WEST NOWRA RECYCLING AND WASTE FACILITY

Proposed Stage 4 Landfill Extension
Soil, Water and Leachate Assessment

Prepared for: Arcadis Australia Pacific

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BASIS OF REPORT

This report has been prepared by SLR Consulting Australia Pty Ltd with all reasonable skill, care and diligence, and taking account of the timescale and resources allocated to it by agreement with Arcadis Australia Pacific. Information reported herein is based on the interpretation of data collected, which has been accepted in good faith as being accurate and valid.

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SLR disclaims any responsibility to the Client and others in respect of any matters outside the agreed scope of the work.

DOCUMENT CONTROL

Reference	Date	Prepared	Checked	Authorised
610.15781-R04-v1.0	19 December 2018	Sarah Kill	John Postlethwaite	John Postlethwaite

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1 Introduction

Shoalhaven City Council (Council) currently operates and manages the West Nowra Recycling and Waste Facility (the Facility), located at 120 Flatrock Road, Mundamia, NSW (Figure 1).

This Soil, Water and Leachate Assessment Report has been prepared by SLR Consulting Australia Pty Ltd (SLR) to address the Secretary's Environmental Assessment Requirements (SEARs), associated with land and water, for the proposed landfill extension (Stage 4) of the existing Facility.

The Facility currently operates in accordance with a Landfill Environmental Management Plan (LEMP) prepared in 2008 by Council (Document Reference 7/28/2008) and an Environment- Protection Licence (EPL) Number 5877, issued by the NSW EPA (EPA).

1.1 Proposed Project Description

A concept design for the proposed landfill extension has been developed and is presented in the SLR report, *West Nowra Recycling and Waste Facility Proposed Stage 4 Landfill Extension Concept Design Report* (610.15781-R01, 2018). The concept design has been prepared to conform to Environmental Guidelines: Solid Waste Landfills (Environmental Guidelines) (NSW EPA, 2016).

The concept design, and consequently this assessment, has been based on the following supplied design parameters and assumptions (only parameters and assumptions relevant to this soil and water assessment have been included):

- To maximise capacity the landfill cells are to be formed by excavating below the current ground level. The level of excavation will be dictated by the level of the groundwater table (see below).
- The groundwater table varies across the site, with an apparent divide approximately one third of the way between the north and south of the available extension footprint area. Based on the piezometer data available to date it is apparent that the average water table level can be defined as follows:
  - South – average of 41.5mAHD (approximately 9.5m below ground level)
  - North – average of 40.5mAHD (approximately 6.5 to 10.5m below ground level)
- In accordance with Victorian Guidelines (BEPM), the top of the basal liner must be greater than 2m above the average groundwater level, therefore the top of the basal liner will be at the following levels:
- South –43.5mAHD
- North – 42.5mAHD
- Excavation below the above RLs will be required to install the basal liner, the depth of which will be dictated by the type of lining system.
- Excavation of batter side slopes is assumed to be as per current site conditions, i.e. 1 Vertical to 2 Horizontal (1V:2H).

- The maximum height of the final landform (at top of batter slope) is to be RL 59m. As agreed with SCC, the maximum height has been established based on a slope of 1% falling from the highest point on Stages 2 and 3 (RL 61m) to Stage 4.
- The access road between Stages 2 and 3 and the Stage 4 extension is to remain in place until final filling and closure.
- Leachate management is to be incorporated into existing site systems and includes the development of a proposed new irrigation disposal area located over the existing closed Stage 2 landfill. There is no sewer connection nearby therefore the leachate must be managed on site. It is understood this may change in the future, with the introduction of a nearby sewer system connection.
- Typical geology in the area comprises sandstone overlain by up to 7.0m of sandy clay. The bedrock profile has been described as being variable, ranging from moderately to heavily weathered.
- The landfill will have an engineered leachate barrier system to contain leachate and prevent the contamination of surface and groundwater over the life of the landfill. The leachate barrier system will be designed to prevent pollutants from migrating beyond the boundaries of the premises.
- The leachate collection layer, comprising a minimum 300 mm thick gravel drainage layer including collection pipework, slopes to a sump or other extraction point from which leachate can be conveyed from the landfill cell.
- Leachate management is to be incorporated into existing site systems and includes the development of a proposed new irrigation disposal area located over the existing Stage 2 landfill area. There is no sewer connection nearby therefore the leachate must be managed on site. It is understood this may change in the future, with the introduction of a nearby sewer system connection. Sufficient leachate storage and disposal will be provided in order to not cause harm to the environment.
- Controls will be implemented to reduce erosion and minimise sediment load in surface water that is discharged from site.

1.2 Planning Context

The following relevant legislation, policies and guidelines were considered as part of this assessment:

- Water Management Act (2000) and Water Act (1912);
- Greater Metropolitan Region Unregulated River Water Sources (2011);
- Protection of the Environment Operations Act (1997);
- Managing Urban Stormwater: Soils & Construction (NSW Government, 2004);
- Site Environmental Planning Policy No. 55 – Remediation of Land;
- National Environmental Protection Council (2013) National Environmental Protection (Assessment of Site Contamination) April 2011, Schedule B2, Guideline on Site Characterisation (hereafter referred to as the Amendment 1 NEPM 2013);
- National Water Quality Management Strategy, Department of Environment, Australian Government, 1992;

- NSW State Rivers and Estuaries Policy, NSW Government 1993; and
- State Water Management Outcomes Plan (WM Act, 2000).

1.3 Water and Soil Quality Objectives

There are no official Water Quality Objectives (WQO) available for the Shoalhaven River however the NSW government has established the following environmental values and uses for protection by WQOs:

- Aquatic ecosystems;
- Aquatic food;
- Drinking water at point of supply;
- Homestead water supply;
- Irrigation and livestock water supply;
- Primary and secondary contact recreation; and
- Visual amenity.

Protection levels for receiving waterways of the southern NSW river systems should be established in line with the following guidelines:

- ANZECC 2000 Water Quality Guidelines for Fresh Waters, Level of Protection (95% Species), for slightly to moderately disturbed ecosystem;
- ANZECC Drinking Water Quality Guidelines; and
- National Health and Medical Research Council (NHMRC) Guidelines for Managing Risks in Recreational Waters 2008.

Soil quality objectives and their associated protection levels will be in accordance with the National Environmental Protection (Assessment of Site Contamination) Measure (NEPM) 2013. NEPM includes investigation levels for groundwater and soil for human and environmental health.

1.4 Data Sources

Information provided in this report has been obtained via desktop assessment with the sources of data relied upon for this assessment including:

- NSW Environmental Protection Authority;
- NSW Office of Environment and Heritage;
- NSW Natural Resources Atlas;
- Google Earth;
- NSW Globe; and
- Shoalhaven City Council.

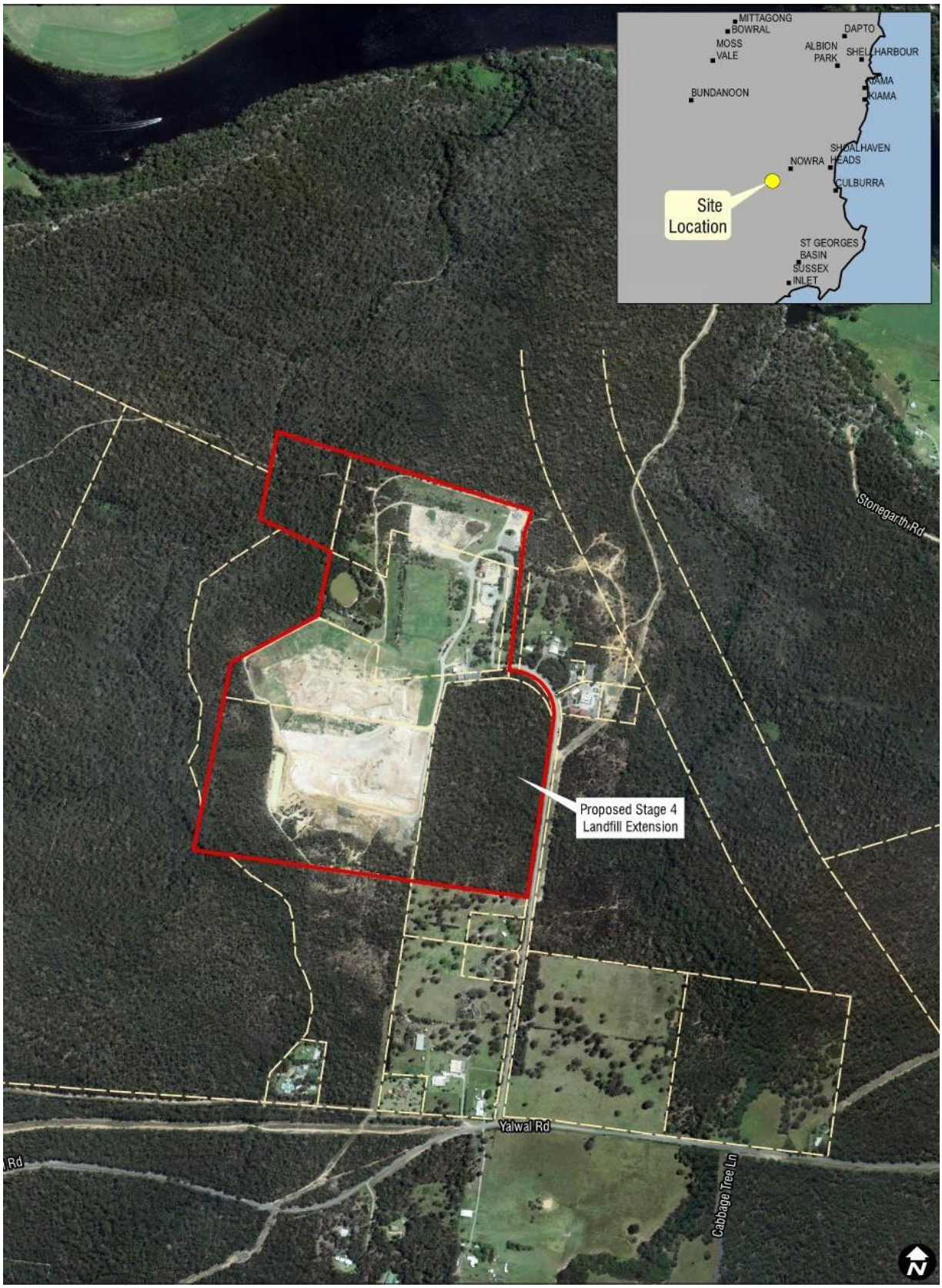


Figure 1 Site Location

2 Existing Environment

A review of the existing environment and surrounding land uses has been completed to identify potential sensitive receptors of any soil and water impacts from the proposed extension.

2.1 Site Location and Property Description

The Facility is located at 120 Flatrock Road, Mundamia and encompasses approximately 65ha of land.

The Facility is situated on Lot 1 on DP1018193 (Stage 1), Lot 1 on DP847203 (Stage 2) and Lot 1 on DP870268 (Stage 3). The proposed Stage 4 landfill extension area will incorporate a portion of Lot 1 on DP847203 (Stage 2) and Lot 1 on DP870268 (Stage 3) however the majority of the extension will be located on Lot 1 on DP1104402 (**Figure 2**). Lot 1 on DP1104402 is 14.52ha in area and 9.94ha of this is area is proposed to be developed.

