS PTY LTD
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ABN 35 229 054 612
Site Investigations, Soil, Aggregate & Concrete Testing Services

BRISBANE LABORATORY
46 Grice Street Clontarf Q 4019
Phone: (07) 32848766
Fax: (07) 32844391

Material Test Report

Report No: MAT:S122-821
Issue No: 1

Client:
Golder Associates Pty Ltd
PO Box 6079
Hawthorn West VIC 3122

Project: Santos Storage Ponds "Narrabri" (127615025)

NATA Accreditation No. 2911

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Approved Signatory: David Hall

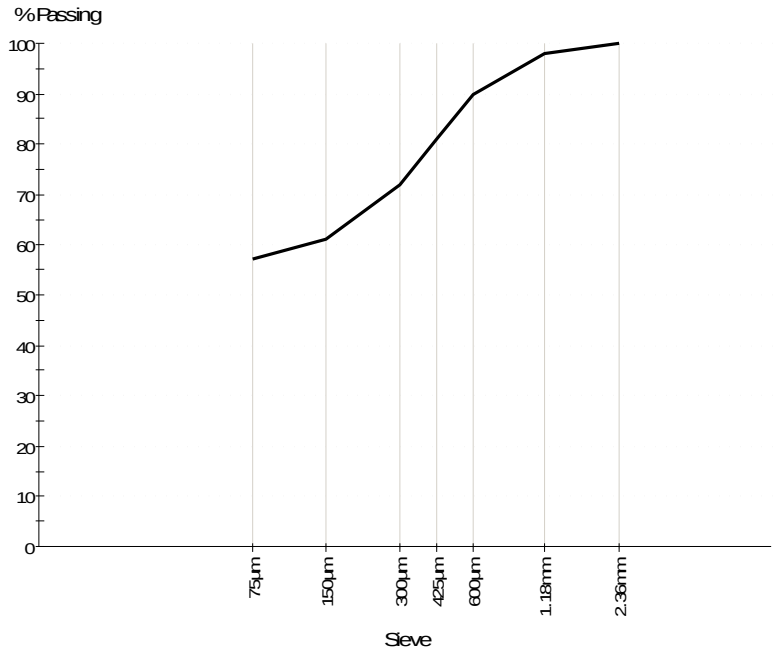
Date of Issue: 17/08/2012

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Sample Details

Sample ID:	S122-821
Client Sample:	TP28-004
Test Request No:	N/A
Sampled By:	Client
Sampling Method:	Bulk Sample
Date Sampled:	2/08/2012
Lot No:	N/A
Source:	In-Situ
Material:	Refer to Log.
Specification:	All Purpose Grading
Location:	TP28, Depth:2.0-2.4m

Particle Size Distribution



FINES (57.0%)		SAND			GRAVEL		COBBLES
Clay	Silt	Fine (24.0%)	Medium (18.4%)	Coarse (0.6%)	Fine (0.0%)	Coarse (0.0%)	(0.0%)

Atterberg Limit:

Liquid Limit:	39
Plastic Limit:	10
Plasticity Index:	29
Linear Shrinkage (%):	N/A

Sample Description:

Grading: AS 1289.3.6.1

Drying by: Oven
Date Tested: 16/08/2012
Note: Sample Washed

Sieve Size	% Passing	Limits
2.36mm	100	
1.18mm	98	
600µm	90	
425µm	81	
300µm	72	
150µm	61	
75µm	57	

D85: 0.4954 **D60:** 0.1261 **D50:** 0.0223
D30: 0.0007 **D15:** 0.0001 **D10:** 0.0000

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BRISBANE LABORATORY
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Phone: (07) 32848766
Fax: (07) 32844391

Material Test Report

Report No: MAT:S122-821
Issue No: 1

Client:
Golder Associates Pty Ltd
PO Box 6079
Hawthorn West VIC 3122

Project: Santos Storage Ponds "Narrabri" (127615025)

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Accreditation No. 2911

Approved Signatory: David Hall

Date of Issue: 17/08/2012

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Sample Details

Sample ID: S122-821
Client Sample: TP28-004
Test Request No: N/A
Sampled By: Client
Sampling Method: Bulk Sample
Date Sampled: 2/08/2012
Lot No: N/A
Source: In-Situ
Material: Refer to Log.
Specification: All Purpose Grading
Location: TP28, Depth:2.0-2.4m

Other Test Results

Description	Method	Result	Limits
Moisture Content (%)	AS 1289.2.1.1	10.6	
Date Tested		11/08/2012	
Sample History	AS 1289.1.1	Oven-dried	
Preparation	AS 1289.1.1	Dry Sieved	
Linear Shrinkage (%)	AS 1289.3.4.1	N/A	
Mould Length (mm)		0	
Crumbling		No	
Curling		No	
Liquid Limit (%)	AS 1289.3.1.2	39	
Method		One Point	
Plastic Limit (%)	AS 1289.3.2.1	10	
Plasticity Index (%)	AS 1289.3.3.1	29	
Date Tested		14/08/2012	
Emerson Class Number	AS 1289.3.8.1	4	
Soil Description		Refer to Log	
Type of Water		Distilled	
Temperature of Water (℃)		20	
Date Tested		14/08/2012	
Standard Maximum Dry Density (t/m³)	AS 1289.5.1.1	1.80	
Standard Optimum Moisture Content (%)		15.5	
Retained Sieve 19mm (%)			
Date Tested		14/08/2012	

Comments

N/A

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BRISBANE LABORATORY
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Phone: (07) 32848766
Fax: (07) 32844391

Material Test Report

Report No: MAT:S122-822
Issue No: 1

Client:
Golder Associates Pty Ltd
PO Box 6079
Hawthorn West VIC 3122

Project: Santos Storage Ponds "Narrabri" (127615025)

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Accreditation No. 2911

Approved Signatory: David Hall

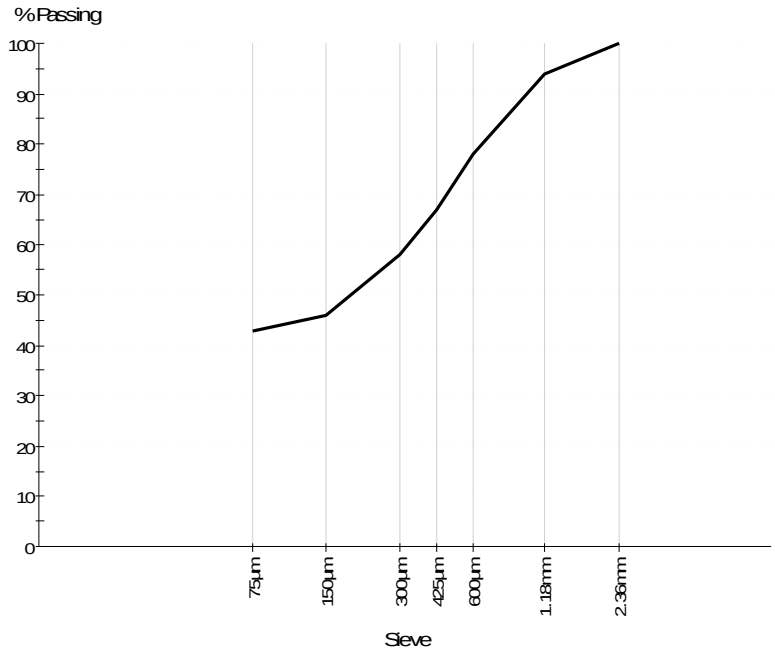
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Sample Details

Sample ID:	S122-822
Client Sample:	TP28-003
Test Request No:	N/A
Sampled By:	Client
Sampling Method:	Disturbed Sample
Date Sampled:	2/08/2012
Lot No:	N/A
Source:	In-Situ
Material:	Refer to Log.
Specification:	All Purpose Grading
Location:	TP28, Depth:3.1-3.2

Particle Size Distribution



FINES (43.0%)		SAND			GRAVEL		COBBLES
Clay	Silt	Fine (24.0%)	Medium (31.2%)	Coarse (1.8%)	Fine (0.0%)	Coarse (0.0%)	(0.0%)

Atterberg Limit:

Liquid Limit:	42
Plastic Limit:	11
Plasticity Index:	31
Linear Shrinkage (%):	N/A

Sample Description:

Grading: AS 1289.3.6.1

Drying by: Oven
Date Tested: 15/08/2012
Note: Sample Washed

Sieve Size	% Passing	Limits
2.36mm	100	
1.18mm	94	
600µm	78	
425µm	67	
300µm	58	
150µm	46	
75µm	43	

D85: 0.8066 **D60:** 0.3241 **D50:** 0.1890
D30: 0.0037 **D15:** 0.0001 **D10:** 0.0000

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BRISBANE LABORATORY
46 Grice Street Clontarf Q 4019
Phone: (07) 32848766
Fax: (07) 32844391

Material Test Report

Report No: MAT:S122-822
Issue No: 1

Client:
Golder Associates Pty Ltd
PO Box 6079
Hawthorn West VIC 3122

Project: Santos Storage Ponds "Narrabri" (127615025)

NATA
Accreditation No. 2911

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Date of Issue: 17/08/2012

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Sample Details

Sample ID: S122-822
Client Sample: TP28-003
Test Request No: N/A
Sampled By: Client
Sampling Method: Disturbed Sample
Date Sampled: 2/08/2012
Lot No: N/A
Source: In-Situ
Material: Refer to Log.
Specification: All Purpose Grading
Location: TP28, Depth:3.1-3.2

Other Test Results

Description	Method	Result	Limits
Emerson Class Number	AS 1289.3.8.1	4	
Soil Description		Refer to Log	
Type of Water		Distilled	
Temperature of Water (℃)		20	
Date Tested		14/08/2012	
Sample History	AS 1289.1.1	Oven-dried	
Preparation	AS 1289.1.1	Dry Sieved	
Linear Shrinkage (%)	AS 1289.3.4.1	N/A	
Mould Length (mm)		0	
Crumbling		No	
Curling		No	
Liquid Limit (%)	AS 1289.3.1.2	42	
Method		One Point	
Plastic Limit (%)	AS 1289.3.2.1	11	
Plasticity Index (%)	AS 1289.3.3.1	31	
Date Tested		16/08/2012	
Moisture Content (%)	AS 1289.2.1.1	12.3	
Date Tested		14/08/2012	

Comments

N/A

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BRISBANE LABORATORY
46 Grice Street Clontarf Q 4019
Phone: (07) 32848766
Fax: (07) 32844391

Material Test Report

Report No: MAT:S122-823
Issue No: 1

Client:
Golder Associates Pty Ltd
PO Box 6079
Hawthorn West VIC 3122

Project: Santos Storage Ponds "Narrabri" (127615025)

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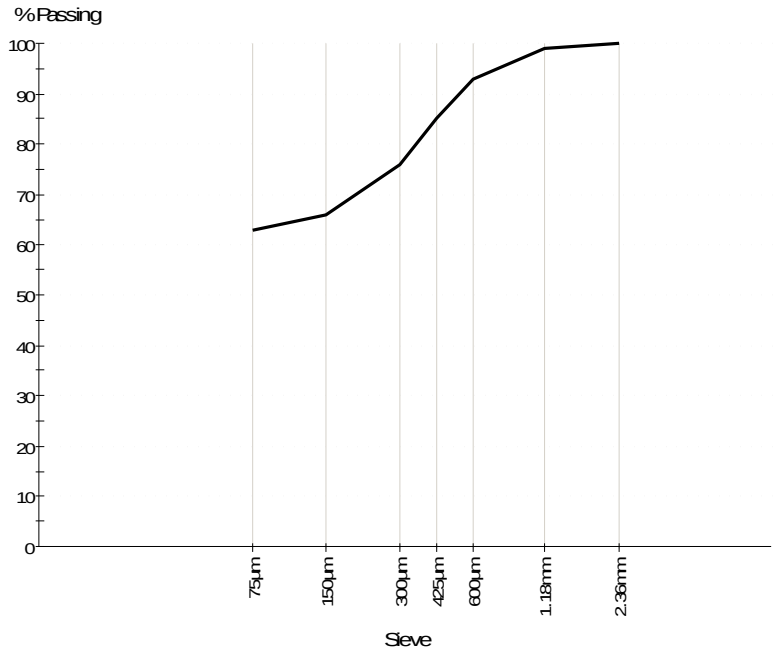
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Sample Details

Sample ID:	S122-823
Client Sample:	TP29-001
Test Request No:	N/A
Sampled By:	Client
Sampling Method:	Disturbed Sample
Date Sampled:	31/07/2012
Lot No:	N/A
Source:	In-Situ
Material:	Refer to Log.
Specification:	All Purpose Grading
Location:	TP29, Depth:1.0-1.1m

Particle Size Distribution



FINES (63.0%)		SAND			GRAVEL		COBBLES
Clay	Silt	Fine (22.0%)	Medium (14.7%)	Coarse (0.3%)	Fine (0.0%)	Coarse (0.0%)	(0.0%)

Atterberg Limit:

Liquid Limit:	51
Plastic Limit:	12
Plasticity Index:	39
Linear Shrinkage (%):	N/A

Sample Description:

Grading: AS 1289.3.6.1

Drying by: Oven
Date Tested: 15/08/2012
Note: Sample Washed

Sieve Size	% Passing	Limits
2.36mm	100	
1.18mm	99	
600µm	93	
425µm	85	
300µm	76	
150µm	66	
75µm	63	

D85: 0.4250 **D60:** 0.0375 **D50:** 0.0037
D30: 0.0000 **D15:** 0.0000 **D10:** 0.0000

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Phone: (07) 32848766
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Material Test Report

Report No: MAT:S122-823
Issue No: 1

Client:
Golder Associates Pty Ltd
PO Box 6079
Hawthorn West VIC 3122

Project: Santos Storage Ponds "Narrabri" (127615025)

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Sample Details

Sample ID:	S122-823
Client Sample:	TP29-001
Test Request No:	N/A
Sampled By:	Client
Sampling Method:	Disturbed Sample
Date Sampled:	31/07/2012
Lot No:	N/A
Source:	In-Situ
Material:	Refer to Log.
Specification:	All Purpose Grading
Location:	TP29, Depth:1.0-1.1m

Other Test Results

Description	Method	Result	Limits
Sample History	AS 1289.1.1	Oven-dried	
Preparation	AS 1289.1.1	Dry Sieved	
Linear Shrinkage (%)	AS 1289.3.4.1	N/A	
Mould Length (mm)		0	
Crumbling		No	
Curling		No	
Liquid Limit (%)	AS 1289.3.1.2	51	
Method		One Point	
Plastic Limit (%)	AS 1289.3.2.1	12	
Plasticity Index (%)	AS 1289.3.3.1	39	
Date Tested		16/08/2012	
Moisture Content (%)	AS 1289.2.1.1	15.6	
Date Tested		14/08/2012	

Comments

N/A

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BRISBANE LABORATORY
46 Grice Street Clontarf Q 4019
Phone: (07) 32848766
Fax: (07) 32844391

