February 2013

GUNNEDAH SECOND ROAD OVER RAIL BRIDGE - CONCEPT OPTIONS

Geotechnical and Environmental Desk Study

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Executive Summary

Golder Associates Pty Ltd was requested by KBR Pty Ltd to undertake a Geotechnical Desk Study to support concept stage options for a proposed new Higher Mass Limit road-over-rail bridge, in the western part of Gunnedah, NSW. The desk study comprised both a preliminary geotechnical assessment and a preliminary environmental assessment, and included a site walkover.

The study area is approximately 25 Hectares in area and includes; residential and commercial properties, two major highways (the Kamilaroi and Oxley highways) and local roads, a rail line, vegetated open space and a north-south aligned watercourse (Blackjack Creek).

The site is generally level, with an elevation around 261 mAHD. The bed of Blackjack Creek is approximately 3 m below the surrounding land, and at the time of the walkover was largely dry with some ponding of shallow standing water.

Geologically, the western side of the study area is underlain by volcanic rock and the eastern side by conglomerate, sandstone and siltstone. More recent Stream Alluvial Deposits, including sandy to silty clays and minor gravels, are present in Blackjack Creek and also over much of Gunnedah.

Findings from the desk study assessment are:

- There is existing limited geotechnical information from across the study area. One previous site investigation report is available, comprising a shallow investigation associated with the replacement of the rail bridge across Blackjack Creek, as well as some groundwater bore records for locations to the south and east of the area. There are no records of recent environmental contamination investigations;
- The area is not within a risk area for Acid Sulphate Soils, though is within an area of high salinity and aggressive groundwater conditions;
- Blackjack Creek presents a notable engineering constraint. The depth to bedrock or competent strata within it, to support foundations, is not known, and may exceed 10 m. There is potential for material within the Creek to be susceptible to settlement if loaded by structures or embankments. The Creek is also a major flood route, and development within it should consider implications of scour and flood impact;
- Beyond the Blackjack Creek watercourse soils are considered likely to be suitable to support road construction at grade, although some localised filling and subgrade treatment, such as removal or improvement, may be required. An existing culvert (near New Street level crossing) will require a geotechnical and structural assessment if being considered as part of the new bridge option;
- Permitted construction footprints may limit the use of fill batters on approach embankments. Depending on the adopted alignment, retaining walls may be required. Large volumes of site won material are not envisaged to be generated from construction and imported fill for embankment construction is likely to be required; and,
- The risk of contaminated soils exists within the study area including the use of unknown material in the filling of light industrial/commercial sites in the area, the possible inclusion of asbestos in the building's structures, the potential for hydrocarbon contamination around the two fuel depots on Railway Avenue and potential hydrocarbon, heavy metals and other contamination within the rail corridor.

Targeted intrusive site investigation, including exploratory fieldworks such as borehole and test pits, and further assessments should be carried out to refine site conditions to support development of a final concept option.

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1.0 INTRODUCTION

Golder Associates Pty Ltd (Golder) was appointed by KBR Pty Ltd (KBR) to undertake a Geotechnical and Environmental Desk Study to support design work for the Development and Assessment of Concept Options for the Gunnedah Second Road Over Rail Bridge, for NSW Roads and Maritime Services (RMS).

The desk study was carried out in accordance with Golder proposal (ref Doc. P27622089-001-L-Rev0), dated 19 October 2012, and is a combined environmental and geotechnical assessment which includes comments and observations from a walkover of the site on 18 February 2013.

The location of the study area is on the outskirts of Gunnedah, in central-northern New South Wales, and is shown in Figure 1.

1.1 Background

The Gunnedah Second Road Over Rail Bridge project involves the development of concept options for a new Higher Mass Limit (HML) road vehicle crossing over the Hunter Valley rail corridor, to upgrade the current route which uses the level crossing located at New Street, in the western part of Gunnedah.

A Concept Design Team internal Technical Workshop, held on the 13 February 2013 and involving representatives from KBR, RMS, Gunnedah Shire Council and appointment sub-consultants, undertook a preliminary evaluation of numerous route options. These options may be generally categorised as three principal route corridors, namely;

- A route connecting Farrar Road to the Kamilaroi Highway or Warrabungle Street
- A route connecting the Oxley Highway to Kamilaroi Highway or Warrabungle Street around the west of the Gunnedah Maize Mill.
- A route connecting the Oxley Highway to Warrabungle Street/New Street around the east of the Gunnedah Maize Mill.

Indicative alignment options are provided on KBR drawing in Figure 2.

However, a preferred route corridor within the study area has not been confirmed at this stage and this desk study considers the full study area.

1.2 Objectives

The objective of the desk study is to provide a review of available site information and assessment of the likely risks associated with soil and groundwater contamination (essentially a Phase 1 Environmental Investigation), as well as preliminary geotechnical issues.

1.3 Scope of Work

The desk study included the following scope of work:

- A review of available geological data, geotechnical investigations and reports from the study area;
- Description of topography, regional geology (including identification of rock types and structural aspects), soils and expected geotechnical conditions;
- An assessment of commercial deposits and past and proposed mining extractive industries, based on relevant publicly available records;
- An assessment of the potential presence of contaminated soils, including agricultural chemical residues. Including;

- A review of publicly available information (NSW EPA databases relating to the Contaminated Land Management Act, Office of Water groundwater records, soil and geological sheets and historical aerial photographs);
- A site visit by a geotechnical engineer to observe general site characteristics;
- An assessment of the historical and current conditions of the site, which could have resulted in contamination of surface water, soil or groundwater;

- An assessment of the potential for the presence of acid sulphate soils, by undertaking a review of the acid sulphate soils risk map for the area; and,
- An assessment of pertinent geological constraints which may affect preliminary concept options.

2.0 STUDY AREA INFORMATION

2.1 Site Location and Physical Description

The RMS defined study area (see Figure 1) is located on the western side of Gunnedah, NSW. A summary of site information is presented in Table 3 below.

Table 3: Study Area Information Summary

Site Name	Gunnedah Second Road Over Rail Bridge
Street Address	Approximate area bounded by Kamilaroi Highway, New Street, Warrabungle Street, Oxley Highway, South Street, and Farrar Road.
Suburb, State, Postal Code	Gunnedah, NSW, 2380
Survey Area	Approximately 25.3 ha is size
Legal Description	Lot 1 and Lot 2 DP 1071991, Lot 7031 DP 1029309, Lot 5 DP 814399, Lot 14 and Lot 25 DP 1006398, Lot 1 DP 818848, Lot 7053 DP 1116141, Lot 17 - Lot 19 DP 258863, Lot 10 – Lot 12 DP 258863, Lot 685 DP 728405, Lot 1 DP 864627, Lot 1 – Lot 3 DP 758492, Lot 7030 DP 1029309, Lot 26 DP 1006398, Lot 7035 DP 1029310, Lot 4 and Lot 5 DP 814399, Lot 644, Lot 684, Lot 685 DP 728405, Lot 1DP 864627, Lot 1 DP 758492.
Zoning	Business, Industry and Residential Zones
Percentage coverage of site by buildings	Approximately 25%
Site Setting	The study area comprises open spaces and low density residential and commercial properties, as well as transport corridors. Open spaces include Blackjack Creek and areas of mature trees. Transport corridors comprise several roads (including Farrar Road, Oxley Highway, View Street, South Street, New Street, Warrabungle Street and Kamilaroi Highway) and a major rail line. The rail line is owned by the Australian Rail Track Corporation (ARTC) (Lot 25 DP 1006398) and aligns approximately north-west to south-east across the study area. The study area includes Gunnedah Maize Mill (formerly Brunton's Flour Mill - Lot 1 and 2 DP 1071991), Gunnedah Grain Silos (Lot 1 DP 818848), Gunnedah Regional Saleyards (Lot 644, Lot 684, Lot 685 DP 728405) and Petroleum Bulk Station and Terminal (Lot 4 and Lot 5 DP 814399).
Buildings or Structures on and around the Site	The ARTC railway line sits on an embankment (up to 2.5 m high) and passes over Blackjack Creek on a box culvert (approximately 25 m wide and 3 m deep), reconstructed during 2011. The Kamilaroi Highway and the Oxley highway both cross Blackjack Creek on bridge/culvert structures, which are not significantly elevated above the immediately surrounding land. The Gunnedah Maize Mill is centrally located within the study area and comprises a three-storey brick mill building with attached engine shed, six contiguous concrete silos with enclosed external stair and a modern single storey office/storage building along New and Barber Streets. A former service station and a petroleum storage business are located in centre of the study area on Railway Avenue opposite the Maize Mill. The petroleum storage business contains 11 above ground storage containers (up to 50,000 L) with up to

	500,000 L of fuel on site. Other significant structures include; ■ Four contiguous grain storage silos, approximately 20 m high, in the south-eastern corner of the study area. ■ Several small light industrial/commercial businesses along Farrer Road, which in include small warehouses, office buildings and storage spaces. ■ Rail yards for storing rail equipment and train shunting, in the south eastern corner of the study area. ■ A single storey pig saleyard, in the north western part of the study area, associated with the Gunnedah Saleyards on the Kamilaroi Highway.
Topography	The study area is relatively flat (approximately 265 m AHD), with significant (approximately 1 m high and 4 m wide) railway easements and flood protection levies which have been constructed on the eastern side of Blackjack Creek. The western portion of the study area also includes the lower slopes of a hill, known locally as Pensioners hill (the highest elevation of which is approximately 310 m AHD although approximately 200 m west of the study area).
Site drainage and Nearest surface water body	The study area generally drains into the Namoi River to the north of Gunnedah, via Blackjack Creek which aligns approximately north-south through the study area. There are several drains through the flood embankment alongside Blackjack Creek to enable local surface water run-off to enter the Creek. A significant surface water culvert system (approximately 1.5 m deep and 2.5 m wide) also transfers water from the south-eastern part of Gunnedah alongside South Street into Blackjack Creek. Blackjack Creek, and its floodplain, is up to 40 m wide and approximately 3 m deep. It connects to the Wandobah wetlands on the southern side of the Oxley Highway.
Surrounding Land Use	Surrounding land use (within 200 m of the study area) includes: ■ North: Kamilaroi Highway followed by residential area and farmland. ■ East: Residential buildings are present at the corner of New Street and Barber Street ■ South: Wandobah Road followed by Wandobah Reserve and wetland. ■ West: Residential and light industrial/commercial area followed by Pensioners Hill Reserve.

2.2 Previous Investigations

Several documents were provided to Golder by KBR for review as part of this desktop study. Golder is unaware of the study area having been subject to any other extensive geotechnical or environmental investigations. Reports provided by KBR include:

■ NSW Public Works – Government Architect's Office, Heritage Assessment "Former Brunton's Flour Mill Gunnedah" (DFS Report No. 12086), September 2012

- Douglas Partners (DP) Report on Geotechnical Assessment, Main Northern Railway Proposed Bridge Replacements North-west Branch Line km 476.500, Gunnedah (Project 49771), August 2011

Additional information was provided by the NSW Department of Primary Industries – Office of Water and a search of the NSW groundwater monitoring data archive, including:

- Field logs from the installation of Groundwater Monitoring Wells by the Gunnedah Shire Council around the Wandobah Reserve to the south of the study area. Copies of these reports are provided in APPENDIX B.
- Blackjack Creek Riparian Corridor/Channel Reconstruction – Review of Environmental Factors – DRAFT Issue 1, Revision C. Constructive Solutions, January 2013.

2.3 Soils, Geology and Hydrogeology

2.3.1 Geology

The 1:250 000 scale NSW Department of Mineral Resources 1973 Geological Map 'Manilla' (series sheet SH56-9) and the 1:100,000 scale Gunnedah Coalfield (South) regional geological series sheet (GSS 8935, Edition 1, 1996) both show that the study area is underlain, at depth, by two geological rock units and is in close proximity to another.

The geological maps show the majority of the study area is underlain by rocks belonging to the Leard Formation (Plf) of the early Permian aged Ballata Group. Rocks types in the Leard Formation include flint claystone, conglomerate, sandstone and siltstones.

The geological maps also indicate two inferred geological boundaries with the Leard Formation exist in the vicinity of the study area:

- The north-east corner of the site is shown to be underlain by the Porcupine Formation (Pps) of the Millie Group of late Permian age. This includes conglomerate, sandstone and siltstone. The local drainage system is shown to follow the contact between the Leard and Porcupine Formations; and
- To the west of the study area, the Boggabri Volcanics (Pbr) of early Permian age, which include andesite, dacite, rhyolite, diorite and monzonite. Inspection of a cutting along Farrar Rd, mid-slope up Pensioner's Hill, indicated potential lava flows and tuffaceous bands between flows exposed by a previous excavation.

The study area (and the majority of Gunnedah) is indicated to be underlain by recent Quaternary Stream Alluvial Deposits, which include riverine plain deposits of sandy to silty clays and minor gravels.

2.3.2 Site Soils

Soils across the study area are anticipated to largely comprise alluvial deposits, associated with the Namoi River floodplain and Blackjack Creek. Residual soils from the weathering of the Leard Formation and colluvial material from the Boggabri Volcanics on Pensioners Hill are also expected in the western half of the study area.