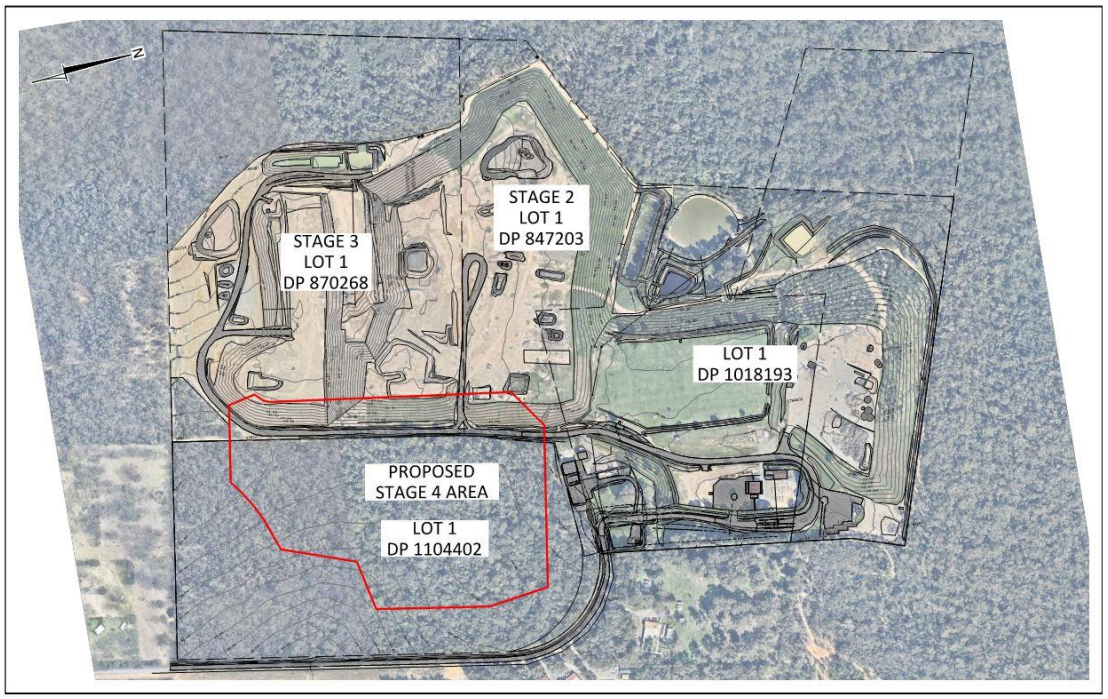


Figure 2 Lot/Plans

The Facility is located on parcels of land owned by Council who is the authority responsible for the operation and management of the Facility.

2.2 Surrounding Land Use

The main township of Nowra is located approximately 4.5km to the east of the Facility. The Facility is bordered to the south by rural residential properties, with the closest being approximately 65m from the site boundary. Other surrounding land is predominantly undeveloped bushland, including the Bamarang Nature Reserve.

2.3 Topography and Hydrology

The Stage 4 landfill extension site is located within the Shoalhaven Catchment and is approximately 1.5km south and 2.5km east of the Shoalhaven River.

The site generally slopes from a north-south ridgeline (~50mAHD) towards Cabbage Tree Creek to the east (~30mAHD). Predominantly the extension area drains towards Cabbage Tree Creek via drainage features. Cabbage Tree Creek is located approximately 30-40m to the east of the extension area and flows northward to the Shoalhaven River. There are no permanent surface water bodies/courses within the Facility.

Sandy Creek flows along the western boundary of the existing landfill site and drains into Shoalhaven River up gradient of the Cabbage Tree Creek outlet. The existing leachate storage pond is located on the western side of the existing landfill site, approximately 225m from Sandy Creek.

There does appear to be a small water body possibly a Dam along the southern boundary, on the neighbouring rural residential property (**Figure 3**).

Figure 3 Potential Landowners Water Supply Dam

There is no available data on the baseline water quality of Cabbage Tree Creek. The limited monitoring data collected from Sandy Creek, upgradient to the landfill extension site at monitoring location SW3 (**Figure 6**), indicates the water in Sandy Creek has low dissolved oxygen, is acidic (pH <6.5) and the conductivity ranges from 460 – 1850uS/cm (ENRS, 2015).

2.4 Geology and Soils

Based on information provided in the Wollongong 1:250 000 Geological Map SI/56-09 Sheer 2nd Ed. 1966 the geology underlying the Stage 4 landfill extension area is the Permian aged Nowra Sandstone of the Shoalhaven Group. The Shoalhaven Group predominantly comprises marine shelf to coastal plain sediments. The Nowra Sandstone consists typically of quartz sandstone.

An investigation conducted by Coffey (2016) indicated the top of bedrock was found to be between 6 and 7 m below ground surface and was found to be highly to moderately weathered sandstone. The overburden material is typically sandy or silty clay of low to high plasticity, overlying clayey sand, which is underlain by bedrock, comprising variably weathered sandstone.

There is no existing soil data available on the current soil quality in Stage 4.

2.4.1 Acid Sulfate Soils

Information obtained from Australian Soil Resource Information System (www.asris.csiro.au) indicated that the site has no known occurrence of Acid Sulfate Soils (ASS). Also, due to the topographical height of the site being 40-50m AHD and Acid Sulfate Soils (ASS) predominately being encountered at <20m AHD, ASS are not expected to be encountered on Site.

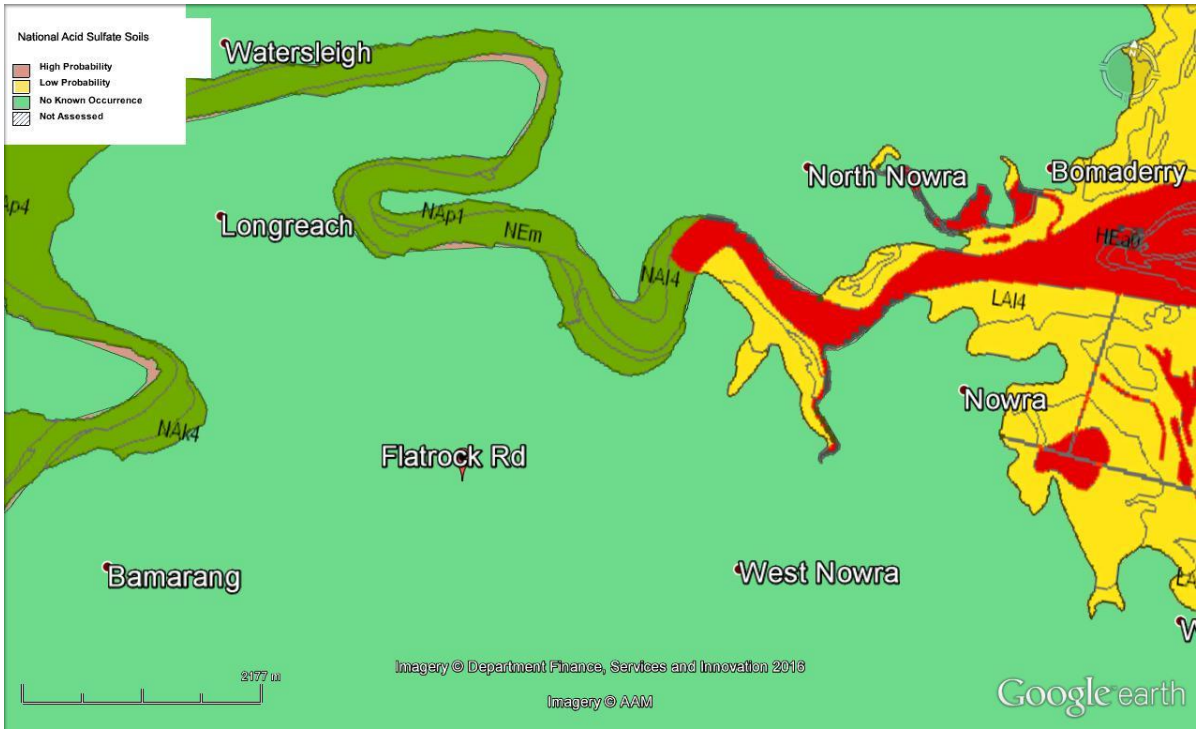


Figure 4 Acid Sulfate Soil Mapping (source www.asris.csiro.au January 2017)

2.4.2 Salinity

Based on salinity mapping provided by the Department of Primary Industries, NSW, the area proposed for Stage 4 is zoned as having a Salinity Hazard Ranking of Low. In this area salt stores are considered low and salinity outbreaks are uncommon. Resilience in this area is considered moderate as the soils are shallow and infertile but this is counterbalanced by relatively high rainfall (DPI, 2013).

2.5 Hydrogeology

Groundwater resources in the area are expected to be associated with 2 primary aquifer systems (ENRS, 2015) including:

- A shallow unconfined alluvial aquifer generally less than 20m in depth with moderate yields, variable water quality and strongly controlled by rainfall recharge; and
- A deep fractured rock aquifer, typically deeper than 20m with low yields, high iron and variable salinity.

An investigation conducted by Coffey (2016) at the Stage 4 landfill extension area indicated the groundwater table ranged from 5 m to 12 m below natural ground level (37-42m AHD) but it was noted that this level may rise after Stage 3 is completed and capped. It was also noted that groundwater table levels may fluctuate up to 5m with rainfall and seasonal variations. Groundwater in Stage 4 (east of the ridgeline) flows predominantly east (Coffey 2016), discharging at Cabbage Tree Creek. West of the ridgeline the groundwater flow is predominantly to the west, discharging at Sandy Creek (Coffey 2016). According to Coffey 2016, recharge to the groundwater system is reliant on rainfall and at lower elevations groundwater occurs within the alluvial sediments of Cabbage Tree and Sandy Creeks.

There are currently twenty four (24) monitoring wells located around the existing Facility available for monitoring the groundwater flow and providing information on environmental impacts. Additional groundwater investigation wells and a surface water monitoring location have been established to capture potential impact from the Stage 4 landfill extension area. Locations of all groundwater and surface water monitoring points are shown in **Figure 6**.

The first round of baseline monitoring of the groundwater wells located in Stage 4 was completed in June 2017 by Environment & Natural Resource Solutions (ENRS 2017). The results of the baseline monitoring indicated the following about the groundwater currently located under Stage 4:

- Salinity levels are elevated across the site with TDS levels ranging from 1870 – 7830mg/L;
- Neutral pH levels;
- Only one heavy metal exceedance, zinc in one of the wells;
- No elevated levels of TOC, Phenols, OC/OPs, TRH, BTEX or PAHs; and
- Nutrient levels are also below adopted trigger levels.

Searches of the NSW government databases indicated there are no recorded water bores within 1km of the investigation area.

A search of the NSW Department of Primary Industries real-time groundwater data (www.realtimedata.water.nsw.gov.au) conducted on 18 February 2016 did not reveal any real-time monitoring groundwater bores in the vicinity of the site.

A search of the Australian Government Bureau of Meteorology (www.bom.gov.au /water /groundwater) indicated the groundwater at the site falls under the Sydney Basin Central Management Area and falls in an area that has a bore density of 7 bores per 25km^2.

Information obtained from the Bureau of Meteorology (BOM) Groundwater Dependent Ecosystem Atlas indicates Shoalhaven River is the only groundwater dependant ecosystem within 5km of the site (**Figure 5).**