Report No: MAT:S122-825
Issue No: 1

Material Test Report

Client:
Golder Associates Pty Ltd
PO Box 6079
Hawthorn West VIC 3122

Project: Santos Storage Ponds "Narrabri" (127615025)

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Date of Issue: 17/08/2012

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Sample Details

Sample ID:	S122-825
Client Sample:	TP30-002
Test Request No:	N/A
Sampled By:	Client
Sampling Method:	Disturbed Sample
Date Sampled:	2/08/2012
Lot No:	N/A
Source:	In-Situ
Material:	Refer to Log.
Specification:	All Purpose Grading
Location:	TP30, Depth:2.4-2.5m

Test Results

Description	Method	Result	Limits
Moisture Content (%)	AS 1289.2.1.1	11.6	
Date Tested		11/08/2012	
Sample History	AS 1289.1.1	Oven-dried	
Preparation	AS 1289.1.1	Dry Sieved	
Linear Shrinkage (%)	AS 1289.3.4.1	N/A	
Mould Length (mm)		0	
Crumbling		No	
Curling		No	
Liquid Limit (%)	AS 1289.3.1.2	37	
Method		One Point	
Plastic Limit (%)	AS 1289.3.2.1	10	
Plasticity Index (%)	AS 1289.3.3.1	27	
Date Tested		16/08/2012	

Comments

N/A

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BRISBANE LABORATORY
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Phone: (07) 32848766
Fax: (07) 32844391

Material Test Report

Report No: MAT:S122-828
Issue No: 1

Client:
Golder Associates Pty Ltd
PO Box 6079
Hawthorn West VIC 3122

Project: Santos Storage Ponds "Narrabri" (127615025)

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Accreditation No. 2911

Approved Signatory: David Hall

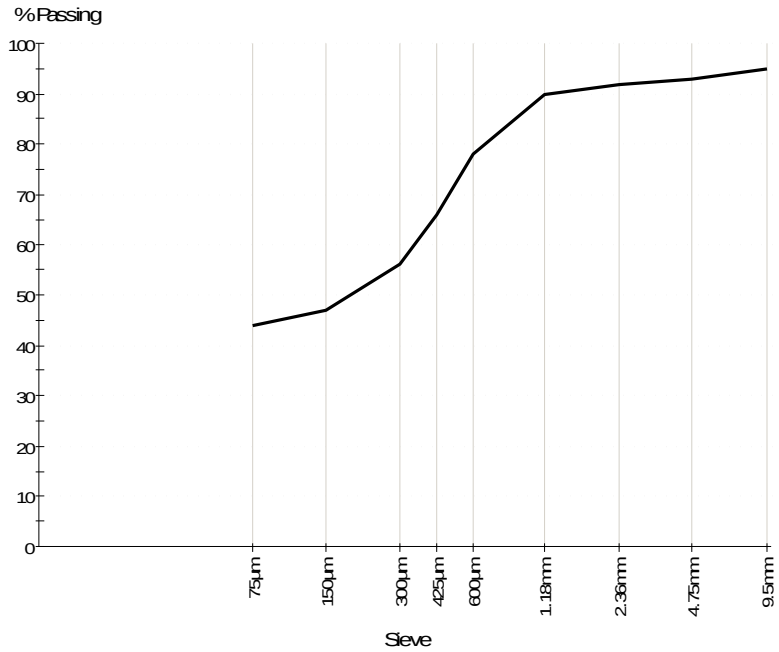
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Sample Details

Sample ID:	S122-828
Client Sample:	TP32-003
Test Request No:	N/A
Sampled By:	Client
Sampling Method:	Disturbed Sample
Date Sampled:	31/07/2012
Lot No:	N/A
Source:	In-Situ
Material:	Refer to Log.
Specification:	All Purpose Grading
Location:	TP32, Depth:2.0-2.1m

Particle Size Distribution



FINES (44.0%)		SAND			GRAVEL		COBBLES
Clay	Silt	Fine (22.0%)	Medium (25.4%)	Coarse (1.6%)	Fine (7.0%)	Coarse (0.0%)	(0.0%)

Atterberg Limit:

Liquid Limit:	34
Plastic Limit:	12
Plasticity Index:	22
Linear Shrinkage (%):	N/A

Sample Description:

Grading: AS 1289.3.6.1

Drying by: Oven
Date Tested: 13/08/2012
Note: Sample Washed

Sieve Size	% Passing	Limits
9.5mm	95	
4.75mm	93	
2.36mm	92	
1.18mm	90	
600µm	78	
425µm	66	
300µm	56	
150µm	47	
75µm	44	

D85: 0.8902 **D60:** 0.3448 **D50:** 0.1890
D30: 0.0030 **D15:** 0.0001 **D10:** 0.0000

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46 Grice Street Clontarf Q 4019
Phone: (07) 32848766
Fax: (07) 32844391

Material Test Report

Report No: MAT:S122-828
Issue No: 1

Client:
Golder Associates Pty Ltd
PO Box 6079
Hawthorn West VIC 3122

Project: Santos Storage Ponds "Narrabri" (127615025)

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Date of Issue: 17/08/2012

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Sample Details

Sample ID:	S122-828
Client Sample:	TP32-003
Test Request No:	N/A
Sampled By:	Client
Sampling Method:	Disturbed Sample
Date Sampled:	31/07/2012
Lot No:	N/A
Source:	In-Situ
Material:	Refer to Log.
Specification:	All Purpose Grading
Location:	TP32, Depth:2.0-2.1m

Other Test Results

Description	Method	Result	Limits
Moisture Content (%)	AS 1289.2.1.1	10.0	
Date Tested		11/08/2012	
Sample History	AS 1289.1.1	Oven-dried	
Preparation	AS 1289.1.1	Dry Sieved	
Linear Shrinkage (%)	AS 1289.3.4.1	N/A	
Mould Length (mm)		0	
Crumbling		No	
Curling		No	
Liquid Limit (%)	AS 1289.3.1.2	34	
Method		One Point	
Plastic Limit (%)	AS 1289.3.2.1	12	
Plasticity Index (%)	AS 1289.3.3.1	22	
Date Tested		8/08/2012	
Emerson Class Number	AS 1289.3.8.1	4	
Soil Description		Refer to Log	
Type of Water		Distilled	
Temperature of Water (℃)		20	
Date Tested		16/08/2012	

Comments

N/A

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Fax: (07) 32844391

Material Test Report

Report No: MAT:S122-829
Issue No: 1

Client:
Golder Associates Pty Ltd
PO Box 6079
Hawthorn West VIC 3122

Project: Santos Storage Ponds "Narrabri" (127615025)

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Approved Signatory: David Hall

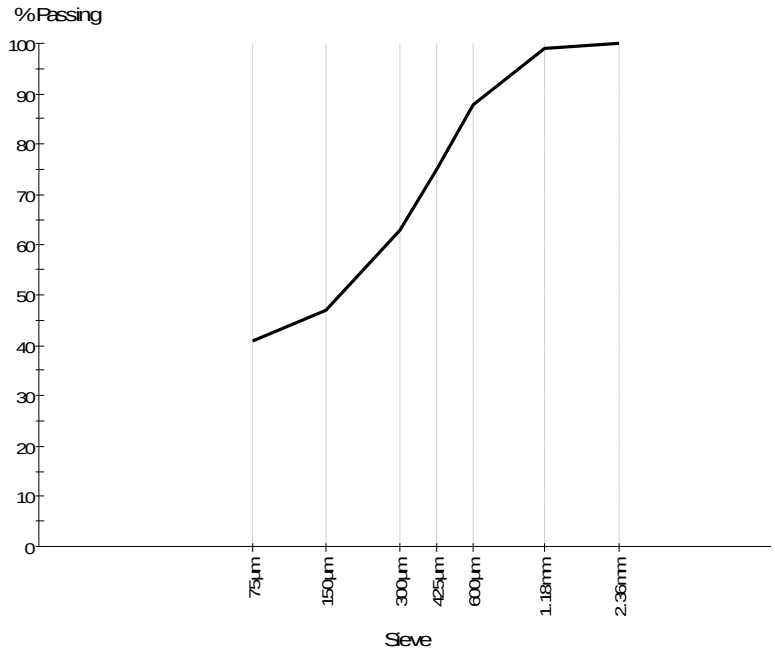
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Sample Details

Sample ID:	S122-829
Client Sample:	TP33-001
Test Request No:	N/A
Sampled By:	Client
Sampling Method:	Disturbed Sample
Date Sampled:	31/07/2012
Lot No:	N/A
Source:	In-Situ
Material:	Refer to Log.
Specification:	All Purpose Grading
Location:	TP33, Depth:0.2-0.3m

Particle Size Distribution



FINES (41.0%)		SAND			GRAVEL		COBBLES
Clay	Silt	Fine (34.0%)	Medium (24.7%)	Coarse (0.3%)	Fine (0.0%)	Coarse (0.0%)	(0.0%)

Atterberg Limit:

Liquid Limit:	20
Plastic Limit:	11
Plasticity Index:	9
Linear Shrinkage (%):	N/A

Sample Description:

Grading: AS 1289.3.6.1

Drying by: Oven
Date Tested: 13/08/2012
Note: Sample Washed

Sieve Size	% Passing	Limits
2.36mm	100	
1.18mm	99	
600µm	88	
425µm	75	
300µm	63	
150µm	47	
75µm	41	

D85: 0.5541 **D60:** 0.2634 **D50:** 0.1708
D30: 0.0210 **D15:** 0.0037 **D10:** 0.0021

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BRISBANE LABORATORY
46 Grice Street Clontarf Q 4019
Phone: (07) 32848766
Fax: (07) 32844391

Report No: MAT:S122-829
Issue No: 1

Material Test Report

Client:
Golder Associates Pty Ltd
PO Box 6079
Hawthorn West VIC 3122

Project: Santos Storage Ponds "Narrabri" (127615025)

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Accreditation No. 2911

Approved Signatory: David Hall

Date of Issue: 20/08/2012

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Sample Details

Sample ID: S122-829
Client Sample: TP33-001
Test Request No: N/A
Sampled By: Client
Sampling Method: Disturbed Sample
Date Sampled: 31/07/2012
Lot No: N/A
Source: In-Situ
Material: Refer to Log.
Specification: All Purpose Grading
Location: TP33, Depth:0.2-0.3m

Other Test Results

Description	Method	Result	Limits
Sample History	AS 1289.1.1	Oven-dried	
Preparation	AS 1289.1.1	Dry Sieved	
Linear Shrinkage (%)	AS 1289.3.4.1	N/A	
Mould Length (mm)		0	
Crumbling		No	
Curling		No	
Liquid Limit (%)	AS 1289.3.1.2	20	
Method		One Point	
Plastic Limit (%)	AS 1289.3.2.1	11	
Plasticity Index (%)	AS 1289.3.3.1	9	
Date Tested		9/08/2012	
Moisture Content (%)	AS 1289.2.1.1	16.2	
Date Tested		11/08/2012	

Comments

N/A

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AS TRUSTEE FOR THE F&B TRUST
ABN 35 229 054 612
Site Investigations, Soil, Aggregate & Concrete Testing Services

BRISBANE LABORATORY
46 Grice Street Clontarf Q 4019
Phone: (07) 32848766
Fax: (07) 32844391

Material Test Report

Report No: MAT:S122-830
Issue No: 1

Client:
Golder Associates Pty Ltd
PO Box 6079
Hawthorn West VIC 3122

Project: Santos Storage Ponds "Narrabri" (127615025)

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Accreditation No. 2911

Approved Signatory: David Hall

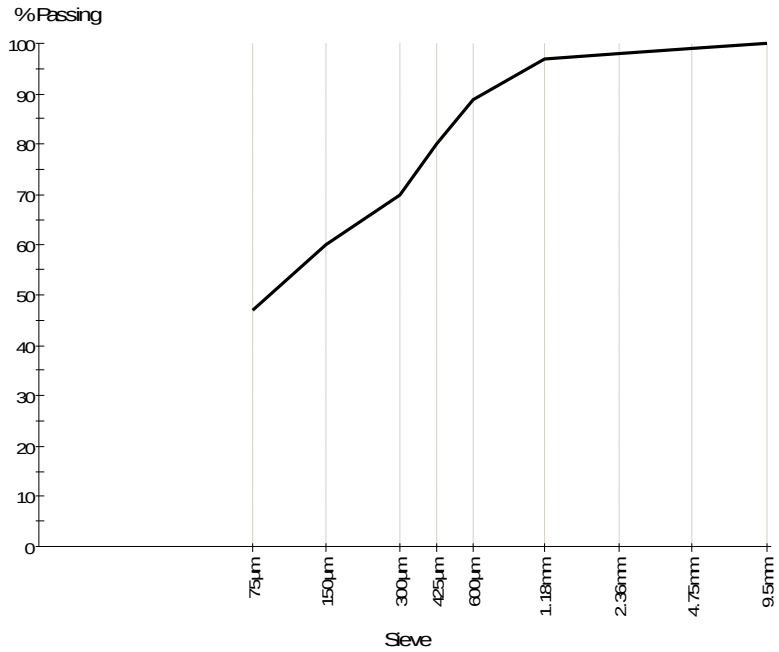
Date of Issue: 20/08/2012

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Sample Details

Sample ID:	S122-830
Client Sample:	TP33-002
Test Request No:	N/A
Sampled By:	Client
Sampling Method:	Disturbed Sample
Date Sampled:	31/07/2012
Lot No:	N/A
Source:	In-Situ
Material:	Refer to Log.
Specification:	All Purpose Grading
Location:	TP33, Depth:1.2-1.3m

Particle Size Distribution



FINES (47.0%)		SAND			GRAVEL		COBBLES
Clay	Silt	Fine (33.0%)	Medium (17.7%)	Coarse (1.3%)	Fine (1.0%)	Coarse (0.0%)	(0.0%)

Atterberg Limit:

Liquid Limit:	52
Plastic Limit:	18
Plasticity Index:	34
Linear Shrinkage (%):	N/A

Sample Description:

Grading: AS 1289.3.6.1

Drying by: Oven
Date Tested: 10/08/2012
Note: Sample Washed

Sieve Size	% Passing	Limits
9.5mm	100	
4.75mm	99	
2.36mm	98	
1.18mm	97	
600µm	89	
425µm	80	
300µm	70	
150µm	60	
75µm	47	

D85: 0.5147 **D60:** 0.1500 **D50:** 0.0880
D30: 0.0303 **D15:** 0.0136 **D10:** 0.0104

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Material Test Report

Report No: MAT:S122-830
Issue No: 1

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Sample Details

Sample ID: S122-830
Client Sample: TP33-002
Test Request No: N/A
Sampled By: Client
Sampling Method: Disturbed Sample
Date Sampled: 31/07/2012
Lot No: N/A
Source: In-Situ
Material: Refer to Log.
Specification: All Purpose Grading
Location: TP33, Depth:1.2-1.3m