Results from three test pits under taken by DP generally reported encountering filling/topsoil overlaying stiff to very stiff sandy clay to a depth of 2.4 m below the rail overpass in Blackjack Creek.

The drilling comments from the cluster of groundwater wells installed towards the south of the study area, within or proximal to Blackjack Creek indicate that soil composition is variable, comprising clay, silt and gravels. One bore located within Blackjack Creek, also indicated the presence of decaying organic matter from 0.2 to 3.0 m depth.

A second cluster of groundwater wells is located some 400 to 500 m east of the study area, near Gunnedah railway station. The drilling comments from this area indicate the shallow ground comprises 'heavy red/brown Clay of medium plasticity'. Of note was a 'slight hydro carbon odour' noted in one bore at a depth of 4.0 m.

2.3.3 Groundwater and Hydrology

The dominant surface water features are the ephemeral Blackjack Creek, which connects to the Namoi River system to the north of the study area. The watercourse is about 25 to 40 m in width and drains in an east-northeast direction under the existing rail bridge toward the Namoi River.

The inferred direction of surface and ground water flow is to the north along the surface and through the alluvium (charged by flow from land at higher elevations south and west of the study area). The embankment on the eastern side of the water course is expected to restrict local water flows around the mill area, which is diverted into the watercourse by several pipes through the embankment. Several large diameter (200-300 mm) pipes were also observed to run from the industrial buildings on the western side of the water course, draining water from Farrar Road.

A large culvert for drainage of surface water crosses under New Street, just south of the existing level crossing. This surface water drain lies within a natural drainage channel, previously known as Ashfords Watercourse, which drains a large area of southern Gunnedah and joins the Blackjack Creek just upstream of the rail overpass.

The location of several monitoring wells (blue icons) and the approximately study area (orange rectangle) is shown in Figure 3.

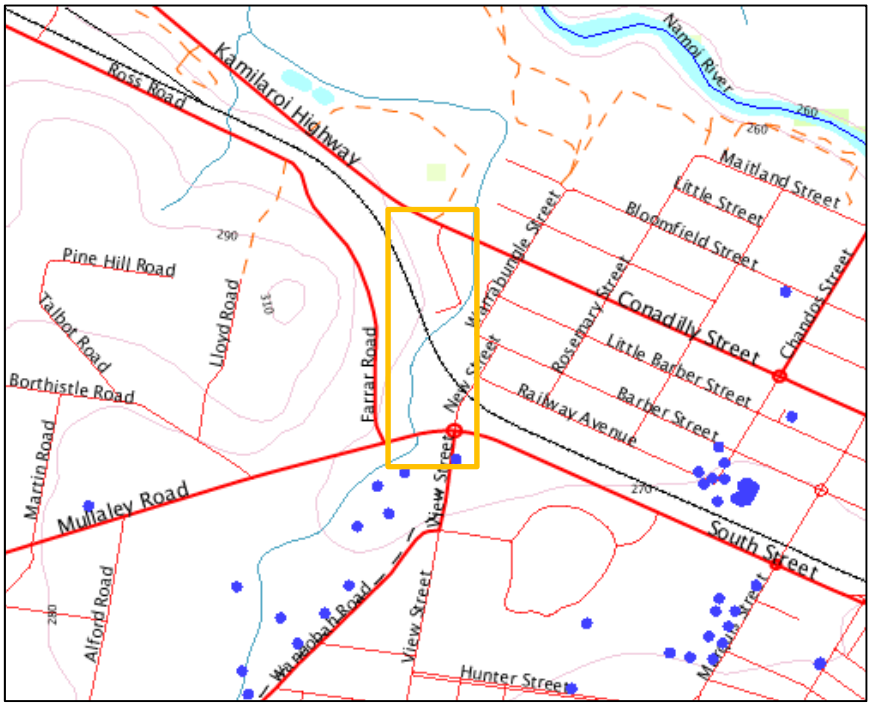

Figure 3: Gunnedah Council – Groundwater Monitoring Well Locations

Water levels within these wells were recently recorded as part of the Blackjack Creek Riparian Corridor/Channel Reconstruction draft report, referenced above. Results generally indicated that the standing groundwater level to the south of the study area is around 1.8 to 2.4 m below the ground surface. It is assumed that these water levels vary seasonally and with climatic conditions.

Anecdotal evidence suggests that three piezometers (to a depth of 6 m) were installed at the Hope Fuel Supplies depot on Railway Street by Esso, approximately 20 years ago, after reconditioning underground fuel storage tanks on the site, and that groundwater levels within the piezometers were generally less than 1 m below the ground surface (the date when these readings may have been taken is unknown).

2.3.4 Site Filling

Available records do not indicate any areas where extensive filling is likely to have been undertaken. One of the water bore records outside of the study area but within Gunnedah (see section 2.3.2) indicates the presence of fill to 0.4 m depth, and this material is not described as being encountered in other water bore records.

It is anticipated that there will be localised areas of fill associated with construction of residential and commercial property, roads, the railway (up to 2.5 m of railway embankment) and a rising mainline duplication (potable water supply) undertaken in 2004.

Comments made by a representative from Gunnedah Shire Council, at the internal workshop on 13 the February, suggests that an embankment was constructed along part of the eastern side of Blackjack Creek as a method of flood control to protect several streets in the northern part of Gunnedah. Further details of the construction of the embankment are not known.

2.3.5 Acid Sulphate Soils

The Australian Soil Resource Information System (http://www.asris.csiro.au) indicates the study area is located within an area recorded as “no known occurrence” for acid sulfate soils (ASS), and that “acid sulfate soils are not expected to occur in these areas”. Follow up site and laboratory testing during the site investigation will confirm this classification.

2.3.6 Soil Reactivity

DP’s Report on the rail culvert investigation discussed soil reactivity and the potential for ground movements with seasonal changes in ground moisture. DP’s assessment was based on the guidelines in AS 2870–2011 and information obtained from the three test pits undertaken and laboratory testing of recovered samples.

Previously predicted characteristic surface movements (y_s) in clay areas are estimated to be in the order of about 40 mm to 60 mm.

2.3.7 Soil Aggressivity

Results of laboratory testing associated with DP’s rail culvert investigation identified that the local groundwater is generally more aggressive than the soil above the local groundwater level.

DP’s assessment of the exposure classification is ‘Mild’ for concrete structures and ‘Moderate’ for steel structures in soil exposed to groundwater, when applying the classification tables within AS 2159-2009 to the laboratory results.

2.3.8 Salinity

Several published reports associated with the Blackjack Creek remediation and reconstruction upstream of the study area indicate that dry-land salinity and high water tables are issues within the Wandobah reserve and Blackjack Creek, which is expected to impact on the study area.

Salinity has been investigated and reported in ‘Use of Geophysical Methods to Delineate Salt Affected Areas for Channel Reconstruction in Wandobah Reserve Gunnedah, NSW’ DIPNR 2003 and the recent Blackjack Creek Riparian Corridor/Channel Reconstruction – Review of Environmental Factors – DRAFT published in January 2013. The reports highlighted that:

- Soil salinity is high near the surface and decreasing with soil depth;
- Soil salinity is high enough to affect plant growth;
- The water tables are impacted by seasons but can range from 0 to 5.5m below ground level;
- Saline water discharges are likely to occur during wet periods; and
- The lack of drainage exacerbates salinity levels.

2.3.9 Earthquake Rating

The methods of assessing the earthquake risk classification are outlined in the Australian Standard AS1170.4 (2007) *Structural Design Actions, Part 4: Earthquake Actions in Australia*.

The hazard factor (z) depends on the geographic location of the proposed structure. For the Gunnedah area, AS 1170.4 indicates a hazard factor of 0.0177.

The governing condition for the site subsoil class is the thickness and consistency of the subsurface materials beneath the building footings. At this stage, this factor is unknown but is expected to be assessed as part of further site investigation work.

2.4 Location of Underground Mining

Review of the mining records held by the NSW Department of Trade and Investment, Regional Infrastructure and Services in Maitland for underground workings indicated that there are no known recorded mine workings in close proximity to or beneath the study area archived at the Department. The closest recorded mine workings are approximately 7 km west of the study area.

3.0 ENVIRONMENTAL ASSESSMENT

The Environmental Site Assessment (ESA) was carried out in general accordance with the principal components of NSW EPA requirements for a Phase 1 – Preliminary Site Investigation and involved the following key tasks:

- Review of selected publicly available historical information, including:
  - Historical aerial photographs from the NSW Department of Land and Property Information, to provide evidence of the history of development of the study area and indications of potential sources of contamination; and
  - NSW Public Works – Government Architect's Office, Heritage Assessment "Former Brunton's Flour Mill Gunnedah" (DFS Report No. 12086), September 2012.
- Review of regulatory databases relating to the study area, including:
  - the NSW Environment Protection Authority (EPA) register of information on environment protection licences (including associated notices and other regulatory action) issued under the Protection of the Environment Operations Act 1997;
  - NSW EPA register list of contaminated sites notified to the EPA and records of notices issued by the EPA under Section 58 of the Contaminated Land Management Act 1997; and,
  - Details of groundwater bores registered on the groundwater bore database maintained by the NSW Department of Land and Property Information and located within 500 metres (m) of the study area.
- Review of relevant publicly available hydrological, geological and soils information including published topographical, geological and soil maps of the area.

4.0 STUDY AREA HISTORICAL REVIEW

4.1 Introduction

This section presents a summary of the historical information reviewed as part of the ESA. The historical review was completed to develop a general understanding of the study area and surrounding area (within 200 metres) with the intention of identifying previous activities on, or nearby, the study area which may indicate the potential for soil or groundwater contamination to be present.

4.2 Site History

A detailed history of the central part of the study area and nearby areas is presented in the HLA (2012) Report. The following are key details derived from the HLA (2012) report and other on-line sources.

- The town of Gunnedah was surveyed and formally established in 1856, and the railway arrived in 1879.
- Gunnedah is located on the Oxley Highway and Kamilaroi Highway providing road links to the State capital Sydney at a distance of 475 kilometers and the nearest regional center is Tamworth approximately 75 kilometers from Gunnedah. Gunnedah is also linked to Sydney by rail.
- Gunnedah railway precinct is located on the Mungindi line, branching from the Great Northern Railway (Main North line) at the major rail centre of Werris Creek, and heading north to the remote town of Mungindi, on the Queensland border. Today the line is utilised for almost its entire length for grain transport, and for coal from the Preston and Gunnedah collieries (www.nswrail.net). The single line from Breeza to Gunnedah opened on 11 September 1879, with the station opening for service on the same day. Gunnedah railway precinct has a history of over 140 years. It has been the site of significant activity servicing the pastoral and mining industries.
- In the twentieth century, the large, early pastoral holdings on the plains gradually disappeared and were replaced by large sheep-stations in the west of the Darling Plains district and the spread of the wheat-sheep farm over most of the centre and east. Subdivision encouraged the growth of the wheat industry in the area, which was more suited to smaller land holdings.
- The nearby Gunnedah Flour Mill was the first flour mill to operate in Gunnedah, opening on 27th January, 1904. The land on which the mill was developed was situated in the south-west corner of the town, adjacent to the railway line and railway yards and on part of a large portion of land originally designated for cattle sale yards.
- The empty premises were acquired in 1915 by Victorian millers, Brunton and Company, which operated the mill under the name of the Gunnedah Flour Milling Company. The current three-story brick mill building was constructed on the site at this time.
- There was a fire at the Gunnedah mill in 1916. Although a considerable amount of produce and plant was lost, most of the complex was saved.
- Gunnedah's first wheat milling venture was registered as WH Short and Co and operated by partners W.Keys of Kibah, W. Doel of Rockleigh and H.P. Grainger, a storekeeper from Gunnedah. It was also known as the Excelsior Mill. The company collapsed during WWI. By this time the original landholding for the mill had expanded with an additional block to the west.
- The mill has been subject to some modernisation and a relatively new single-storey office/store building has been built on the corner of New Street and Barber Street. The mill has otherwise remained free from large scale redevelopment like many of the still operating historic flour mills in the State, including the Namoi Flour Mill at the northern end of Railway Avenue. This has contributed substantially to the historic character of the former Brunton's Flour Mill site being retained.

- The mill is a landmark in Gunnedah. The silos in particular are a dominant visual feature being one of the highest structures in town. The historic mill building itself is clearly seen with distant and close views from the length of Railway Avenue to the East and the roundabout on the Oxley Highway to the south and south-east.
- There were no known structures on the site prior to the turn of the twentieth century. Parish plans indicate that prior to the development of the mill; the site was allocated for cattle sale yards. The areas of archaeological potential associated with the historic use of the mill are likely to relate to:
  - The former manager's cottage on the southern corner of the site fronting New Street and the railway line. This may present as brick or stone building footings, evidence of services and artefact deposits;
  - The former wheat sheds behind (to the north-west) of the brick mill building. Remains of the wheat sheds are likely to be ephemeral including post-holes and possibly some artefact deposits.
  - The three to four storey structures to the west of the mill building in historical photographs, which may have been for wheat storage and processing. This may present as building footings, equipment bases and artefact deposits.
- Gunnedah Regional Saleyards has been located near Kamilaroi Highway, since 1959. Gunnedah Saleyards is one of the largest stock selling centres in NSW and is located on the edge of town 1 km from the town centre on the Narrabri Road. The selling area can accommodate 5000 head. There is a truck wash area, cattle crushes with veterinarian facility and water treatment works as shown in Figure 4 and Figure 5. (Reference http://www.saleyards.info).

