Douglas Partners
Geotechnics / Environment / Groundwater

Integrated Practical Solutions

Report on
Preliminary Site Investigation

Site 1 - Lake Munmorah Rezoning
Lake Munmorah and Crangan Bay

Prepared for
Darkinjung Local Aboriginal Land Council

Project 83115.00
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Douglas Partners
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The undersigned, on behalf of Douglas Partners Pty Ltd, confirm that this document and all attached drawings, logs and test results have been checked and reviewed for errors, omissions and inaccuracies.

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1. Introduction

This report presents the results of a preliminary site investigation undertaken at a parcel of land identified as 'Site 1' located at Lake Munmorah and Crangan Bay on the NSW Central Coast. The investigation was commissioned by Ms Brooke Harb of Darkinjung Local Aboriginal Land Council (DLALC) by Purchase Order No 5445 dated 24 November 2016, and was undertaken in accordance with Douglas Partners' proposal WYG160309 dated 12 October 2016 and in consultation with ADW Johnson Pty Ltd.

The investigation comprised two main components, namely:

- Preliminary site investigation (PSI) for contamination; and
- Preliminary geotechnical investigation to assess issues regarding slope stability.

The objective of the PSI was to provide an initial assessment of the site's contamination status to support a rezoning application. For the purposes of this PSI, it is understood that future development will comprise a low density residential land use.

This PSI report presents the results of a review of readily available site history information and a walkover of Site 1. No intrusive investigations or testing were undertaken for this PSI. The PSI was undertaken with respect to the staged investigation approach outlined in *State Environmental Planning Policy No. 55 – Remediation of Land* (SEPP 55 – Ref 1) and the National Environment Protection Council (NEPC) *National Environment Protection (Assessment of Site Contamination) Measure 1999* (amended 2013) (NEPC, 2013 – Ref 2).

The assessment was carried out with reference to an indicative subdivision layout (Ref 3) provided by ADW Johnson Pty Ltd.

1.1 Objectives

The objectives of the PSI were to:

- Identify past and present potentially contaminating activities that may have been undertaken at Site 1;
- Identify potential contaminants of potential concern associated with the past and present site activities;
- Provide a preliminary assessment of site contamination and likely compatibility with a proposed residential land use; and
- Assess the need for further investigation and/or site remediation.

1.2 Site Identification

A summary of the site identification details are presented in Table 1, and the location of the site is shown in Figure 1 and 2 (below) and Drawing 1, Appendix A.

Table 1: Site Identification Details

Identification	Description
Registered Owner	Darkinjung Local Aboriginal Land Council
Street Address	405 – 415 Pacific Highway, Lake Munmorah; 425 Pacific Highway, Crangan Bay; and 2 Kanangra Drive, Crangan Bay.
Lot Numbers	Lot 642 in Deposited Plan 1027231; Lot 100 in Deposited Plan 10444282; and Lot 644 in Deposited Plan 1027231.
Site Area	Approximately 164 hectares (approximately 58 hectares proposed for re-zoning)
Current Site Zoning	E2 Environmental Conservation and E3 Environmental Management
Parish	Wyong, County of Northumberland
Local Government Area	Central Coast Council (CCC)
Current Land use	Vacant bushland.

Figure 1, is a plan of the local area and shows the site in relation to various local features.

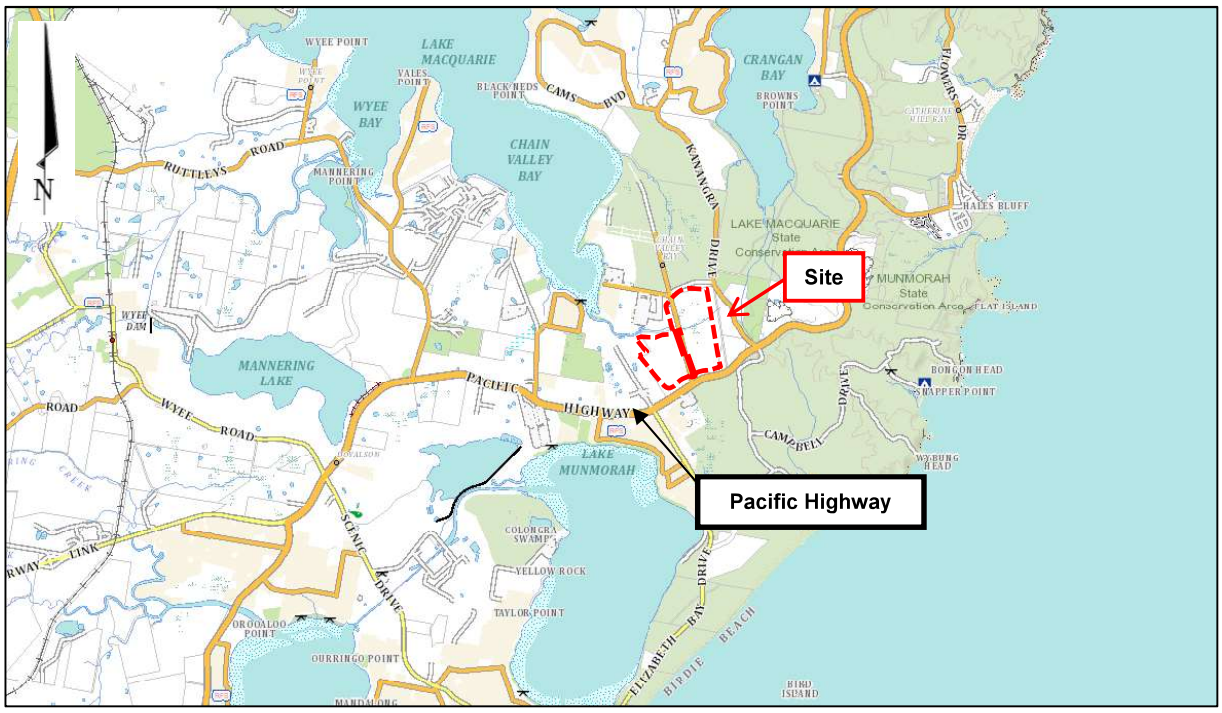


Figure 1: Location of the site within Lake Munmorah (image sourced from SIX Maps)

Figure 2, is an aerial view of the local area and shows the site in relation to the cross streets.

Figure 2: Location of the site (image sourced from nearmap.com, dated 23 February 2016)

At the time of the investigation, the majority of the site comprised dense bushland and had a grass surface cover. No structures were evident at the site, although the site was bisected in a north-south direction by Chain Valley Bay Road. Other site features are discussed in Section 5.

Drawing 1, which is included in Appendix A, shows the existing layout of the site.

2. Scope of Work

The scope of work completed comprised:

- Collation and interpretation of readily available site data from the following sources:
  - Published public data, including topographical, geological and hydrogeological maps;
  - A search of the Registered Groundwater Bore database of the NSW Department of Primary Industries Water;
  - NSW EPA Contaminated Land and Protection of Environment Operations databases;
  - Readily available Central Coast Council (CCC) Property Enquiry Information; and

- Historical aerial photographs;

- Site walkover to provide a visual assessment of potential contamination sources;
- Development of a preliminary conceptual site model (CSM); and
- Preparation of this report outlining the works undertaken and the findings of the PSI.

The preliminary geotechnical assessment comprised:

- Review of geological mapping and regional contour maps;
- Site walkover by a senior geotechnical engineer to check for evidence or indicators of slope instability; and
- Preparation of relevant sections of this report relating to slope stability.

3. Physical Setting

3.1 Topography

Review of the local topographic mapping and site observations indicated that surface levels at the site generally slope toward Karignan Creek. Surface levels at Lot 642 fall from approximately RL 32 m in the southern section to RL 10 m along the northern boundary of the lot i.e., where Karignan Creek meets Chain Valley Bay Road. With regard to Lot 100 and Lot 644, Karignan Creek flows through the centre of the lot, and has minor tributaries extending towards the north and south. As a result, surface levels at Lot 100 and Lot 644 range from approximately RL 34 m at the southern and northern boundaries of the lot to RL 12 m in the central western portion of the lot, i.e. where Karignan Creek meets Chain Valley Bay Road (refer to Figure 3).

Surface water would generally be expected to infiltrate at the site and/or would flow into Karignan Creek and its tributaries.

Figure 3 is a plan of the local area and shows the site in relation to surface elevation contours and local watercourses.