Other Test Results

Description	Method	Result	Limits
Sample History	AS 1289.1.1	Oven-dried	
Preparation	AS 1289.1.1	Dry Sieved	
Linear Shrinkage (%)	AS 1289.3.4.1	N/A	
Mould Length (mm)		0	
Crumbling		No	
Curling		No	
Liquid Limit (%)	AS 1289.3.1.2	52	
Method		One Point	
Plastic Limit (%)	AS 1289.3.2.1	18	
Plasticity Index (%)	AS 1289.3.3.1	34	
Date Tested		9/08/2012	
Moisture Content (%)	AS 1289.2.1.1	13.8	
Date Tested		9/08/2012	

Comments

N/A

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BRISBANE LABORATORY
46 Grice Street Clontarf Q 4019
Phone: (07) 32848766
Fax: (07) 32844391

Material Test Report

Report No: MAT:S122-831
Issue No: 1

Client:
Golder Associates Pty Ltd
PO Box 6079
Hawthorn West VIC 3122

Project: Santos Storage Ponds "Narrabri" (127615025)

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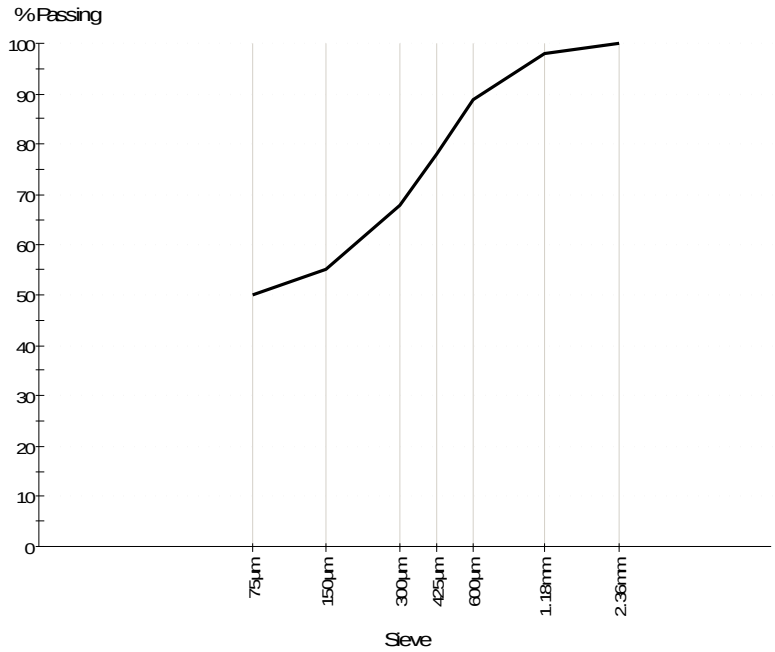
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Sample Details

Sample ID:	S122-831
Client Sample:	TP34-001
Test Request No:	N/A
Sampled By:	Client
Sampling Method:	Disturbed Sample
Date Sampled:	31/07/2012
Lot No:	N/A
Source:	In-Situ
Material:	Refer to Log.
Specification:	All Purpose Grading
Location:	TP34, Depth:0.2-0.3m

Particle Size Distribution



FINES (50.0%)		SAND			GRAVEL		COBBLES
Clay	Silt	Fine (28.0%)	Medium (21.4%)	Coarse (0.6%)	Fine (0.0%)	Coarse (0.0%)	(0.0%)

Atterberg Limit:

Liquid Limit:	29
Plastic Limit:	9
Plasticity Index:	20
Linear Shrinkage (%):	N/A

Sample Description:

Grading: AS 1289.3.6.1

Drying by: Oven
Date Tested: 10/08/2012
Note: Sample Washed

Sieve Size	% Passing	Limits
2.36mm	100	
1.18mm	98	
600µm	89	
425µm	78	
300µm	68	
150µm	55	
75µm	50	

D85: 0.5293 **D60:** 0.1958 **D50:** 0.0750
D30: 0.0047 **D15:** 0.0006 **D10:** 0.0003

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Phone: (07) 32848766
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Report No: MAT:S122-831
Issue No: 1

Material Test Report

Client:
Golder Associates Pty Ltd
PO Box 6079
Hawthorn West VIC 3122

Project: Santos Storage Ponds "Narrabri" (127615025)

NATA
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Date of Issue: 20/08/2012

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Sample Details

Sample ID: S122-831
Client Sample: TP34-001
Test Request No: N/A
Sampled By: Client
Sampling Method: Disturbed Sample
Date Sampled: 31/07/2012
Lot No: N/A
Source: In-Situ
Material: Refer to Log.
Specification: All Purpose Grading
Location: TP34, Depth:0.2-0.3m

Other Test Results

Description	Method	Result	Limits
Moisture Content (%)	AS 1289.2.1.1	13.4	
Date Tested		9/08/2012	
Sample History	AS 1289.1.1	Oven-dried	
Preparation	AS 1289.1.1	Dry Sieved	
Linear Shrinkage (%)	AS 1289.3.4.1	N/A	
Mould Length (mm)		0	
Crumbling		No	
Curling		No	
Liquid Limit (%)	AS 1289.3.1.2	29	
Method		One Point	
Plastic Limit (%)	AS 1289.3.2.1	9	
Plasticity Index (%)	AS 1289.3.3.1	20	
Date Tested		17/08/2012	

Comments

N/A

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BRISBANE LABORATORY
46 Grice Street Clontarf Q 4019
Phone: (07) 32848766
Fax: (07) 32844391

Material Test Report

Report No: MAT:S122-832
Issue No: 1

Client:
Golder Associates Pty Ltd
PO Box 6079
Hawthorn West VIC 3122

Project: Santos Storage Ponds "Narrabri" (127615025)

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Approved Signatory: David Hall

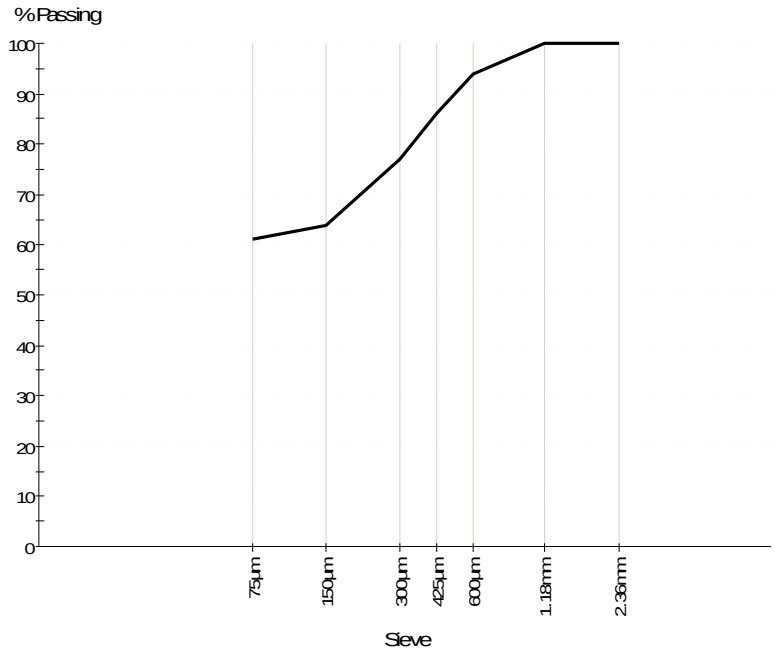
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Sample Details

Sample ID:	S122-832
Client Sample:	TP34-002
Test Request No:	N/A
Sampled By:	Client
Sampling Method:	Disturbed Sample
Date Sampled:	31/07/2012
Lot No:	N/A
Source:	In-Situ
Material:	Refer to Log.
Specification:	All Purpose Grading
Location:	TP34, Depth:1.8-1.9m

Particle Size Distribution



FINES (61.0%)		SAND			GRAVEL		COBBLES
Clay	Silt	Fine (25.0%)	Medium (14.0%)	Coarse (0.0%)	Fine (0.0%)	Coarse (0.0%)	(0.0%)

Atterberg Limit:

Liquid Limit:	28
Plastic Limit:	13
Plasticity Index:	15
Linear Shrinkage (%):	N/A

Sample Description:

Grading: AS 1289.3.6.1

Drying by: Oven
Date Tested: 15/08/2012
Note: Sample Washed

Sieve Size	% Passing	Limits
2.36mm	100	
1.18mm	100	
600µm	94	
425µm	86	
300µm	77	
150µm	64	
75µm	61	

D85: 0.4089 **D60:** 0.0595 **D50:** 0.0059
D30: 0.0001 **D15:** 0.0000 **D10:** 0.0000

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Material Test Report

Report No: MAT:S122-832
Issue No: 1

Client:
Golder Associates Pty Ltd
PO Box 6079
Hawthorn West VIC 3122

Project: Santos Storage Ponds "Narrabri" (127615025)

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Sample Details

Sample ID: S122-832
Client Sample: TP34-002
Test Request No: N/A
Sampled By: Client
Sampling Method: Disturbed Sample
Date Sampled: 31/07/2012
Lot No: N/A
Source: In-Situ
Material: Refer to Log.
Specification: All Purpose Grading
Location: TP34, Depth:1.8-1.9m

Other Test Results

Description	Method	Result	Limits
Sample History	AS 1289.1.1	Oven-dried	
Preparation	AS 1289.1.1	Dry Sieved	
Linear Shrinkage (%)	AS 1289.3.4.1	N/A	
Mould Length (mm)		0	
Crumbling		No	
Curling		No	
Liquid Limit (%)	AS 1289.3.1.2	28	
Method		One Point	
Plastic Limit (%)	AS 1289.3.2.1	13	
Plasticity Index (%)	AS 1289.3.3.1	15	
Date Tested		9/08/2012	
Moisture Content (%)	AS 1289.2.1.1	12.8	
Date Tested		14/08/2012	
Emerson Class Number	AS 1289.3.8.1	4	
Soil Description		Refer to Log	
Type of Water		Distilled	
Temperature of Water (℃)		20	
Date Tested		13/08/2012	

Comments

N/A

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46 Grice Street Clontarf Q 4019
Phone: (07) 32848766
Fax: (07) 32844391

Material Test Report

Report No: MAT:S122-833
Issue No: 1

Client:
Golder Associates Pty Ltd
PO Box 6079
Hawthorn West VIC 3122

Project: Santos Storage Ponds "Narrabri" (127615025)

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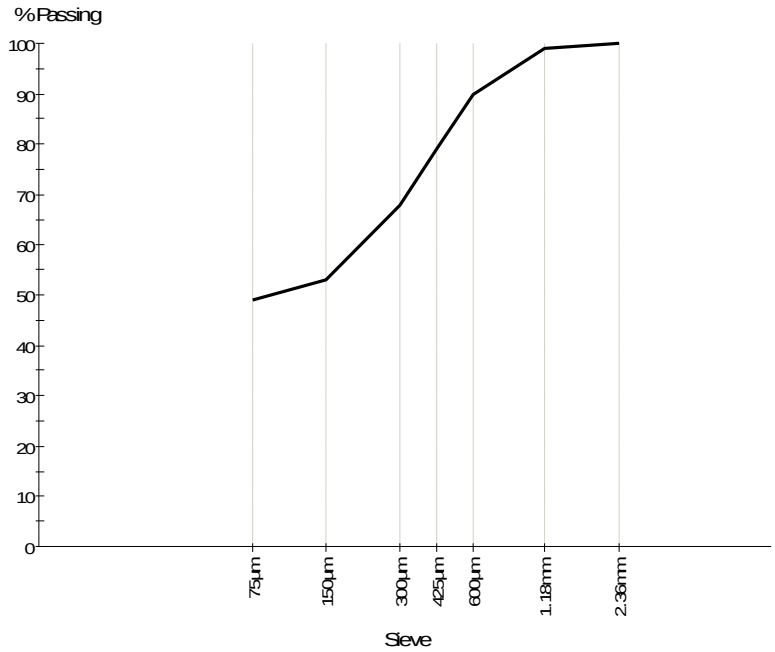
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Sample Details

Sample ID:	S122-833
Client Sample:	TP35-001
Test Request No:	N/A
Sampled By:	Client
Sampling Method:	Disturbed Sample
Date Sampled:	31/07/2012
Lot No:	N/A
Source:	In-Situ
Material:	Refer to Log.
Specification:	All Purpose Grading
Location:	TP35, Depth:0.3-0.4m

Particle Size Distribution



FINES (49.0%)		SAND			GRAVEL		COBBLES
Clay	Silt	Fine (30.0%)	Medium (20.7%)	Coarse (0.3%)	Fine (0.0%)	Coarse (0.0%)	(0.0%)

Atterberg Limit:

Liquid Limit:	27
Plastic Limit:	9
Plasticity Index:	18
Linear Shrinkage (%):	N/A

Sample Description:

Grading: AS 1289.3.6.1

Drying by: Oven
Date Tested: 16/08/2012
Note: Sample Washed

Sieve Size	% Passing	Limits
2.36mm	100	
1.18mm	99	
600µm	90	
425µm	79	
300µm	68	
150µm	53	
75µm	49	

D85: 0.5130 **D60:** 0.2073 **D50:** 0.0892
D30: 0.0028 **D15:** 0.0002 **D10:** 0.0001

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Sample Details

Sample ID: S122-833
Client Sample: TP35-001
Test Request No: N/A
Sampled By: Client
Sampling Method: Disturbed Sample
Date Sampled: 31/07/2012
Lot No: N/A
Source: In-Situ
Material: Refer to Log.
Specification: All Purpose Grading
Location: TP35, Depth:0.3-0.4m

Other Test Results

Description	Method	Result	Limits
Sample History	AS 1289.1.1	Oven-dried	
Preparation	AS 1289.1.1	Dry Sieved	
Linear Shrinkage (%)	AS 1289.3.4.1	N/A	
Mould Length (mm)		0	
Crumbling		No	
Curling		No	
Liquid Limit (%)	AS 1289.3.1.2	27	
Method		One Point	
Plastic Limit (%)	AS 1289.3.2.1	9	
Plasticity Index (%)	AS 1289.3.3.1	18	
Date Tested		13/08/2012	
Moisture Content (%)	AS 1289.2.1.1	12.3	
Date Tested		11/08/2012	
Emerson Class Number	AS 1289.3.8.1	4	
Soil Description		Refer to Log	
Type of Water		Distilled	
Temperature of Water (℃)		20	
Date Tested		13/08/2012	

Comments

N/A

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Material Test Report

Report No: MAT:S122-834
Issue No: 1

Client:
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PO Box 6079
Hawthorn West VIC 3122

Project: Santos Storage Ponds "Narrabri" (127615025)