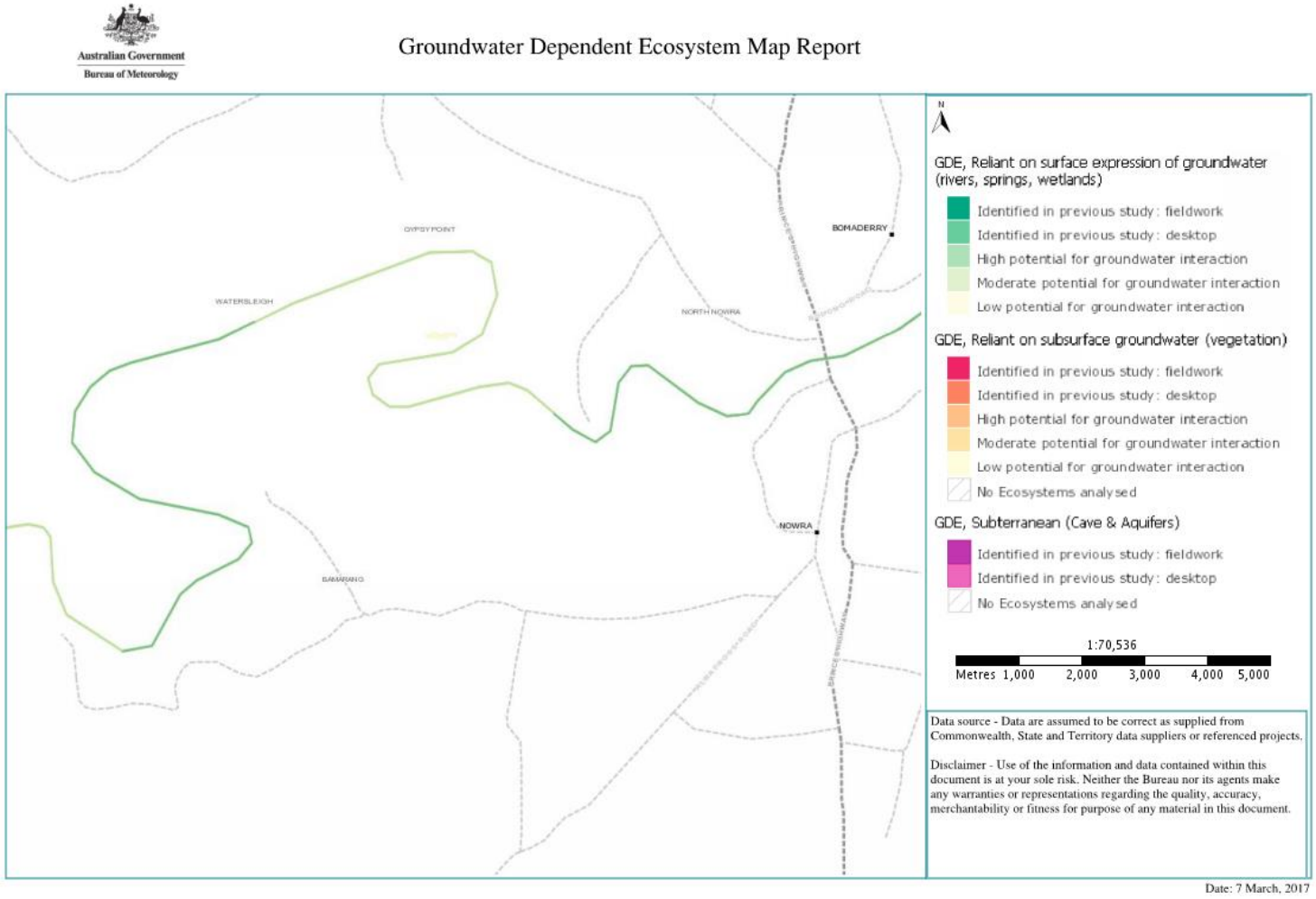


Figure 5 Groundwater Dependent Ecosystems Map Report

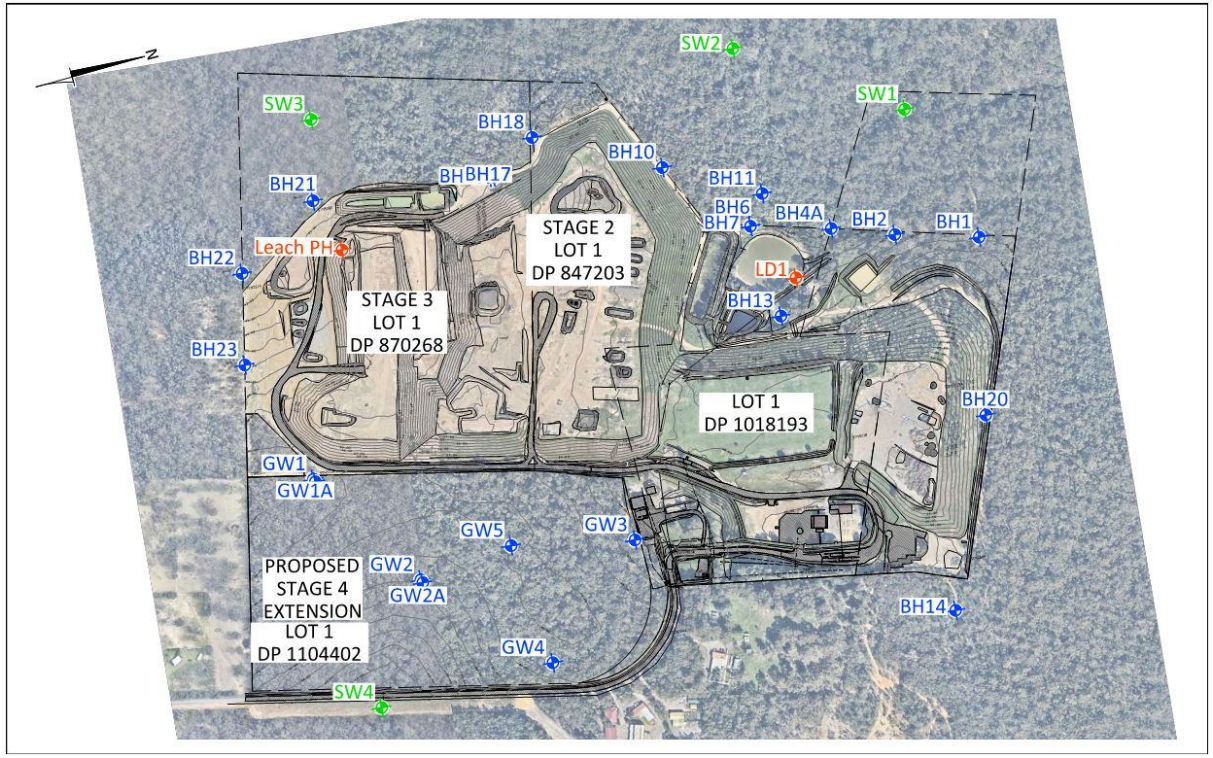


Figure 6 Groundwater and Surface Water Monitoring Locations

2.6 Flooding

Detailed flood study reports do not currently exist for the investigation area (Upper Shoalhaven River). Information provided on the Shoalhaven City Council webpage indicates flooding in the Upper Shoalhaven River is not considered high risk, however they advise any development to ensure a buffer of 40m to a creek or within 10m of a drainage system, overland flowpath or drainage easement, as these areas may be subject to flooding.

2.7 Water Sharing Plans

The Facility is located with the Shoalhaven Estuary Sub-Catchment, which makes up part of the Shoalhaven Catchment and is located within an area that operates under the following plans:

- Water Sharing Plan for the Greater Metropolitan Region Unregulated Water Sources (Lower Shoalhaven River Management Zone); and
- Water Sharing Plan for the Greater Metropolitan Region Groundwater Sources (Lower Shoalhaven River Management Zone).

No extraction of waterways or groundwater is proposed for this extension.

Stormwater runoff that comes into contact with an open landfill cell will be contained with the existing leachate management system. The impact of containing this water from entering waterways will mitigate impacts on downstream users, as no licenced water users were identified directly downstream of the site prior to Shoalhaven River. The quantity of surface water runoff that would reach Shoalhaven River, prior to development of the Landfill Extension area, would be minimal due to the site currently being vegetated, the distance it needs to travel to reach Shoalhaven River and the evaporation that may occur en-route.

The reduction of groundwater infiltration areas resulting from the Landfill Extension will also be minimal when compared to the area of the overall recharge zone so overall impact upon the existing groundwater resource is expected to be minimal.

2.8 Flora and Fauna

A vegetation survey conducted at the Landfill Extension Site by Hyder Consultants (Hyder, 2007) identified three distinct vegetation communities:

- Woodland / Open Woodland;
- Woodland of Grey Gum, Blue-leaved Stringybark and Blackbutt variety, and
- Sedgeland / Heathland vegetation.

The Nowra Tea Tree (*Leptospermum sejunctum*), classified by EPA as a rare plant species, was found in the north-western and south-western corners of the site and an endangered[1] Nowra Heath-myrtle (*Triplarina nowraensis*) was found in the eastern portion of the Stage 4 area (Hyder 2007).

[1] *Threatened Species Conservation Act 1995 (New South Wales)*: December 2015 list.

Fauna identified during site surveys (Hyder, 2007) included a range of bird species including the Powerful Owl, Glossy Black Cockatoo and Yellow-bellied Glider along with wombats, wallabies, kangaroos and herpetofauna including lizards, goannas, froglets and toadlets. The presence of foxes and feral dogs was also identified.

The potential for fifty three (53) listed threatened or migratory fauna and flora species was also identified via a search of State and Commonwealth conservation databases (Hyder, 2007).

2.9 Climate

The nearest Bureau of Meteorology (BOM) automatic weather station (AWS) to the site is the Nowra RAN Air Station AWS (AWS 068072) located approximately 7.5 km south of the Facility.

2.9.1 Rainfall and Temperature

A summary of the rainfall and minimum and maximum temperature means recorded by BOM, identifying climatic distribution throughout the years, are shown in **Table 1**.

Table 1 Climate data from AWS 068072 between 2000 and 2016

	Mean Max daily temperature (°C)	Mean Min daily temperature (°C)	Mean monthly rainfall (mm)
Jan	27.4	16.4	65.8
Feb	26.1	16.6	132.6
Mar	25.1	14.8	100.8
Apr	22.6	12.3	70.9
May	19.5	9.1	54.4
Jun	16.9	7.7	102
Jul	16.5	6.6	60.4
Aug	18.2	6.8	72.7
Sep	21	8.7	42.5
Oct	23.2	10.6	66.7
Nov	24.7	13.6	72.2
Dec	25.8	14.7	79.9

2.9.2 Wind

Wind direction information given by BOM indicates the prevailing winds at West Nowra are westerlies and north-westerlies.

2.9.3 Evaporation

Evaporation data available from BOM indicates the average annual pan evaporation rate in the region is 1400-1600mm and the average annual evapotranspiration rate is 600-700mm.

2.10 Heritage Sites

A search of the NSW Office of Environment and Heritage (OEH) State Heritage Register was undertaken in February 2017 by SLR for an area of 2km radius surrounding the Landfill Extension Site. No Aboriginal Places or places listed on the State Heritage Register were encountered.

2.11 Receiving Environment and Sensitive Receptors

Based on the desktop assessment of existing environment and surrounding land uses, the receiving environment of potential soil and water impacts has been determined as:

- Adjacent drainage features, Cabbage Tree Creek, Sandy Creek and Shoalhaven River;
- Groundwater;
- Surrounding Bushland; and
- Rural Residential Properties.

These receiving environments are also classified as Sensitive Receptors of the proposed Landfill Extension development, along with:

- Recreational users of associated waterways; and
- Rare and Endangered Fauna and Riparian Vegetation.

3 Site History

Site history review has been undertaken for the Landfill Extension Site to determine if there is the potential for site contamination to exist.

3.1 Existing Landfill Facility Operations

The Facility commenced operations in 1979, accepting domestic, industrial, commercial liquid, solid and hazardous wastes including asbestos and oil. Landfilling practices originally involved the excavation and filling of a series of trenches. Operations have since progressed to comply with the 2016 EPA Guidelines (as well as the former NSW EPA (1996) Environmental Guidelines: Solid Waste Landfills). The Facility no longer accepts liquid wastes and only small quantities of asbestos waste.

Operationally, the Facility is divided into several stages (**Figure 2**):

- Stage 1: “Old” unlined landfill, stockpile and irrigation areas, and landfill gas extraction comprising the northern portion of the Facility;
- Stage 2: Completed lined landfill areas, now used for stockpiling and landfill gas extraction;
- Stage 3: Active lined landfilling of solid waste and wet weather tipping areas, and future landfill gas extraction area; and
- Stage 4: Proposed lined landfilling areas for solid waste, and future landfill gas extraction.

In accordance with the requirements of EPL Number 5877, the NSW EPA (2014) *Waste Classification Guidelines* (the *Waste Classification Guidelines)* and SCC policies, the Facility can accept the following types of waste:

- Mixed municipal waste (SCC kerbside collection and small vehicle/public drop off);
- Mixed commercial waste;
- Virgin Excavated Natural Material (VENM);
- Inert, construction and demolition waste (e.g. concrete, brick, tile and glass);
- Separated green and wood wastes;
- Tyres;
- Small household quantities of asbestos; and
- Other solid wastes as defined as General Solid Waste in the *Waste Classification Guidelines* and permitted under the EPA guidelines or approved by the NSW EPA.

Environmental management of the site is governed by the site specific Landfill Environmental Management Plan (LEMP).

3.2 Historical Aerial Photographs

A review of a selection of historical aerial photographs was undertaken. Observations made during the review are presented in Table 2, while the aerial photographs reviewed are provided in Appendix A.