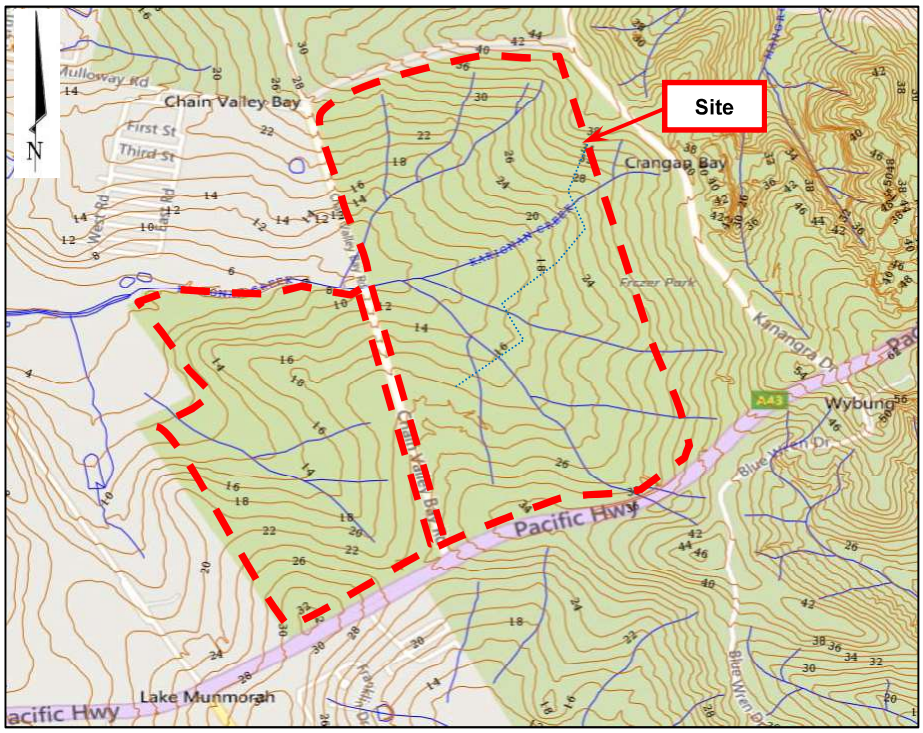


Figure 3: Site Topography (image sourced from Microsoft Virtual Earth with 2 m elevation contour overlay)

3.2 Adjacent Site Uses

Surrounding land uses include the following:

- North – Bushland and residential properties;
- East – Bushland;
- South – Pacific Highway and beyond this, residential properties and bushland; and
- West – Schools including St Brendan's Catholic Primary School, Lake Munmorah Public School, Lake Munmorah High School, and St Brigid's Catholic College and a church.

The potential for contamination from existing off-site land uses or activities to have impacted the site is considered to be relatively low.

A walkover of the adjacent properties was not undertaken as part of this PSI.

3.3 Regional Geology and Soil Landscape

Reference to the *Gosford-Lake Macquarie* 1:100,000 Geology Sheet Provisional 2012 indicates that Site 1 is underlain by Munmorah Conglomerate (identified as 'Rnm' in Figure 4), which typically comprises conglomerate, pebbly sandstone, siltstone and claystone. This is overlain in the areas close to Karignan Creek by Quaternary Alluvium (identified as 'Qa' in Figure 4) which typically comprises a mix of gravel, sand, silt and clay.

Reference to Gosford-Lake Macquarie 1:100,000 *Soil Landscapes Sheet* indicates that the majority of the site is underlain by Doyalson Erosional soil landscape (identified as 'aw' in Figure 5). Additionally, areas in close proximity to the Karignan Creek are mapped as Wyong Alluvial (identified as 'wy' in Figure 5) and Tacoma Swamp (identified as 'ts' in Figure 5) soil landscapes. Additionally, in the southern section, there is a small area mapped as disturbed terrain (identified as 'xx' in Figure 5) and this is associated with a network of tracks and mounds used by dirt bike and off-road enthusiasts.

Figure 4: Site Geology Mapping (image sourced from Microsoft Virtual Earth with Gosford-Lake Macquarie 1:100,000 Geology Sheet Provisional 2012 overlay)

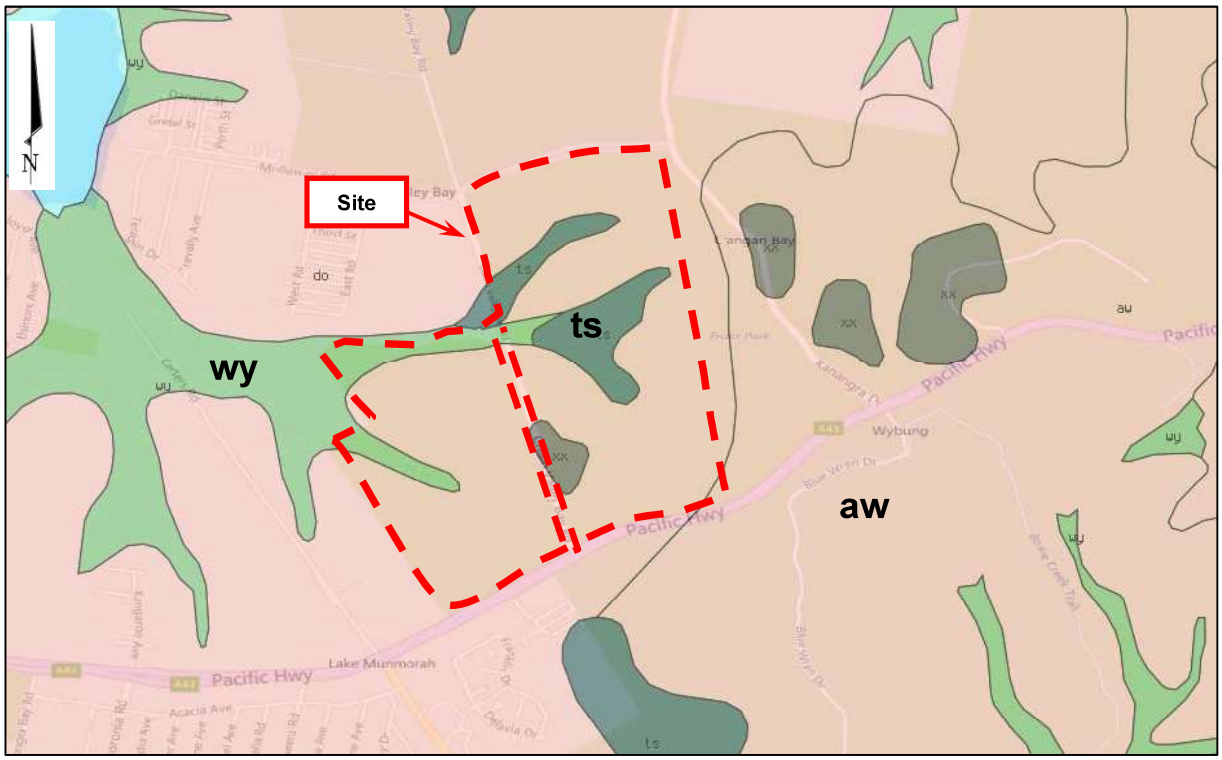


Figure 5: Site Soil Landscape Mapping (image sourced from Microsoft Virtual Earth with Gosford-Lake Macquarie 1:100,000 Soil Landscapes Sheet overlay)

3.4 Acid Sulfate Soils

The local acid sulfate risk mapping indicates that the north-western boundary of the site adjoins an area mapped as having a high risk of acid sulfate soils within 1 m of the ground surface. The remainder of the site is located within an area mapped as having no known occurrence of acid sulfate soils. Figure 6 is a street map of the local area and shows the site in relation to areas mapped as having a probability of acid sulfate soils.

It is noted that the mapping generally only provides an indication of the presence/absence of acid sulfate soils. In this regard, during the site walkover, waterlogged areas were present in the central portions of Lot 100 and the northern portion of Lot 642 which are associated with Karignan Creek. These correspond with the areas mapped as Quaternary Alluvium 'Qa' in Figure 4, which also match the areas mapped as Wyong Alluvial 'wy' and Tacoma Swamp 'ts' in Figure 5.

Development within Site 1 is proposed in areas that are mapped as being underlain by the Munmorah Conglomerate formation ('Rnm' in Figure 4) and do not encroach into the areas mapped as Quaternary Alluvium ('Qa'). For the current indicative subdivision layout, acid sulfate soils are, therefore, not considered to be an issue. If the areas of proposed development were to change such that work is expected to encroach into the lower-lying areas associated with the watercourses, then further review and assessment for the presence of acid sulfate soils would be warranted.

This conclusion is supported by observations made during the site walkover where residual soils were exposed along trails within the current proposed development areas.

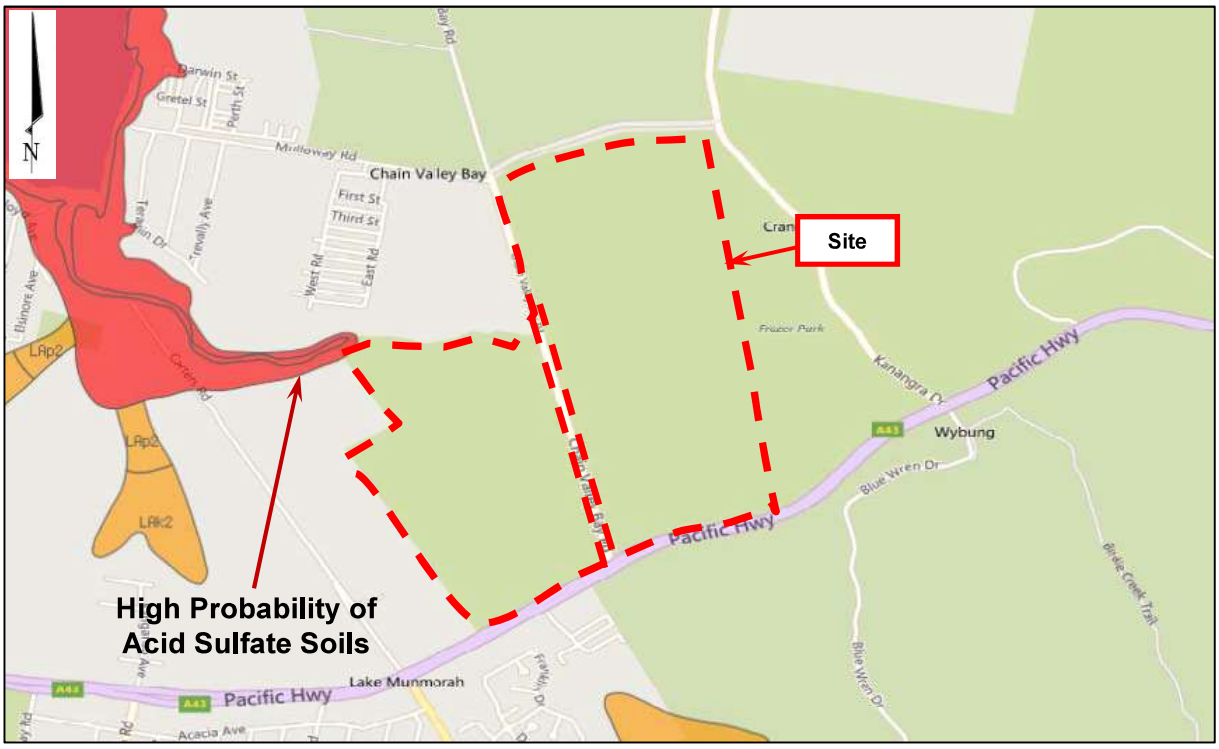


Figure 6: Site Acid Sulfate Soil Risk Mapping **(image sourced from Microsoft Virtual Earth with Acid Sulfate Risk Mapping Sheet overlay)**