Figure 4: Gunnedah Saleyards

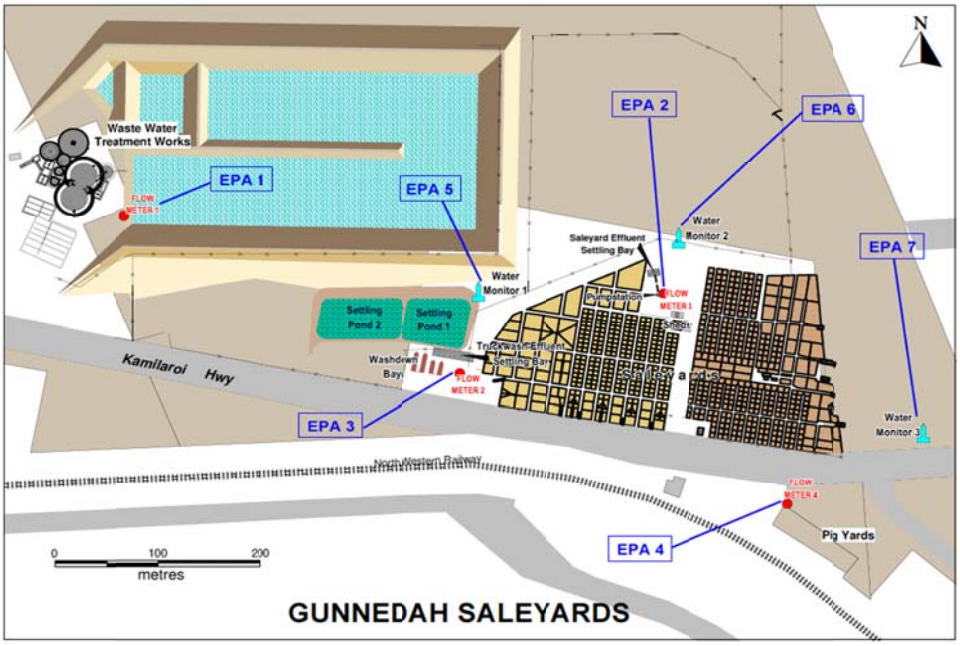

Figure 5: Gunnedah Saleyards (Map showing monitoring locations - EPA licence L11561)

- The historical records show that the Petroleum Bulk Station and Terminal located in Railway Avenue was built in early 1960. The sites were originally part of the railway easement and provided diesel for the locomotives and were later purchased by Esso Australia for use as a petroleum distribution and service station. During the site walkover eleven above ground petroleum tanks were observed on the site, and in discussion with the site's operator at the time, there is anecdotal evidence of historic spills in the fuel storage areas at the roadside (northern) part of the site.

4.3 Aerial Photographs

Selected historic aerial photographs for the study area and surrounding land, dated 1958, 1966 and 1986, were obtained from NSW Land and Property Information for review (copies are provided in APPENDIX C).

The aerial photograph review was conducted to develop a general history of the development of the study area and surrounding properties (within approximately 200 m) and is summarised in Table 4.

Table 4: Summary of Historic Aerial Photograph Review

Date	Scale	Comments (Study Area and Surrounding land)
1958	Not specified	North: There is evidence of several potentially residential buildings along Warrabungle Street, in the centre of the study area, north of the mill. The area is still entirely open space grazing land and no evidence of industrial development is shown on the photo. South: The Gunnedah Flour Mill is clearly presented with many of the major buildings visible. There was an attached brick and corrugated iron structure adjoining the southern and eastern sides of the mill building, which appeared to have been the steam engine house. A large structure extended along the full width of the mill building and possibly comprised the original silos. The land is vacant on either side of the Oxley Highway. The grain silos and some associated buildings are visible in the south eastern corner of the study area. East: The rail line, numerous accommodation and recreational buildings were present in the eastern side of the study area. The sports ovals were evident to the south-east. The railway station was located to the south-east of the study area. West: Several areas of earthworks (potentially landfilling, as they are appear as structured cell excavations) were evident on the west of the study area. The surrounding land on the west and north was predominantly vacant agricultural land.
1966	Not specified	North: Gunnedah Regional Saleyards was present on the north of the study area. The surrounding area continues to be dominated by farm land. South: The main infrastructure of the Flour Mill including the rail line appeared relatively unchanged from the 1958 photograph. The petroleum product storage was constructed on the south, the storage terminal was originally part of the railway easement and provided diesel for the locomotives. The grain silos appeared relatively unchanged. East: Increased infrastructure and residential area was evident to the east and south east of the study area. West: The excavation activities in the western corner appeared to have ceased and three industrial buildings were present in that area. The surrounding area continued to be dominated by farm land on the west and residential lots on the east of the study area.

Date	Scale	Comments (Study Area and Surrounding land)
1986	1:40,000	North: Gunnedah Regional Saleyards appeared to have undergone continued development. South: The Flour Mill had undergone significant continued development since the previous aerial photograph 1966, with several buildings removed from the area. The rail line easement appeared relatively unchanged. There were a few industrial buildings on the corner of Oxley Highway and Farrar Road. East: The residential infrastructure on the east remained relatively unchanged. West: The accommodation precinct appeared to have undergone continued development since the previous aerial photograph (1966). New buildings, likely to be residential units, were visible in the western portion of the study area. Farming was the dominant surrounding land use, and the Wandobah Reserve appeared unchanged. The surrounding area was relatively unchanged from the 1966 photograph.
2013	NearMap Image (Provided by KBR)	The study area appeared relatively unchanged, although residential and industrial buildings had been constructed on the immediate west of the study area and a new L- shape building constructed in the Flour Mill area. The Pensioners Hill Reserve and the main infrastructure on the site remain relatively unchanged from 1986.

Notes: Images taken prior to 1996 are “black and white” and photographs from 1996 onwards are “colour”.

4.4 Regulatory Agency Records Search

The following regulatory agency record sources were accessed for relevant information on potential environmental impacts, from current and historical on-site and surrounding off-site activities.

4.4.1 NSW Environment Protection Authority

A search of the NSW EPA’s public register, on 21 February 2013, indicated that the study area, and other locations within 200 metres of it, is not listed as either of the following:

- Sites notified to the EPA which the owner “believes” is contaminated under Section 60 of the *Contaminated Land Management (CLM) Act 1997*.
- Sites subject to a Notice issued by the NSW EPA with regards to Section 58 of the CLM Act 1997.

A copy of the NSW EPA search results is presented in APPENDIX B.

4.4.2 Gunnedah Shire Council

Gunnedah Shire Council Planning and Development Department indicated there are no records of any Environmentally Relevant Activity (ERA) being undertaken at the study area and no records of environmental licences being issued for the study area (Gunnedah Local Environmental Plan 2012).

A Heritage Assessment of a former flour mill within the study area (HLA 2012) has been made available and states that ‘the heritage clauses of the Gunnedah Local Environmental Plan 2012, will not apply to the development of a new road over Rail Bridge’, and that ‘the provisions of State Environmental Planning Policy (Infrastructure) 2007, will apply instead’. This policy allows developing certain road infrastructure, including bridges, without consent. There are however, consultation requirements for developments without consent that have the potential to impact listed heritage items.

5.0 SITE INSPECTION

A site inspection of the study area was conducted by experienced Golder personnel on Monday 18th February, 2012, following collation of desk study data and preliminary appraisal of concept options by KBR and Golder. A summary of the key findings from the site inspections is provided below and pertinent photographic records are included in APPENDIX D.

GEOTECHNICAL FINDINGS

- The study area is generally easily trafficable and access should not be a significant issue for tyred vehicles which stay on higher ground during dry weather periods. Areas associated within the Blackjack Creek watercourse appear saturated and are compressible while traversing. Signs that a large volume of water had passed through the area recently were evident, which had left flood debris up to 1.5 m above the base of the watercourse.
- Within Blackjack Creek, running surface water to depths of about 0.2 m was observed at the time of the site walkover. In areas further upstream and downstream of the rail bridge, water depths were observed to be greater than 1 m and extensive beds of reeds had developed.
- Modification appears to have been undertaken on the Blackjack Creek waterway, including widening of the water course upstream and downstream of the railway culverts and construction of an embankment along the eastern side of the watercourse, protecting the western side of the township from high flows in the creek.
- The embankment structure's dimensions were approximately 1 m high and 4 m wide and, from visual observation, it appears to be constructed of clay, though the actual construction methods and materials are unknown. The surface of the embankment around the rail overpass appears to be covered with railway ballast potentially in an attempt to improve trafficability during the construction of the overpass during 2011.
- A relatively new culvert has been installed for the railway line passing over Blackjack Creek. This 2011 construction includes seven large box culverts and required the use of large amounts of railway ballast to make the base of the waterway trafficable for construction.
- The railway embankment consists of course granular filling up to approximately 2.5 m high at the abutment of the embankment and the new Blackjack Creek Culvert. The railway line is at ground level at the New Street Level crossing and continues on a raised embankment to the north-east of the study area, after crossing Blackjack Creek.
- Inspection of an existing excavation associated with the widening Farrar Road, mid-slope up Pensioner's Hill to the west of the study area, indicated potential high strength lava flows and tuffaceous bands. The lava flows appeared to be massive, with an outcrop higher up the slope up to 3 m thick.
- At 35 Farrar Road and two retaining walls have been constructed which appear to prevent movement of material downslope towards Blackjack Creek. A 'post and panel' retaining wall, with timber panels is located along the rail easement boundary.

ENVIRONMENTAL FINDINGS

- Some filling (appears to be coal wash rejects) has been used to level the site at 35 Farrar Road.
- Two sites at 2 and 12 Railway Avenue have a long history of petroleum product storage. The sites were originally part of the railway easement and provided diesel for the locomotives and were later purchased by Esso Australia for use as a petroleum distribution and service station. The property of 12 Railway Avenue currently has 11 large above ground petroleum storage tanks with a capacity of approximately 500,000 Litres.
- Discussion with the local operator of the Hope Fuel Supplies Fuel depot suggested that a significant spill had occurred previously at 12 Railway Avenue when underground petroleum storage tanks and

pipes leaked (approximately 20 years ago). The site was remediated by excavating the leaking tanks and replacing them with fibreglass tanks and treating the contaminated soil onsite. No records of this work were available with the EPA. The local operator also thought a larger spill had occurred at 2 Railway Avenue, which has since been converted to a warehouse/distribution centre and the presence of petroleum tanks, pipes or contamination at this site is unknown.

- Within the rail yards on the northern side of the railway there are several stock piles of unknown material and numerous stock piles of waste (old track, sleepers etc.) which could be sources of contamination. Additional sources of contamination that could be present within the rail corridor include hydrocarbons from the greases used and hydraulic fluids, asbestos from within older style brake pads, dumps of ash from the use of coal to drive steam locomotives around the start of the twentieth century and areas of filling in old stock yards where coal was laid down prior to loading.

6.0 POTENTIAL CONTAMINATION SOURCES AND CONTAMINANTS OF POTENTIAL CONCERN

The aim of the Environmental Assessment was to identify and summarise the areas of potential soil, groundwater and/or vapour contamination.

Based on the findings of the Environmental Assessment, Table 3 below presents a summary of the areas of potential environmental concern and the potential contaminants that may be associated with these areas.

Table 3: Summary of Potential Issues and Contaminants

Key Areas of Interest	Potential Contaminants
Industrial buildings (metal fabricators, workshops and mechanics) near Farrer Rd (Lot 17 - Lot 19 DP 258863), mill flour and grain silos buildings	TPH, MAH, PAH, SVOC/VOC, asbestos and lead
Unidentified dumping areas located across the study area and areas where waste water treatment has occurred on the site.	BTEX, TPH, PAHs, SVOCs, VOCs, metals, asbestos and PCBs
Underground storage tanks including former petrol UST	BTEX, TPH, MAH, PAH, SVOC/VOC lead
Flour mills and grain silos	Pesticides, Metals
Gunnedah Regional Saleyards including machinery and equipment wash-down in washdown bay	TPH, MAH, PAH, SVOC, metals, pesticides, in addition, nutrients and microbiological contaminants may also be present in areas where sewage treatment has occurred
Above ground petroleum tanks – historic spills	TPH, PAH
Hazardous materials **-** these include the various areas of the study area where buildings containing hazardous materials have been demolished without controls.	Asbestos, lead, PCBs and PAHs
Areas across the study area where high voltage electrical equipment may be currently, or was potentially historically positioned.	TPH, PAHs, phenols PCBs and asbestos
The ARTC rail corridor and siding area, which passes through the study area. The land is owned by the ARTC. The rail siding was most likely subjected to ongoing pesticide and herbicide treatment during its operations.	TPH, PAHs, metals/metalloids, OCPs and OPPs
Possible importation of fill	Metals, PAH, TPH

Notes:

Total petroleum hydrocarbons (TPH); benzene, ethylbenzene, toluene and xylene (BTEX); polycyclic aromatic hydrocarbons (PAH); monocyclic aromatic hydrocarbons (MAH), semi-volatile organic compounds (SVOCs); volatile organic compounds (VOCs) and Polychlorinated Biphenyls (PCB), Metals / Metalloids (arsenic [As], cadmium [Cd], chromium (total) [Cr], copper [Cu], nickel [Ni], lead [Pb], zinc [Zn] and mercury [Hg].