Table 2 Aerial Photography Review

Year of Photograph	Site Land Use Observations	Surrounding Land Use Observations
1961	Some areas where the existing landfill is located today have been cleared. It is possible the site is operating as a landfill or quarrying. The site for the proposed Landfill extension remains undeveloped bushland.	The area surrounding the existing Landfill site is undeveloped bushland. The residential properties that currently exist to the south have also not been developed.
1974	Further clearing has occurred in the vicinity of where the existing landfill is situated. It is unclear why the clearing has occurred but may be for landfilling or quarrying/extraction. The site for the proposed Landfill extension remains undeveloped bushland.	The area surrounding the existing Landfill site is undeveloped bushland. The residential properties that currently exist to the south have also not been developed.
1997	Further clearing from that encountered in 1974 has occurred in the vicinity of where the existing landfill is situated. Some of the areas cleared earlier are revegetating. It appears the site is now being used as a landfill.	The area surrounding the existing Landfill site is undeveloped bushland. The rural residential properties that currently exist to the south have been developed.

Year of Photograph	Site Land Use Observations	Surrounding Land Use Observations
2004 (Google Earth)	Stage 1 and 2 of the existing landfill are built and appear to be operational. The area proposed for Stage 4 is undeveloped bushland. Works look like they are occurring on Stage 3 of the existing landfill.	The area surrounding the existing Landfill site is undeveloped bushland with rural residential to the south.
2015	Stage 3 of the existing landfill has been built and is operational. The area proposed for Stage 4 is undeveloped bushland.	The area surrounding the existing Landfill site is undeveloped bushland with rural residential to the south. There is what appears to be a dam located along the landfill extension area southern boundary on the residential property.

The aerial photography review indicates that no potential land contaminating activities appear to have been undertaken on the Landfill Extension site, however the site is immediately adjacent and downgradient of the existing landfilling operations which may have resulted in impacts from windblown debris, stormwater runoff or groundwater contamination migration.

3.3 Historical Land Titles

A search of historical land title ownership records was undertaken in February 2016. The search indicated the land was owned by the proprietors set out below:

Table 3 Historical Land Titles

Date of Acquisition and term held	Registered Proprietor(s) & Occupations where available	Reference to Title at Acquisition and sale
09/12/1914	Crown Reserve No. 50414 from Sale	Revoked 01/07/1917
27/01/1939	Crown Tenure Annual Lease 1938/5	Not renewed 26/01/1940
07/12/2007 (2007 to date)	# Council of the City of Shoalhaven (Resumed for the purposes of a landfill site and recycling centre)	Government Gazette Now 1/1104402

There are no records of leases or easements attached to the property.

The historical land title ownership records indicate the potential for land contaminating activities (landfilling) to have occurred on the site, however based on the aerial photograph review landfill activities have not yet occurred on the landfill extension site.

A copy of the search record is presented in Appendix B.

3.4 Regulatory Authorities

3.4.1 NSW Environment-Protection -Authority

A search of the NSW EPA contaminated land public register of records of notices (maintained under Section 58 of the Contaminated Land Act 1997) was undertaken by SLR on the 8 September 2016. With regards to the Site, the search results indicated that there are no:

- Orders made under Part 3 of the Contaminated Land Management Act 1997 (CLM Act).
- Approved voluntary management proposals under the CLM Act that have not been fully carried out and where the approval of the Environmental Protection Authority has not been revoked.
- Site audit statements provided under Section 53B of the CLM Act that relate to significantly contaminated land.
- Where practicable, copies of anything formerly required to be part of the public record.
- Actions taken by EPA under Section 35 or 36 of the Environmentally Hazardous Chemicals Act 1985.

A search of the NSW Protection of the Environment Operations (POEO) Act public register of licence, applications and notices (maintained under Section 308 of the POEO Act 1997) was undertaken on September 2016. The register contains information on:

- Environment-Protection Licences;
- Applications for new licences and to transfer or vary existing licences;
- Environment protection and noise control notices;
- Convictions in prosecutions under the POEO Act;
- The results of civil proceedings;
- Licence review information;
- Exemptions from the provisions of the POEO Act or Regulations;
- Approvals granted under clause 9 of the POEO (Control of Burning) Regulations;
- Approvals granted under clause 7A of the POEO (Clean Air) Regulation;
- Any mandatory audits required to be undertaken in relation to a licence;
- Each pollution study requires to be a condition of licence;
- Each pollution reduction program required by a condition of a licence; and
- Each penalty notice issued in relation to a premises.

A search of the NSW -POEO Act public register for Mundamia, NSW in March 2017 returned 18 results. One of the results was related to a pending POEO licence for Shoalhaven City Council for 114 Flat Rock Road. The remaining 17 were related to the issuing of the existing landfilling operations POEO licence and subsequent variations.

A search of the NSW EPA public register of contaminated sites notified to NSW EPA under Section 60 of the Contaminated Land Management Act did not identify any records for the Site. There was 1 site listed from the West Nowra area however this was not a property located adjacent to the Site.

A copy of the search records is presented in Appendix C.

3.4.2 SafeWork NSW

A search of the stored chemical information database (SCID) held by SafeWork NSW for the Site was not undertaken.

3.5 Previous Contamination Assessments

The Facility Annual Environmental Monitoring Report October 2014-2015 (ENRS, 2015) was reviewed to assess the potential for contamination to be present on the landfill extension site as a result of adjacent landfilling operations. This monitoring activity includes sampling of surface waters, groundwater and leachate at locations that have been established to monitor the potential impacts of the existing landfilling operations. ENRS concluded, at completion of the annual monitoring event, that there was unlikely to be any significant off-site impacts from site operations. The receiving environment for the existing landfill site has been established as Sandy Creek (located downgradient to the west) and ultimately the Shoalhaven River.

There were no monitoring locations currently within or downgradient of the landfill extension site during the 2014-2015 monitoring event.

3.6 Areas of Environmental Concern

Based on the desktop assessment of the site history review no Areas of Environmental Concern (AEC) were identified as having occurred on the Landfill Extension Site.

With respect to surrounding land uses, there is the potential for wind-blown litter and potentially contaminated groundwater and/or surface water flow from the existing landfilling operations to have impacted the Landfill Extension Site. However, given the topography and inferred groundwater flow direction, at the landfill extension site, stormwater runoff and groundwater is directed towards the east, rather than the west as is the case with the existing landfill operations. The impact upon the landfill extension site from contaminated groundwater and/or surface water from the existing landfill facility is expected to be low.

A summary of the potential AEC identified by the desktop assessment are provided in **Table 4.**

Table 4 Summary of Potential AEC

AEC	Receiving Environment	PCOC	Risk[1]
Leachate originating from unlined landfill at existing facility	Groundwater Surface waters	Asbestos Metals Hydrocarbons Pesticides/Herbicides Phenols Nutrients Salinity	Low-Medium: • existence of an historical unlined landfill • inferred groundwater direction being towards the west, away from the landfill extension area • groundwater collection curtains/ drains for Stages 1 & 2 and subsurface leachate collection drains exist Annual environmental monitoring results indicate no current significant impact upon receiving environment
Contaminated surface water runoff from existing facility	Surface waters Land	Asbestos Metals Hydrocarbons Pesticides/Herbicides Phenols Nutrients Salinity	Low: • topography and current management practices divert majority of stormwater away from landfill areas • stormwater that comes into contact with the open landfill face is treated as leachate First flush and sediment ponds are used to manage sediment laden run-off
Wind-blown litter originating from existing landfill operations	Surface waters Land	Asbestos- Metals Hydrocarbons Pesticides/Herbicides Phenols Nutrients Salinity	Low-Medium: • historical landfilling of asbestos when daily cover practices may not have been adequate or in place. Adequate capping and daily cover management practices at the existing facility currently in place

Note: 1. Qualitative Assessment only based on available data and SLR's experience with comparable land use activities

3.7 Site Suitability

Based on the site history desktop assessment of the Landfill Extension Site, the investigation site is suitable for use as a Landfill Facility in relation to potential site contamination.

4 Potential Soil and Water Impacts

The potential soil and water impacts resulting from both the construction and operational phases of the landfill extension site that could impact upon the identified receiving environments have been identified as:

- Leachate impact on groundwater and surface waters, including riparian and protected vegetation and neighbouring rural residential dam;
- Erosion and sedimentation on surrounding surface waters;
- Wind-blown litter impact upon surrounding land and surface waters; and
- Increased on-site water demand.

4.1 Water Balance for On-site Water Demand

A water balance has been completed to determine whether the proposed water harvesting will result in adequate water quantity for re-use on site for dust suppression (if required) so that potable water will not be required.

The water balance took into consideration the annual rainfall, runoff volumes, evaporation rates and estimated re-use quantities (dust suppression) (**Table 5**). There is no proposed potable water usage for this project.

Table 5 Water Balance Data

		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
IN														
Runoff (m3)	**Average**	2983	6322	5463	3145	2423	5643	2902	3311	2119	3069	3306	3738	**44,422**
	10th Percentile	1069	2204	1905	1078	812	1055	185	385	722	442	1287	1012	**12,155**
	Median	2575	5543	3363	2100	1283	3753	2318	1786	2342	2442	2793	2983	**33,279**
	90th Percentile	5558	11775	13785	4907	4826	15618	6370	7211	3154	5520	6156	5980	**90,858**
OUT														
Dam Evap (m3)		552	456	350	219	140	96	105	166	245	342	438	534	**3,644**
Dust Suppression (m3)		475	190	190	475	475	190	475	475	475	475	475	190	**4,560**
Results														
Average (m3)		1956	5677	4922	2451	1807	5357	2322	2669	1398	2252	2393	3014	**36,218**
10th Percentile (m3)		1069	2204	1905	1078	812	1055	185	385	722	442	1287	1012	**12,155**
Median (m3)		2100	5353	3173	1625	808	3563	1843	1311	1867	1967	2318	2793	**28,719**
90th Percentile (m3)		3601	6099	8862	2456	3019	10261	4048	4541	1756	3268	3763	2966	**54,640**

Runoff storage volumes were calculated by SLR using Hydraulic Evaluation of Landfill Performance (HELP) Modelling (SLR, 2018: Conceptual Design). Result of the modelling relating to runoff storage is provided in **Table 6**.

Table 6 Shoalhaven Sediment Dam Capacity Details

Dam	Catchment Area (ha)	Settling Zone Volume (ML)	Sediment storage zone (ML)	Total Dam Storage Volume (ML)
Dam 1	3.0ha	1.58	0.79	2.37
Dam 2	6.5ha	3.46	1.73	5.19
			Total Dam Storage Volume:	7.56

Source: SLR, 2017: Conceptual Design

The water balance shows the annual predicted flow volumes and predicts there will be excess on-site water for dust suppression uses. The catchment is large and the estimated re-use is low which results in an overflow that greatly exceeds the onsite re-use demands as is represented in **Figure 7**.

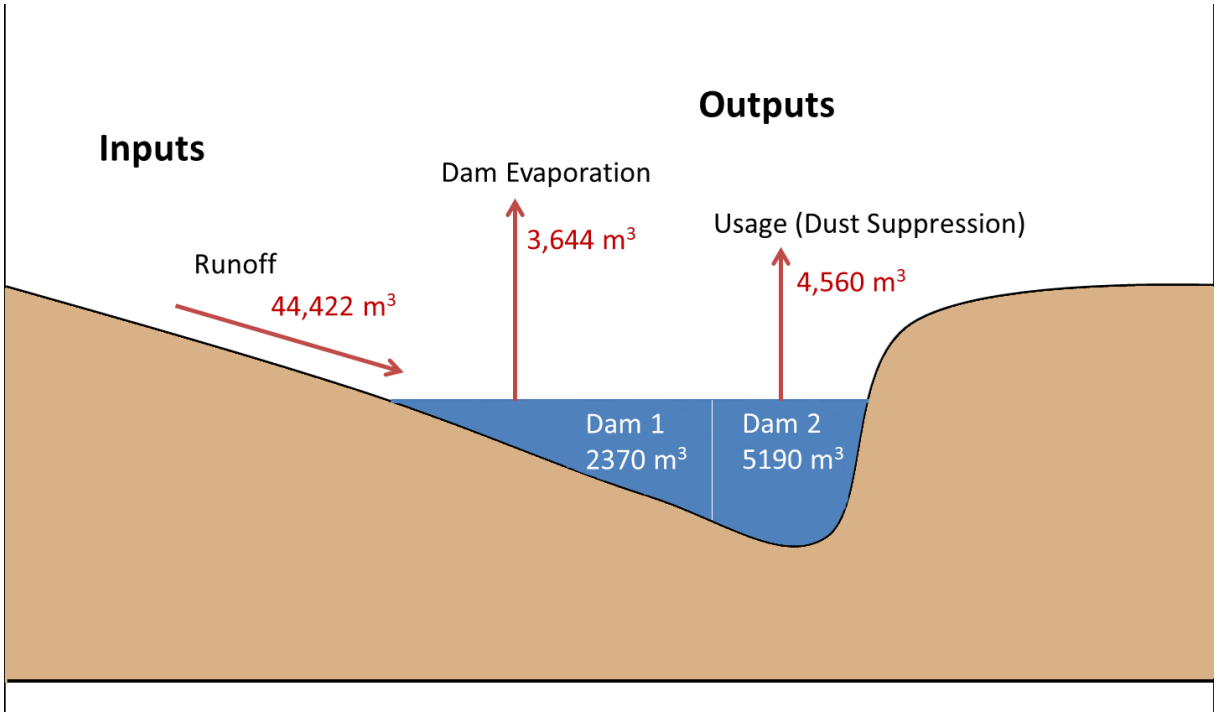


Figure 7 Water Balance for On-site Water Demand

4.2 Potential Leachate Impacts

Leachate is considered liquid that passes through the landfill waste mass as well as any stormwater runoff that may have come into contact with landfill footprint.