3.5 Groundwater

Given the topography and geology, and noting the presence of the Karignan Creek within the site, it is considered likely that a permanent groundwater table is present at relatively shallow depths (i.e. less than 4 m to 6 m depth) in the central portions of Site 1. It should be noted that groundwater levels are potentially transient and can be affected by factors such as soil permeability and recent weather conditions.

Figure 7 is a street map of the local area and shows the site in relation to the local registered groundwater bores.

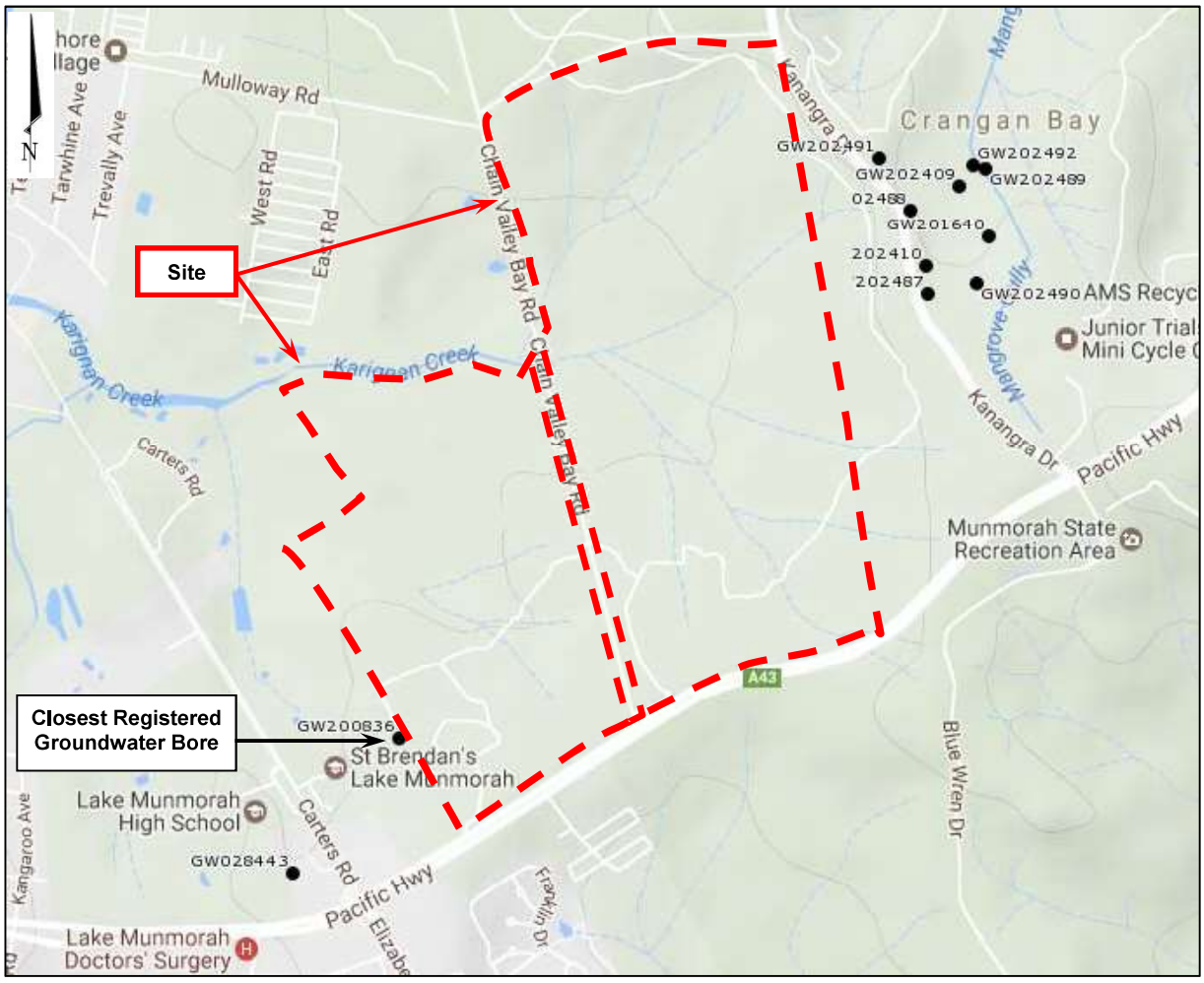


Figure 8: Registered Groundwater Bores **(image sourced from Microsoft Virtual Earth with NSW Office of Water Registered Groundwater Bore location overlay)**

A search for registered groundwater bores in the Department of Natural Resources groundwater bore database [Note: this function has been taken up by NSW Department of Industries Water] indicated that there are 11 registered groundwater bores within a 2.5 km radius of the site. The information available from the reports suggests that the closest bore (GW200836) was installed for monitoring purposes to a depth of 210 m, and the available information for this bore suggests that sandstone bedrock was encountered at a depth 5 m. A copy of the search results is provided in Appendix B.

Given the site topography in relation to the locations of the bores and the presence of intermittent watercourses within the site, it is considered unlikely that any potential groundwater contamination from the site would impact any registered groundwater bores.

4. Site History

4.1 Regulatory Notices Search

The NSW EPA Register of Contaminated Land was searched for any Regulatory Notices that may be current on the site issued under the *Contaminated Land Management (CLM) Act* 1997 and Section 308 of the *Protection of the Environment Operations (POEO) Act* 1997. The information obtained at the time of preparing this report indicated that no current or previous Licences, Notices or Orders were applicable for the site.

The closest identified property is a service station located approximately 2 km west of the site which is currently being investigated for potential contamination. Given the distance from the site, and noting the topography and underlying geology, the potential for contamination from the service station to impact upon the site is considered to be low.

4.2 Council Enquiry Information

A search for readily available council records was made through Central Coast Council's (CCC) web site. The enquiry identified that no applications were recorded. No other applicable information was obtained from CCC. A copy of the CCC Property Report is provided in Appendix B.

4.3 Historical Aerial Photographs

Historical aerial photographs were reviewed dating back to the earliest available record (1975) and approximately every 10 to 20 years thereafter, to assess any major changes to the site and surrounding areas during this period. The following historical aerial photographs were reviewed:

- Photograph – Gosford NSW 1975 2315-58 Run 4, dated 28.05.1975;
- Photograph – Gosford NSW 1984 3384-17 Run 4, dated 27.04.1984;
- Photograph – Gosford NSW 3730-103 Run 9, dated 25.04.1990;
- Photograph – Gosford NSW 4309 (M2029) Run 14, dated 29.05.1996;
- Photograph – Google Earth Image, dated 22.04.2005;
- Photograph – Google Earth Image, dated 06.11.2016.

Extracts of the historical aerial photographs are included as Drawings 2 and 3 in Appendix A. Table 2 summarises the observations made during the aerial photograph review.

Table 2: Aerial Photograph Review

Year	Site	Surrounding Land Use
1975	With the exception of a small cleared area in the south-western section of Lot 100, the remainder of the site is occupied by natural bushland. Chain Valley Bay Road which separates Lot 642 from Lot 100 was constructed prior to 1975.	The area immediately north and west of Lot 642 has been cleared of the natural vegetation and some ground disturbance is evident in this area. The area to the north and east of Lot 100 comprises natural bushland with some unpaved tracks. To the south of the site Pacific Highway has been constructed and beyond this, natural bushland is present.
1984	The cleared area in the south-western portion of Lot 100 is marginally larger when compared to the 1975 aerial photograph. The remainder of the site is largely unchanged since 1975.	The cleared area north of Lot 642 appears to have been revegetated. To the west of Lot 642, the building associated with the St Brendan's School appears to have been constructed or is under construction. The remainder of the land use surrounding the site appears largely unchanged since in 1975.
1990	Largely unchanged since 1984.	No significant changes were observed, other than a residential development to the north, and schools to the west of Lot 642.
1996	Largely unchanged since 1990.	No significant changes were observed other than ground disturbance activities south of site (beyond Pacific Highway).
2005	Largely unchanged since 1996.	No significant changes were observed other than residential development activities south of site (beyond Pacific Highway).
2016	Largely unchanged since 2005.	No significant changes were evident.

4.4 Site History Integrity Assessment

The information used to determine the history of the site was sourced from reliable reference documents, many of which were official records held by Government agencies. The databases maintained by various Government agencies can contain high quality information, but some of these do not contain any data at all.