7.0 PRELIMINARY GEOTECHNICAL ASSESSMENT

In assessing the available desk study information and following the site walkover, the following geotechnical issues which may impact on the options assessment for the concept design stage have been identified:

- Within Blackjack Creek: there is potential for alluvial deposits of variable composition, possibly being loose and/or compressible which may result in settlement if loaded by structures or embankments.
- Blackjack Creek: this watercourse is a flood route and structures proposed within it should be considered in terms of both scour and potential flood impact. For the latter, this assessment should be undertaken by an appropriate specialist and is outside the scope of this report.
- Piled foundations: west of Blackjack Creek the underlying bedrock is expected to comprise volcanic rock which may be high strength and difficult to bore for the construction of pile sockets.
- Piled foundations: if constructed within Blackjack Creek, piled foundations would need to found on competent bedrock or within dense gravels to provide sufficient end-bearing capacity. The depths of alluvial deposits within the creek has not been established at this stage, but are thought to extend to depths exceeding 10 m. Driving piles through coarse gravels may prove difficult and driven piles may refuse prematurely. Furthermore, should bedrock be encountered at relatively shallow depths then sufficient lateral support may not be provided to driven piles.
- Outside of Blackjack Creek: soils are considered likely to be suitable to support proposed road construction at grade, although some localised filling and upper alluvial soil may require removal or improvement.
- Existing building structures: if required to be demolished to enable construction of the new route, they may have existing foundations which need to be removed.
- Existing Culvert (near New Street level crossing): Settlement of this structure and or damage to the structure may occur if subject to additional loadings. A structural assessment and possible investigation of the underlying ground should be undertaken to assess whether this structure can be incorporated into the concept deign.
- Earth Embankments and Retaining Walls: permitted construction footprints may limit the use of batters on the approach embankments, especially where sufficient clearance over the railway, which is already situated on an embankment, is required. Retaining walls may be required due to the acute angles of possible intersections between the new route and the existing railway easement.
- Earth Embankments – material supply: The study area is generally flat and the new route is not expected to generate site-won material suitable for embankment construction.
- Aggressivity: in general accordance with AS 2159-2009, the exposure classification is expected to be ‘Mild’ for concrete structures and ‘Moderate’ for steel structures in soil exposed to groundwater.

8.0 FURTHER GEOTECHNICAL AND ENVIRONMENTAL INVESTIGATION

As part of the Concept Options delivery programme, a targeted intrusive site investigation is recommended to further characterise site conditions and enable refinement of development of the concept option(s).

It is recommended that a detailed scope of the intrusive investigation, to support the concept options study, is confirmed after consideration of the various desk study reports, prepared by the project team, and feedback from relevant stakeholders.

The scope of the intrusive investigation is likely to comprise boreholes and test pits to confirm the sub-surface strata, including the depth to bedrock - particularly within Blackjack Creek, establish groundwater conditions and recover both geotechnical and environmental soils and groundwater samples for laboratory testing.

The intrusive investigation should also obtain data to enable Earthquake Rating and soil aggressivity classifications.

It is recommended that a Phase 2 Environmental Investigation is undertaken to assess the potential extents of contamination, impact to receptors and gain further understanding of the potential implications of associated risks and liability. This could be carried out as part of the intrusive investigation.

At this stage several route options could be investigated with individual holes providing information suitable for more than one option, due to the overlap of most likely options.

The majority of the study area is reasonably accessible by a truck mounted rig, although permissions would need to be sought to enter properties, as required, and traffic management may also be needed if work cannot be located outside of road corridors. Drilling work within Blackjack Creek is likely to be dependent on climatic conditions, and may only be accessible during extended periods of dry weather. If not accessible due to soft ground, drilling may require the use of a track mounted rig. The site walkover has also identified that underground and overhead service locations may be a significant limiting factor to the investigation.

9.0 CONCLUSIONS AND SUMMARY

Based on the available information, the following conclusions are made.

- Limited geotechnical information is available across the study area. There is limited data available from water bore records close to the site, test pits to approximately 2.4 m depth within Blackjack Creek and site walkover observations. Shallow ground conditions within the study area are likely to comprise alluvial deposits of gravel, sand, silt and clay. The depth to bedrock is not known, and may exceed 10 m within Blackjack Creek.
- Blackjack Creek presents several geotechnical constraints which should be characterised by further site investigation and assessment. They are the potential for settlement of compressible soils if loaded, the depth to bedrock and competent strata within the Creek, and the potential impact on flooding from development within the Creek.
- The local groundwater table appears to be relatively shallow with records to the north of the railway line of less than 1 m below ground level and up to 2.4 m on the southern side of the railway. Within Blackjack Creek the groundwater level is expected to be close to the surface, with the ground in this area currently saturated and previous construction requiring working platforms.
- An absence of underground mining within the study area has been confirmed by the regulator, the nearest mining was approximately 7 km to the west of the study area.
- The risk of contaminated soils exists within the study area including the use of unknown material in the filling of light industrial sites in the area, the possible inclusion of asbestos in the building's structures, the potential for hydrocarbon contamination around the two fuel depots on Railway Avenue and potential TPH, PAHs, metals/metalloids, OCPs and OPPs within the rail corridor. Further environmental site investigation and assessment should be undertaken to refine the risk presented by potential contamination.
- The results of a previous shallow investigation and review of the ASS maps indicated that the area is not within a risk area for ASS, though is within an area of high salinity and aggressive groundwater conditions.

10.0 REFERENCES

- HLA (2012) - “Heritage Assessment, Former Brunton’s Flour Mill, Gunnedah.”, NSW Public Works, Government Architect’s Office, DFS Report No. 12086, September 2012.
- Report on Geotechnical Assessment, Main Northern Railway Proposed Bridge Replacements North-west Branch Line km 476.500, Gunnedah. Douglas Partners (Project 49771), August 2011.
- 1:250 000 scale NSW Department of Mineral Resources 1973 Geological Map ‘Manilla’ (series sheet SH56-9).
- 1:100,000 scale Gunnedah Coalfield (South) regional geological series sheet (GSS 8935, Edition 1, 1996).
- Use of Geophysical Methods to Delineate Salt Affected Areas for Channel Reconstruction in Wandobah Reserve Gunnedah, NSW Department of Infrastructure, Planning and Natural Resources 2003.
- Blackjack Creek Riparian Corridor/Channel Reconstruction – Review of Environmental Factors – DRAFT Issue 1, Revision C. Constructive Solutions, January 2013.
- AS 2870–2011 Residential Slabs and Footings
- AS 1170.4-2007 Structural Design Actions. Part 4 Earthquake Actions in Australia
- AS 2159-2009 Piling, Design and Installation
- Gunnedah Local Environmental Plan 2012

Report Signature Page

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j:\geo\2012\127622030_kbr_bridge si_gunnedah\correspondence out\127622030-r-002-rev0-kbr_bridge si_gunnedah-desk study.docx

FIGURES

SOURCE: DRAWING SUPPLIED BY KBR ON 04.10.12

EXTENT OF STUDY AREA

Golder Associates www.golder.com GOLDER ASSOCIATES PTY. LTD.	CLIENT: KBR		PROJECT: GUNNEDAH SECOND ROAD OVER RAIL BRIDGE					
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	CHECKED BY: BJF	DATE: 25.02.2013						
	SCALE: NOT TO SCALE	SHEET SIZE: A3	PROJECT No: 127622030	DOC No: 002	DOC TYPE: R	FIGURE No: F001	REVISION: 0	FIGURE 1

Plot Date: 25 February 2013 Time:1:26:20 PM By: Campbell, Helen Path: J:\geo\2012\127622030_KBR_Bridge SI_Gunnedah\Technical Docs\CADD\FIGURES - File Name:127622030-002-R-F001-REV0.dwg
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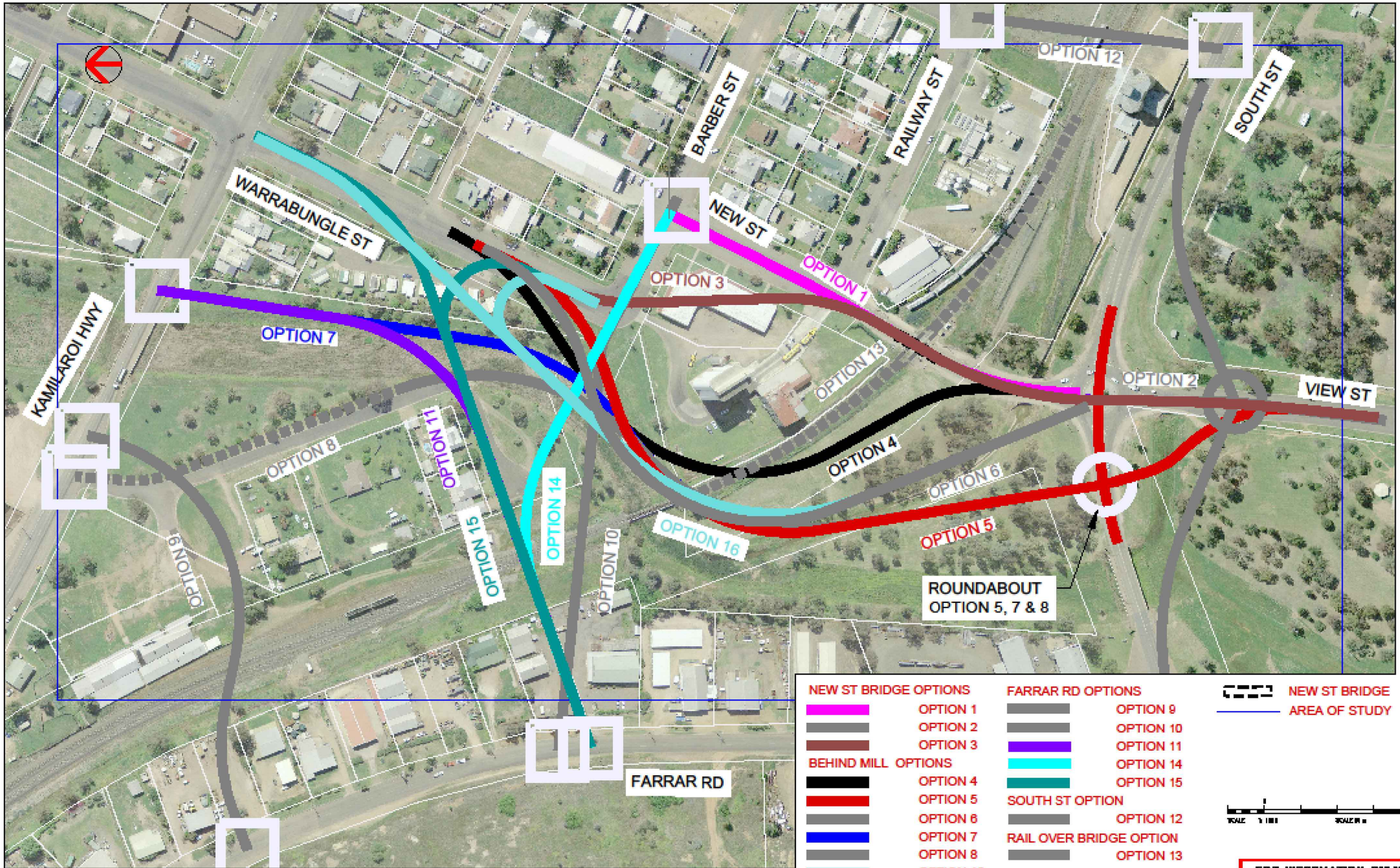

SOURCE: DRAWING SUPPLIED BY KBR ON 22.02.13,
REF. SEC143-SKH-PRE-1999, REV A

Golder Associates
www.golder.com
GOLDER ASSOCIATES PTY. LTD.