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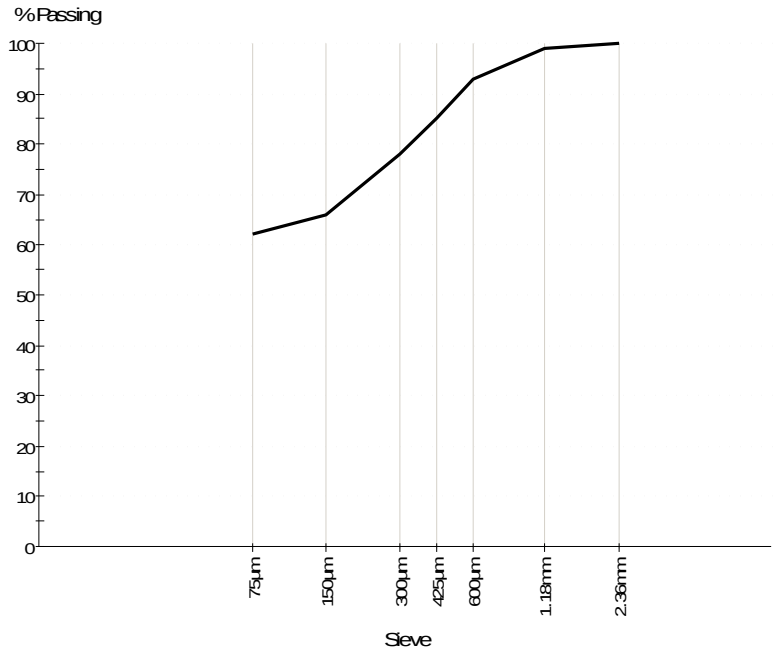
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Sample Details

Sample ID:	S122-834
Client Sample:	TP35-002
Test Request No:	N/A
Sampled By:	Client
Sampling Method:	Disturbed Sample
Date Sampled:	31/07/2012
Lot No:	N/A
Source:	In-Situ
Material:	Refer to Log.
Specification:	All Purpose Grading
Location:	TP35, Depth:0.7-0.8m

Particle Size Distribution



FINES (62.0%)		SAND			GRAVEL		COBBLES
Clay	Silt	Fine (23.0%)	Medium (14.7%)	Coarse (0.3%)	Fine (0.0%)	Coarse (0.0%)	(0.0%)

Atterberg Limit:

Liquid Limit:	32
Plastic Limit:	11
Plasticity Index:	21
Linear Shrinkage (%):	N/A

Sample Description:

Grading: AS 1289.3.6.1

Drying by: Oven
Date Tested: 10/08/2012
Note: Sample Washed

Sieve Size	% Passing	Limits
2.36mm	100	
1.18mm	99	
600µm	93	
425µm	85	
300µm	78	
150µm	66	
75µm	62	

D85: 0.4250 **D60:** 0.0530 **D50:** 0.0094
D30: 0.0003 **D15:** 0.0000 **D10:** 0.0000

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Report No: MAT:S122-834
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Sample Details

Sample ID: S122-834
Client Sample: TP35-002
Test Request No: N/A
Sampled By: Client
Sampling Method: Disturbed Sample
Date Sampled: 31/07/2012
Lot No: N/A
Source: In-Situ
Material: Refer to Log.
Specification: All Purpose Grading
Location: TP35, Depth:0.7-0.8m

Other Test Results

Description	Method	Result	Limits
Sample History	AS 1289.1.1	Oven-dried	
Preparation	AS 1289.1.1	Dry Sieved	
Linear Shrinkage (%)	AS 1289.3.4.1	N/A	
Mould Length (mm)		0	
Crumbling		No	
Curling		No	
Liquid Limit (%)	AS 1289.3.1.2	32	
Method		One Point	
Plastic Limit (%)	AS 1289.3.2.1	11	
Plasticity Index (%)	AS 1289.3.3.1	21	
Date Tested		13/08/2012	
Moisture Content (%)	AS 1289.2.1.1	10.3	
Date Tested		9/08/2012	

Comments

N/A

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Material Test Report

Report No: MAT:S122-835
Issue No: 1

Client:
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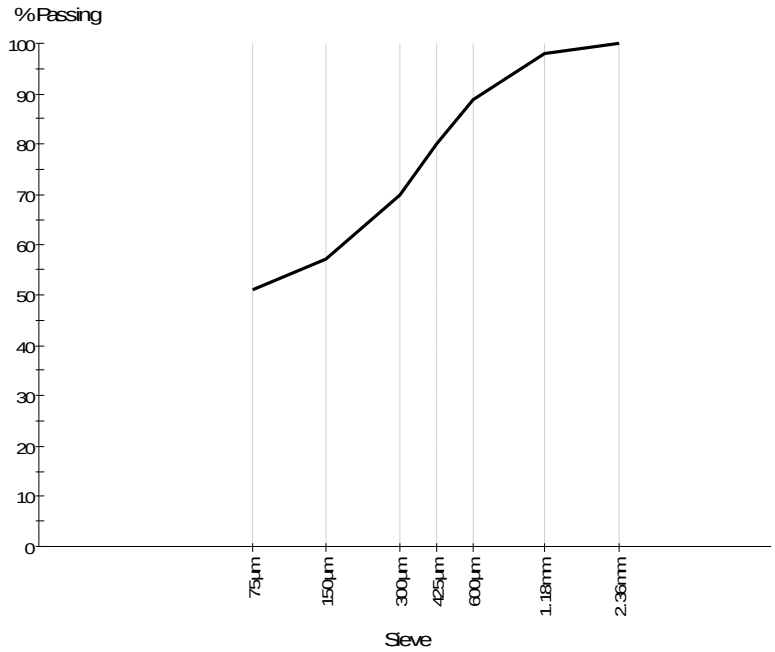
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Sample Details

Sample ID:	S122-835
Client Sample:	TP36-001
Test Request No:	N/A
Sampled By:	Client
Sampling Method:	Disturbed Sample
Date Sampled:	31/07/2012
Lot No:	N/A
Source:	In-Situ
Material:	Refer to Log.
Specification:	All Purpose Grading
Location:	TP36, Depth:0.3-0.4m

Particle Size Distribution



FINES (51.0%)		SAND			GRAVEL		COBBLES
Clay	Silt	Fine (29.0%)	Medium (19.4%)	Coarse (0.6%)	Fine (0.0%)	Coarse (0.0%)	(0.0%)

Sample Description:

Grading: AS 1289.3.6.1

Drying by: Oven
Date Tested: 15/08/2012
Note: Sample Washed

Sieve Size	% Passing	Limits
2.36mm	100	
1.18mm	98	
600µm	89	
425µm	80	
300µm	70	
150µm	57	
75µm	51	

D85: 0.5147 **D60:** 0.1760 **D50:** 0.0668
D30: 0.0066 **D15:** 0.0012 **D10:** 0.0007

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Phone: (07) 32848766
Fax: (07) 32844391

Report No: MAT:S122-835
Issue No: 1

Material Test Report

Client:
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PO Box 6079
Hawthorn West VIC 3122

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Approved Signatory: David Hall

Date of Issue: 20/08/2012

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Sample Details

Sample ID:	S122-835
Client Sample:	TP36-001
Test Request No:	N/A
Sampled By:	Client
Sampling Method:	Disturbed Sample
Date Sampled:	31/07/2012
Lot No:	N/A
Source:	In-Situ
Material:	Refer to Log.
Specification:	All Purpose Grading
Location:	TP36, Depth:0.3-0.4m

Other Test Results

Description	Method	Result	Limits
Moisture Content (%)	AS 1289.2.1.1	10.3	
Date Tested		14/08/2012	

Comments

N/A

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Site Investigations, Soil, Aggregate & Concrete Testing Services

BRISBANE LABORATORY
46 Grice Street Clontarf Q 4019
Phone: (07) 32848766
Fax: (07) 32844391

Report No: MAT:S122-836
Issue No: 1

Material Test Report

Client:
Golder Associates Pty Ltd
PO Box 6079
Hawthorn West VIC 3122

Project: Santos Storage Ponds "Narrabri" (127615025)

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Approved Signatory: David Hall

Date of Issue: 20/08/2012

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Sample Details

Sample ID:	S122-836
Client Sample:	TP37-001
Test Request No:	N/A
Sampled By:	Client
Sampling Method:	Disturbed Sample
Date Sampled:	31/07/2012
Lot No:	N/A
Source:	In-Situ
Material:	Refer to Log.
Specification:	All Purpose Grading
Location:	TP37, Depth:0.4-0.5m

Test Results

Description	Method	Result	Limits
Sample History	AS 1289.1.1	Oven-dried	
Preparation	AS 1289.1.1	Dry Sieved	
Linear Shrinkage (%)	AS 1289.3.4.1	N/A	
Mould Length (mm)		0	
Crumbling		No	
Curling		No	
Liquid Limit (%)	AS 1289.3.1.2	29	
Method		One Point	
Plastic Limit (%)	AS 1289.3.2.1	9	
Plasticity Index (%)	AS 1289.3.3.1	20	
Date Tested		16/08/2012	
Moisture Content (%)	AS 1289.2.1.1	13.9	
Date Tested		11/08/2012	

Comments

N/A

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APPENDIX H

Laboratory Test Results - Standard Compaction

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Fax: (07) 32844391

Maximum Dry Density Report

Report No: MDD:S122-849
Issue No: 1

Client:
Golder Associates Pty Ltd
PO Box 6079
Hawthorn West VIC 3122

Project: Santos Storage Ponds "Narrabri" (127615025)

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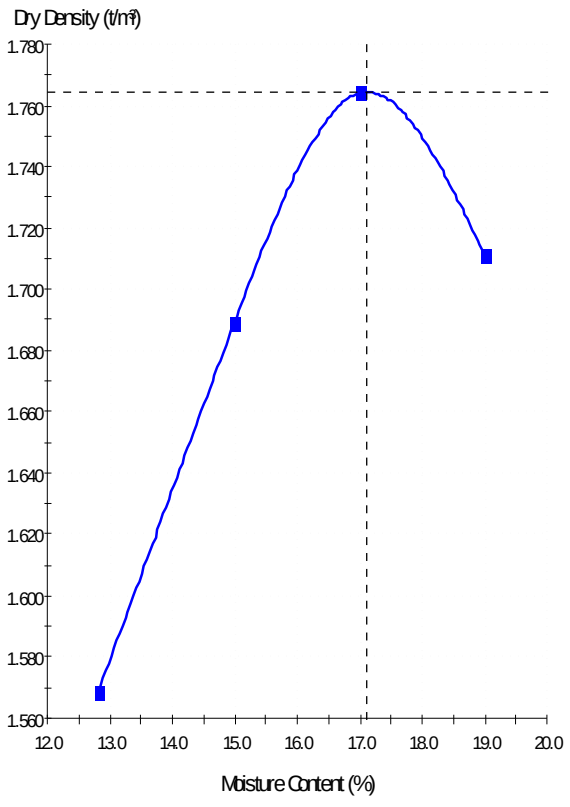
Date of Issue: 21/08/2012

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Sample Details

Location:	Leewood		
Sample ID:	S122-849	**Date Sampled:**	4/08/2012
Sampling Method:	Disturbed Sample		
Source:	In-Situ	**Material:**	Refer to Log.
Specification:	All Purpose Grading		
Location:	TP.02, Depth:2.0-2.3m		
Tested By:	David Hall	**Date Tested:**	14/08/2012

Dry Density - Moisture Content Relationship



Test Results

AS 1289.5.1.1

Standard MDD (t/m³): **1.76**

Standard OMC (%): **17.0**

Retained Sieve 19mm (%):

Comments

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Phone: (07) 32848766
Fax: (07) 32844391

Maximum Dry Density Report

Report No: MDD:S122-875
Issue No: 1

Client:
Golder Associates Pty Ltd
PO Box 6079
Hawthorn West VIC 3122

Project: Santos Storage Ponds "Narrabri" (127615025)

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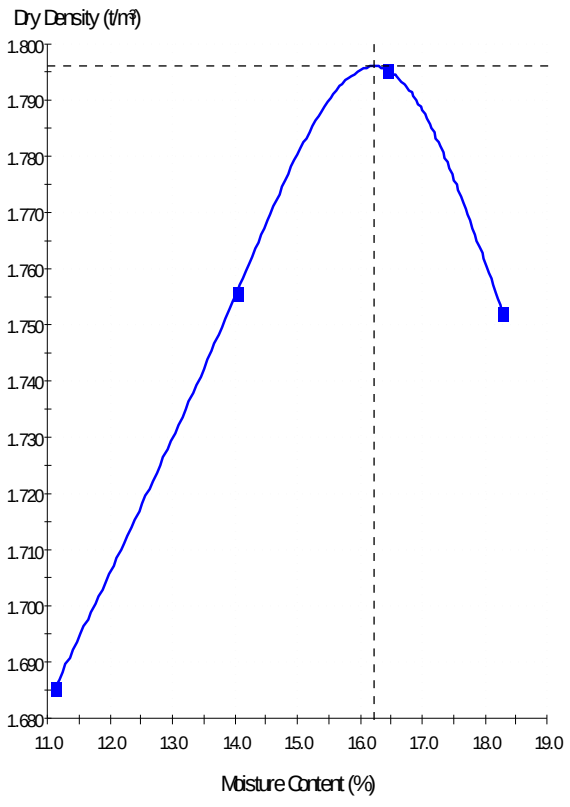
Date of Issue: 21/08/2012

THIS DOCUMENT SHALL NOT BE REPRODUCED EXCEPT IN FULL

Sample Details

Location:	Leewood		
Sample ID:	S122-875	**Date Sampled:**	3/08/2012
Sampling Method:	Disturbed Sample		
Source:	In-Situ	**Material:**	Refer to Log.
Specification:	All Purpose Grading		
Location:	TP.03, Depth:1.4-1.5m		
Tested By:	David Hall	**Date Tested:**	20/08/2012

Dry Density - Moisture Content Relationship



Test Results

AS 1289.5.1.1

Standard MDD (t/m³): 1.80
Standard OMC (%): 16.0
Retained Sieve 19mm (%): 0

Comments

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Maximum Dry Density Report

Report No: MDD:S122-853
Issue No: 1

Client:
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PO Box 6079
Hawthorn West VIC 3122

Project: Santos Storage Ponds "Narrabri" (127615025)

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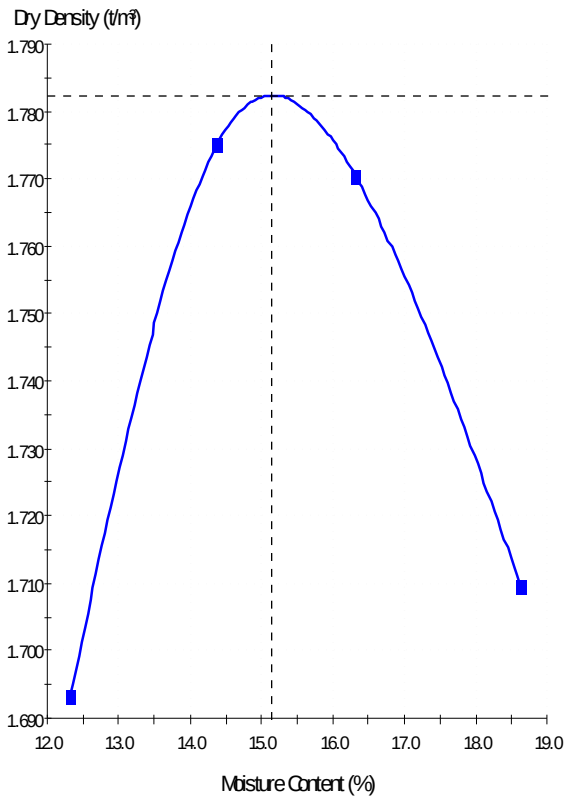
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Sample Details