In particular, aerial photographs provide high quality information that is generally independent of memory or documentation. They are only available at intervals of several years, so some gaps exist in the information from this source. The observed site features are open to different interpretations and can be affected by the time of day and/or year at which they were taken, as well as specific events such as flooding. Care has been taken to consider different possible interpretations of aerial photographs and to consider them in conjunction with other lines of evidence. Overall, the site history information is considered to provide a relatively reliable indication of past land uses and likely site activities.

5. Site Walkover / Observations

A walkover of Site 1 was undertaken on 7 March 2017 by a Senior Environmental Scientist and a Senior Geotechnical Engineer from DP. The site features observed during the walkover are summarised below. The general site topography was consistent with that described in Section 3.1.

The site layout appears to have remained unchanged from the November 2016 aerial photograph (refer to Drawing 1, Appendix A). The following key site features pertinent to the PSI were observed:

- With the exception of minor tracks in the southern and central portions, the remainder of the site comprised thick natural vegetation which limited access to other areas (refer Photographs 1 and 2). Therefore, the walkover was limited to accessible areas along the existing tracks;
- A number of fragments of asbestos-containing material (ACM) were observed amongst tile and demolition debris in the central portion of Lot 642 (Reference Point 10 on Drawing 1, Appendix A). Additionally, the south-western portion of Lot 100 comprises a cleared area of approximately 1 hectare, where a number of ACM fragments were observed on the ground surface (refer Photograph 4). The approximate locations of these and other areas where ACM fragments were observed are shown on Drawing 1, Appendix A;
- Small quantities of rubbish, derelict car bodies and suspected fly-tipped materials comprising demolition debris (bricks, concrete, potential asbestos-containing materials (PACM) and metal scraps) were observed in southern and central portions of the site (refer Photographs 5 and 6). Whilst the fly-tipped materials were observed to predominantly be present in areas generally bordering the site boundaries or adjacent to tracks bisecting the site, given the access restrictions associated with dense vegetation, the potential for such materials to be present in other areas of the site cannot be completely ruled out. The approximate locations of the identified fly-tipped materials are shown on Drawing 1, Appendix A;
- Small stockpiles ranging between approximately 5 m^3 to 10m^3 of suspected imported fill were observed in the south-eastern section of Lot 642 and the western portion of Lot 100 (refer Photographs 7 and 8). The approximate locations of these stockpiles and other areas where fill stockpiles were observed are shown on Drawing 1, Appendix A.

Photograph 1: View along southern boundary of Lot 642 with Pacific Highway on right.

Photograph 2: Access track in southern portion of Lot 642 (facing north). Walkover of the site was restricted by dense vegetation.

Photograph 3: ACM fragments and demolition debris observed in central portion of Lot 642 (Reference Point 10 on Drawing 1, Appendix A).

Photograph 4: Cleared area and access path in south-western portion of Lot 100 where ACM fragments were observed on the ground surface (Reference Point 16 on Drawing 1, Appendix A)

Photograph 5: Derelict car body in Lot 642 (Reference Point 1 on Drawing 1, Appendix A).

Photograph 6: Fly-tipped waste comprising demolition debris in Lot 100 (Reference Point 18 on Drawing 1, Appendix A).

Photograph 7: Fill stockpile observed in south-western portion in Lot 642 (Reference Point 3 on Drawing 1, Appendix A).

Photograph 8: Possible fill stockpile observed in western portion in Lot 100 (Reference Point 17 on Drawing 1, Appendix A).

Surface slopes across most of the site were generally less than about 3°, although locally steeper areas (slopes up to about 5°) over a distance of about 100 m were observed in the northern portions of the site. These areas are outside of the development areas shown in the current indicative subdivision layout for the site. Soils exposed along the network of trails within the site comprised predominately residual sandy clay/clayey sand. Pockets of weathered sandstone were also exposed

in elevated parts of the site where the trails had been worn to depths of about 0.5 m below the surrounding ground.

6. Preliminary Conceptual Site Model

A conceptual site model (CSM) is a representation of site-related information regarding contamination sources, receptors and exposure pathways between those sources and receptors. The CSM provides the framework for identifying how the site became contaminated and how potential receptors may be exposed to contamination either in the present or in the future i.e. it enables an assessment of the potential source – pathway – receptor linkages (complete pathways).

6.1 Potential Contamination Sources and Contaminants of Concern

Table 3 summarises the potential sources of contamination and associated contaminants of concern that have been identified at the site.

Table 3: Potential Contamination Sources and Contaminants of Concern

Potential Contamination Source/Activity	Description of Potential Contaminating Activity	Primary Potential Contaminants of Concern
Fly-tipping	Fly-tipped materials comprising demolition debris, ACM, PACM, old oil cans etc have been observed at the site.	Various - Common contaminants associated with fly-tipping are metals (As, Cd, Cr, Cu, Pb, Hg, Ni and Zn), TRH, BTEX, PAH, PCB, OCP, phenols and asbestos
Importation and/or placement of contaminated filling	Importation of substantial filling is unlikely based on site history and observations. However, small quantities of potentially imported fill were observed and may be associated with illegal dumping. As the source of the fill is not known, the contamination status of the material is also unknown.	Various - Common contaminants associated with filling are metals (As, Cd, Cr, Cu, Pb, Hg, Ni and Zn), TRH, BTEX, PAH, PCB, OCP, phenols and asbestos

Notes:
As = arsenic, Cd = cadmium, Cr = chromium, Cu = copper, Pb = lead, Hg = mercury, Ni = nickel and Zn = zinc
TRH = total recoverable hydrocarbons, BTEX = benzene, toluene, ethylbenzene and xylene, PAH = polycyclic aromatic hydrocarbons, PCB = polychlorinated biphenyls, OCP = organochlorine pesticides

For the purpose of developing a conceptual site model, the potential sources (S) of contamination are summarised as:

- S1 - Fly-tipped waste (comprising demolition debris, ACM, old oil cans, etc)
- S2 - Imported fill (imported filling from unknown sources);

6.2 Potential Receptors of Concern

The potential receptors of potential contamination sourced from the site are considered to be:

- R1 - Site users (future workers and residential users);
- R2 - Adjacent site users;
- R3 - Construction and maintenance workers;
- R4 - Surface water (Karignan Creek);
- R5 - Groundwater;
- R6 - Terrestrial ecology; and
- R7 - Property (current and future).

6.3 Potential Contamination Migration Pathways

The pathways by which the potential sources of contamination could reach potential receptors are described below:

- P1 - Ingestion and dermal contact;
- P2 - Inhalation of dust and / or vapours;
- P3 - Surface run off;
- P4 - Leaching and vertical migration into groundwater;
- P5 - Lateral migration of groundwater providing base flow to water courses; and
- P6 - Direct contact with terrestrial ecology / property.

6.4 Summary of Preliminary Conceptual Site Model

A summary of the preliminary conceptual site model (CSM) is presented in Table 4.

Table 4: Conceptual Site Model

Potential Source	Pathway	Receptor
S1 - Fly-tipped waste (metals, TRH, BTEX, PAH, PCB, OCP and asbestos)	P1 – Ingestion and dermal contact	R1 – Site users R3 –Construction & maintenance workers.
	P2 – Inhalation of dust and / or vapours	R1 – Site users R2 – Adjacent site users R3 – Construction & maintenance workers.
S2 - Imported fill (metals, TRH, BTEX, PAH, PCB, OCP and asbestos)	P3 – Surface run off P5 – Lateral migration of groundwater.	R4 –Surface water (Karignan Creek).
	P4 - Leaching and vertical migration into groundwater	R5 - Groundwater
	P6 – Direct contact with terrestrial ecology / property	R6 – Terrestrial ecology R7 – Property

7. Slope Stability

Stability of slopes is governed by many factors including:

- Surface slopes;
- Soil types (cohesion, angle of friction);
- Depth to rock; and
- Groundwater seepage.

No indicators of slope instability were observed within Site 1 during the walkover assessment. Furthermore, surface slopes are relatively low (typically less than 3°, but up to about 5° in parts of the site), and the soil profile comprises sandy topsoils overlying mainly residual sandy clay/clayey sand with weathered rock at relatively shallow depth. In low lying areas where soils are likely to be weaker and seepage issues more prevalent (i.e. in areas of alluvial soils), the surface slopes are relatively flat, typically less than about 2°.

Based on the inferred geology of the site, and conditions observed during the walkover, it is considered that Site 1 as noted on Drawing 1) has a very low risk of slope instability. As such, it is

considered that the areas proposed to be developed for the residential subdivisions would not need to incorporate any particular design measures to mitigate the risk of landslide.

Other measures, such as managing areas of existing uncontrolled filling (for example the fill mounds associated with the dirt bike tracks to the east of Chain Valley Bay Road) or possible scouring of sandy topsoils, would need to be addressed as part of the development of the site.

In DP's experience, slope instability is not normally associated with Munmorah Conglomerate provided that localised cuts and fills are not excessively steep. These conditions do not typically occur in natural landforms within the Munmorah Conglomerate (with the general exception of coastal bluffs).

8. Conclusions and Recommendations

Based on the findings of the desktop review and site walkover, DP considers that there is a low to medium potential for contamination given the past site activities and the existing site conditions. Some potential contamination sources were identified (refer Table 4 – Section 6); including fly-tipped materials and imported filling materials.

Overall, Site 1 would generally be considered compatible (from a site contamination perspective) with the proposed residential land uses, subject to removal of all existing fly-tipped material (including ACM) and the results of further intrusive contamination investigations to obtain quantitative data on the contamination status of the site. In this regard, prior to commencement of intrusive investigations, it would be prudent to also undertake a detailed site walkover in conjunction with vegetation clearing activities with a view to verifying the presence/absence of additional fly-tipped materials and/or areas of concern in parts of the site that were previously inaccessible. Subsequent to removal of all fly-tipped materials, the intrusive investigations could initially be limited to the assessment of soils on a broad grid, combined with additional targeted sampling in the areas of environmental concern.