CLIENT: KBR			PROJECT: GUNNEDAH SECOND ROAD OVER RAIL BRIDGE				
DRAWN BY: HC	DATE: 25.02.2013		DRAWING TITLE: PRELIMINARY OPTIONS SKETCH				
CHECKED BY: BJF	DATE: 25.02.2013						
SCALE: NOT TO SCALE	SHEET SIZE: A3	PROJECT No: 127622030	DOC No: 002	DOC TYPE: R	FIGURE No: F002	REVISION: 0	FIGURE 2

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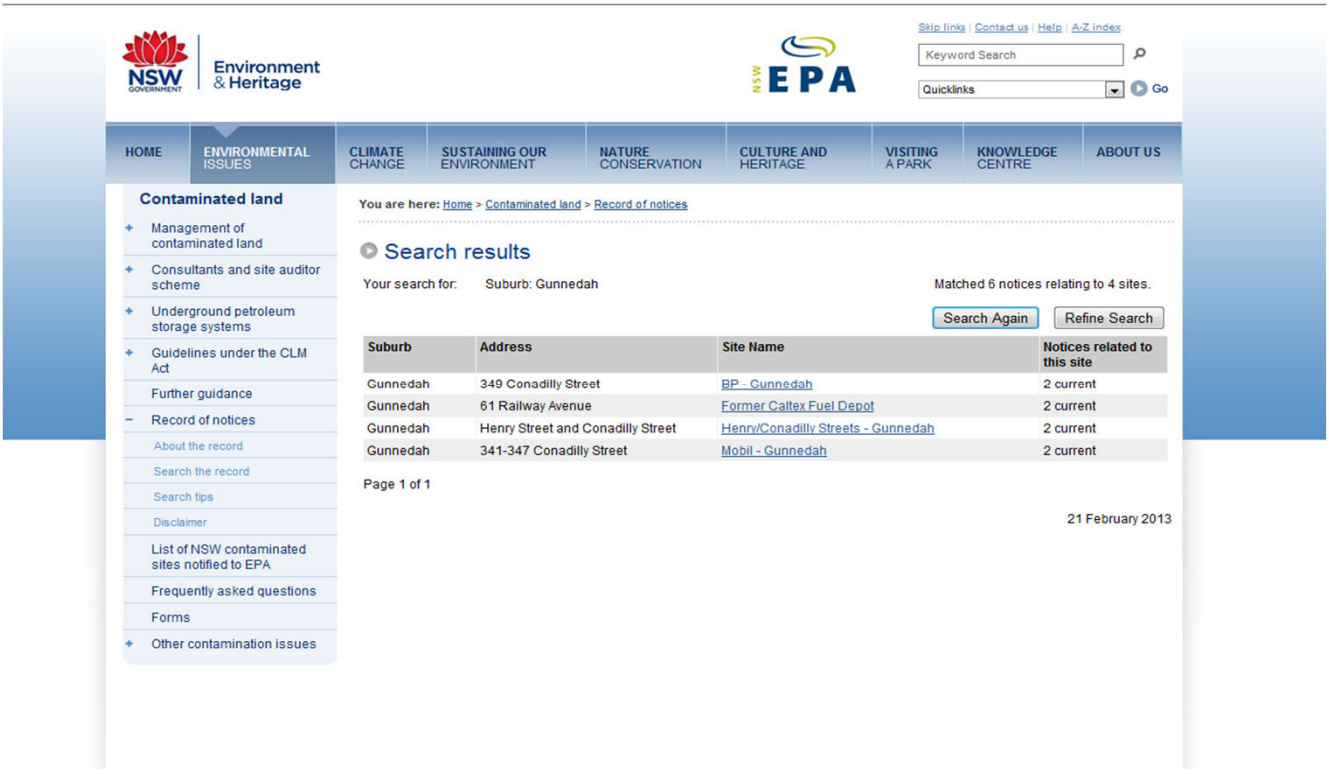
APPENDIX A

NSW EPA Register Database Search Results



Gulgong	Gulgong Depot (Reliance Petroleum) Railway Street	Other Petroleum	Yes	In progress	A
Gulgong	The Oval Site Queen Street	Unclassified	No	Completed	F
Gumly Gumly	Brick Kiln Reserve Eunony Bridge Road	Landfill	yes	Completed	G
Gumly Gumly	Caltex Service Station Sturt Hwy	Service Station	Yes	In progress	B
Gundagai	Mobil Depot 98 Mount Street	Other Petroleum	Yes	In Progress	E
Gunnedah	Adjacent to Service Station Intersection of Henry and Conadilly Streets	Service Station	Yes	Completed	C
Gunnedah	BP Service Station Corner Conadilly & Henry Streets	Service Station	Yes	Completed	C
Gunnedah	Caltex Service Station 21 Abbott St	Service Station	Yes	In progress	B
Gunnedah	Former Caltex Depot Railway Ave	Other Petroleum	Yes	Completed	C
Gunnedah	Former Shell Depot 85-89 Barber Street	Other Petroleum	Yes	In Progress	A
Gunnedah	Former Telstra Line Depot 81 Barber Street	Other Petroleum	Yes	In Progress	B
Gunnedah	Mobil Gunnedah Depot 16-24 Wentworth Street	Other Petroleum	Yes	Completed	G
Gunnedah	Mobil Service Station 341 Conadilly Street	Service Station	Yes	Completed	C
Gunnedah	Sate Property Authority Site 35 -37 Abbott Street	Other Petroleum	Yes	In progress	A
Gunning	Shell Service Station 56 Yass Street	Service Station	No	In Progress	B
Guyra	Caltex Service Station New England Hwy	Service Station	Yes	In progress	B
Guyra	StateRail land leased to Incitec Starr Rd	Other Industry	Yes	Completed	G

Golder Associates	CLIENT	KBR		PROJECT	Gunnedah - Second Road Over Rail Bridge
	DRAWN	JS	DATE 22/02/2013	TITLE	NSW EPA Search Results
	CHECKED	BF	DATE 22/02/2013		
	SCALE	N/A	A4	PROJECT No	127622030 FIGURE No APP A

APPENDIX B

Registered Groundwater Bore Search Results

Groundwater Works Summary

For information on the meaning of fields please see Glossary
Document Generated on Thursday, January 31, 2013

Print Report

Works Details Site Details Form A Licensed Construction Water Bearing Zones Drillers Log

Work Requested -- GW965533

Works Details (top)

GROUNDWATER NUMBER	GW965533
LIC-NUM	
AUTHORISED-PURPOSES	
INTENDED-PURPOSES	MONITORING BORE
WORK-TYPE	Bore
WORK-STATUS	
CONSTRUCTION-METHOD	Auger
OWNER-TYPE	
COMMENCE-DATE	
COMPLETION-DATE	2000-02-02
FINAL-DEPTH (metres)	10.00
DRILLED-DEPTH (metres)	10.00
CONTRACTOR-NAME	
DRILLER-NAME	
PROPERTY	
GWMA	
GW-ZONE	
STANDING-WATER-LEVEL	
SALINITY	
YIELD	

Site Details (top)

REGION	90 - BARWON
RIVER-BASIN	
AREA-DISTRICT	
CMA-MAP	
GRID-ZONE	
SCALE	
ELEVATION	
ELEVATION-SOURCE	
NORTHING	6569057.00
EASTING	237021.00
LATITUDE	30 58' 58"
LONGITUDE	150 14' 47"
GS-MAP	

AMG-ZONE	56
COORD-SOURCE	
REMARK	

Form-A (top)

no details

Licensed (top)

no details

Construction (top)

Negative depths indicate Above Ground Level;H-Hole;P-Pipe;OD-Outside Diameter;
ID-Inside Diameter;C-Cemented;SL-Slot Length;A-Aperture;GS-Grain Size;Q-Quantity

HOLE-NO	PIPE-NO	COMPONENT-CODE	COMPONENT-TYPE	DEPTH-FROM (metres)	DEPTH-TO (metres)	OD (mm)	ID (mm)	INTERVAL	DETAIL
1		Hole	Hole	0.00	10.00	150			Auger
1	1	Casing	P.V.C.	-1.20	10.00	50			Seated on Bottom
1	1	Opening	Slots	8.50	10.00	50			PVC; Mechanically Slotted
1		Annulus	(Unknown)	8.40	10.00				Graded

Water Bearing Zones (top)

no details

Drillers Log (top)

FROM	TO	THICKNESS	DESC	GEO-MATERIAL	COMMENT
0.00	1.00	1.00	silty/clay with sand		
1.00	2.00	1.00	silty/clay with sand brown		
2.00	3.00	1.00	silty/clay		
3.00	4.00	1.00	silty/clay gravelly		
4.00	5.00	1.00	gravelly/silty/clay		
5.00	6.00	1.00	silty/clay with gravel		
6.00	10.00	4.00	silty/clay		

Groundwater Works Summary

For information on the meaning of fields please see Glossary
Document Generated on Thursday, January 31, 2013

Print Report

Works Details Site Details Form A Licensed Construction Water Bearing Zones Drillers Log

Work Requested -- GW965541

Works Details (top)

GROUNDWATER NUMBER	GW965541
LIC-NUM	
AUTHORISED-PURPOSES	
INTENDED-PURPOSES	MONITORING BORE
WORK-TYPE	Bore
WORK-STATUS	
CONSTRUCTION-METHOD	Auger
OWNER-TYPE	
COMMENCE-DATE	
COMPLETION-DATE	2000-02-05
FINAL-DEPTH (metres)	7.00
DRILLED-DEPTH (metres)	7.00
CONTRACTOR-NAME	
DRILLER-NAME	
PROPERTY	
GWMA	
GW-ZONE	
STANDING-WATER-LEVEL	
SALINITY	
YIELD	

Site Details (top)

REGION	90 - BARWON
RIVER-BASIN	
AREA-DISTRICT	
CMA-MAP	
GRID-ZONE	
SCALE	
ELEVATION	
ELEVATION-SOURCE	
NORTHING	6569639.00
EASTING	237495.00
LATITUDE	30 58' 39"
LONGITUDE	150 15' 5"
GS-MAP	

AMG-ZONE	56
COORD-SOURCE	
REMARK	

Form-A (top)

no details

Licensed (top)

no details

Construction (top)

Negative depths indicate Above Ground Level;H-Hole;P-Pipe;OD-Outside Diameter;
ID-Inside Diameter;C-Cemented;SL-Slot Length;A-Aperture;GS-Grain Size;Q-Quantity

HOLE-NO	PIPE-NO	COMPONENT-CODE	COMPONENT-TYPE	DEPTH-FROM (metres)	DEPTH-TO (metres)	OD (mm)	ID (mm)	INTERVAL	DETAIL
1		Hole	Hole	0.00	7.00	150			Auger
1	1	Casing	P.V.C.	-1.10	7.00	50			
1	1	Opening	Slots	5.50	7.00	50			PVC; Mechanically Slotted
1		Annulus	(Unknown)	5.40	7.00				Graded

Water Bearing Zones (top)

no details

Drillers Log (top)

FROM	TO	THICKNESS	DESC	GEO-MATERIAL	COMMENT
0.00	1.00	1.00	silty/clay		
1.00	2.00	1.00	clay/brown with sand		
2.00	3.00	1.00	clay/brown with gravel		
3.00	4.00	1.00	clay/brown with sand and gravel		
4.00	5.00	1.00	silty/clay brown		
5.00	7.00	2.00	clay/brown		

Groundwater Works Summary

For information on the meaning of fields please see Glossary
Document Generated on Thursday, January 31, 2013

Print Report

Works Details Site Details Form A Licensed Construction Water Bearing Zones Drillers Log

Work Requested -- GW965542

Works Details (top)

GROUNDWATER NUMBER	GW965542
LIC-NUM	
AUTHORISED-PURPOSES	
INTENDED-PURPOSES	MONITORING BORE
WORK-TYPE	Bore
WORK-STATUS	
CONSTRUCTION-METHOD	Auger
OWNER-TYPE	
COMMENCE-DATE	
COMPLETION-DATE	2000-02-10
FINAL-DEPTH (metres)	8.00
DRILLED-DEPTH (metres)	8.00
CONTRACTOR-NAME	
DRILLER-NAME	
PROPERTY	
GWMA	
GW-ZONE	
STANDING-WATER-LEVEL	
SALINITY	
YIELD	

Site Details (top)

REGION	90 - BARWON
RIVER-BASIN	
AREA-DISTRICT	
CMA-MAP	
GRID-ZONE	
SCALE	
ELEVATION	
ELEVATION-SOURCE	
NORTHING	6569983.00
EASTING	237471.00
LATITUDE	30 58' 28"
LONGITUDE	150 15' 5"
GS-MAP	

AMG-ZONE	56
COORD-SOURCE	
REMARK	

Form-A (top)

no details

Licensed (top)

no details

Construction (top)

Negative depths indicate Above Ground Level;H-Hole;P-Pipe;OD-Outside Diameter;
ID-Inside Diameter;C-Cemented;SL-Slot Length;A-Aperture;GS-Grain Size;Q-Quantity

HOLE-NO	PIPE-NO	COMPONENT-CODE	COMPONENT-TYPE	DEPTH-FROM (metres)	DEPTH-TO (metres)	OD (mm)	ID (mm)	INTERVAL	DETAIL
1		Hole	Hole	0.00	8.00	150			Auger
1	1	Casing	P.V.C.	-1.28	8.00	50			
1	1	Opening	Slots	6.50	8.00	50			PVC; Mechanically Slotted
1		Annulus	(Unknown)	6.40	8.00				Graded

Water Bearing Zones (top)

no details

Drillers Log (top)

FROM	TO	THICKNESS	DESC	GEO-MATERIAL	COMMENT
0.00	1.00	1.00	clay/black		
1.00	2.00	1.00	clay/brown		
2.00	3.00	1.00	clay/black		
3.00	6.00	3.00	clay/brown		
6.00	8.00	2.00	clay		