Location:	Leewood		
Sample ID:	S122-853	**Date Sampled:**	4/08/2012
Sampling Method:	Bulk Sample		
Source:	In-Situ	**Material:**	Refer to Log.
Specification:	All Purpose Grading		
Location:	TP.05, Depth:1.1-1.4m		
Tested By:	David Hall	**Date Tested:**	20/08/2012

Dry Density - Moisture Content Relationship



Test Results

AS 1289.5.1.1

Standard MDD (t/m³): 1.78

Standard OMC (%): 15.0

Retained Sieve 19mm (%):

Comments

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Fax: (07) 32844391

Maximum Dry Density Report

Report No: MDD:S122-876
Issue No: 1

Client:
Golder Associates Pty Ltd
PO Box 6079
Hawthorn West VIC 3122

Project: Santos Storage Ponds "Narrabri" (127615025)

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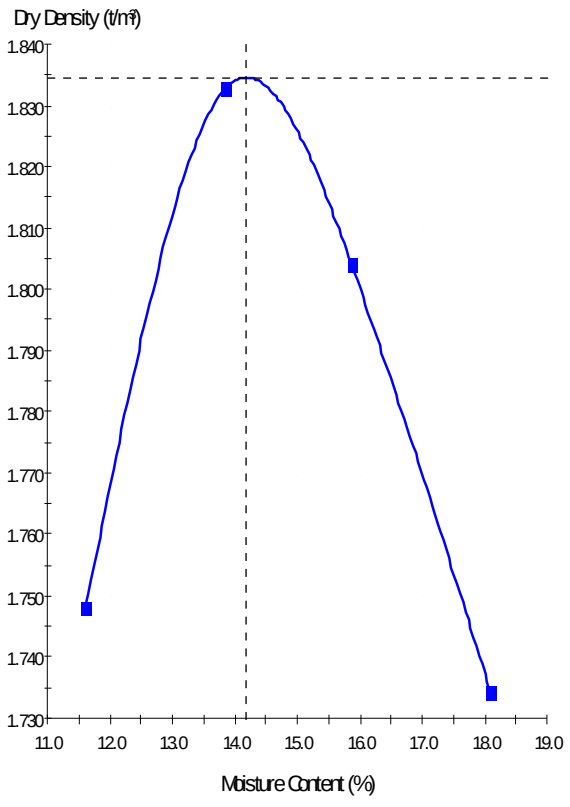
Date of Issue: 21/08/2012

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Sample Details

Location:	Leewood		
Sample ID:	S122-876	**Date Sampled:**	3/08/2012
Sampling Method:	Bulk Sample		
Source:	In-Situ	**Material:**	Refer to Log.
Specification:	All Purpose Grading		
Location:	TP.06, Depth:1.0-1.3m		
Tested By:	David Hall	**Date Tested:**	20/08/2012

Dry Density - Moisture Content Relationship



Test Results

AS 1289.5.1.1

Standard MDD (t/m³): 1.83
Standard OMC (%): 14.0
Retained Sieve 19mm (%): 0

Comments

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BRISBANE LABORATORY
46 Grice Street Clontarf Q 4019
Phone: (07) 32848766
Fax: (07) 32844391

Maximum Dry Density Report

Report No: MDD:S122-881
Issue No: 1

Client:
Golder Associates Pty Ltd
PO Box 6079
Hawthorn West VIC 3122

Project: Santos Storage Ponds "Narrabri" (127615025)

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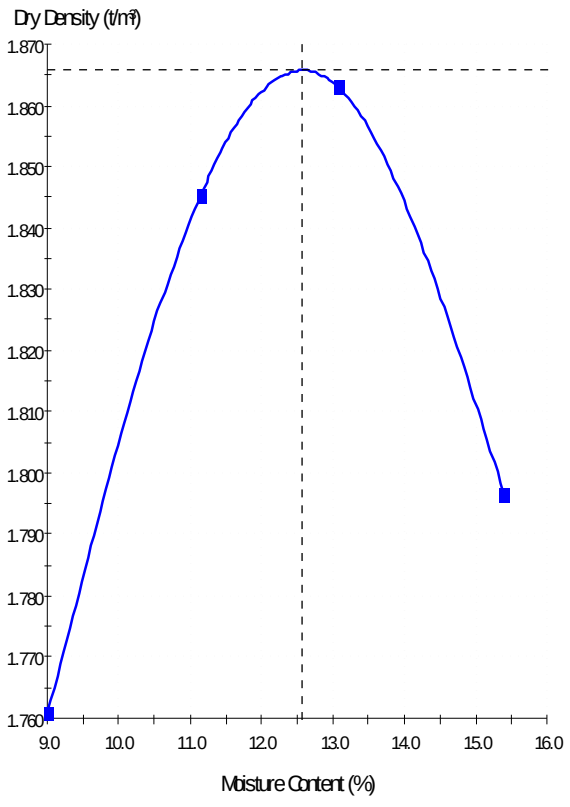
Date of Issue: 22/08/2012

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Sample Details

Location:	Leewood		
Sample ID:	S122-881	**Date Sampled:**	3/08/2012
Sampling Method:	Bulk Sample		
Source:	In-Situ	**Material:**	Refer to Log.
Specification:	All Purpose Grading		
Location:	TP.11, Depth:0.2-0.5m		
Tested By:	David Hall	**Date Tested:**	21/08/2012

Dry Density - Moisture Content Relationship



Test Results

AS 1289.5.1.1

Standard MDD (t/m³): **1.87**
Standard OMC (%): **12.5**
Retained Sieve 19mm (%): 0

Comments

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Phone: (07) 32848766
Fax: (07) 32844391

Maximum Dry Density Report

Report No: MDD:S122-917
Issue No: 1

Client:
Golder Associates Pty Ltd
PO Box 6079
Hawthorn West VIC 3122

Project: Santos Storage Ponds "Narrabri" (127615025)

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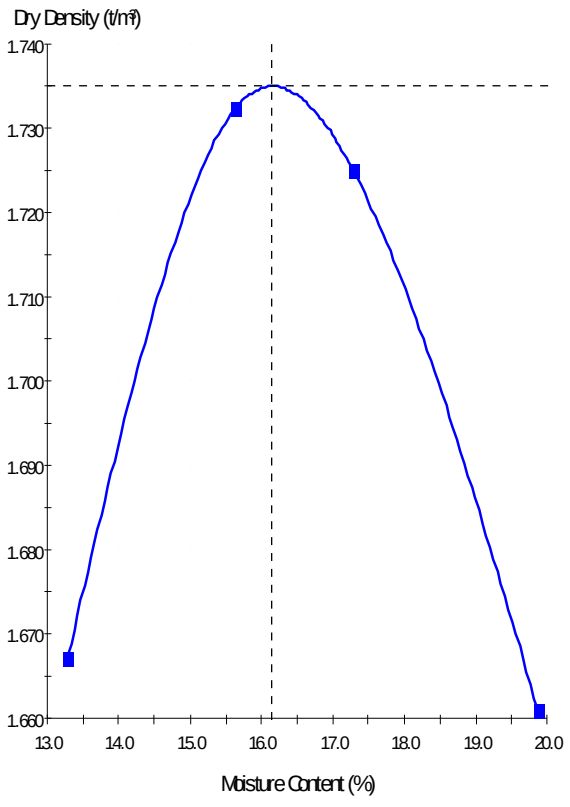
Date of Issue: 27/08/2012

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Sample Details

Location:	Leewood		
Sample ID:	S122-917	**Date Sampled:**	2/08/2012
Sampling Method:	Bulk Sample		
Source:	In-Situ	**Material:**	Refer to Log.
Specification:	All Purpose Grading		
Location:	TP.12, Depth:1.0-1.3m		
Tested By:	David Hall	**Date Tested:**	21/08/2012

Dry Density - Moisture Content Relationship



Test Results

AS 1289.5.1.1

Standard MDD (t/m³): 1.73
Standard OMC (%): 16.0
Retained Sieve 19mm (%): 0

Comments

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Fax: (07) 32844391

Maximum Dry Density Report

Report No: MDD:S122-922
Issue No: 1

Client:
Golder Associates Pty Ltd
PO Box 6079
Hawthorn West VIC 3122

Project: Santos Storage Ponds "Narrabri" (127615025)

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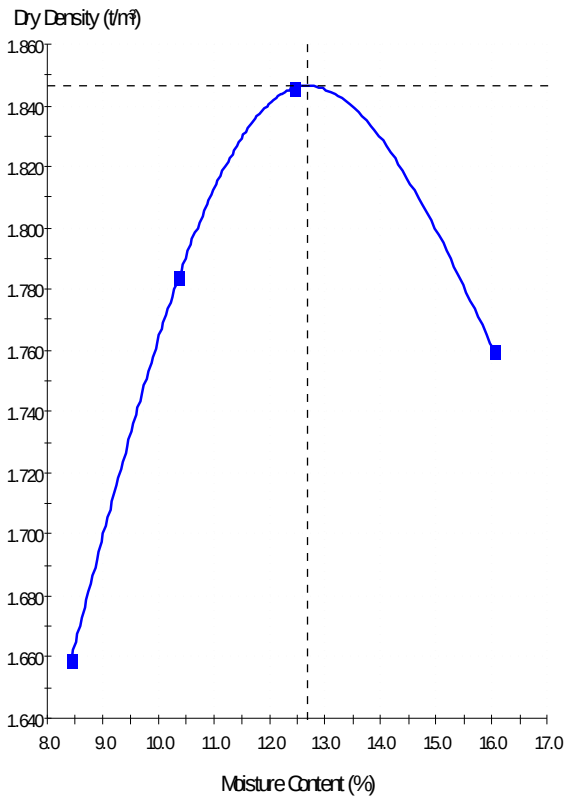
Date of Issue: 27/08/2012

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Sample Details

Location:	Leewood		
Sample ID:	S122-922	**Date Sampled:**	2/08/2012
Sampling Method:	Bulk Sample		
Source:	In-Situ	**Material:**	Refer to Log.
Specification:	All Purpose Grading		
Location:	TP.15, Depth:0.5-0.8m		
Tested By:	David Hall	**Date Tested:**	20/08/2012

Dry Density - Moisture Content Relationship



Test Results

AS 1289.5.1.1

Standard MDD (t/m³): **1.85**

Standard OMC (%): **12.5**

Retained Sieve 19mm (%):

Comments

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Phone: (07) 32848766
Fax: (07) 32844391

Maximum Dry Density Report

Report No: MDD:S122-928
Issue No: 1

Client:
Golder Associates Pty Ltd
PO Box 6079
Hawthorn West VIC 3122

Project: Santos Storage Ponds "Narrabri" (127615025)

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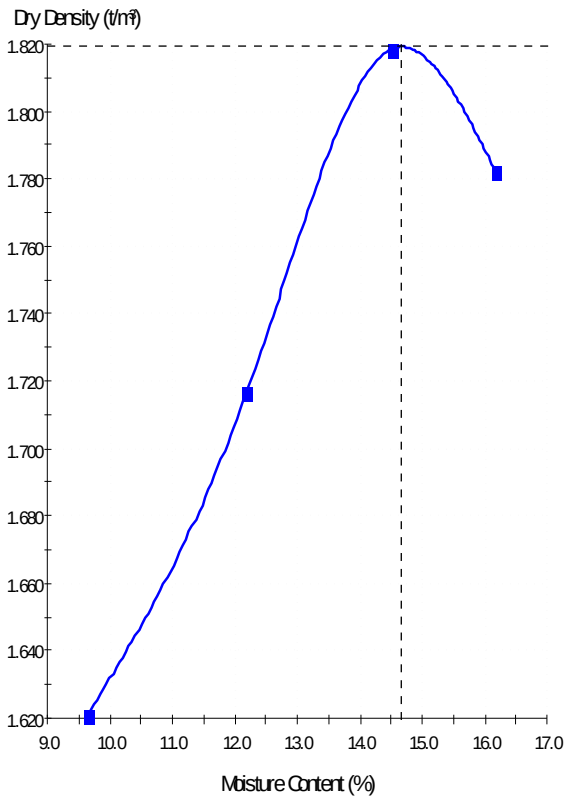
Date of Issue: 11/09/2012

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Sample Details

Location:	Leewood		
Sample ID:	S122-928	**Date Sampled:**	2/08/2012
Sampling Method:	Disturbed Sample		
Source:	In-Situ	**Material:**	Refer to Log.
Specification:	All Purpose Grading		
Location:	TP24, Depth:5.0-5.3m		
Tested By:	David Hall	**Date Tested:**	28/08/2012

Dry Density - Moisture Content Relationship



Test Results

AS 1289.5.1.1

Standard MDD (t/m³): **1.82**
Standard OMC (%): **14.5**
Retained Sieve 19mm (%): 0

Comments

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46 Grice Street Clontarf Q 4019
Phone: (07) 32848766
Fax: (07) 32844391

Maximum Dry Density Report

Report No: MDD:S122-821
Issue No: 1

Client:
Golder Associates Pty Ltd
PO Box 6079
Hawthorn West VIC 3122

Project: Santos Storage Ponds "Narrabri" (127615025)

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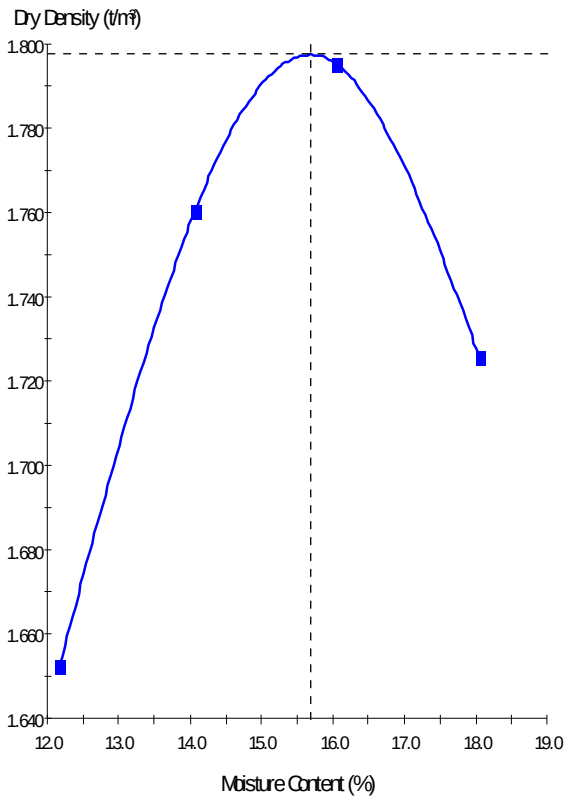
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Sample Details

Location:	Leewood		
Sample ID:	S122-821	**Date Sampled:**	2/08/2012
Sampling Method:	Bulk Sample		
Source:	In-Situ	**Material:**	Refer to Log.
Specification:	All Purpose Grading		
Location:	TP28, Depth:2.0-2.4m		
Tested By:	Tim Pascoe	**Date Tested:**	14/08/2012