HELP-Modelling was conducted by SLR during the conceptual designing stage of the project (SLR, 2018: Conceptual Design) and estimated the existing leachate production from Stages 1-3 and the leachate production from Stage 4 (**Table 7 and Table 8**).

Table 7 Leachate Production Volumes – Stage 1 – 3

		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual Total (m^3)
	Monthly Precipitation (mm)	63.5	81.5	93.4	96.0	87.3	70.5	98.5	121.5	138.3	108.0	106.8	115.6	1170.9
Stage 1 Closure Area	Leakage (mm)	3.24	3.2	3.1	3.24	3.12	3.19	3.21	2.9	3.26	3.15	3.28	3.19	
	Monthly Infiltration Percentage (%)	4.8%	3.0%	3.2%	2.8%	2.6%	3.6%	2.3%	1.6%	1.7%	2.0%	2.4%	1.8%	
	Leachate Production (m^3)	92.34	91.2	88.35	92.34	88.92	90.915	91.485	82.65	92.91	89.775	93.48	90.915	1,085.28
Stage 2 Closure Area	Leakage (mm)	1.3	0.93	1.66	1.36	0.9	0.46	0.73	0.73	1.08	1.17	1.78	1.36	
	Monthly Infiltration Percentage (%)	2.0%	1.1%	2.0%	1.4%	1.0%	0.7%	0.7%	0.6%	0.8%	1.1%	1.7%	1.2%	
	Leachate Production (m^3)	115.7	82.77	147.74	121.04	80.1	40.94	64.97	64.97	96.12	104.13	158.42	121.04	1,197.9
Stage 3 Closure Area	Leakage (mm)	1.03	1.04	1.52	1.43	1.02	0.66	0.8	0.69	0.86	1.01	1.37	1.23	
	Monthly Infiltration Percentage (%)	1.6%	1.3%	1.8%	1.5%	1.2%	0.9%	0.8%	0.6%	0.6%	0.9%	1.3%	1.1%	
	Leachate Production (m^3)	91.67	92.56	135.28	127.27	90.78	58.74	71.2	61.41	76.54	89.89	121.93	109.47	1,126.7
Stage 3 Operational Area	Leakage (mm)	26.5	23.1	20.2	23.1	25.7	27.9	27.2	25.6	28.5	26	26.6	27.1	
	Monthly Infiltration Percentage (%)	41.73%	28.34%	24.22%	24.06%	29.44%	39.57%	27.61%	21.07%	20.61%	24.07%	24.91%	23.44%	
	Leachate Production (m^3)	212	184.8	161.6	184.8	205.6	223.2	217.6	204.8	228	208	212.8	216.8	2460
Estimated Monthly Stage 1 -3 leachate production (m^3)		511.7	451.3	533.0	525.5	465.4	413.8	445.3	413.8	493.6	491.8	586.6	538.2	**5869.96**

Table 8 Leachate Production Values – Stage 4

		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual Total (m^3)
	Precipitation (mm)	63.5	81.5	83.4	96.0	87.3	70.5	98.5	121.5	138.3	108.0	106.8	115.6	
Closure 8.9 Ha	Leakage (mm)	4.75	4.73	4.57	4.72	4.54	4.65	4.63	4.23	4.68	4.55	4.75	4.6	
	Monthly Infiltration Percentage (%)	7.5%	5.8%	5.5%	4.9%	5.2%	6.6%	4.7%	3.5%	3.4%	4.2%	4.4%	4.0%	
	Leachate Production (m^3)	422.75	420.97	406.73	420.08	404.06	413.85	412.07	376.47	416.52	404.95	422.75	409.4	4930.6
Operational 0.8 Ha	Leakage (mm)	26.5	23.1	20.2	23.1	25.7	27.9	27.2	25.6	28.5	26	26.6	27.1	
	Monthly Infiltration Percentage (%)	41.73%	28.34%	24.22%	24.06%	29.44%	39.57%	27.61%	21.07%	20.61%	24.07%	24.91%	23.44%	
	Leachate Production (m^3)	212	184.8	161.6	184.8	205.6	223.2	217.6	204.8	228	208	212.8	216.8	2460
Stage 4 monthly leachate production (m^3)		634.75	605.77	568.33	604.88	609.66	637.05	629.67	581.27	644.52	612.95	635.55	626.2	**7390.6**

Based on the assessment conducted by the Assets & Works Group, Shoalhaven City Council (11 September 2017) the existing leachate pond has a working capacity of approximately 8.9ML.

A water balance of the existing leachate ponds capability to store the additional leachate generated from Stage 4 was completed (SLR Leachate Management Memo, 2018). The results indicated the existing leachate pond has sufficient capacity to accommodate two consecutive 90th Percentile rainfall years together with the leachate that would be generated from Stage 1 – 4 if a new leachate irrigation area of 14,000m^2 is established.

As the proposed landfill extension will be similar to the current landfill operations particularly in relation to the types of waste received, the quality of the leachate generated from the proposed landfill extension is expected to be of the same quality as the leachate that is currently generated from the existing landfill. A summary of the current leachate quality based on monitoring data collected from the existing leachate storage dam and pump station is provided in **Table 9**.

Table 9 Estimate Leachate Quality

Analyte	Range Encountered	Trigger Value
Salinity	1740-1840mg/L	1500mg/L
pH	7.2-8.0	6.5-8.0
TSS	<LOR – 5mg/L	50mg/L
Phosphorus	0.4-0.42mg/L	0.05mg/L
Phosphate	0.15-0.16mg/L	0.02mg/L
Ammonia	42.1-43.1mg/L	2.57mg/L
Nitrate	0.04-0.05mg/L	0.7mg/L
TOC	43-43.7mg/L	-
TPH C10-C36	0.24-0.27mg/L	0.6mg/L
Aluminium	0.21mg/L	0.055mg/L

Source: Annual Environmental Monitoring Results October 2014 – October 2015, West Nowra Recycling and Waste Facility (ENRS, 2015).

Bold indicates range encountered is greater than the Trigger Value

Trigger Values – Australian and New Zealand Guidelines for Fresh and Marine Water, 95% Level of Species Protection in Fresh Waters (ANZECC, 2014)

The raw leachate quality has the potential to be a source of contamination to the receiving environment if leachate collection, storage and treatment/disposal are not adequately implemented and maintained.

Potential impacts resulting from inadequate collection, storage and treatment/disposal of leachate that will be generated from the Stage 4 landfill extension include:

- Infiltration of contaminated leachate into the groundwater underlying the landfill or the leachate storage dam. Groundwater at times can discharge into the surrounding creek systems potentially impacting upon the waterways ecosystem, riparian zones and downstream users.
- Overflow of contaminated leachate from the leachate pond into Sandy Creek.

- Stormwater run-off coming into contact with landfill waste materials resulting in contaminated run-off potentially impacting upon the waterways ecosystem, riparian zones, protected vegetation and downstream users.

4.2.1 Leachate Mitigation

It is anticipated that the quality of the leachate generated from Stage 4 should be similar to that which is currently generated in the Stage 2 and 3 cells as the wastes types disposed into Stage 4 will be of similar types already disposed. As a result, the Facility proposes to manage leachate generated from Stage 4 utilising the existing leachate management infrastructure, which includes a collection system and leachate storage dam.

As per the existing landfill EPL 5877 the leachate currently collected from Stage 1-3 in the leachate dam may be irrigated over the following areas:

- Spraying over the "irrigation area"/"utilisation area" (EPA Identification No. 26 in EPL Number 5877), immediately north of Stage 2, and/or
- Irrigation at waste tipping faces.

Due to the increase of leachate quantity from the Stage 4 extension and the potential for the existing irrigation area to result in the seepage of leachate off-site (due to it being located on a closed unlined landfill cell), a new irrigation area has been proposed. The new irrigation area will be a minimum of 14,000m^2 in area and will be utilised to receive leachate from Stages 1-4. This area was determined by Hydrological Evaluation of Landfill Performance (HELP) modelling (SLR Leachate Management Memo, 2018). The proposed location for the new irrigation area will be on the surface of the existing lined Stage 2 landfill area.

A geotechnical investigation of the existing leachate dam clay base liner was conducted by GHD in 2018 to determine whether the existing clay base liner is suitable to prevent leaching from the dam. Results of the assessment summarised below indicate the permeability of the clay encountered is satisfactory to act as a liner. A copy of the full GHD geotechnical assessment of the clay based liner is provided in **Appendix D**.

"The Work as Executed (WAE) drawings show a Geosynthetic Clay Liner (GCL) was placed over the floor and walls of the leachate dam and that a select material was placed over the GCL to a thickness of at least 300mm. Testing of the select material for permeability indicates that the material has a high clay content with a hydraulic conductivity (k) of at least 4x10 -10 m/sec. When combined with a GCL having a typical k of 1.9x10 -11 m/sec, we are satisfied that the permeability of the clay liner and GCL provides a barrier at least equivalent to a 1,000 mm thick compacted clay liner with k of less than 1x10 -9 m/sec. In relation to our site observations of the general integrity of the leachate dam, the dam walls and floor exhibit no evidence of erosion or deformation that would influence the performance of the dam to contain leachate. We note also, as a further indicator of the integrity of the leachate dam liner, that testing of groundwater samples taken from monitoring points downstream of the leachate dam have not revealed any evidence of leakage of leachate from the dam" (GHD, 2018).

It was also recommended that future groundwater monitoring hydraulically downgradient of the leachate pond be undertaken to determine if leachate is evident in the groundwater. The recommended groundwater monitoring was conducted by ENRS (2018), the results did not identify any evidence of leachate leakage from the pond.

Further mitigation measures that will be implemented into the landfill extension project to reduce potential leachate impact include:

- Installation of additional groundwater monitoring wells hydraulically downgradient of the existing leachate dam and the new irrigation area, for the identification of leachate indicators.
- Placement of landfill base at least 2m above the groundwater table to minimise potential for interface with groundwater.
- Containment of stormwater that comes into contact with the landfill waste material and diversion of this stormwater to the leachate management system.
- Maintenance of existing surface water management infrastructure (first flush dams, sedimentation dams) to ensure clean surface water runoff is intercepted and diverted from the landfill footprint prior to entering the waste mass and thus becoming leachate.
- Installation of an engineered containment system comprising a 200mm thick compacted subgrade, 1000 mm compacted clay liner (or an alternative geosynthetic liner), a 2mm thick HDPE flexible geomembrane.
- A minimum 300 mm thick layer of drainage aggregate with perforated (drilled holes or slotted) HDPE drainage pipes to promote the flow of leachate under the waste and into the leachate collection system. A separation geotextile shall be placed over the leachate collection layer to minimise fines migration. The drainage aggregate shall be uniform, non-reactive aggregate with fines less than 1%, and particle size 20-50mm, with hydraulic conductivity greater than1 x 10-4 m/sec.
- The Stage 4 leachate collection system will be graded at a minimum of 1% longitudinally into leachate collection sumps and 3% in the transverse direction. From the sumps, a series of inclined HDPE leachate extraction pipes shall be designed to draw leachate from the base of the landfill cell to the surface by a series of submersible pumps.
- Leachate collection pipes in each cell shall comprise a 200mm internal diameter (ID) spine drain with 150mm minimum ID spur drains. Leachate pipework inspection openings located between the access road and the south of Stages 2 and 3 to be cut back to subgrade and capped prior to construction of liner in this section of Stage 4 Landfill Extension. Pipe material will be chemically compatible with the leachate and functional at elevated temperature consistent with the landfill environment.
- Implementation of an environmental monitoring program that includes groundwater, surface water and leachate as per existing varied EPL requirements.
- Preparation and submission of a Landfill Closure Plan (LCP) to the EPA for approval no later than 12 months before the last load of waste is due to be landfilled at the Facility. This LCP will include measures to reduce any impacts to soil and water during and after closure of the Landfill along with on-going post closure monitoring requirements.