Groundwater Works Summary

For information on the meaning of fields please see Glossary
Document Generated on Thursday, January 31, 2013

Print Report

Works Details Site Details Form A Licensed Construction Water Bearing Zones Drillers Log

Work Requested -- GW965543

Works Details (top)

GROUNDWATER NUMBER	GW965543
LIC-NUM	
AUTHORISED-PURPOSES	
INTENDED-PURPOSES	MONITORING BORE
WORK-TYPE	Bore
WORK-STATUS	
CONSTRUCTION-METHOD	Auger
OWNER-TYPE	
COMMENCE-DATE	
COMPLETION-DATE	2000-02-10
FINAL-DEPTH (metres)	10.00
DRILLED-DEPTH (metres)	10.00
CONTRACTOR-NAME	
DRILLER-NAME	
PROPERTY	
GWMA	
GW-ZONE	
STANDING-WATER-LEVEL	
SALINITY	
YIELD	

Site Details (top)

REGION	90 - BARWON
RIVER-BASIN	
AREA-DISTRICT	
CMA-MAP	
GRID-ZONE	
SCALE	
ELEVATION	
ELEVATION-SOURCE	
NORTHING	6569501.00
EASTING	236699.00
LATITUDE	30 58' 43"
LONGITUDE	150 14' 35"
GS-MAP	

AMG-ZONE	56
COORD-SOURCE	
REMARK	

Form-A (top)

no details

Licensed (top)

no details

Construction (top)

Negative depths indicate Above Ground Level;H-Hole;P-Pipe;OD-Outside Diameter;
ID-Inside Diameter;C-Cemented;SL-Slot Length;A-Aperture;GS-Grain Size;Q-Quantity

HOLE-NO	PIPE-NO	COMPONENT-CODE	COMPONENT-TYPE	DEPTH-FROM (metres)	DEPTH-TO (metres)	OD (mm)	ID (mm)	INTERVAL	DETAIL
1		Hole	Hole	0.00	10.00	150			Auger
1	1	Casing	P.V.C.	-1.08	10.00	50			
1	1	Opening	Slots	8.50	10.00	50			PVC; Mechanically Slotted
1		Annulus	(Unknown)	8.40	10.00				Graded

Water Bearing Zones (top)

no details

Drillers Log (top)

FROM	TO	THICKNESS	DESC	GEO-MATERIAL	COMMENT
0.00	1.00	1.00	gravelly/sandy clay		
1.00	2.00	1.00	sandy/clay dark brown		
2.00	3.00	1.00	silty/clay with sand		
3.00	4.00	1.00	clay/gravel/sand dark brown		
4.00	6.00	2.00	silty/clay with rhyolite chips		
6.00	7.00	1.00	clay/gravel with some quatz		
7.00	8.00	1.00	silty/clay light		
8.00	10.00	2.00	silty/clay with gravel		

Groundwater Works Summary

For information on the meaning of fields please see Glossary
Document Generated on Thursday, January 31, 2013

Print Report

Works Details Site Details Form A Licensed Construction Water Bearing Zones Drillers Log

Work Requested -- GW966959

Works Details (top)

GROUNDWATER NUMBER	GW966959
LIC-NUM	
AUTHORISED-PURPOSES	
INTENDED-PURPOSES	
WORK-TYPE	Bore
WORK-STATUS	(Unknown)
CONSTRUCTION-METHOD	(Unknown)
OWNER-TYPE	(Unknown)
COMMENCE-DATE	
COMPLETION-DATE	2005-01-20
FINAL-DEPTH (metres)	
DRILLED-DEPTH (metres)	
CONTRACTOR-NAME	
DRILLER-NAME	
PROPERTY	
GWMA	
GW-ZONE	
STANDING-WATER-LEVEL	
SALINITY	
YIELD	

Site Details (top)

REGION	90 - BARWON
RIVER-BASIN	
AREA-DISTRICT	
CMA-MAP	
GRID-ZONE	
SCALE	
ELEVATION	
ELEVATION-SOURCE	
NORTHING	6569462.00
EASTING	236578.00
LATITUDE	30 58' 44"
LONGITUDE	150 14' 30"
GS-MAP	

AMG-ZONE	56
COORD-SOURCE	GPS - Global Positioning System
REMARK	

Form-A (top)

no details

Licensed (top)

no details

Water Bearing Zones (top)

no details

Drillers Log (top)

no details

Groundwater Works Summary

For information on the meaning of fields please see Glossary
Document Generated on Thursday, January 31, 2013

Print Report

Works Details Site Details Form A Licensed Construction Water Bearing Zones Drillers Log

Work Requested -- GW966960

Works Details (top)

GROUNDWATER NUMBER	GW966960
LIC-NUM	
AUTHORISED-PURPOSES	
INTENDED-PURPOSES	
WORK-TYPE	Bore
WORK-STATUS	(Unknown)
CONSTRUCTION-METHOD	(Unknown)
OWNER-TYPE	(Unknown)
COMMENCE-DATE	
COMPLETION-DATE	2005-01-20
FINAL-DEPTH (metres)	
DRILLED-DEPTH (metres)	
CONTRACTOR-NAME	
DRILLER-NAME	
PROPERTY	
GWMA	
GW-ZONE	
STANDING-WATER-LEVEL	
SALINITY	
YIELD	

Site Details (top)

REGION	90 - BARWON
RIVER-BASIN	
AREA-DISTRICT	
CMA-MAP	
GRID-ZONE	
SCALE	
ELEVATION	
ELEVATION-SOURCE	
NORTHING	6569147.00
EASTING	236453.00
LATITUDE	30 58' 54"
LONGITUDE	150 14' 25"
GS-MAP	

AMG-ZONE	56
COORD-SOURCE	GPS - Global Positioning System
REMARK	

Form-A (top)

no details

Licensed (top)

no details

Water Bearing Zones (top)

no details

Drillers Log (top)

no details

Groundwater Works Summary

For information on the meaning of fields please see Glossary
Document Generated on Thursday, January 31, 2013

Print Report

Works Details Site Details Form A Licensed Construction Water Bearing Zones Drillers Log

Work Requested -- GW966966

Works Details (top)

GROUNDWATER NUMBER	GW966966
LIC-NUM	
AUTHORISED-PURPOSES	
INTENDED-PURPOSES	
WORK-TYPE	Bore
WORK-STATUS	(Unknown)
CONSTRUCTION-METHOD	(Unknown)
OWNER-TYPE	School
COMMENCE-DATE	
COMPLETION-DATE	2005-01-20
FINAL-DEPTH (metres)	
DRILLED-DEPTH (metres)	
CONTRACTOR-NAME	
DRILLER-NAME	
PROPERTY	
GWMA	
GW-ZONE	
STANDING-WATER-LEVEL	
SALINITY	
YIELD	

Site Details (top)

REGION	90 - BARWON
RIVER-BASIN	
AREA-DISTRICT	
CMA-MAP	
GRID-ZONE	
SCALE	
ELEVATION	
ELEVATION-SOURCE	
NORTHING	6569028.00
EASTING	237312.00
LATITUDE	30 58' 59"
LONGITUDE	150 14' 58"
GS-MAP	

AMG-ZONE	56
COORD-SOURCE	GPS - Global Positioning System
REMARK	

Form-A (top)

no details

Licensed (top)

no details

Construction (top)

Negative depths indicate Above Ground Level;H-Hole;P-Pipe;OD-Outside Diameter;
ID-Inside Diameter;C-Cemented;SL-Slot Length;A-Aperture;GS-Grain Size;Q-Quantity

HOLE-NO	PIPE-NO	COMPONENT-CODE	COMPONENT-TYPE	DEPTH-FROM (metres)	DEPTH-TO (metres)	OD (mm)	ID (mm)	INTERVAL	DETAIL
1	1	Casing	(Unknown)	0.00	0.00				

Water Bearing Zones (top)

no details

Drillers Log (top)

no details

Groundwater Works Summary

For information on the meaning of fields please see Glossary
Document Generated on Thursday, January 31, 2013

Print Report

Works Details Site Details Form A Licensed Construction Water Bearing Zones Drillers Log

Work Requested -- GW969175

Works Details (top)

GROUNDWATER NUMBER	GW969175
LIC-NUM	90BL254624
AUTHORISED-PURPOSES	DEWATERING (GROUNDWATER)
INTENDED-PURPOSES	DEWATERING (GROUNDWATER)
WORK-TYPE	Bore
WORK-STATUS	Supply Obtained
CONSTRUCTION-METHOD	Rotary
OWNER-TYPE	Private
COMMENCE-DATE	
COMPLETION-DATE	2008-12-01
FINAL-DEPTH (metres)	8.60
DRILLED-DEPTH (metres)	8.60
CONTRACTOR-NAME	
DRILLER-NAME	
PROPERTY	LOT 9 DP 663187
GWMA	604 - GUNNEDAH BASIN
GW-ZONE	-
STANDING-WATER-LEVEL	
SALINITY	
YIELD	

Site Details (top)

REGION	90 - BARWON
RIVER-BASIN	419 - NAMOI RIVER
AREA-DISTRICT	
CMA-MAP	8936-2S
GRID-ZONE	56/1
SCALE	1:25,000
ELEVATION	
ELEVATION-SOURCE	
NORTHING	6569407.00
EASTING	237394.00
LATITUDE	30 58' 47"
LONGITUDE	150 15' 1"
GS-MAP	

AMG-ZONE	56
COORD-SOURCE	GIS - Geographic Information System
REMARK	

Form-A (top)

COUNTY	POTTINGER
PARISH	GUNNEDAH
PORTION-LOT-DP	9//663187

Licensed (top)

COUNTY	POTTINGER
PARISH	GUNNEDAH
PORTION-LOT-DP	9 663187

Construction (top)

Negative depths indicate Above Ground Level;H-Hole;P-Pipe;OD-Outside Diameter;
ID-Inside Diameter;C-Cemented;SL-Slot Length;A-Aperture;GS-Grain Size;Q-Quantity

HOLE-NO	PIPE-NO	COMPONENT-CODE	COMPONENT-TYPE	DEPTH-FROM (metres)	DEPTH-TO (metres)	OD (mm)	ID (mm)	INTERVAL	DETAIL
1		Hole	Hole	0.00	8.60	100			Rotary
1	1	Casing	P.V.C.	0.00	8.60	50			Seated on Bottom; End cap
1	1	Opening	Slots	5.50	8.60	50			PVC
1		Annulus	Crushed Aggregate	0.00	3.60	100	50		
1		Annulus	Bentonite	3.60	4.70	100	50		
1		Annulus	Waterworn/Rounded	4.70	8.60	100	50		Graded; GS: 2-6mm

Water Bearing Zones (top)

no details

Drillers Log (top)

FROM	TO	THICKNESS	DESC	GEO-MATERIAL	COMMENT
0.00	0.40	0.40	Fill		
0.40	4.80	4.40	Silty Clay, brown/dark brown, medium-high plasticity		
4.80	8.60	3.80	Silty Clay, as above, red brown colour change at 4.8m		

(DIPNR) by drillers, licensees and other sources. The DIPNR does not verify the accuracy of this data. The data is presented for use by you at your own risk. You should consider verifying this data before relying on it. Professional hydrogeological advice should be sought in interpreting and using this data.