Dry Density - Moisture Content Relationship



Test Results

AS 1289.5.1.1

Standard MDD (t/m³): **1.80**
Standard OMC (%): **15.5**
Retained Sieve 19mm (%):

Comments

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APPENDIX I

Laboratory Test Results - Remoulded Permeability

Trilab
Soil Rock Calibration

Brisbane
346A Bilsen Road,
Geebung
QLD 4034
Ph: +61 7 3265 5656

Perth
2 Kimmer Place,
Queens Park
WA 6107
Ph: +61 8 9258 8323

PERMEABILITY BY FALLING HEAD TEST REPORT

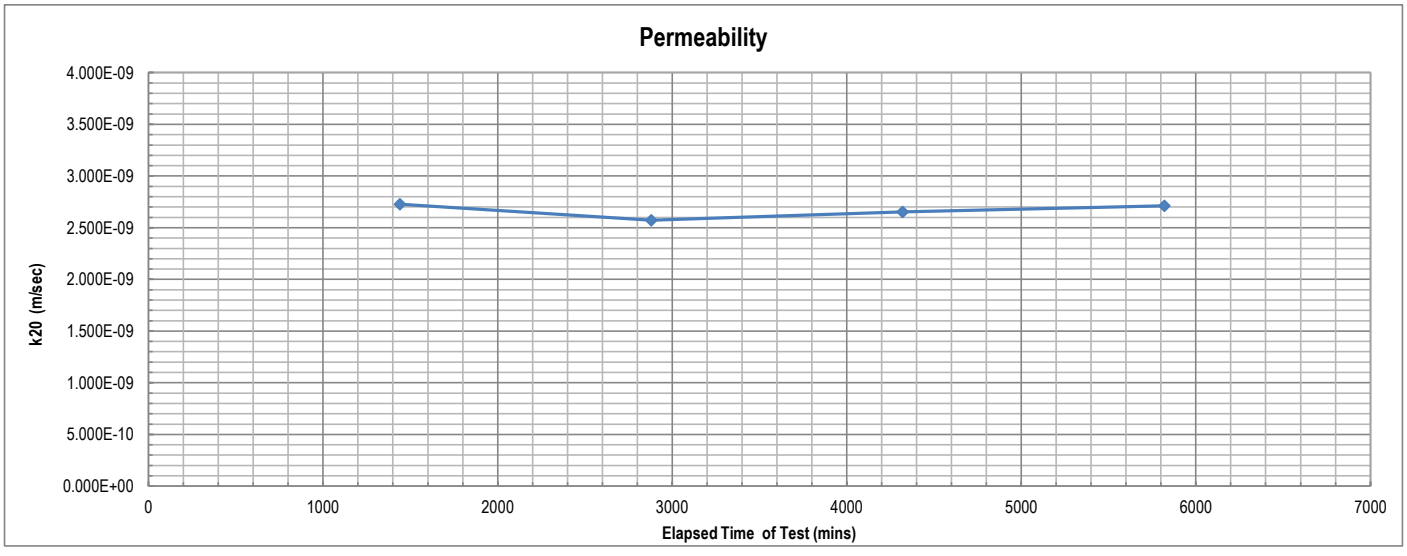
Test Method AS 1289 6.7.2, 5.1.1 , KH2 (Based on K H Head (1988) Manual of Laboratory Testing,10.7)

Client	South Qld Soils Pty Ltd	**Report No.**	12081295-FHPT
Project	2PR-0677 Santos Storage Ponds "Narrabri"	**Test Date**	5/9/12 - 10/9/12
		Report Date	10/09/2012
Client ID	S122-809 / TP19	**Depth (m)**	1.50-1.70
Description	SANDY CLAYEY SILT, brown	**Sample Type**	Remoulded Soil Specimen

RESULTS OF TESTING

Compaction Method	**AS1289.5.1.1 - Standard Compaction**		
Maximum Dry Density (t/m^3)	**1.77**	Hydraulic Gradient	**9.3**
Optimum Moisture Content (%)	**15.0**	Surcharge (kPa)	**25.0**
Placement Moisture Content (%)	**14.6**	Head Pressure Applied (kPa)	**4.58**
Moisture Ratio (%)	**97.3**	Water Type	**De-Aired**
Placement Wet Density (t/m^3)	**1.93**	Percentage Material Retained/Sieve Size (mm)	**0 % /2.36 mm**
Density Ratio (%)	**95.4**	Sample Height and Diameter (mm)	**50.41 / 19.99 mm**

PERMEABILITY $k_{(20)}$ = 2.7E-09 (m/sec)



Remarks: The above specimen was remoulded to a target of 95% of Standard Dry Density and at 100% of Optimum Moisture Content.

Sample/s supplied by client The compaction data was supplied by the client. Tested as received **Page: 1 of 1** REP06301

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Authorised Signatory

C. Park

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Laboratory No. 9926

The results of calibrations and tests performed apply only to the specific instrument or sample at the time of test unless otherwise clearly stated.
Reference should be made to Trilab's "Standard Terms and Conditions of Business" for further details.
Trilab Pty Ltd ABN 25 065 630 506

ACCURATE QUALITY RESULTS FOR TOMORROW'S ENGINEERING

APPENDIX J

Limitations

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Golder Associates Pty Ltd
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570 – 588 Swan Street
Richmond, Victoria 3121
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T: +61 3 8862 3500

Golder Associates

Appendix 12

Flood Study

2 October 2012

SANTOS NARRABRI GAS PROJECT

Flood Study Assessment - Leewood Ponds

Submitted to:
Andrew Shek
Santos Ltd
Level 16
40 Creek Street
Brisbane QLD 4000

REPORT

Report Number. 127615025-009-R-Rev1

Golder Associates

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1.0 INTRODUCTION

Santos Ltd (Santos) has commissioned Golder Associates Pty Ltd (Golder) to undertake a flood study in the location of the proposed Leewood Ponds. The flood study is required as part of the submission for the Review of Environmental Factors to the NSW Office of Environment and Heritage.

The Basis of Design documentation (*Golder, July 2012)*[1] identified that the ponds are to be located in areas outside of a recognised watercourse and above the 0.02 annual exceedance probability (AEP) flood level, also referred to as the 50 year average recurrence interval (ARI). This report provides a flood study of the 50 year ARI flood and additionally assesses the impacts of the 100 year ARI flood.

2.0 SITE AND WATERCOURSE DESCRIPTION

The proposed Leewood Ponds described in this flood assessment are located in the northwestern portion of the property known as Leewood (Lot 1 DP 771141), see Figure 1. The property is located on the western side of the Newell Highway, south of Narrabri. The site comprises predominantly cleared grazing land with scattered trees.

The headwater tributary of Mollee Creek is the focus of this flood study. Mapping by Geoscience Australia shows the start of Mollee Creek beginning approximately 3 km north of the site and flows in a northward direction. A lesser defined headwater tributary of Mollee Creek flows from the southeast to north through the site. Approximately 1 km upstream (southeast) of the proposed ponds, the headwater of Mollee Creek crosses the Newell Highway via two 1200 mm by 650 mm box culverts, see Figure 2. The tributary is non-perennial and not well-defined at the location of the proposed ponds. It enters the Namoi River more than 30 km downstream of the site.

Two other nearby watercourses were not considered a flood risk to the proposed Leewood Ponds and not included in this analysis. Bohena Creek is located approximately 2 km to the east of the site, with its apparent floodplain level approximately 3 m below the site level. Bundock Creek is located approximately 4 km to the west of the site, with its apparent floodplain level approximately 2 m below the site level.

[1] *Golder July 2012 Santos Leewood Ponds – Basis of Design 127615025 001 L Rev0*

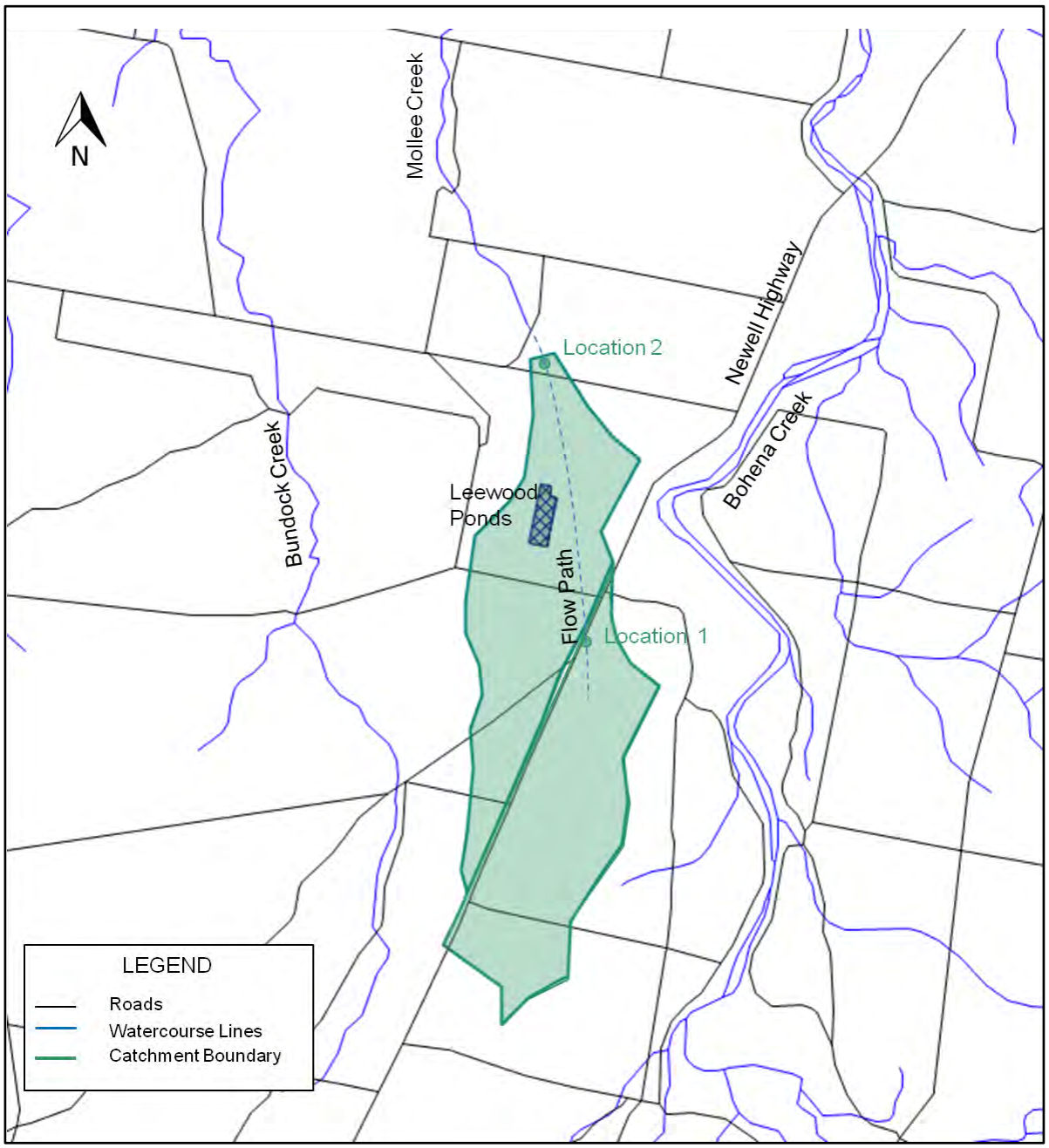


Figure 1: Pond location and catchment areas used for modelling.



Figure 2: Culvert under the Newell Highway.

3.0 APPROACH

The hydrology for this flood study was assessed using the Rational Method to estimate the 50 year and 100 year Average Recurrence Interval (ARI) peak discharge. The Rational Method is a standard flood estimation technique described in Australian Rainfall and Runoff[2].

A hydraulic model was then developed in XPSWMM. XPSWMM is a 1D-2D hydraulic modelling package.

3.1 Hydrology

The discharge was estimated for the watercourse at two locations (Location 1 and 2), see Figure 1. Location 1 reports upstream of the site at the culvert under the Newell Highway. Location 2 includes the total catchment reporting to the watercourse downstream of the ponds. The peak discharge was then calculated using the Rational Method. Catchment areas and peak discharge are provided in Table 1. Rational Method calculations are provided in APPENDIX A.

Table 1: 50 year and 100 year ARI peak discharge

Location	Catchment Area (ha)	50 year ARI (m^3/s)	100 year ARI (m^3/s)
1 (above road)	1060	35.5	42.4
2 (below ponds)	2180	50.5	60.7

3.2 Hydraulics

An steady flow 2D hydraulic model was developed in XPSWMM. The model incorporates the following elements/properties.

- A digital terrain model (DTM) - using LiDAR survey data supplied by Santos.
- Model extents - as shown in Figure 3.
- Watercourse inflows – peak discharges were input as steady flows at the flow input boundary and three nodes to the east of the ponds, as shown in Figure 3.
- Model duration – the model was run for a duration of 6 hours when steady flow conditions were achieved.
- Manning's Roughness – Manning's coefficients of 0.05 (for cleared areas) and 0.07 (for treed areas).
- 2D Grid Resolution – Grid size of 10 m.
- Time Step – Time step of 10 seconds.
- Culvert – The inclusion of two (2) box culverts of 1200 mm by 650 mm, conduit length 10 m, Manning's n value of 0.014.
- Pond Extents – The ponds were included as ineffective flow areas for flood inundation.

[2] Engineers Australia 2001 Australian Rainfall and Runoff Book 1

4.0 RESULTS

4.1 50 year ARI flood inundation

The 50 year ARI flood inundation extent for the modelled reach is provided in Figure 3. The flow direction is from south to north. Flood water from east of the Newell Highway flows via the culvert and overtops the highway to the watercourse. The highway/culvert causes backwater during the 50 year ARI, which results in 9 m^3/s of runoff being diverted to the east towards Bohena Creek.