These investigations should include an assessment of site soils for chemical and physical characteristics to confirm the perceived low to moderate risk of contamination. The investigations should also target the areas where ACM and/or PACM have been observed on the ground surface to evaluate the vertical and lateral extent of ACM contamination (if any) at the site. Should the results of the intrusive investigations identify the need for remediation, then an adequate remediation and validation programme will need to be implemented to render Site1 suitable for the proposed residential development.

Depending on the final design plans, preliminary investigations for acid sulfate soils should also target the areas where deep excavations are proposed (if in areas of alluvial soils), with a view to confirming the presence/absence of acid sulfate soils. Such assessment should be carried out in accordance with the ASSMAC Guidelines (Ref 4).

Furthermore, it is considered that the portions of the sites that are currently proposed to be developed for residential allotments and roads do not pose any significant risk with regard to landslide or slope instability. Construction of the development will still need to adopt suitable excavation support measures and safe batter slopes, and these would be determined at a later stage.

9. References

1. Department of Urban Affairs and Planning, Managing Land Contamination, Planning Guidelines SEPP 55 – Remediation of Land, 1998.
2. National Environment Protection Council (NEPC), National Environment Protection (Assessment *of Site Contamination) Measure 1999* (amended 2013), 2013.
3. ADW Johnson Pty Ltd, '*Concept Masterplan Residential Subdivision'*, drawing attached to project brief dated 16 September 2016.
4. NSW Acid Sulfate Soil Management Advisory Committee – *Acid Sulfate Soil Manual*, August 1998.

10. Limitations

Douglas Partners (DP) has prepared this report for this project at 405 – 415 Pacific Highway, Lake Munmorah, 425 Pacific Highway and 2 Kanangra Drive, Crangan Bay in accordance with DP's proposal WYG160309, dated 12 October 2016 and acceptance received from Darkinjung Local Aboriginal Land Council dated 24 November 2016. The work was carried out under DP's Conditions of Engagement. This report is provided for the exclusive use of the Darkinjung Local Aboriginal Land Council for this project only and for the purposes as described in the report. It should not be used by or relied upon for other projects or purposes on the same or other site or by a third party. Any party so relying upon this report beyond its exclusive use and purpose as stated above, and without the express written consent of DP, does so entirely at its own risk and without recourse to DP for any loss or damage. In preparing this report DP has necessarily relied upon information provided by the client and/or their agents.

DP's contamination assessment is necessarily based on the result of a desktop site historical search and site inspection only and did not include surface or subsurface sample screening and/or chemical testing. DP's advice is based upon the conditions encountered during this investigation. The accuracy of the advice provided by DP in this report may be affected by undetected variations in ground conditions across the site.

It is noted that this assessment does not constitute a hazardous material building assessment. The advice may also be limited by budget constraints imposed by others or by site accessibility.

This report must be read in conjunction with all of the attached and should be kept in its entirety without separation of individual pages or sections. DP cannot be held responsible for interpretations or conclusions made by others unless they are supported by an expressed statement, interpretation, outcome or conclusion stated in this report. This report, or sections from this report, should not be used as part of a specification for a project, without review and agreement by DP. This is because this report has been written as advice and opinion rather than instructions for construction.

The contents of this report do not constitute formal design components such as are required, by the Health and Safety Legislation and Regulations, to be included in a Safety Report specifying the hazards likely to be encountered during construction and the controls required to mitigate risk. This design process requires risk assessment to be undertaken, with such assessment being dependent

upon factors relating to likelihood of occurrence and consequences of damage to property and to life. This, in turn, requires project data and analysis presently beyond the knowledge and project role respectively of DP. DP may be able, however, to assist the client in carrying out a risk assessment of potential hazards contained in this report, as an extension to the current scope of works, if so requested, and provided that suitable additional information is made available to DP. Any such risk assessment would, however, be necessarily restricted to the environmental components set out in this report and to their application by the project designers to project design, construction, maintenance and demolition.

Asbestos has been detected by observation on the surface of the site. Building demolition materials, such as concrete and brick were also observed on the ground surface and these are considered as indicative of the possible presence of hazardous building materials (HBM), including asbestos. It is therefore considered possible that HBM, including asbestos, may be present in unobserved parts of the site (including below the ground surface), and hence no warranty can be given that asbestos is not present elsewhere on site.

Douglas Partners Pty Ltd

Appendix A

About This Report

Drawings 1 - 3

About this Report

Douglas Partners

Introduction

These notes have been provided to amplify DP's report in regard to classification methods, field procedures and the comments section. Not all are necessarily relevant to all reports.

DP's reports are based on information gained from limited subsurface excavations and sampling, supplemented by knowledge of local geology and experience. For this reason, they must be regarded as interpretive rather than factual documents, limited to some extent by the scope of information on which they rely.

Copyright

Borehole and Test Pit Logs

The borehole and test pit logs presented in this report are an engineering and/or geological interpretation of the subsurface conditions, and their reliability will depend to some extent on frequency of sampling and the method of drilling or excavation. Ideally, continuous undisturbed sampling or core drilling will provide the most reliable assessment, but this is not always practicable or possible to justify on economic grounds. In any case the boreholes and test pits represent only a very small sample of the total subsurface profile.

Interpretation of the information and its application to design and construction should therefore take into account the spacing of boreholes or pits, the frequency of sampling, and the possibility of other than 'straight line' variations between the test locations.

Groundwater

Where groundwater levels are measured in boreholes there are several potential problems, namely:

- In low permeability soils groundwater may enter the hole very slowly or perhaps not at all during the time the hole is left open;
- A localised, perched water table may lead to an erroneous indication of the true water table;
- Water table levels will vary from time to time with seasons or recent weather changes. They may not be the same at the time of construction as are indicated in the report; and
- The use of water or mud as a drilling fluid will mask any groundwater inflow. Water has to be blown out of the hole and drilling mud must first be washed out of the hole if water measurements are to be made.

More reliable measurements can be made by installing standpipes which are read at intervals over several days, or perhaps weeks for low permeability soils. Piezometers, sealed in a particular stratum, may be advisable in low permeability soils or where there may be interference from a perched water table.

Reports

The report has been prepared by qualified personnel, is based on the information obtained from field and laboratory testing, and has been undertaken to current engineering standards of interpretation and analysis. Where the report has been prepared for a specific design proposal, the information and interpretation may not be relevant if the design proposal is changed. If this happens, DP will be pleased to review the report and the sufficiency of the investigation work.

Every care is taken with the report as it relates to interpretation of subsurface conditions, discussion of geotechnical and environmental aspects, and recommendations or suggestions for design and construction. However, DP cannot always anticipate or assume responsibility for:

- Unexpected variations in ground conditions. The potential for this will depend partly on borehole or pit spacing and sampling frequency;
- Changes in policy or interpretations of policy by statutory authorities; or
- The actions of contractors responding to commercial pressures.

If these occur, DP will be pleased to assist with investigations or advice to resolve the matter.

About this Report

Site Anomalies

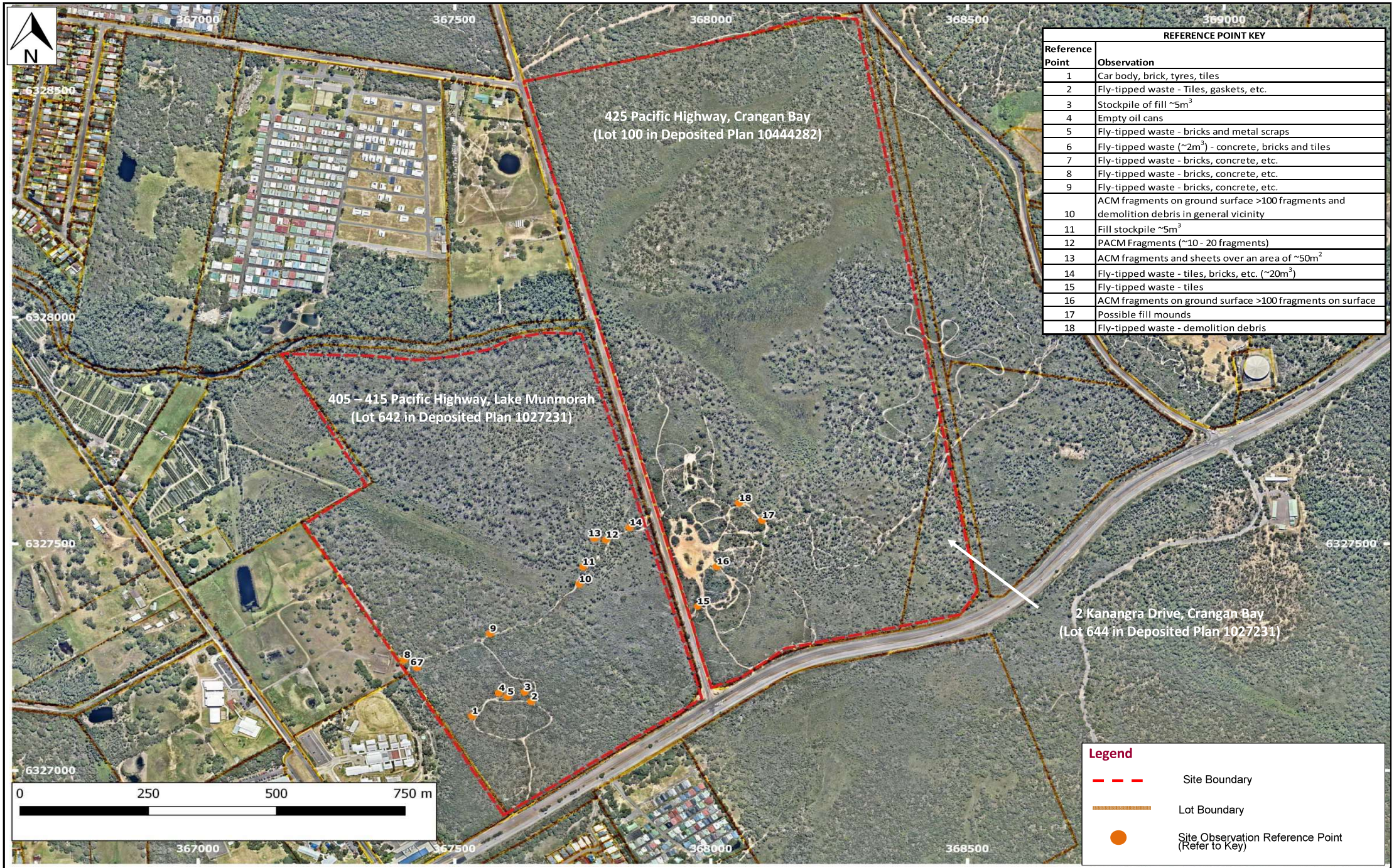
In the event that conditions encountered on site during construction appear to vary from those which were expected from the information contained in the report, DP requests that it be immediately notified. Most problems are much more readily resolved when conditions are exposed rather than at some later stage, well after the event.