Groundwater Works Summary

For information on the meaning of fields please see Glossary
Document Generated on Thursday, January 31, 2013

Print Report

Works Details Site Details Form A Licensed Construction Water Bearing Zones Drillers Log

Work Requested -- GW969177

Works Details (top)

GROUNDWATER NUMBER	GW969177
LIC-NUM	90BL254624
AUTHORISED-PURPOSES	DEWATERING (GROUNDWATER)
INTENDED-PURPOSES	DEWATERING (GROUNDWATER)
WORK-TYPE	Bore
WORK-STATUS	Supply Obtained
CONSTRUCTION-METHOD	Rotary
OWNER-TYPE	Private
COMMENCE-DATE	
COMPLETION-DATE	2008-12-01
FINAL-DEPTH (metres)	8.50
DRILLED-DEPTH (metres)	8.50
CONTRACTOR-NAME	
DRILLER-NAME	
PROPERTY	LOT 9 DP 663187
GWMA	604 - GUNNEDAH BASIN
GW-ZONE	-
STANDING-WATER-LEVEL	
SALINITY	
YIELD	

Site Details (top)

REGION	90 - BARWON
RIVER-BASIN	419 - NAMOI RIVER
AREA-DISTRICT	
CMA-MAP	8936-2S
GRID-ZONE	56/1
SCALE	1:25,000
ELEVATION	
ELEVATION-SOURCE	
NORTHING	6569410.00
EASTING	237367.00
LATITUDE	30 58' 47"
LONGITUDE	150 15' 0"
GS-MAP	

AMG-ZONE	56
COORD-SOURCE	GIS - Geographic Information System
REMARK	

Form-A (top)

COUNTY	POTTINGER
PARISH	GUNNEDAH
PORTION-LOT-DP	9//663187

Licensed (top)

COUNTY	POTTINGER
PARISH	GUNNEDAH
PORTION-LOT-DP	9 663187

Construction (top)

Negative depths indicate Above Ground Level;H-Hole;P-Pipe;OD-Outside Diameter;
ID-Inside Diameter;C-Cemented;SL-Slot Length;A-Aperture;GS-Grain Size;Q-Quantity

HOLE-NO	PIPE-NO	COMPONENT-CODE	COMPONENT-TYPE	DEPTH-FROM (metres)	DEPTH-TO (metres)	OD (mm)	ID (mm)	INTERVAL	DETAIL
1		Hole	Hole	0.00	8.50	100			Rotary
1	1	Casing	P.V.C.	0.00	8.50	50			Seated on Bottom; End cap
1	1	Opening	Slots	5.50	8.50	50			PVC
1		Annulus	Crushed Aggregate	0.00	4.00	100	50		
1		Annulus	Bentonite	4.00	4.70	100	50		
1		Annulus	Waterworn/Rounded	4.70	8.50	100	50		Graded; GS: 2-6mm

Water Bearing Zones (top)

no details

Drillers Log (top)

FROM	TO	THICKNESS	DESC	GEO-MATERIAL	COMMENT
0.00	0.40	0.40	Fill		
0.40	5.00	4.60	Silty Clay, brown/dark brown, high plasticity		
5.00	8.50	3.50	Silty Clay, red brown colour change at 5m		

Groundwater Works Summary

For information on the meaning of fields please see Glossary
Document Generated on Thursday, January 31, 2013

Print Report

Works Details Site Details Form A Licensed Construction Water Bearing Zones Drillers Log

Work Requested -- GW969879

Works Details (top)

GROUNDWATER NUMBER	GW969879
LIC-NUM	90BL255812
AUTHORISED-PURPOSES	MONITORING BORE
INTENDED-PURPOSES	MONITORING BORE
WORK-TYPE	Bore
WORK-STATUS	Equipped - bore used for obs
CONSTRUCTION-METHOD	Auger - Solid Flight
OWNER-TYPE	Private
COMMENCE-DATE	
COMPLETION-DATE	2010-11-03
FINAL-DEPTH (metres)	8.20
DRILLED-DEPTH (metres)	8.50
CONTRACTOR-NAME	
DRILLER-NAME	
PROPERTY	61 RAILWAY AVENUE
GWMA	024 - MISCELLANEOUS FRACTURED ROCK OF THE BARWON REGION
GW-ZONE	999 - (blank)
STANDING-WATER-LEVEL	4.00
SALINITY	
YIELD	

Site Details (top)

REGION	90 - BARWON
RIVER-BASIN	419 - NAMOI RIVER
AREA-DISTRICT	
CMA-MAP	8936-3S
GRID-ZONE	56/1
SCALE	1:25,000
ELEVATION	
ELEVATION-SOURCE	
NORTHING	6569481.00
EASTING	237277.00
LATITUDE	30 58' 44"
LONGITUDE	150 14' 57"
GS-MAP	

AMG-ZONE	56
COORD-SOURCE	GPS - Global Positioning System
REMARK	

Form-A (top)

COUNTY	POTTINGER
PARISH	GUNNEDAH
PORTION-LOT-DP	Rd Adj 1//1133912

Licensed (top)

COUNTY	POTTINGER
PARISH	GUNNEDAH
PORTION-LOT-DP	1 814399

Construction (top)

Negative depths indicate Above Ground Level;H-Hole;P-Pipe;OD-Outside Diameter;
ID-Inside Diameter;C-Cemented;SL-Slot Length;A-Aperture;GS-Grain Size;Q-Quantity

HOLE-NO	PIPE-NO	COMPONENT-CODE	COMPONENT-TYPE	DEPTH-FROM (metres)	DEPTH-TO (metres)	OD (mm)	ID (mm)	INTERVAL	DETAIL
1		Hole	Hole	0.00	8.50	125			Auger - Sol Flight
1	1	Backfill	Drilled cuttings	8.20	8.50	125			
1	1	Casing	PVC Class 18	0.00	8.20	60	50		Screwed; Seated; En cap
1	1	Opening	Slots - Horizontal	3.70	8.20	60			PVC Class 18; Mechanica Slotted; A: .4mm; Screwed
1		Annulus	Concrete	0.00	3.20	125	60		
1		Annulus	Bentonite	3.20	3.70	125	60		
1		Annulus	Waterworn/Rounded	3.70	8.20	125	60		Graded; GS 1-2mm

Water Bearing Zones (top)

FROM-DEPTH (metres)	TO-DEPTH (metres)	THICKNESS (metres)	ROCK-CAT-DESC	S-W-L	D-D-L	YIELD	TEST-HOLE-DEPTH (metres)	DURATION	SALINITY
6.50	8.50	2.00		4.00					

Drillers Log (top)

FROM	TO	THICKNESS	DESC	GEO-MATERIAL	COMMENT
			Topsoil; red brown, medium plasticity moist clay,		

0.00	0.20	0.20	with minor fine to coarse sand
0.20	6.50	6.30	Clay; red brown, medium to low plasticity, with trace fine to medium sand, dry
6.50	8.50	2.00	Clay; red brown, medium to low palsticity clay with trace fine sand, moist to wet at 7.6m

Groundwater Works Summary

For information on the meaning of fields please see Glossary
Document Generated on Thursday, January 31, 2013

Print Report

Works Details Site Details Form A Licensed Construction Water Bearing Zones Drillers Log

Work Requested -- GW969882

Works Details (top)

GROUNDWATER NUMBER	GW969882
LIC-NUM	90BL255812
AUTHORISED-PURPOSES	MONITORING BORE
INTENDED-PURPOSES	MONITORING BORE
WORK-TYPE	Bore
WORK-STATUS	Equipped - bore used for obs
CONSTRUCTION-METHOD	Auger - Solid Flight
OWNER-TYPE	Private
COMMENCE-DATE	
COMPLETION-DATE	2010-11-03
FINAL-DEPTH (metres)	9.00
DRILLED-DEPTH (metres)	9.00
CONTRACTOR-NAME	
DRILLER-NAME	
PROPERTY	61 RAILWAY AVENUE
GWMA	024 - MISCELLANEOUS FRACTURED ROCK OF THE BARWON REGION
GW-ZONE	999 - (blank)
STANDING-WATER-LEVEL	4.40
SALINITY	
YIELD	

Site Details (top)

REGION	90 - BARWON
RIVER-BASIN	419 - NAMOI RIVER
AREA-DISTRICT	
CMA-MAP	8936-3S
GRID-ZONE	56/1
SCALE	1:25,000
ELEVATION	
ELEVATION-SOURCE	
NORTHING	6569448.00
EASTING	237290.00
LATITUDE	30 58' 45"
LONGITUDE	150 14' 57"
GS-MAP	

AMG-ZONE	56
COORD-SOURCE	GPS - Global Positioning System
REMARK	

Form-A (top)

COUNTY	POTTINGER
PARISH	GUNNEDAH
PORTION-LOT-DP	Rd Adj 1//814399

Licensed (top)

COUNTY	POTTINGER
PARISH	GUNNEDAH
PORTION-LOT-DP	1 814399

Construction (top)

Negative depths indicate Above Ground Level;H-Hole;P-Pipe;OD-Outside Diameter;
ID-Inside Diameter;C-Cemented;SL-Slot Length;A-Aperture;GS-Grain Size;Q-Quantity

HOLE-NO	PIPE-NO	COMPONENT-CODE	COMPONENT-TYPE	DEPTH-FROM (metres)	DEPTH-TO (metres)	OD (mm)	ID (mm)	INTERVAL	DETAIL
1		Hole	Hole	0.00	9.00	125			Auger - Sol Flight
1	1	Casing	PVC Class 18	0.00	9.00	60	50		Screwed; Seated on Bottom; En cap
1	1	Opening	Slots - Horizontal	4.50	9.00	60			PVC Class 18; Mechanica Slotted; A: .4mm; Screwed
1		Annulus	Concrete	0.00	3.20	125	60		
1		Annulus	Bentonite	3.20	4.10	125	60		
1		Annulus	Waterworn/Rounded	4.10	9.00	125	60		Graded; GS 1-2mm

Water Bearing Zones (top)

FROM-DEPTH (metres)	TO-DEPTH (metres)	THICKNESS (metres)	ROCK-CAT-DESC	S-W-L	D-D-L	YIELD	TEST-HOLE-DEPTH (metres)	DURATION	SALINITY
6.70	9.00	2.30		4.40					

Drillers Log (top)

FROM	TO	THICKNESS	DESC	GEO-MATERIAL	COMMENT
			Topsoil; grass cover with red brown, moist, medium		

0.00	0.15	0.15	plasticity clay
0.15	3.00	2.85	Clay; red brown, medium plasticity, dry
3.00	6.70	3.70	Clay; red brown, medium plasticity, with minor subangular-subrounded fine gravels (ironstone), mosit, HC odour at 3.4m
6.70	7.20	0.50	Clay; red brown, very stiff, low palsticity, moist to wet, strong HC odour at 6.7m
7.20	9.00	1.80	Clay; red brown, medium plasticity, with some subangular fine gravel (ironstone), wet

Groundwater Works Summary

For information on the meaning of fields please see Glossary
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Print Report

Works Details Site Details Form A Licensed Construction Water Bearing Zones Drillers Log

Work Requested -- GW969883

Works Details (top)

GROUNDWATER NUMBER	GW969883
LIC-NUM	90BL255812
AUTHORISED-PURPOSES	MONITORING BORE
INTENDED-PURPOSES	MONITORING BORE
WORK-TYPE	Bore
WORK-STATUS	Equipped - bore used for obs
CONSTRUCTION-METHOD	Auger - Solid Flight
OWNER-TYPE	Private
COMMENCE-DATE	
COMPLETION-DATE	2010-11-03
FINAL-DEPTH (metres)	9.80
DRILLED-DEPTH (metres)	9.80
CONTRACTOR-NAME	
DRILLER-NAME	
PROPERTY	61 RAILWAY AVENUE
GWMA	024 - MISCELLANEOUS FRACTURED ROCK OF THE BARWON REGION
GW-ZONE	999 - (blank)
STANDING-WATER-LEVEL	4.20
SALINITY	
YIELD	

Site Details (top)

REGION	90 - BARWON
RIVER-BASIN	419 - NAMOI RIVER
AREA-DISTRICT	
CMA-MAP	8936-3S
GRID-ZONE	56/1
SCALE	1:25,000
ELEVATION	
ELEVATION-SOURCE	
NORTHING	6569401.00
EASTING	237324.00
LATITUDE	30 58' 47"
LONGITUDE	150 14' 58"
GS-MAP	

AMG-ZONE	56
COORD-SOURCE	GPS - Global Positioning System
REMARK	

Form-A (top)

COUNTY	POTTINGER
PARISH	GUNNEDAH
PORTION-LOT-DP	1//814399

Licensed (top)

COUNTY	POTTINGER
PARISH	GUNNEDAH
PORTION-LOT-DP	1 814399

Construction (top)

Negative depths indicate Above Ground Level;H-Hole;P-Pipe;OD-Outside Diameter;
ID-Inside Diameter;C-Cemented;SL-Slot Length;A-Aperture;GS-Grain Size;Q-Quantity

HOLE-NO	PIPE-NO	COMPONENT-CODE	COMPONENT-TYPE	DEPTH-FROM (metres)	DEPTH-TO (metres)	OD (mm)	ID (mm)	INTERVAL	DETAIL
1		Hole	Hole	0.00	9.80	125			Auger - Sol Flight
1	1	Casing	PVC Class 18	0.00	9.80	60	50		Screwed; Seated on Bottom; En cap
1	1	Opening	Slots - Horizontal	6.30	9.80	60			PVC Class 18; Mechanica Slotted; A: .4mm; Screwed
1		Annulus	Concrete	0.00	4.70	125	60		
1		Annulus	Bentonite	4.70	5.20	125	60		
1		Annulus	Waterworn/Rounded	5.20	9.80	125	60		Graded; GS 1-2mm

Water Bearing Zones (top)

FROM-DEPTH (metres)	TO-DEPTH (metres)	THICKNESS (metres)	ROCK-CAT-DESC	S-W-L	D-D-L	YIELD	TEST-HOLE-DEPTH (metres)	DURATION	SALINITY
7.00	9.80	2.80		4.20					

Drillers Log (top)

FROM	TO	THICKNESS	DESC	GEO-MATERIAL	COMMENT
			Fill; Bitumen - roadbase with red brown clay &		

0.00	0.20	0.20	bituminous gravels, moist
0.20	2.00	1.80	Clay; red brown, medium plasticity, with some fine sand & fine gravel, moist
2.00	9.80	7.80	Clay; red brown, low to medium plasticity, with trace fine to medium sand, dry to wet (very stiff), Slight HC odour @ 4m

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Groundwater Works Summary

For information on the meaning of fields please see Glossary
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Print Report

Works Details Site Details Form A Licensed Construction Water Bearing Zones Drillers Log

Work Requested -- GW970240

Works Details (top)