The following future leachate management system may also be utilised (under separate approval):

- Installation of a reverse osmosis treatment plant;
- Evaporation of leachate; or
- Potential future connection to sewer.

If the proposed mitigation measures are implemented for the landfill extension project, the risk of leachate impacts upon receiving environments should be low.

More detail on the proposed Liners and Leachate Collection and Management System, for the proposal, is provided in the SLR report, *West Nowra Recycling and Waste Facility Proposed Stage 4 Landfill Extension Concept Design Report* (610.15781-R01, 2018).

4.3 Erosion and Sediment Impacts

Potential impacts resulting from erosion and sedimentation of waterways during construction and operational phases of the landfill extension project include:

- Exposed soils during construction and operation resulting in erosion and potential impact on downstream waterways through sedimentation including a potential Landowners water supply dam.
- Runoff coming into contact with daily cover soil stockpiles resulting in potential impact on downstream waterways through sedimentation.

4.3.1 Erosion and Sedimentation Mitigation

Erosion and sediment controls will be implemented during construction and operation of the Stage 4 Landfill extension.

A conceptual Erosion and Sediment Control Plan (ESCP) has been developed to reduce the occurrence of erosion and reduce sedimentation during operation of the landfill extension. The ESCP has been designed in accordance with the 'Blue Book' Managing Urban Stormwater: Soils and Construction Vol.1, 4th Ed. And Vol.2B Waste Landfills (Landcom, 2004 and DECC, 2008). Copy of the Conceptual ESCP is provided in **Figure 8** and detailed in the SLR report *West Nowra Recycling and Waste Facility Proposed Stage 4 Landfill Extension Concept Design Report* (610.15781-R01, 31 January 2017).

An ESCP will also be developed in accordance with the 'Blue Book' for the construction phase of the project.

The conceptual ESCP for the operation of the landfill includes the following measures to minimise the discharge of sediment laden water downstream:

- Collection and management of disturbed runoff into two sedimentation dams, one to the north and one to the south of the Stage 4 landfill extension area. Sediment ponds have been designed to adequately capture and retain sediment laden runoff allowing for the settlement of suspended sediment from the stormwater prior to release.
- Monitoring and management of the sedimentation dams and surface waters to ensure minimal discharge of sediment laden waters as per the Landfill Environmental Management Plan (LEMP) and the ESCPs.
- Diversion of clean runoff around the disturbed areas. This will include the installation and management of erosion and sediment control structures such as surface diversion bunds and swale drains around open excavations (unfilled) and active landfill cells.

- Minimisation of disturbed areas and minimising the disturbance period. The Stage 4 landfill extension will take place as 6 landfill cell sub-stages, minimising exposed soils and the potential for erosive effects.
- Stockpiles will be placed at a minimum of 5m from concentrated flow paths and any soils stockpiled for further use will be vegetated to stabilise the surface and reduce erosion risks.

If the proposed mitigation measures are implemented for the landfill extension project the risk of impact on receiving environments from erosion and sedimentation events should be low to medium.

4.4 Wind-blown Litter

Potential impacts to soil and water resulting from wind-blown litter during operation of the Stage 4 landfill extension include:

- Contamination of soil and water with gross pollutants and potentially asbestos fibres
- Impact upon visual amenity of waterways and bushland
- Impact upon waterway ecosystems

4.4.1 Wind-blown Litter Mitigation

Mitigation measures proposed for the Stage 4 landfill extension project to minimise the impact of wind-blown litter on receiving environments include:

- As a minimum, at the end of each working day, all exposed waste surfaces at the active tipping face that have not achieved final landform levels will be covered with a minimum 150 mm thick layer of VENM or an alternative material(s) approved by the EPA.
- When receiving and disposing of asbestos waste, it is managed in accordance with NSW safework requirements and covered immediately.
- Implementation of dust suppression measures.
- Covering of loads entering site and during transit within the Facility.
- Establishment of litter screens around the strategic locations.
- Avoiding, if practicable, tipping and/or waste handling during windy conditions and keeping the active waste tipping face area as small as possible.
- Prompt efficient placement, continuous compaction and covering of waste when unloading.
- Litter to be collected from surface water storm drains, inlets of pipes, culverts and outside the landfill perimeter on a regular basis.

If the proposed mitigation measures are implemented for the landfill extension project the risk of impacts on receiving environments from wind-blown debris should be low.

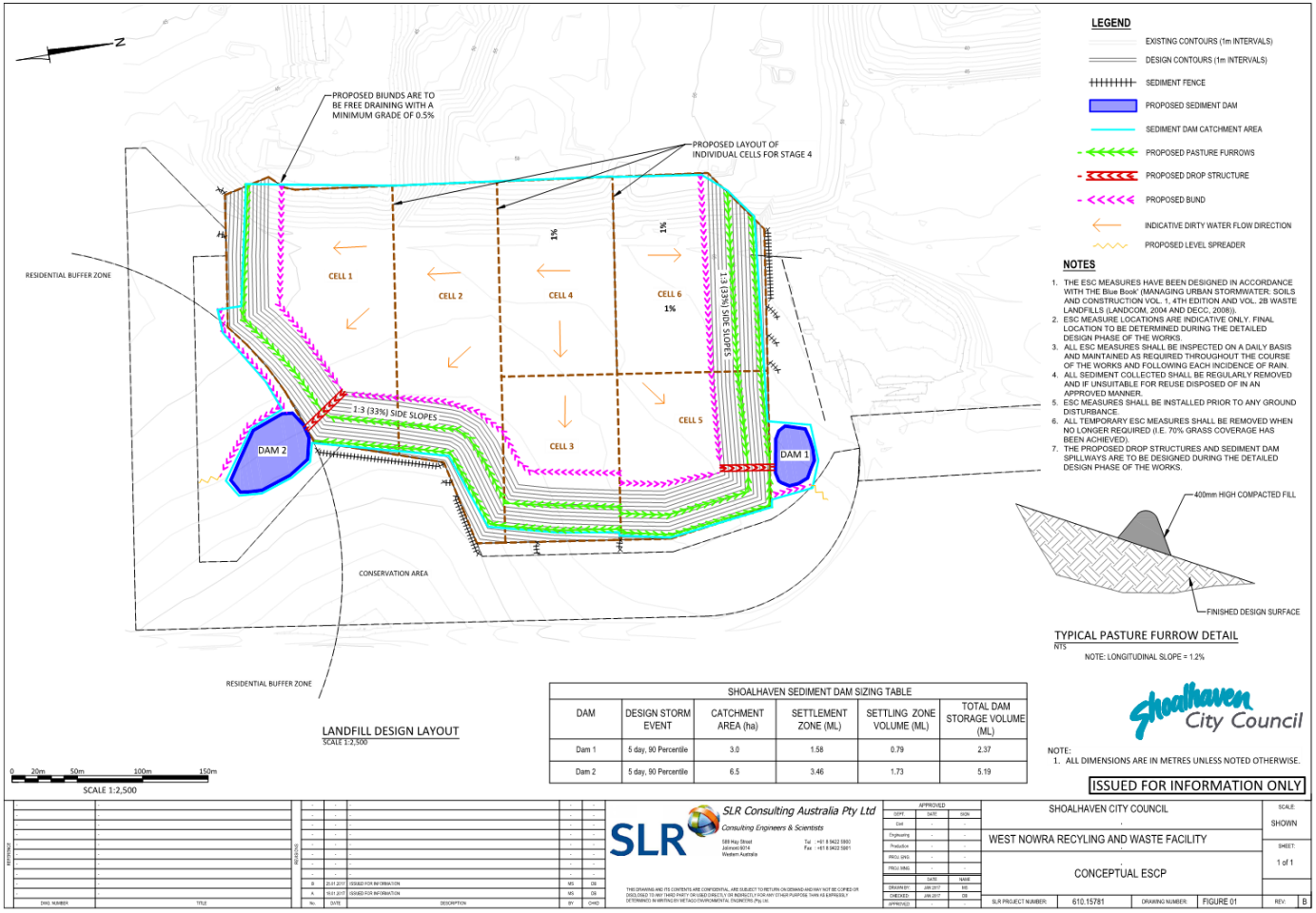


Figure 8 Conceptual ESCP for Stage 4 Extension

5 Conclusions

SLR undertook a desktop assessment to identify the following:

- Existing environment and surrounding land use including site location, description, topography, hydrology, hydrogeology, geology, soils, flooding, heritage and climate. This was undertaken to determine potential sensitive receptors and the receiving environment of the proposed development.
- Site History including a review of aerial photographs, government databases and title searches. This was undertaken to determine potential site contamination.
- Identification of potential soil and water impacts from the proposed development on the receiving environment and sensitive receptors.
- Assessment of the mitigation measures that have been proposed to remove/reduce potential soil and water impacts of the proposed development.

The receiving environments and sensitive receptors of the proposed development identified include:

- Adjacent drainage features, Cabbage Tree Creek, Sandy Creek and Shoalhaven River;
- Groundwater;
- Rural Residential Properties; and
- Rare and Endangered Fauna and Riparian Vegetation.

In relation to potential site contamination, no AECs were identified as having occurred on the Landfill extension site itself; however there is the potential for contaminated groundwater and/or surface water flow from the existing Landfill Facility to have impacted the Site area. Based on the findings of the desktop assessment the site has been deemed suitable for use as an extension of the existing Landfill.

The potential soil and water impacts resulting from both the construction and operational phases of the landfill extension site that could impact upon the identified receiving environments were identified as:

- Leachate impact on groundwater and surface waters, including riparian and protected vegetation due to overflow of existing leachate dam, irrigation of leachate and/or breach of leachate dam base and wall clay lining;
- Erosion and sedimentation of surface waters; and
- Wind-blown litter impact upon surrounding land and surface waters.

Mitigation measures have been proposed to control these potential impacts and include the following:

- A leachate management system that involves the use of the existing leachate dam and irrigation of leachate to a new and appropriate sized irrigation area in the lined Stage 2;
- Detailed erosion and sediment control plans;
- Dust suppression and litter management procedures; and

- Additional groundwater monitoring for identification of dam leachate and irrigation area seepage and/or run-off.

If the proposed mitigation measures are implemented for the landfill extension project and the new irrigation area is established as per the requirements specified in leachate report, the risk of leachate impacts upon receiving environments should be low.

6 References

Coffey Geotechnics Pty Ltd (July 2016). *Shoalhaven City Council, Geotechnical and Hydrogeological Investigation, West Nowra Recycling and Waste Facility*.

Environment & Natural Resource Solutions (ENRS). (February 2012). *Leachate Potential and Water Balance Analysis, West Nowra Waste and Recycling Facility, Flatrock Road Mundamia, NSW 2540, Environmental Protection License (EPL) 5877*. Report Prepared for Shoalhaven City Council.

Environment & Natural Resource Solutions (ENRS, 2015). *Annual Environmental Monitoring Results - 30 October 2014 – 29 October 2015, West Nowra Recycling and Waste Facility, 120 Flatrock Road, Mundamia, NSW 2540, Environmental Protection Licence (EPL) 5877*. Report Preparaed for Shoalhaven City Council.

Environment & Natural Resource Solutions (ENRS) (July 2017). *Stage 4 Land Baseline Water Quality Report, West Nowra Recycling and Waste Facility, 120 Flatrock Road Mundamia, NSW 2540, Environmental Protection License (EPL) 5877*. Report Prepared for Shoalhaven City Council.

Environment & Natural Resource Solutions (ENRS) (January 2018). *Hydrogeological Investigation – Leachate Dam, West Nowra Recycling and Waste Facility, 120 Flatrock Road Mundamia, NSW 2540, Environmental Protection License (EPL) 5877*. Report Prepared for Shoalhaven City Council.