Information for Contractual Purposes

Where information obtained from this report is provided for tendering purposes, it is recommended that all information, including the written report and discussion, be made available. In circumstances where the discussion or comments section is not relevant to the contractual situation, it may be appropriate to prepare a specially edited document. DP would be pleased to assist in this regard and/or to make additional report copies available for contract purposes at a nominal charge.

Site Inspection

The company will always be pleased to provide engineering inspection services for geotechnical and environmental aspects of work to which this report is related. This could range from a site visit to confirm that conditions exposed are as expected, to full time engineering presence on site.

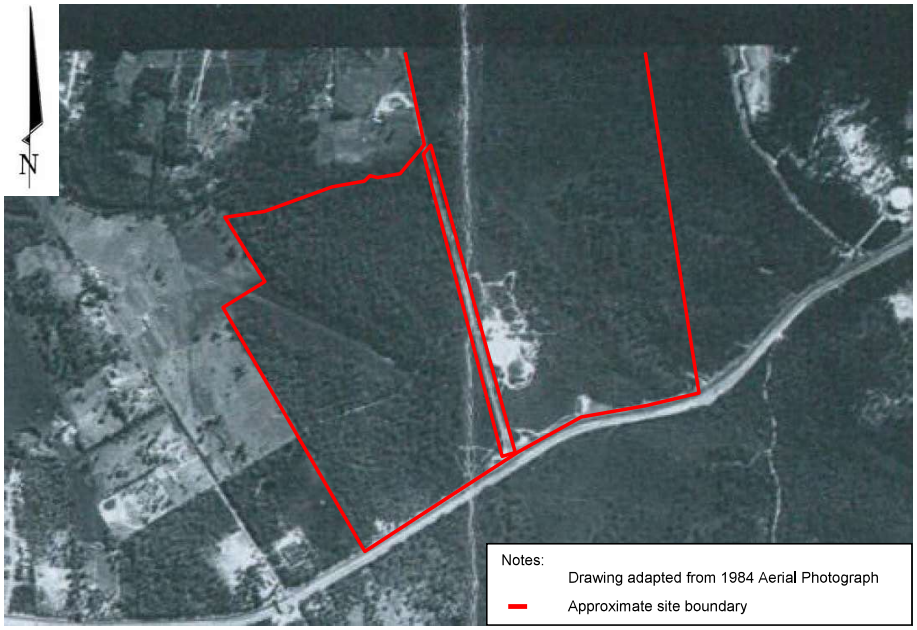


REFERENCE POINT KEY	
Reference Point	Observation
1	Car body, brick, tyres, tiles
2	Fly-tipped waste - Tiles, gaskets, etc.
3	Stockpile of fill ~5m^3
4	Empty oil cans
5	Fly-tipped waste - bricks and metal scraps
6	Fly-tipped waste (~2m^3) - concrete, bricks and tiles
7	Fly-tipped waste - bricks, concrete, etc.
8	Fly-tipped waste - bricks, concrete, etc.
9	Fly-tipped waste - bricks, concrete, etc.
10	ACM fragments on ground surface >100 fragments and demolition debris in general vicinity
11	Fill stockpile ~5m^3
12	PACM Fragments (~10 - 20 fragments)
13	ACM fragments and sheets over an area of ~50m^2
14	Fly-tipped waste - tiles, bricks, etc. (~20m^3)
15	Fly-tipped waste - tiles
16	ACM fragments on ground surface >100 fragments on surface
17	Possible fill mounds
18	Fly-tipped waste - demolition debris

Base Image Source: Nearmap

Douglas Partners
Geotechnics / Environment / Groundwater

CLIENT: Darkinjung Local Aboriginal Land Council		**Site Plan and Features**	Project 83115.00
OFFICE: Central Coast	DRAWN BY: NSA	**Preliminary Site Investigation for Contamination**	Drawing No: 1
SCALE: As shown	DATE: 13.03.2017	**405 – 415 Pacific Highway, Lake Munmorah, 425 Pacific Highway, Crangan Bay and 2 Kanangra Drive, Crangan Bay**	Revision: 0



Douglas Partners
Geotechnics / Environment / Groundwater

CLIENT:	Darkinjung Local Aboriginal Land Council		
OFFICE:	Central Coast	DRAWN BY:	MJH
SCALE:	NTS	DATE:	Feb 2017

TITLE: **Historical Aerial Photographs**
Preliminary Site Investigation for Contamination
Pacific Highway, Lake Munmorah

PROJECT No:	83115.00
DRAWING No:	2
REVISION:	0

Douglas Partners
Geotechnics / Environment / Groundwater

CLIENT:	Darkinjung Local Aboriginal Land Council		TITLE:	**Historical Aerial Photographs**	PROJECT No: 83115.00
OFFICE:	Central Coast	DRAWN BY: MJH		**Preliminary Site Investigation for Contamination**	DRAWING No: 3
SCALE:	NTS	DATE: Feb 2017		**Pacific Highway, Lake Munmorah**	REVISION: 0

Appendix B

Background Information

Property Details

Important Information:

Applications listed on this page are only from a lodgement date of 01/01/2007 onwards.

The information listed on this page is supplied by Council for general information purposes only and does not reflect all records and information available for the identified parcel of land. No reliance should be placed on the information on this page to determine the planning or other legislative controls affecting the identified parcel of land. Applications may be made in accordance with the *Government Information (Public Access) Act 2009* to inspect information held by Council in relation to the identified parcel of land. Applications may also be made for planning certificates under sec. 149 of the *Environmental Planning and Assessment Act 1979*. Additionally, the parcel conditions listed are not a complete list of conditions imposed on the identified parcel of land. For example, site compatibility, flooding and coastal hazards are not listed on this page. Also, a reference to a chapter of Council's Development Control Plan (DCP), does not mean that other chapters of the DCP are not relevant. Please refer to Council's full Terms and Conditions applicable to the use of this service.

405-415 Pacific Highway LAKE MUNMORAH NSW 2259

Details
Property Number: 344088
Lot/DP: Lot 642 DP 1027231

Ward: A Riding
Alternate Addresses:
405 - 415 Pacific Highway, LAKE MUNMORAH (Primary)
405 - 415 Pacific Highway, LAKE MUNMORAH (Historic)

Zoning
E2 - E2 Environmental Conservation
E3 - E3 Environmental Management

Applications No applications recorded against this property.

Conditions
Parcel Conditions
Bush Fire Prone Land - Yes - 07/05/2015
No Road widening under Planning Instrument - 05/12/2011
RMS Road Widening - 24/10/2007
SEPP - Affordable Rental Housing - 12/01/2011
SEPP - BASIX 2004 - 08/09/2006
SEPP - Exempt & Complying (Housing Code) - 26/02/2009
SEPP - Infrastructure - 02/09/2008
SEPP - Mining, Petroleum & Extractive Industries - 24/02/2010
SEPP - Miscellaneous Consent Provisions - 22/02/2014
SEPP - State & Regional Development - 30/09/2011
SEPP - State Significant Precincts - 07/06/2005
SEPP 21 - Caravan Parks - 22/05/2013
SEPP 30 - Intensive Agriculture - 06/03/2009
SEPP 36 - Manufactured Home Estates - 06/03/2009
SEPP 44 - Koala Habitat Protection - 11/09/2012
SEPP 62 - Sustainable Aquaculture - 31/12/2013
SEPP 64 - Advertising Policy - 31/12/2013
Mine Subsidence - YES - 03/02/1995
SEPP - Housing for Seniors or People with Disabili - 22/12/2000
SEPP 50 - Canal Estate Development - 25/11/1997
SEPP 55 - Remediation of Land - 17/09/1998
Wyong LEP 2013 - 27/11/1995

Services There are no services for this property.

close all | open all

Wyong Shire Council

Property Details

Important Information:

Applications listed on this page are only from a lodgement date of 01/01/2007 onwards.