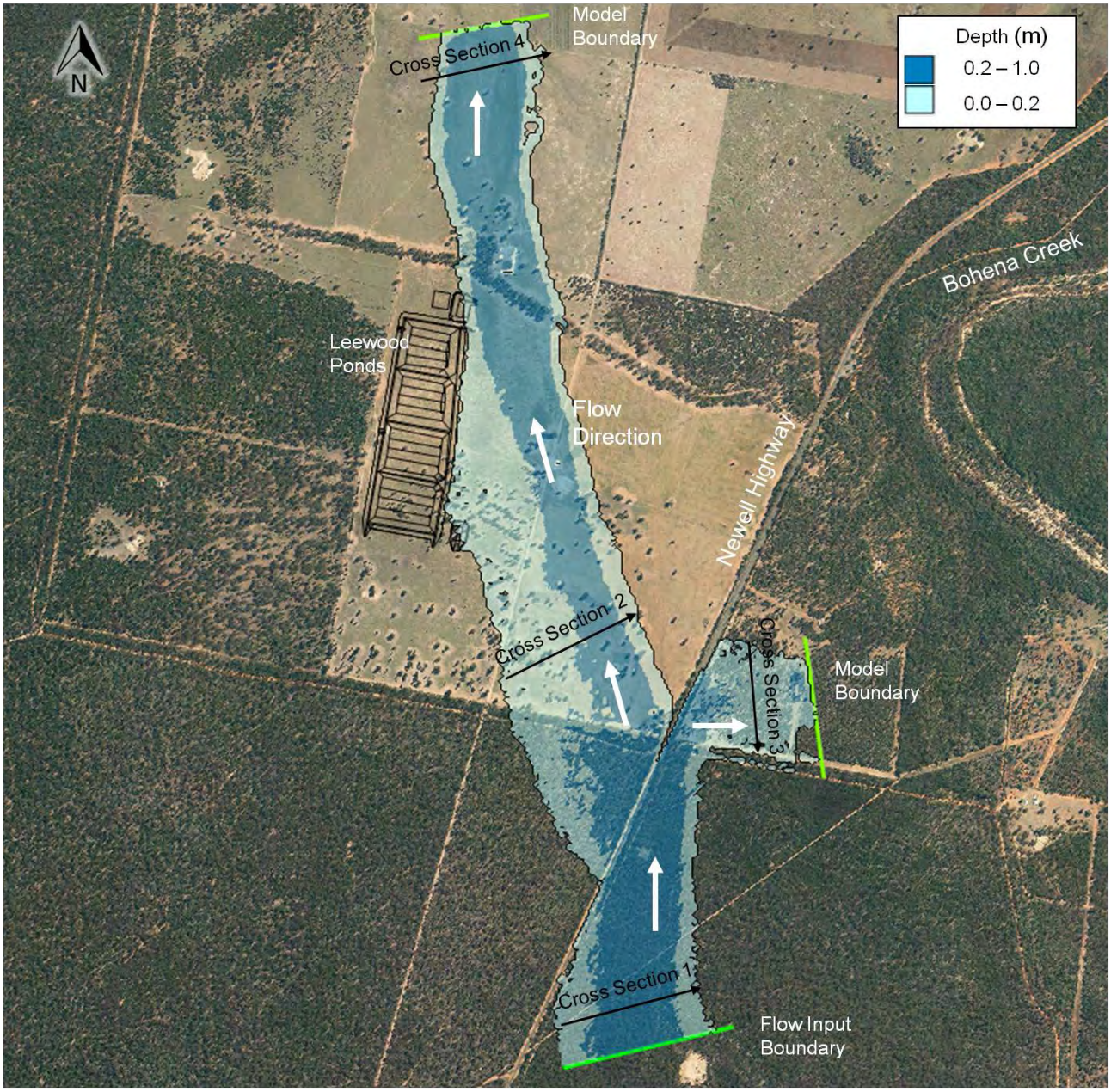


Figure 3: 50 year flood inundation.

A close up view of the flood adjacent to the ponds is provided in Figure 4. There is shallow flooding adjacent to the ponds (less than 0.2 m depth). The maximum flood depth in the modelled reach of the watercourse is 0.79 m.

Note the irregular shape of the water's edge is related to the resolution of the model output.

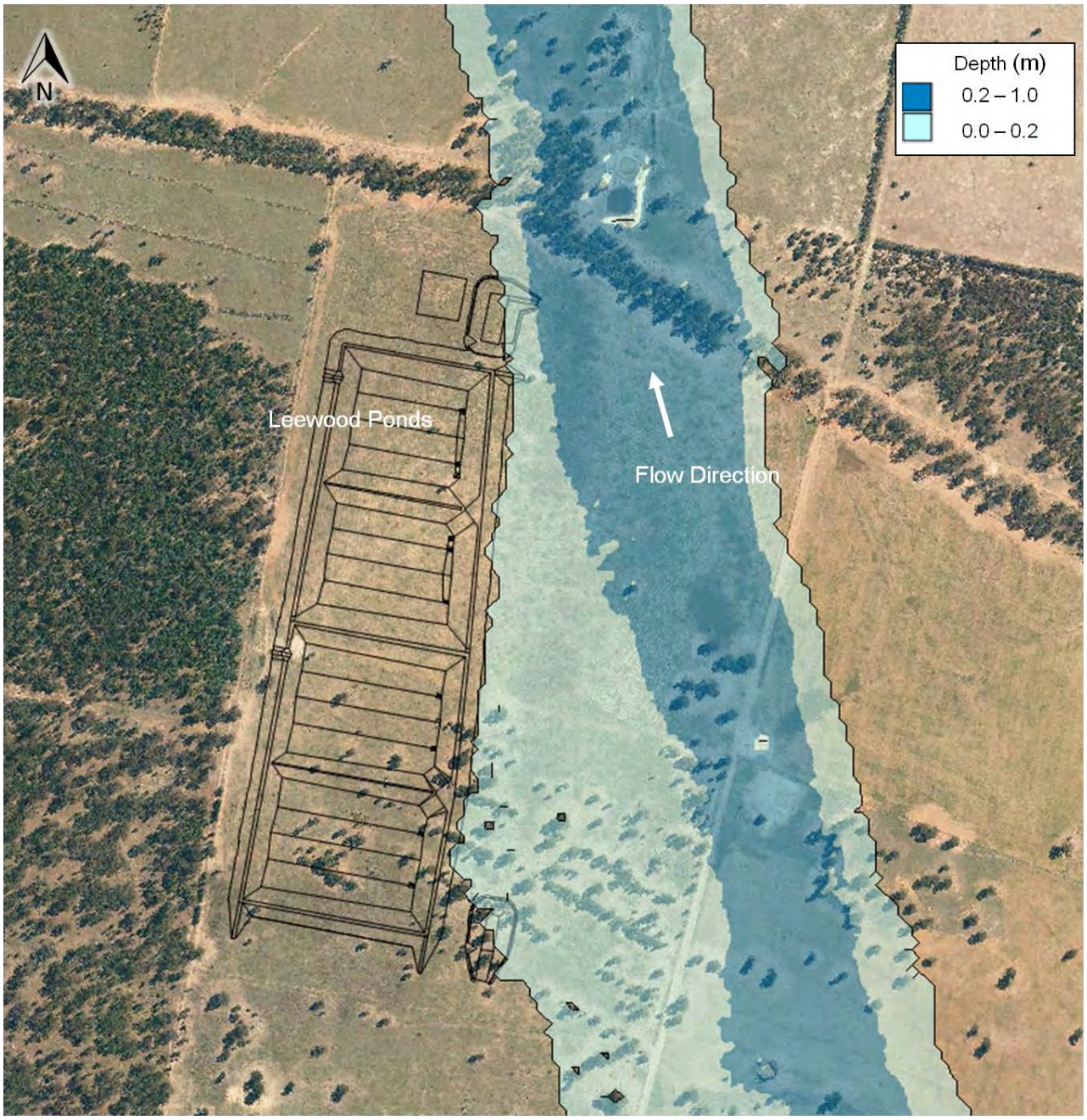
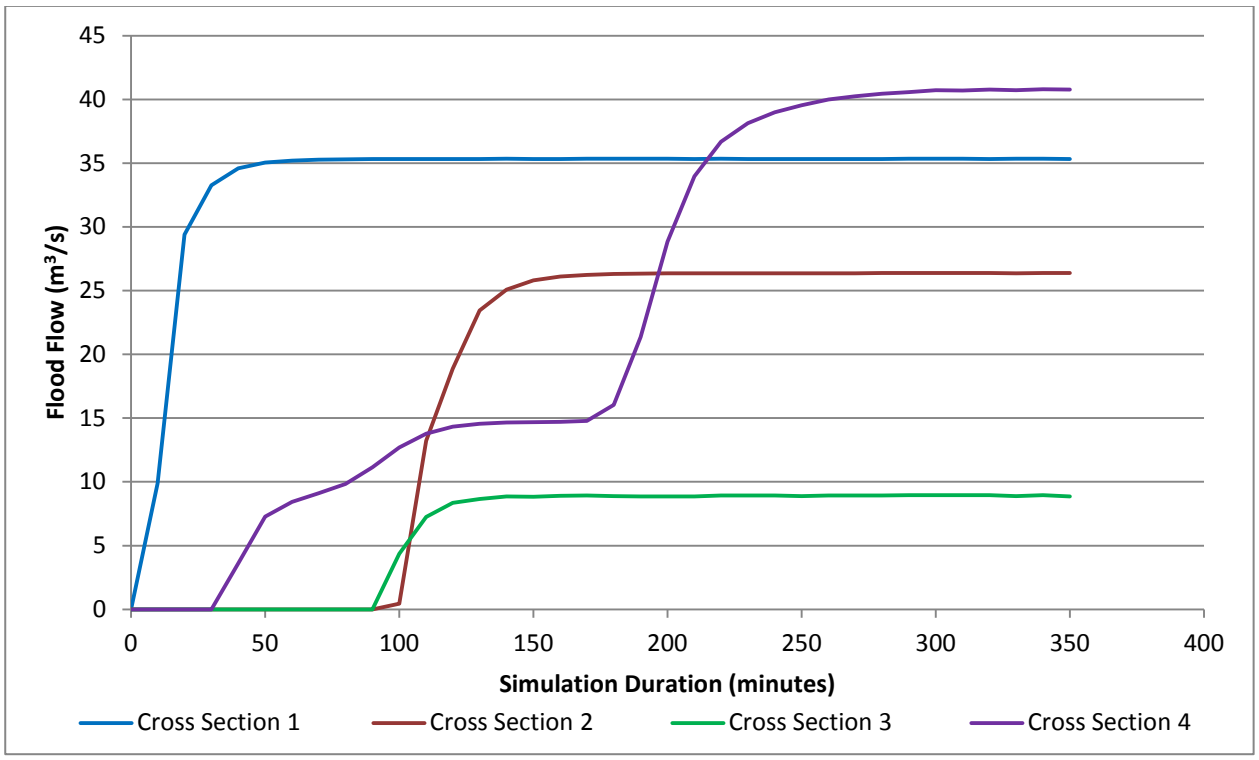


Figure 4: 50 year flood inundation (close up view).

The flood flow at each Cross Section is provided in Figure 5. At steady state 35 m^3/s enters at Cross Section 1, 9 m^3/s exits the model at Cross Section 3 and 26 m^3/s flows via the culvert or across the highway to the site. Additional flow enters the model to the east of the ponds as discussed in Section 3.2. At Cross Section 4, 41 m^3/s exits the modelled reach.



Note: Cross Sections are identified in Figure 3

Figure 5: 50 year flood flow at each cross section.

The flow depth and velocity at each Cross Section after steady state conditions are achieved is provided in Table 2. There is shallow flow across the area of inundation. Velocities are in the range of 0.33 m/s to 0.80 m/s.

Table 2: XPSWMM depth and velocity results 50 year ARI flood.

Cross Section	Maximum Depth (m)	Maximum Velocity (m/s)
1	0.50	0.33
2	0.33	0.44
3	0.26	0.80
4	0.45	0.47

4.2 100 year ARI flood inundation

The 100 year ARI flood inundation extent for the modelled reach is provided in Figure 6. The flow direction is from south to north. Flood water from east of the Newell Highway flows via the culvert and overtops the highway to the watercourse. The highway/culvert causes backwater during the 100 year ARI, which results in 9 m^3/s of runoff being diverted to the east towards Bohena Creek.

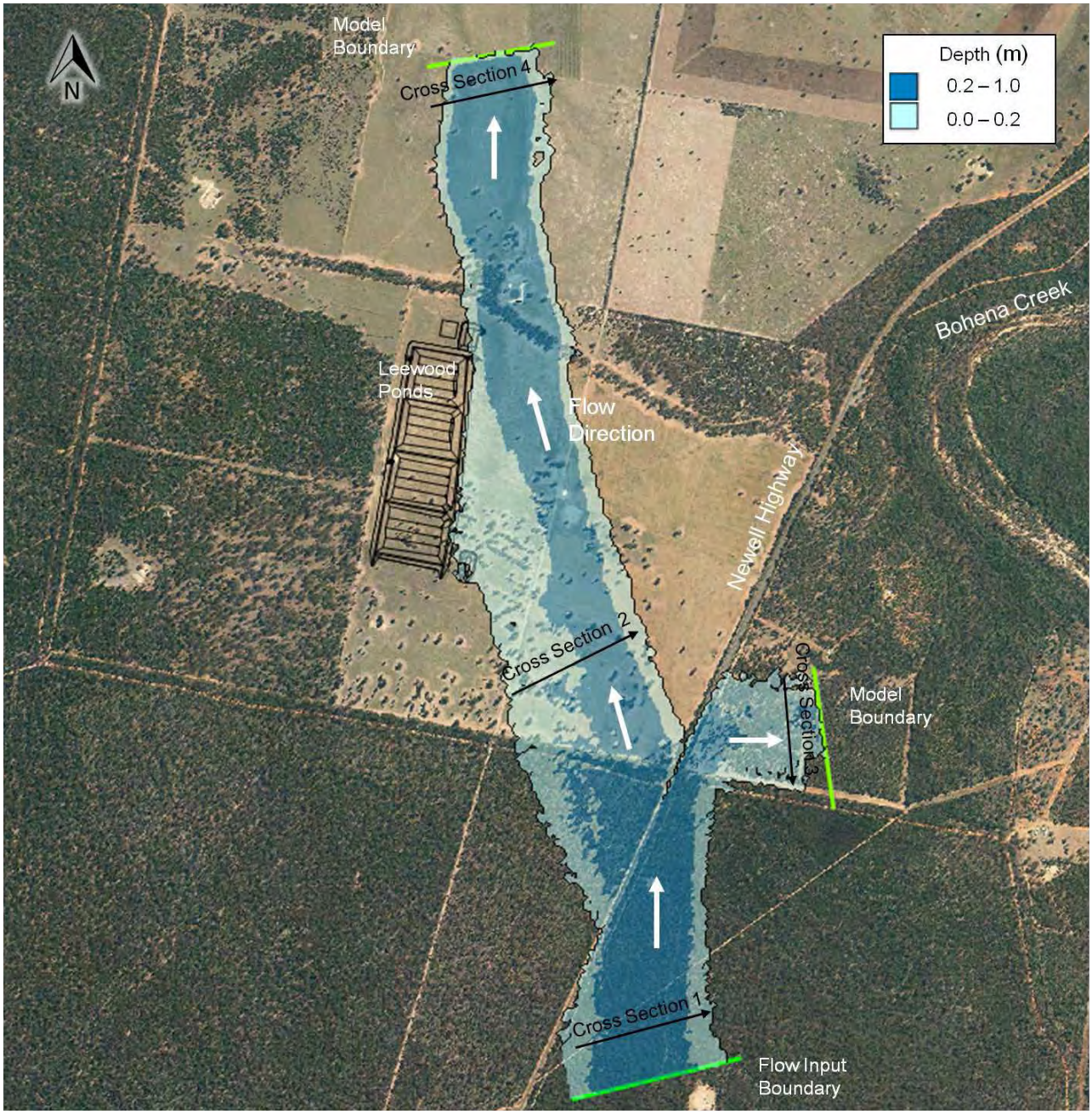


Figure 6: 100 year flood inundation.