GROUNDWATER NUMBER	GW970240
LIC-NUM	90BL256052
AUTHORISED-PURPOSES	MONITORING BORE
INTENDED-PURPOSES	MONITORING BORE
WORK-TYPE	Bore
WORK-STATUS	Equipped - bore used for obs
CONSTRUCTION-METHOD	Auger - Solid Flight
OWNER-TYPE	Local Govt
COMMENCE-DATE	
COMPLETION-DATE	2012-05-24
FINAL-DEPTH (metres)	9.80
DRILLED-DEPTH (metres)	9.80
CONTRACTOR-NAME	
DRILLER-NAME	
PROPERTY	WANDOBAH RESERVE
GWMA	024 - MISCELLANEOUS FRACTURED ROCK OF THE BARWON REGION
GW-ZONE	-
STANDING-WATER-LEVEL	
SALINITY	
YIELD	

Site Details (top)

REGION	90 - BARWON
RIVER-BASIN	419 - NAMOI RIVER
AREA-DISTRICT	
CMA-MAP	8936-3S
GRID-ZONE	56/1
SCALE	1:25,000
ELEVATION	
ELEVATION-SOURCE	
NORTHING	6569423.00
EASTING	236514.00
LATITUDE	30 58' 46"
LONGITUDE	150 14' 28"
GS-MAP	

AMG-ZONE	56
COORD-SOURCE	GPS - Global Positioning System
REMARK	

Form-A (top)

COUNTY	POTTINGER
PARISH	GUNNEDAH
PORTION-LOT-DP	7053//1116141

Licensed (top)

COUNTY	POTTINGER
PARISH	GUNNEDAH
PORTION-LOT-DP	7053 1116141

Construction (top)

Negative depths indicate Above Ground Level;H-Hole;P-Pipe;OD-Outside Diameter;
ID-Inside Diameter;C-Cemented;SL-Slot Length;A-Aperture;GS-Grain Size;Q-Quantity

HOLE-NO	PIPE-NO	COMPONENT-CODE	COMPONENT-TYPE	DEPTH-FROM (metres)	DEPTH-TO (metres)	OD (mm)	ID (mm)	INTERVAL	DETAIL
1		Hole	Hole	0.00	9.80	125			Auger - Sol Flight
1	1	Casing	PVC Class 18	0.00	3.80	60	50		Screwed; Cemented; End cap
1	1	Opening	Slots - Horizontal	3.80	9.50	60			PVC Class 18; Mechanica Slotted; A: .04mm; Screwed
1		Annulus	Cement Grout	0.00	0.20	125	60		
1		Annulus	Bentonite	0.20	2.80	125	60		
1		Annulus	Waterworn/Rounded	2.80	9.80	125	60		Graded; GS 1-2mm

Water Bearing Zones (top)

FROM-DEPTH (metres)	TO-DEPTH (metres)	THICKNESS (metres)	ROCK-CAT-DESC	S-W-L	D-D-L	YIELD	TEST-HOLE-DEPTH (metres)	DURATION	SALINITY
7.00	7.50	0.50							

Drillers Log (top)

FROM	TO	THICKNESS	DESC	GEO-MATERIAL	COMMENT
0.00	0.41	0.41	Loam; dry crumbly, brown, slight creams, slightly gravel		

0.41	1.11	0.70	Loam; texture change, moist, heavy clay, red orange, slight grey colours
1.11	3.30	2.19	Clay; grey colours increasing, moist, calcite throughout, red oranges
3.30	3.40	0.10	Gravel, river gravel, reds oranges, clay, very moist
3.40	9.50	6.10	Clay, moisture thoughout, grey colours, heavy clay, red oranges

Groundwater Works Summary

For information on the meaning of fields please see Glossary
Document Generated on Thursday, January 31, 2013

Print Report

Works Details Site Details Form A Licensed Construction Water Bearing Zones Drillers Log

Work Requested -- GW970245

Works Details (top)

GROUNDWATER NUMBER	GW970245
LIC-NUM	90BL256052
AUTHORISED-PURPOSES	MONITORING BORE
INTENDED-PURPOSES	MONITORING BORE
WORK-TYPE	Bore
WORK-STATUS	Abandoned - Backfilled
CONSTRUCTION-METHOD	Hand Auger
OWNER-TYPE	Local Govt
COMMENCE-DATE	
COMPLETION-DATE	2012-05-25
FINAL-DEPTH (metres)	3.00
DRILLED-DEPTH (metres)	3.00
CONTRACTOR-NAME	
DRILLER-NAME	
PROPERTY	WANDOBAH RESERVE
GWMA	024 - MISCELLANEOUS FRACTURED ROCK OF THE BARWON REGION
GW-ZONE	-
STANDING-WATER-LEVEL	
SALINITY	
YIELD	

Site Details (top)

REGION	90 - BARWON
RIVER-BASIN	419 - NAMOI RIVER
AREA-DISTRICT	
CMA-MAP	8936-3S
GRID-ZONE	56/1
SCALE	1:25,000
ELEVATION	
ELEVATION-SOURCE	
NORTHING	6569348.00
EASTING	236543.00
LATITUDE	30 58' 48"
LONGITUDE	150 14' 29"
GS-MAP	

AMG-ZONE	56
COORD-SOURCE	GPS - Global Positioning System
REMARK	

Form-A (top)

COUNTY	POTTINGER
PARISH	GUNNEDAH
PORTION-LOT-DP	7053//1116141

Licensed (top)

COUNTY	POTTINGER
PARISH	GUNNEDAH
PORTION-LOT-DP	7053 1116141

Construction (top)

Negative depths indicate Above Ground Level;H-Hole;P-Pipe;OD-Outside Diameter;
ID-Inside Diameter;C-Cemented;SL-Slot Length;A-Aperture;GS-Grain Size;Q-Quantity

HOLE-NO	PIPE-NO	COMPONENT-CODE	COMPONENT-TYPE	DEPTH-FROM (metres)	DEPTH-TO (metres)	OD (mm)	ID (mm)	INTERVAL	DETAIL
1		Hole	Hole	0.00	3.00	56			Hand Auger
1	1	Backfill	Drilled cuttings	0.00	3.00	56			

Water Bearing Zones (top)

no details

Drillers Log (top)

FROM	TO	THICKNESS	DESC	GEO-MATERIAL	COMMENT
0.00	0.08	0.08	Clay, black, calcite chunk		
0.08	0.30	0.22	Clay, lighter textures, lighter clay, some mottles, slightly sandy texture, red		
0.30	2.34	2.04	Clay, red orange some mottle, heavier textures, progressive decaying organic matter, black mottle colours		
2.34	2.53	0.19	Clay, slight texture changes, crumbly calcite		
2.53	2.74	0.21	Clay, heavy, mottling, red orange		
2.74	2.82	0.08	Clay, calcite chunks, crumbly		
2.82	3.00	0.18	Clay, heavy, mottling, very moist, red orange		

APPENDIX C

Historical Aerial Photos

SOURCE: AERIAL PHOTOGRAPHS OBTAINED FROM NSW LAND AND PROPERTY INFORMATION

Golder Associates www.golder.com GOLDER ASSOCIATES PTY. LTD.	CLIENT: KBR		PROJECT: GUNNEDAH SECOND ROAD OVER RAIL BRIDGE						
	DRAWN BY: HC	DATE: 2.02.2013	DRAWING TITLE: AERIAL PHOTO 1958						
	CHECKED BY: BJF	DATE: 25.02.2013							
	SCALE: NOT TO SCALE	SHEET SIZE: A4	PROJECT No: 127622030	DOC No: 002	DOC TYPE: R	FIGURE No: APP-C	REVISION: R	PHOTO 1	

SOURCE: AERIAL PHOTOGRAPHS OBTAINED FROM NSW LAND AND PROPERTY INFORMATION

Golder Associates

www.golder.com
GOLDER ASSOCIATES PTY. LTD.

CLIENT: KBR				PROJECT: GUNNEDAH SECOND ROAD OVER RAIL BRIDGE				
DRAWN BY: HC	DATE: 25.02.2013			DRAWING TITLE: AERIAL PHOTO 1958				
CHECKED BY: BJF	DATE: 25.02.2013							
SCALE: NOT TO SCALE	SHEET SIZE: A3	PROJECT No: 127622030	DOC No: 002	DOC TYPE: R	FIGURE No: APP-C	REVISION: 0	PHOTO 2	

Plot Date: 25 February 2013 Time:2:00:58 PM By: Campbell, Helen Path: J:\geo\2012\127622030_KBR_Bridge Sl_Gunnedah\Technical Docs\CADD\FIGURES - File Name:127622030-002-R-APP-C-REV0.dwg
Xref: GAP_LOGO-A3.dwg;

SOURCE: AERIAL PHOTOGRAPHS OBTAINED FROM NSW LAND AND PROPERTY INFORMATION

Golder Associates www.golder.com GOLDER ASSOCIATES PTY. LTD.	CLIENT: KBR		PROJECT: GUNNEDAH SECOND ROAD OVER RAIL BRIDGE						
	DRAWN BY: HC	DATE: 2.02.2013	DRAWING TITLE: AERIAL PHOTO 1966						
	CHECKED BY: BJF	DATE: 25.02.2013							
	SCALE: NOT TO SCALE	SHEET SIZE: A4	PROJECT No: 127622030	DOC No: 002	DOC TYPE: R	FIGURE No: APP-C	REVISION: R	PHOTO 3	

SOURCE: AERIAL PHOTOGRAPHS OBTAINED FROM NSW LAND AND PROPERTY INFORMATION

Golder Associates

www.golder.com
GOLDER ASSOCIATES PTY. LTD.

CLIENT: KBR				PROJECT: GUNNEDAH SECOND ROAD OVER RAIL BRIDGE				
DRAWN BY: HC	DATE: 25.02.2013			DRAWING TITLE: AERIAL PHOTO 1966				
CHECKED BY: BJF	DATE: 25.02.2013							
SCALE: NOT TO SCALE	SHEET SIZE: A3	PROJECT No: 127622030	DOC No: 002	DOC TYPE: R	FIGURE No: APP-C	REVISION: 0	PHOTO 4	

Plot Date: 25 February 2013 Time:2:02:58 PM By: Campbell, Helen Path: J:\geo\2012\127622030_KBR_Bridge SI_Gunnedah\Technical Docs\CADD\FIGURES - File Name:127622030-002-R-APP-C-4-REV0.dwg
Xref: GAP_LOGO-A3.dwg;

SOURCE: AERIAL PHOTOGRAPHS OBTAINED FROM NSW LAND AND PROPERTY INFORMATION

Golder Associates www.golder.com GOLDER ASSOCIATES PTY. LTD.	CLIENT: KBR		PROJECT: GUNNEDAH SECOND ROAD OVER RAIL BRIDGE						
	DRAWN BY: HC	DATE: 2.02.2013	DRAWING TITLE: AERIAL PHOTO 1986						
	CHECKED BY: BJF	DATE: 25.02.2013							
	SCALE: NOT TO SCALE	SHEET SIZE: A4	PROJECT No: 127622030	DOC No: 002	DOC TYPE: R	FIGURE No: APP-C	REVISION: R	PHOTO 5	

SOURCE: AERIAL PHOTOGRAPHS OBTAINED FROM NSW LAND AND PROPERTY INFORMATION

Golder Associates

www.golder.com
GOLDER ASSOCIATES PTY. LTD.

CLIENT: KBR				PROJECT: GUNNEDAH SECOND ROAD OVER RAIL BRIDGE			
DRAWN BY: HC	DATE: 25.02.2013			DRAWING TITLE: AERIAL PHOTO 1986			
CHECKED BY: BJF	DATE: 25.02.2013						
SCALE: NOT TO SCALE	SHEET SIZE: A3	PROJECT No: 127622030	DOC No: 002	DOC TYPE: R	FIGURE No: APP-C	REVISION: 0	PHOTO 6

Plot Date: 25 February 2013 Time:2:05:49 PM By: Campbell, Helen Path: J:\geo\2012\127622030_KBR_Bridge Sl_Gunnedah\Technical Docs\CADD\FIGURES - File Name:127622030-002-R-APP-C-6-REV0.dwg
Xref: GAP_LOGO-A3.dwg;

APPENDIX D

Photographic Record of Site Inspection

Photograph D- 1: Blackjack Creek watercourse, looking north from the Oxley Highway

Photograph D- 2: Ashford Water Course, looking north-west from New Street. Note running water and flood debris on the right.

Photograph D- 3: Rail Culvert over Blackjack Creek constructed in 2011

Photograph D- 4: Site Access from the South from New Street to the Rail Culvert. The mill and grain storage silos can also be seen.

Photograph D- 5: Blackjack Creek upstream of the Rail Culvert, looking west. Note the stagnant water and reed growth.

Photograph D- 6: Blackjack Creek upstream of the Rail Culvert, looking west. Note the stagnant water, reed growth and the rail ballast working platform.

Photograph D- 7: Blackjack Downstream of Culvert

Photograph D- 8: Old working platform

Photograph D- 9: Blackjack Creek

Photograph D- 10: Hope Fuel Supplies Tank Farm

Photograph D- 11: Fulwood Transport Fuel Compound

Photograph D- 12: Study Area from Farrar Road

Photograph D- 13: Study Area from Pensioners Mill

APPENDIX E

Limitations

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