The information listed on this page is supplied by Council for general information purposes only and does not reflect all records and information available for the identified parcel of land. No reliance should be placed on the information on this page to determine the planning or other legislative controls affecting the identified parcel of land. Applications may be made in accordance with the *Government Information (Public Access) Act 2009* to inspect information held by Council in relation to the identified parcel of land. Applications may also be made for planning certificates under sec. 149 of the *Environmental Planning and Assessment Act 1979*. Additionally, the parcel conditions listed are not a complete list of conditions imposed on the identified parcel of land. For example, site compatibility, flooding and coastal hazards are not listed on this page. Also, a reference to a chapter of Council's Development Control Plan (DCP), does not mean that other chapters of the DCP are not relevant. Please refer to Council's full Terms and Conditions applicable to the use of this service.

425 Pacific Highway CRANGAN BAY NSW 2259

Details
Property Number: 360367
Lot/DP: Lot 100 DP 1044282

Ward: A Riding

Zoning
E2 - E2 Environmental Conservation
E3 - E3 Environmental Management

Applications
No applications recorded against this property.

Conditions
Parcel Conditions
Bush Fire Prone Land - Yes - 07/05/2015
No Road widening under Planning Instrument - 05/12/2011
RMS Road Widening - 24/10/2007
SEPP - Affordable Rental Housing - 12/01/2011
SEPP - BASIX 2004 - 08/09/2006
SEPP - Exempt & Complying (Housing Code) - 26/02/2009
SEPP - Infrastructure - 02/09/2008
SEPP - Mining, Petroleum & Extractive Industries - 24/02/2010
SEPP - Miscellaneous Consent Provisions - 22/02/2014
SEPP - State & Regional Development - 30/09/2011
SEPP 21 - Caravan Parks - 22/05/2013
SEPP 30 - Intensive Agriculture - 06/03/2009
SEPP 36 - Manufactured Home Estates - 06/03/2009
SEPP 44 - Koala Habitat Protection - 11/09/2012
SEPP 62 - Sustainable Aquaculture - 31/12/2013
SEPP 64 - Advertising Policy - 31/12/2013
Mine Subsidence - YES - 03/02/1995
SEPP - State Significant Precincts - 07/06/2005
Wyong LEP 2013 - 27/11/1995
SEPP 50 - Canal Estate Development - 25/11/1997
SEPP 55 - Remediation of Land - 17/09/1998
SEPP - Housing for Seniors or People with Disabili - 22/12/2000

Services
There are no services for this property.

close all | open all

Wyong Shire Council

NSW Office of Water
Work Summary

GW200836

Licence: 20BL172252 **Licence Status:** ACTIVE

Authorised Purpose(s): TEST BORE
Intended Purpose(s): TEST BORE

Work Type: Bore
Work Status: Supply Obtained
Construct.Method: Rotary Air
Owner Type: School

Commenced Date:
Completion Date: 13/08/2009
Final Depth: 210.00 m
Drilled Depth: 210.00 m

Contractor Name: INTERTEC DRILLING SERVICES
Driller: Paul Sheehy
Assistant Driller:

Property: ST BRENDANS PUBLIC SCHOOL
29 CARTERS ROAD LAKE
MUNMORAH 2259
Standing Water Level:
GWMA:
GW Zone:
Salinity:
Yield: 0.200

Site Details

Site Chosen By:

	County	Parish	Cadastre
Form A:	NORTH	NORTH.63	1//133300
Licensed:			

Region: 20 - Hunter
CMA Map: 9231-4S
River Basin: 211 - MACQUARIE - TUGGERAH LAKES
Grid Zone:
Scale:
Area/District:

Elevation: 0.00 m (A.H.D.)
Elevation Source: Unknown
Northing: 6327110.0
Easting: 367460.0
Latitude: 33°11'12.3"S
Longitude: 151°34'41.7"E

GS Map: -
MGA Zone: 0
Coordinate Source: GIS - Geographic Information System

Construction

Negative depths indicate Above Ground Level; C-Cemented; SL-Slot Length; A-Aperture; GS-Grain Size; Q-Quantity; PL-Placement of Gravel Pack; PC-Pressure Cemented; S-Sump; CE-Centralisers

Hole	Pipe	Component	Type	From (m)	To (m)	Outside Diameter (mm)	Inside Diameter (mm)	Interval	Details
1		Hole	Hole	0.00	1.80	300			Rotary Air
1		Hole	Hole	1.80	5.60	168			Down Hole Hammer
1		Hole	Hole	5.60	210.00	165			Down Hole Hammer
1	1	Casing	Pvc Class 9	-0.40	35.60	140			Suspended in Clamps, Glued
1	1	Casing	Steel	-0.40	5.60	168	158		Suspended in Clamps, Driven into Hole

Water Bearing Zones

From (m)	To (m)	Thickness (m)	WBZ Type	S.W.L. (m)	D.D.L. (m)	Yield (L/s)	Hole Depth (m)	Duration (hr)	Salinity (mg/L)
9.50	10.00	0.50	Unknown			0.20		01:00:00	375.00

Geologists Log

Drillers Log

From	To	Thickness	Drillers Description	Geological Material	Comments

(m)	(m)	(m)			
0.00	2.00	2.00	Sandy Clay, yellow	Sandy Clay	
2.00	4.50	2.50	Clay, red/white	Clay	
4.50	9.50	5.00	Sandstone, yellow	Sandstone	
9.50	10.00	0.50	Sandstone, quartz	Sandstone	
10.00	28.50	18.50	Sandstone/Conglomerate	Sandstone	
28.50	28.80	0.30	Sandstone/Conglomerate, fractured	Sandstone	
28.80	56.00	27.20	Sandstone/Conglomerate	Sandstone	
56.00	58.00	2.00	Siltstone, red	Siltstone	
58.00	62.00	4.00	Sandstone/Conglomerate	Sandstone	
62.00	82.00	20.00	Siltstone, red/grey	Siltstone	
82.00	112.00	30.00	Sandstone/Conglomerate	Sandstone	
112.00	118.00	6.00	Sandstone, grey	Sandstone	
118.00	119.50	1.50	Coal	Coal	
119.50	121.00	1.50	Sandstone, grey	Sandstone	
121.00	136.00	15.00	Sandstone/Conglomerate	Sandstone	
136.00	138.50	2.50	Coal	Coal	
138.50	141.00	2.50	Siltstone, grey	Siltstone	
141.00	167.00	26.00	Sandstone/Conglomerate	Sandstone	
167.00	174.00	7.00	Coal	Coal	
174.00	205.00	31.00	Sandstone/Conglomerate	Sandstone	
205.00	208.00	3.00	Coal	Coal	
208.00	210.00	2.00	Sandstone/Conglomerate	Sandstone	

Remarks

13/08/2009: Form A Remarks:
Nat Carling, 28-Oct-2010: Coordinates based on location map provided with the Form-A.

***** End of GW200836 *****

NSW Office of Water
Work Summary

GW202410

Licence: 20BL172889 **Licence Status:** ACTIVE

Authorised Purpose(s): MONITORING BORE
Intended Purpose(s): MONITORING BORE

Work Type: Bore
Work Status: Equipped
Construct.Method:
Owner Type: Local Govt

Commenced Date:
Completion Date: 26/11/2009
Final Depth: 3.70 m
Drilled Depth: 3.80 m

Contractor Name: NEALINGS DRILLING
Driller: Unkown Unknown
Assistant Driller:

Property: FORMER GWANDALAN LANDFILL KANANGRA DRIVE CRANGAN BAY 2259 NSW
Standing Water Level:
GWMA:
GW Zone:
Salinity:
Yield:

Site Details

Site Chosen By:

	County	Parish	Cadastre
Form A:	NORTH	NORTH.63	512//755266
Licensed:			

Region: 20 - Hunter
CMA Map: 9231-4S
River Basin: 211 - MACQUARIE - TUGGERAH LAKES
Grid Zone:
Scale:
Area/District:

Elevation: 0.00 m (A.H.D.)
Elevation Source: Unknown
Northing: 6328205.0
Easting: 368650.0
Latitude: 33°10'37.3"S
Longitude: 151°35'28.2"E

GS Map: -
MGA Zone: 0
Coordinate Source: GIS - Geographic Information System

Construction

Negative depths indicate Above Ground Level; C-Cemented; SL-Slot Length; A-Aperture; GS-Grain Size; Q-Quantity; PL-Placement of Gravel Pack; PC-Pressure Cemented; S-Sump; CE-Centralisers

Hole	Pipe	Component	Type	From (m)	To (m)	Outside Diameter (mm)	Inside Diameter (mm)	Interval	Details
1		Hole	Hole	0.00	3.80	100			(Unknown)
1		Annulus	Cement Grout	0.00	0.25	100	50		
1		Annulus	Bentonite	0.25	1.75	100	50		
1		Annulus	Waterworn/Rounded	1.75	3.70	100	50		Graded
1		Backfill	Sand	3.70	3.80	100			
1	1	Casing	P.V.C.	0.00	3.70	50			Seated on Bottom
1	1	Opening	Slots	2.70	3.70	50		1	PVC

Water Bearing Zones

From (m)	To (m)	Thickness (m)	WBZ Type	S.W.L. (m)	D.D.L. (m)	Yield (L/s)	Hole Depth (m)	Duration (hr)	Salinity (mg/L)

Geologists Log

Drillers Log

From (m)	To (m)	Thickness (m)	Drillers Description	Geological Material	Comments
0.00	0.60	0.60	Fill, Silty Sand; medium grained, sub-angular, orange brown, some sub-angular gravel, moist	Fill	
0.60	3.00	2.40	Fill, Silty Sand; medium to coarse grained, sub-angular, grey, with some waste (scrap metal, wood, brick, glass, metal w	Fill	
3.00	3.60	0.60	Fill, Silty Sand; as above, pale grey, less waste, trace of oily creosote zone, moist	Fill	
3.60	3.80	0.20	Conglomerate, extremely weathered, with quartz of ironstone, moist	Unknown	

Remarks

26/11/2009: Form A Remarks:
Nat Carling, 8-Oct-2012; All details were provided by consultant on location map & logs.