A close up view of the flood adjacent to the ponds is provided in Figure 7. There is shallow flooding adjacent to the ponds (less than 0.2 m depth). The flood extents are just slightly broader than the 50 year flood. The maximum flood depth in the modelled reach of the watercourse is 0.82 m.

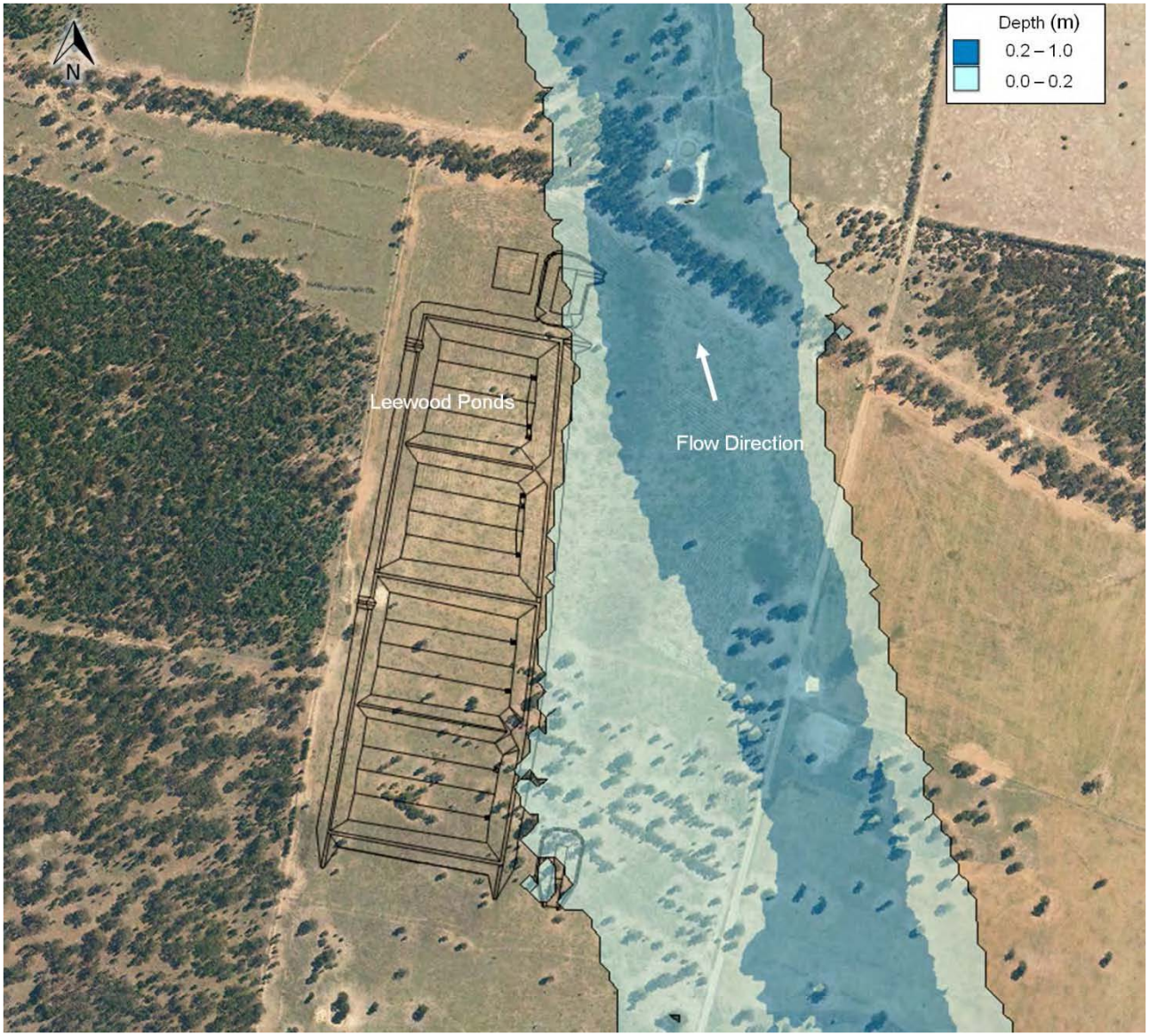
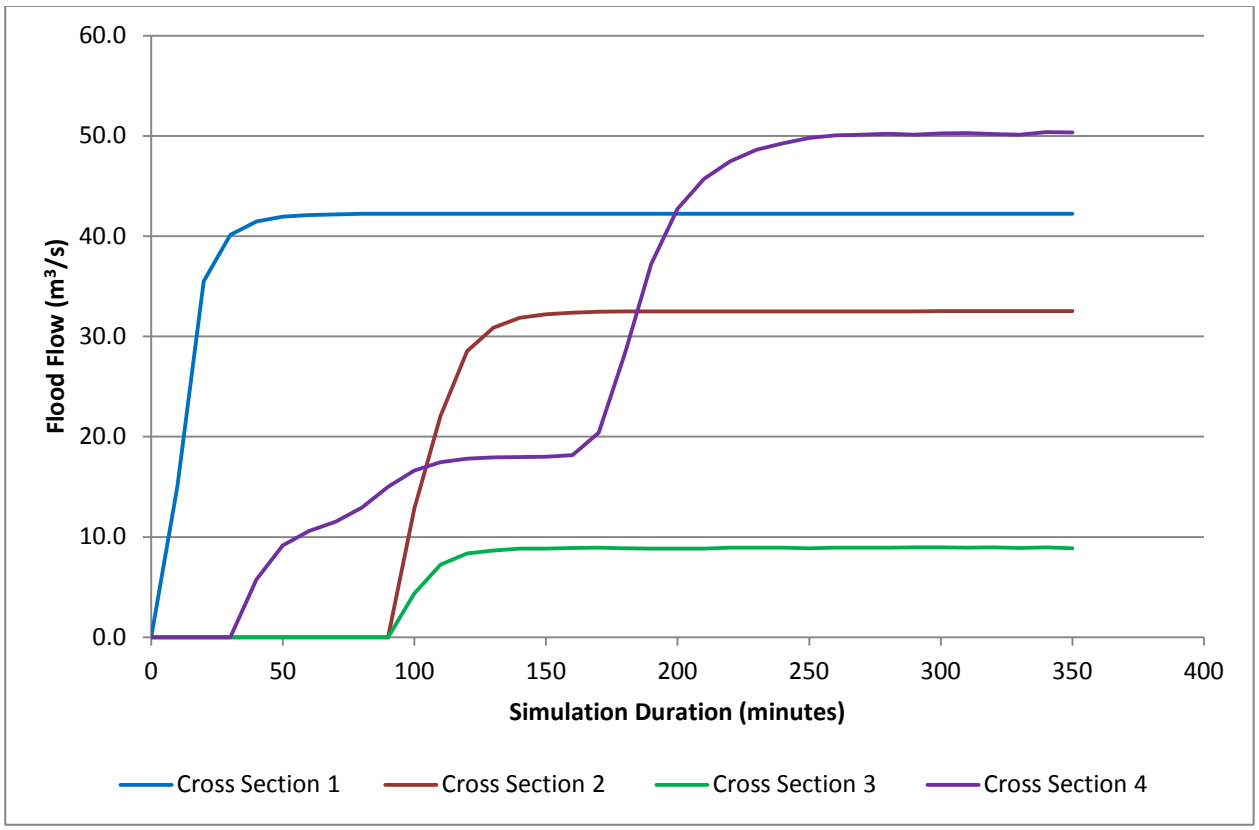


Figure 7: 100 year flood inundation (close up view).

The flood flow at each Cross Section is provided in Figure 8. At steady state 42 m^3/s enters at Cross Section 1, 9 m^3/s exits the model at Cross Section 3. At Cross Section 2, 32 m^3/s flows via the culvert or across the highway to the site. Additional flow enters the model to the east of the ponds as discussed in Section 3.2. At Cross Section 4, 50 m^3/s exits the modelled reach.



Note: Cross Sections are identified in Figure 3

Figure 8: 100 year flood flow at each cross section.

The flow depth and velocity at each Cross Section after steady state conditions are achieved is provided in Table 3. There is shallow flow across the area of inundation. Velocities are in the range of 0.37 m/s to 0.83 m/s.

Table 3: XPSWMM depth and velocity results 100 year ARI flood

Cross Section	Maximum Depth (m)	Maximum Velocity (m/s)
1	0.61	0.37
2	0.40	0.47
3	0.28	0.83
4	0.49	0.52

4.3 100 year ARI flood inundation (with proposed pond)

A second 100 year ARI flood model was run taking into account the footprint of the proposed pond to see what effects the pond has on the 100 year ARI flood levels. Figure 9 presents the results of this modelling. It shows that the flood extents are very similar to the results shown in Figure 8 except that flooding is restricted by the pond footprint. The model results show that the footprint of the proposed ponds only causes an increase of flood levels less than 10 mm adjacent to the ponds and near 0 mm elsewhere.

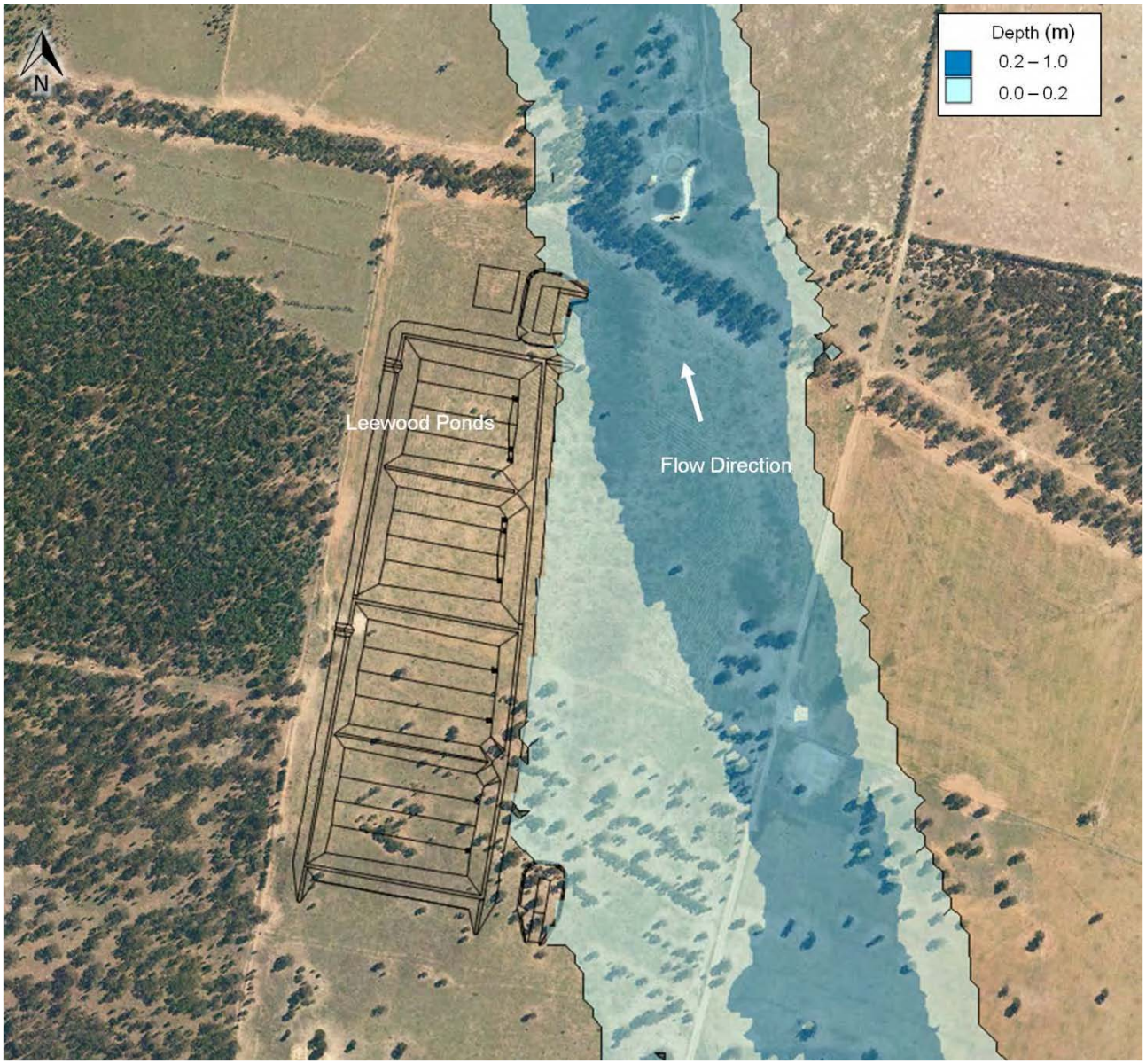


Figure 9: 100 year flood inundation (with proposed pond).

5.0 CONCLUSIONS

The extents of water inundation of the 50 year ARI flood have been provided in Figures 3 and 4. Flood inundation extends to the toe of the pond's embankment. Flow velocities are low throughout the modelled reach (between 0.33 m/s and 0.80 m/s).

The 100 year ARI flood extents are also provided. There is only a small encroachment of the ponds into the 100 year ARI flood. The hydraulic model shows that the pond will have almost no effect on the flood levels adjacent to the pond and is expected to have no significant downstream impacts.

6.0 STUDY LIMITATIONS

Your attention is drawn to the document - "Limitations", which is included in APPENDIX B of this report. The statements presented in this document are intended to advise you of what your realistic expectations of this report should be, and to present you with recommendations on how to minimise the risks associated with the services provided for this project. The document is not intended to reduce the level of responsibility accepted by Golder Associates, but rather to ensure that all parties who may rely on this report are aware of the responsibilities each assumes in so doing.

Report Signature Page

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APPENDIX A

Rational Method Calculations

Rational Method Calculations Leewood Ponds

Queensland Urban Drainage Manual Vol 1 Second Edition 2007 4-14

Catchment ID	above road	below pond	above road	below pond
ARI (years)	**100**	**100**	**50**	**50**
Catchment Area				
A, catchment area (ha)	1060	2180	1060	2180
Runoff Coefficent				
*C = Fy * C10*				
Fy, Frequency factor, see Table 4.05.2	1.20	1.20	1.15	1.15
C10, runoff coefficient, see Table 4.05.3 (b), med on light cover bushland and med soil permeability	0.4	0.4	0.4	0.4
Cy, calc'd runoff coefficient dependent upon ARI	**0.48**	**0.48**	**0.46**	**0.46**
Time of Concentration				
Bransby-Williams' rural catchments initial overland flow travel time is incorporated				
$tc=58L/(A^{0.1}.Se^{0.2})$				
L, length (km) of flow path from catchment divide to outlet	6.40	11.00	6.40	11.00
Se, equal area slope of stream flow path (%)	0.23	0.20	0.23	0.20
t, calc'd overland travel time (min)	**248**	**408**	**248**	**408**
Rainfall Intensity				
I, rainfall intensity for duration equal to tc, see attached IFD table, (mm/hr)	30	21	26	18
Rational Method: Q = 1/360 * C I (mm/h)A (ha)				
Q, calc'd peak discharge (m3/s)	**42.4**	**60.7**	**35.5**	**50.5**

APPENDIX B

Limitations

LIMITATIONS

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