GHD Pty Ltd. (January 2016). *Shoalhaven City Council, West Nowra Resource Recovery Park, Environmental Impact Statement, Volume 1*.

GHD Pty Ltd (December 2017). *Shoalhaven City Council, Geotechnical Investigation – Leachate Pond, Mundamia*.

GHD Pty Ltd (April 2018). *Shoalhaven City Council, Geotechnical Services, West Nowra Recycling and Waste Facility, Mundamia Report*.

Hyder Consulting (June, 2007). *Threatened Biodiversity Survey and Assessment - West Nowra. Report to Shoalhaven City Council*.

Landcom, 2004 and DECC, 2008. *'Blue Book' Managing Urban Stormwater: Soils and Construction* Vol.1, 4th Ed. and Vol.2B Waste Landfills.

NSW Department of Primary Industries. (February 2013). *Salinity hazard report for Catchment Action Plan upgrade – Southern Rivers CMA.*

SLR Consulting Australia Pty Ltd (December 2018). *West Nowra Recycling and Waste Facility Proposed Stage 4 Landfill Extension Concept Design Report* (610.15781-R01-V1.0).

SLR Consulting Australia Pty Ltd (December 2018). *West Nowra Recycling and Waste Facility Landfill Environmental Management Plan* (610.15781-R02-V1.0).

SLR Consulting Australia Pty Ltd (December 2018). *West Nowra Recycling and Waste Facility Proposed Stage 4 Landfill Extension Landfill Master Plan* (610.15781-R03-V1.0).

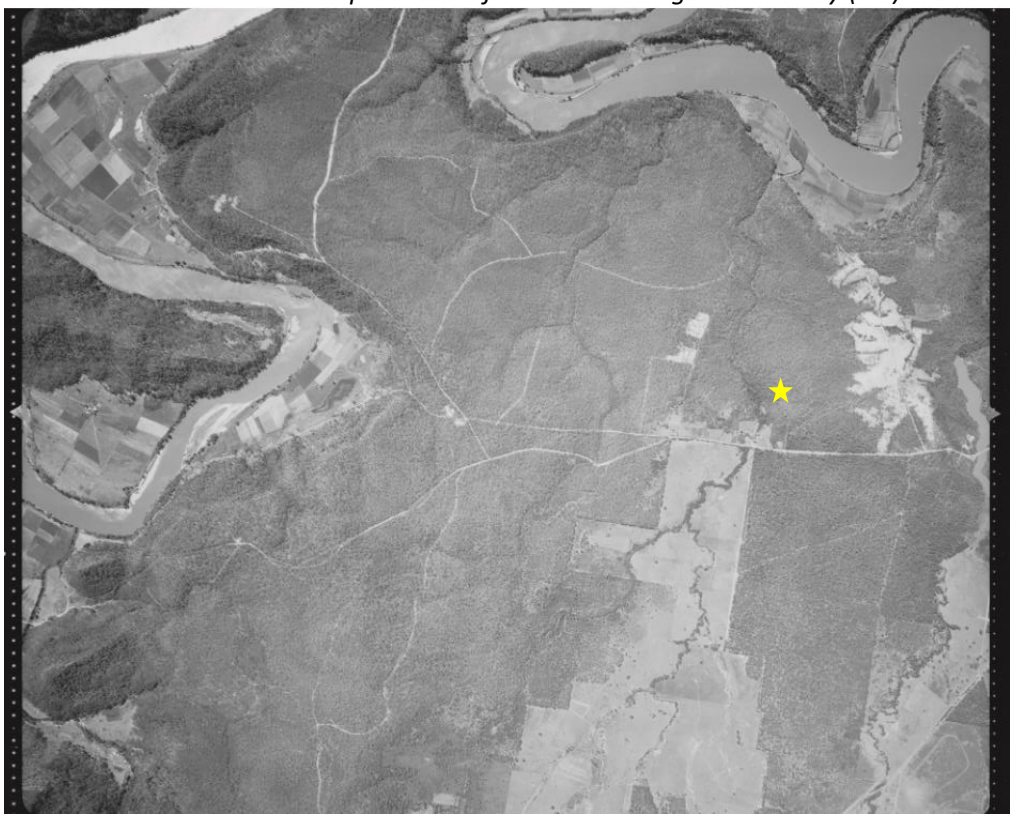
SLR Consulting Australia Pty Ltd (December 2018). Review of leachate Management Measures, West Nowra Recycling and Waste Facility (610.15781-Leachate Management-V1.0).

APPENDIX A

Historical Aerial Photographs

Photograph taken 1961

Source: NSW Government Department of Local Plannning and Industry (LPI)

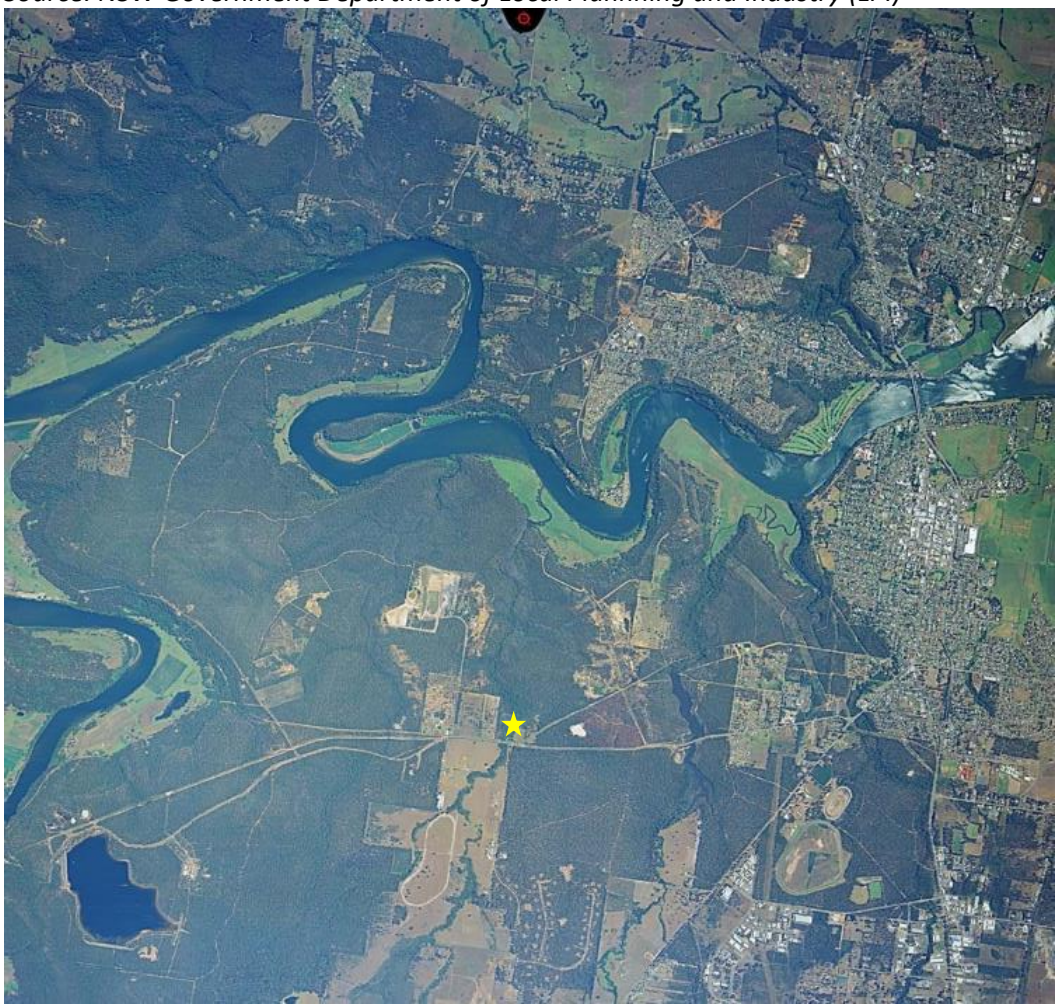


Photograph taken 1981

Source: NSW Government Department of Local Plannning and Industry (LPI)

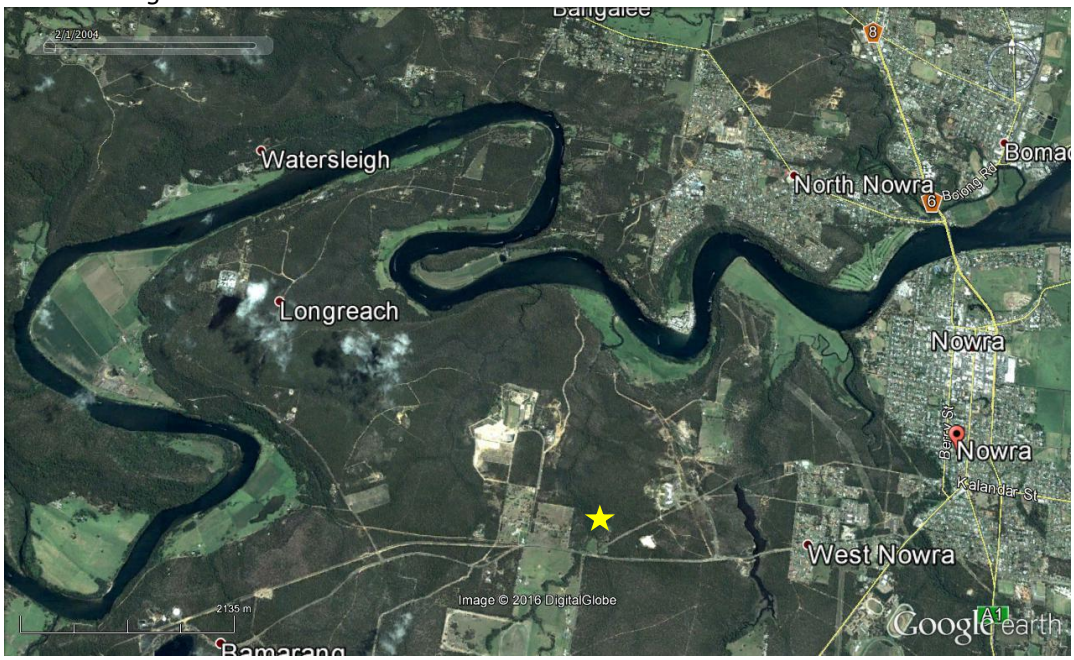
Photograph taken 1997

Source: NSW Government Department of Local Plannning and Industry (LPI)