***** End of GW202410 *****

NSW Office of Water
Work Summary

GW202488

Licence: 20BL173338 **Licence Status:** ACTIVE

Authorised Purpose(s): MONITORING BORE
Intended Purpose(s): MONITORING BORE

Work Type: Bore - Nested (2)
Work Status: Equipped
Construct.Method:
Owner Type: Local Govt

Commenced Date:
Completion Date: 01/09/2009
Final Depth: 11.20 m
Drilled Depth: 11.30 m

Contractor Name: NEALINGS DRILLING
Driller: Unkown Unknown
Assistant Driller:

Property: N A 35 KANANGRA DRIVE CRANGAN BAY 2259 NSW
GWMA:
GW Zone:
Standing Water Level:
Salinity:
Yield:

Site Details

Site Chosen By:

	County	Parish	Cadastre
Form A:	NORTH	NORTH.63	531//755266
Licensed:			

Region: 20 - Hunter
River Basin: 211 - MACQUARIE - TUGGERAH LAKES
Area/District:
CMA Map: 9231-4S
Grid Zone:
Scale:

Elevation: 0.00 m (A.H.D.)
Elevation Source: Unknown
Northing: 6328331.0
Easting: 368616.0
Latitude: 33°10'33.2"S
Longitude: 151°35'26.9"E

GS Map: -
MGA Zone: 0
Coordinate Source: GIS - Geographic Information System

Construction

Negative depths indicate Above Ground Level; C-Cemented; SL-Slot Length; A-Aperture; GS-Grain Size; Q-Quantity; PL-Placement of Gravel Pack; PC-Pressure Cemented; S-Sump; CE-Centralisers

Hole	Pipe	Component	Type	From (m)	To (m)	Outside Diameter (mm)	Inside Diameter (mm)	Interval	Details
1		Hole	Hole	0.00	7.50	150			(Unknown)
1		Annulus	Concrete	0.00	0.50	150	50		
1		Annulus	Bentonite	0.50	1.50	150	50		
1		Annulus	Waterworn/Rounded	1.50	7.00	150	50		
1		Backfill	Bentonite	7.00	7.50	100			
1	1	Casing	P.V.C.	0.00	7.00	50			Seated
1	1	Opening	Slots	4.00	7.00	50		1	PVC
2		Hole	Hole	0.00	11.30	150			Rotary - Coring
2		Annulus	Concrete	0.00	0.20	150	50		
2		Annulus	Waterworn/Rounded	0.20	6.20	150	50		Graded
2		Annulus	Bentonite	6.20	7.70	150	50		
2		Annulus	Waterworn/Rounded	7.70	11.20	150	50		Graded
2		Backfill	Drilled Cuttings	11.20	11.30	100			
2	2	Casing	P.V.C.	0.00	11.20	50			Seated
2	2	Opening	Slots	8.20	11.20	50		1	PVC

Water Bearing Zones

From (m)	To (m)	Thickness (m)	WBZ Type	S.W.L. (m)	D.D.L. (m)	Yield (L/s)	Hole Depth (m)	Duration (hr)	Salinity (mg/L)

Geologists Log
Drillers Log

From (m)	To (m)	Thickness (m)	Drillers Description	Geological Material	Comments
0.00	0.65	0.65	Fill: Gravelly Sandy Clay; low plasticity, brown, fine to medium grained sand, fine grained black (basalt) gravel	Fill	
0.65	0.76	0.11	Fill: Sandy Gravel; fine grained, sub-rounded, black, fine to medium grained sand	Fill	
0.76	1.50	0.74	Fill: Gravelly Sandy Clay; low plasticity, fine-medium grained sub-rounded sand, pale brown & seams of dark orange, fine	Fill	
1.50	1.70	0.20	Fill: Gravelly Sandy Clay; as above, fine grained, black, fine grained, sub-rounded black gravel	Fill	
1.70	1.90	0.20	Fill: Gravelly Sand; fine grained, black, fine grained, sub-rounded, black gravel, trace of wood @ 1.75-1.9m	Fill	
1.90	3.15	1.25	Fill: Gravelly Sand; as above, with waste materials including nylong, plastic bags, metal wires, cans, papers, wood, fab	Fill	
3.15	5.00	1.85	Fill: Gravelly Sand; as above, zone of Gravelly Sand brown & orange 50mm	Fill	
5.00	6.00	1.00	Fill: Gravelly Sand; fine grained, black, fine grained, sub-rounded, black gravel, dry	Fill	
6.00	6.20	0.20	Sandy Clay; low plasticity, dark grey mottled with red brown	Sandy Clay	
6.20	7.00	0.80	Clay, Gravelly Sandy; low plasticity, dark grey to blue, fine-medium grained sand, fine-medium grained sub-angular grave	Clay	
7.00	7.50	0.50	Siltstone, Extremely Weathered; fine, brown with red brown, extremely low strength, dry-moist	Siltstone	
7.50	7.85	0.35	Siltstone; fine grained, pale grey & dark grey, some dark red brown staining, slightly weathered, high strength, dry	Siltstone	
7.85	8.00	0.15	(Unknown) Core Loss	(Unknown)	
8.00	10.20	2.20	Siltstone; fine grained, pale grey & dark grey, slightly weathered to fresh, high to very high strength, dry	Siltstone	
10.20	11.30	1.10	Conglomerate; fine to coarse grained, pale grey, seam of orange brown staining, fresh, high to very high strength, dry	Unknown	

Remarks

17/09/2009: Form A Remarks:
Nat Carling, 15-Oct-2012; All details were provided on consultants log & location map. Lithology taken from PGB4-D.

***** End of GW202488 *****

NSW Office of Water
Work Summary

GW202491

Licence: 20BL173337 **Licence Status:** ACTIVE

Authorised Purpose(s): MONITORING BORE
Intended Purpose(s): MONITORING BORE

Work Type: Bore
Work Status: Equipped
Construct.Method:
Owner Type: Local Govt

Commenced Date:
Completion Date: 26/11/2009
Final Depth: 5.00 m
Drilled Depth: 5.00 m

Contractor Name: NEALINGS DRILLING
Driller: Unkown Unknown
Assistant Driller:

Property: N A 55 KANANGRA DRIVE CRANGAN BAY 2259 NSW
GWMA:
GW Zone:
Standing Water Level:
Salinity:
Yield:

Site Details

Site Chosen By:

	County	Parish	Cadastre
Form A:	NORTH	NORTH.63	646//1027231
Licensed:			

Region: 20 - Hunter
River Basin: 211 - MACQUARIE - TUGGERAH LAKES
Area/District:
CMA Map: 9231-4S
Grid Zone:
Scale:

Elevation: 0.00 m (A.H.D.)
Elevation Source: Unknown
Northing: 6328452.0
Easting: 368540.0
Latitude: 33°10'29.2"S
Longitude: 151°35'24.1"E

GS Map: -
MGA Zone: 0
Coordinate Source: GIS - Geographic Information System

Construction

Negative depths indicate Above Ground Level; C-Cemented; SL-Slot Length; A-Aperture; GS-Grain Size; Q-Quantity; PL-Placement of Gravel Pack; PC-Pressure Cemented; S-Sump; CE-Centralisers

Hole	Pipe	Component	Type	From (m)	To (m)	Outside Diameter (mm)	Inside Diameter (mm)	Interval	Details
1		Hole	Hole	0.00	5.00	150			(Unknown)
1		Annulus	Concrete	0.00	0.20	150	50		
1		Annulus	Bentonite	0.20	1.00	150	50		
1		Annulus	Waterworn/Rounded	1.00	5.00	150	50		Graded
1	1	Casing	P.V.C.	0.00	5.00	50			Seated on Bottom
1	1	Opening	Slots	2.00	5.00	50		1	PVC

Water Bearing Zones

From (m)	To (m)	Thickness (m)	WBZ Type	S.W.L. (m)	D.D.L. (m)	Yield (L/s)	Hole Depth (m)	Duration (hr)	Salinity (mg/L)

Geologists Log
Drillers Log

From (m)	To (m)	Thickness (m)	Drillers Description	Geological Material	Comments

0.00	0.10	0.10	Topsoil: Silty Sand; medium grained, subangular, dark grey brown, organic, trace roots, moist	Topsoil	
0.10	0.30	0.20	Fill: Sand; medium grained, subangular, orange, moist	Fill	
0.30	1.00	0.70	Fill: Silty Sand & Gravel; pale brown, moist	Fill	
1.00	2.50	1.50	Sand, Silty; medium-coarse grained, subangular, orange, trace gravel & cobbles, moist	Sand	
2.50	4.00	1.50	Sand, Silty; medium grained, subangular, pale brown to orange, some gravel, trace cobbles, moist	Sand	
4.00	5.00	1.00	Conglomerate; extremely weathered, with quartz & ironstone, dry	Conglomerate	

Remarks

26/11/2009: Form A Remarks:
Nat Carling, 15-Oct-2012; All details were provided on consultants log & location map.

***** End of GW202491 *****