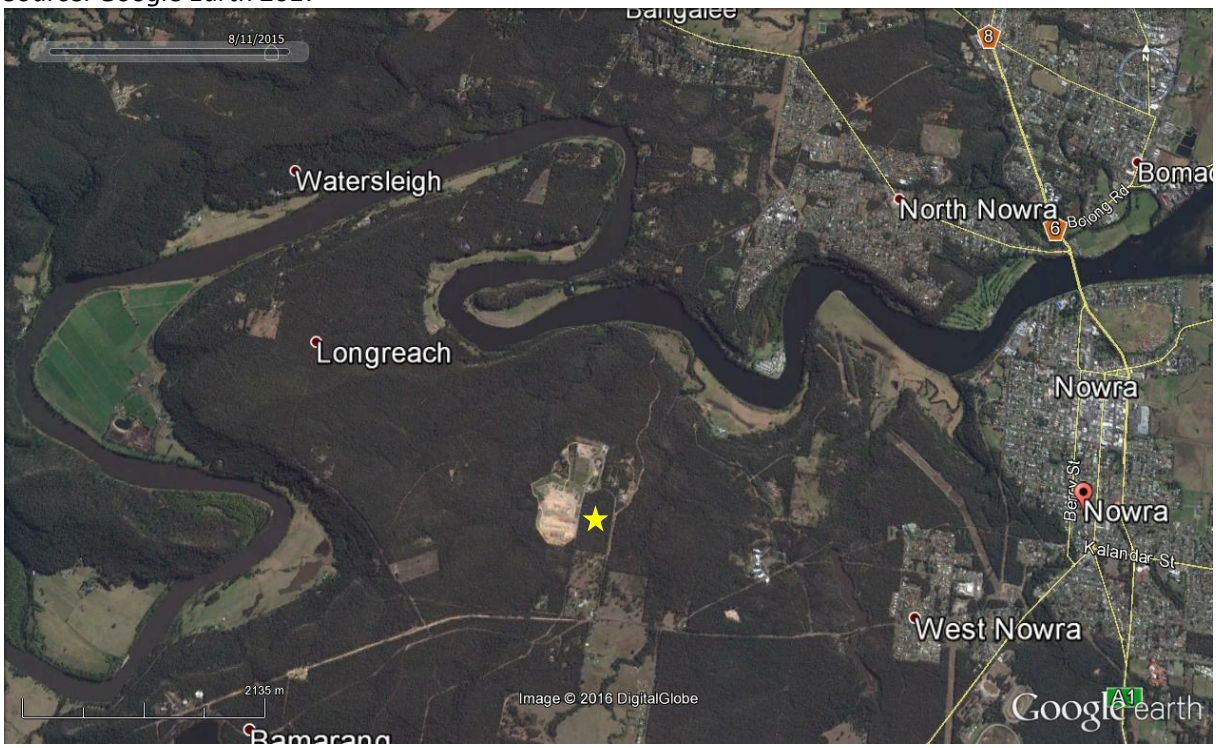
Photograph taken 2004

Source: Google Earth 2017



Photograph taken 2015

Source: Google Earth 2017



APPENDIX B

Historical Title Search

NSW Land & Property Information

Cadastral Records Enquiry Report

Requested Parcel : Lot 1 DP 1104402

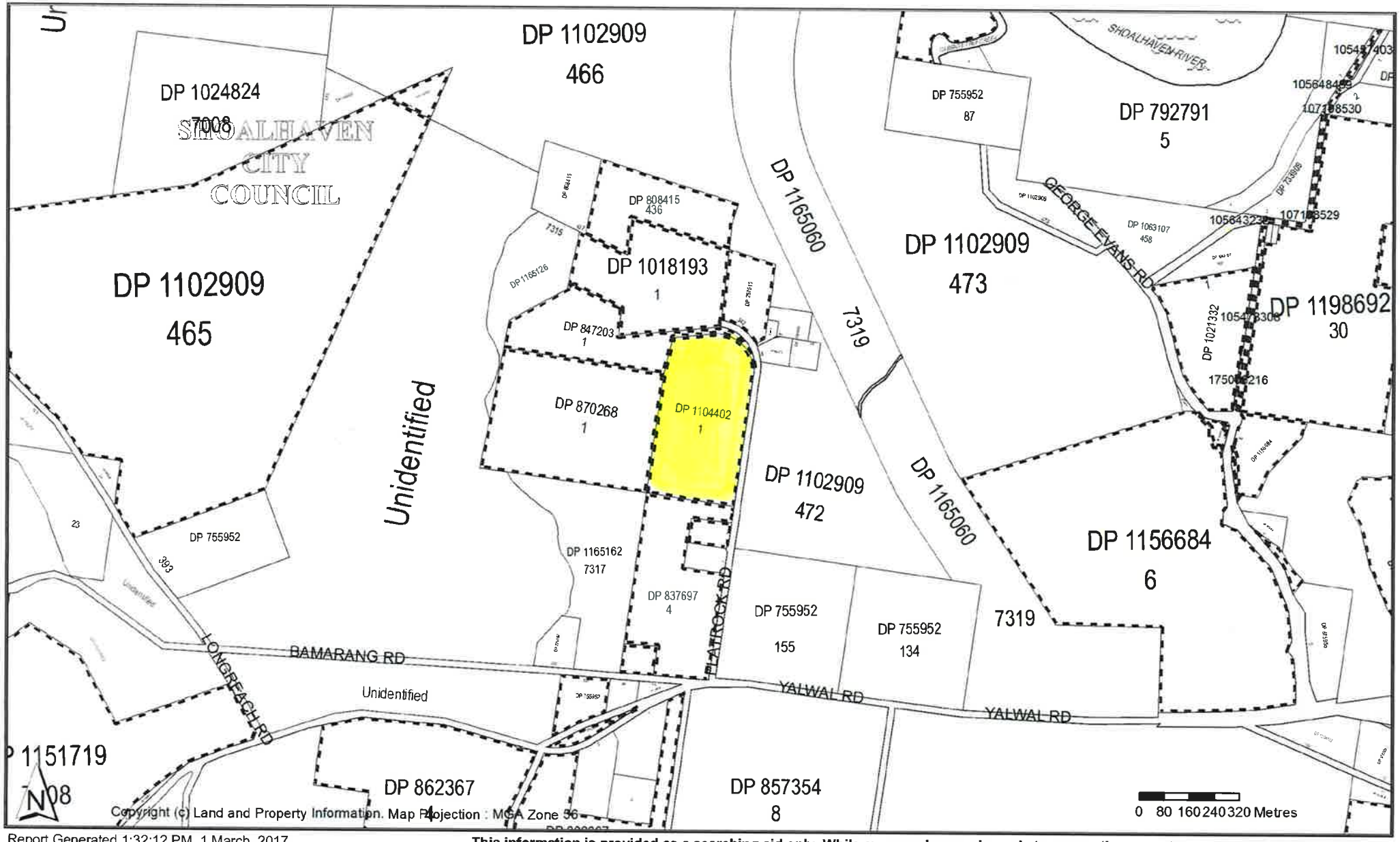
Identified Parcel : Lot 1 DP 1104402

Locality : MUNDAMIA

LGA : SHOALHAVEN

Parish : NOWRA

County : ST VINCENT



Report Generated 1:32:12 PM, 1 March, 2017

This information is provided as a searching aid only. While every endeavour is made to ensure the current cadastral pattern is accurately reflected, the Registrar General cannot guarantee the information provided. For all ACTIVITY PRIOR to SEPT 2002 you must refer to the RGs Charting and Reference Maps.

PLAN FORM 2 — Plan Drawing only to appear in this space — ePlan

SIGNATURES AND SEALS ONLY.

FOR SIGNATURES, SEALS AND CERTIFICATES SEE SIGNATURES FORM

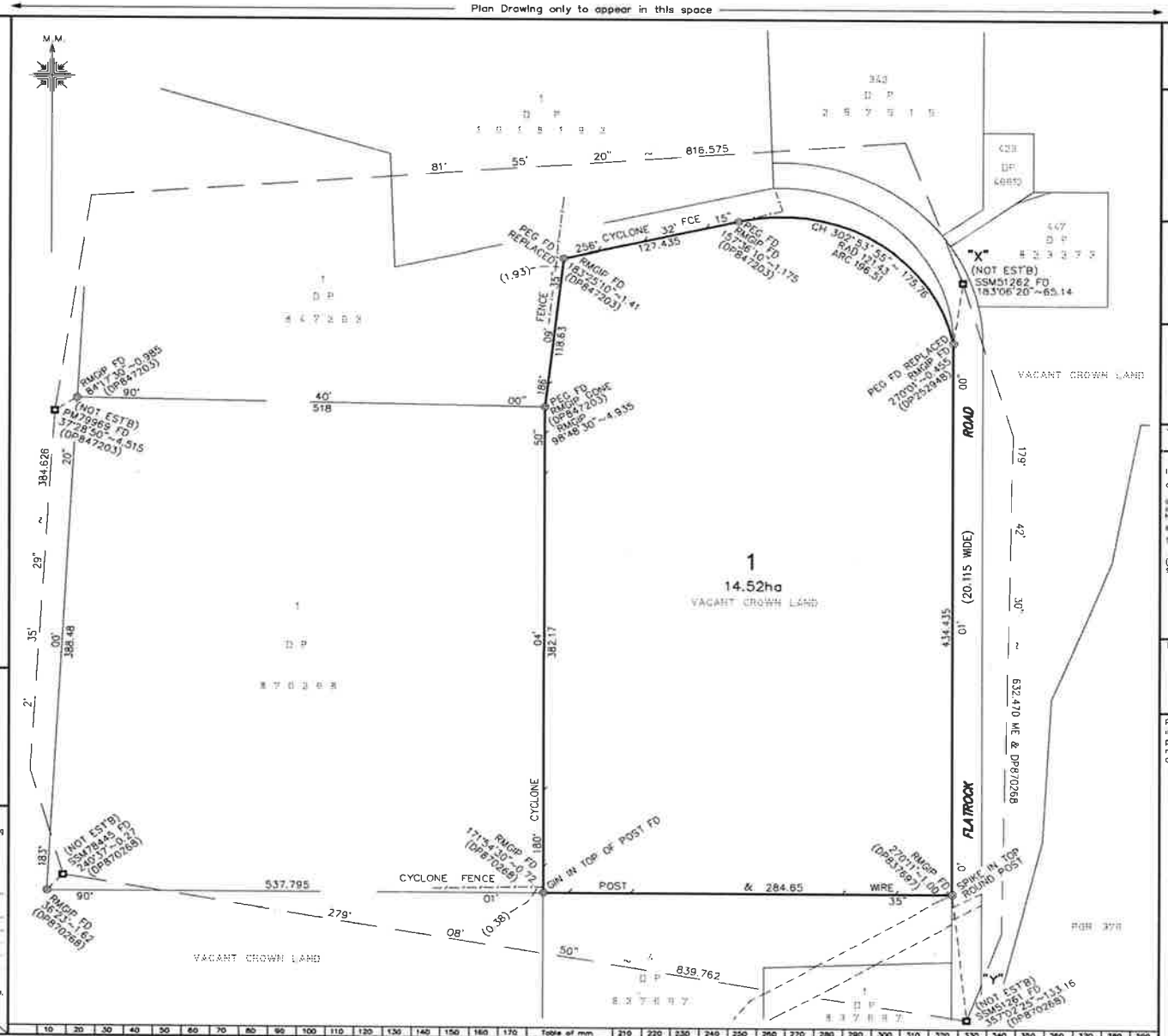


Table of mm: 10 20 30 40 50 60 70 80 90 100 110 120 130 140 150 160 170 210 220 230 240 250 260 270 280 290 300 310 320 330 340 350 360 370 380 390

WARNING: CREASING OR FOLDING WILL LEAD TO REJECTION

Department of Lands Approval

I PETER GILSON (Authorised Officer) in approving this plan certify that all necessary approvals in regard to the allocation of the land shown hereon have been given.

Signature: SEE SIGNATURES FORM

Date: 10 OCTOBER 2006

File Number: NA86H141

Office: NOWRA

Subdivision Certificate

I certify that the provisions of s.109J of the Environmental Planning and Assessment Act 1979 have been satisfied in relation to the proposed ~~subdivision / new road~~ set out herein

SEE SIGNATURES FORM
* Authorised Person/General Manager/Accredited Certifier

Consent Authority:

Date of endorsement:

Accreditation no:

Subdivision Certificate no:

File no:

Note
When the plan is to be lodged electronically in the land Titles Office, it should include a signature in an electronic or digital format approved by the Registrar-General.
* Delete whichever is inapplicable

SURVEYOR'S REFERENCE: SR17-2006 "CHECKLIST" 2006M7100(835) SURVEY

DP1104402

Registered: 8/11/2006

Title System: CROWN LAND

Purpose: ACQUISITION (NOT A CURRENT PLAN AT REGISTRATION)

Ref.Map: PARISH#

Last Plan:

PLAN OF

LAND TO BE ACQUIRED FOR THE PURPOSES OF THE LOCAL GOVERNMENT ACT 1993.

Lengths are in metres. Reduction Ratio 1:2000

L.G.A. SHOALHAVEN

Locality: BAMARANG

Parish: NOWRA

County: ST. VINCENT

This is ~~sheet 1 of my plan in~~ sheets (Delete if inapplicable)

Surveying Regulation, 2001

I, STEPHEN MICHAEL ROBINSON

of SHOALHAVEN CITY COUNCIL PO. BOX 42 NOWRA 2541.

a surveyor registered under the Surveying Act, 2002 hereby certify that the survey represented in this plan is accurate, has been made in accordance with the Surveying Regulation 2001 and was completed on 20/07/2006

The survey relates to LOT 1

(here specify the land actually surveyed or specify any land shown in the plan that is not the subject of the survey)

(Signature) SEE SIGNATURES FORM
Surveyor registered under the Surveying Act, 2002

Datum line "X"—"Y"

Type : ~~Urban~~/Rural

Plans used in preparation of survey/~~compilation~~

DP870268
DP847203
DP252948

PANEL FOR USE ONLY for statements of intention to dedicate public roads or to create public reserves, drainage reserves, easements, restrictions on the use of land or positive covenants

LOT 1 IS TO BE ACQUIRED.

* OFFICE USE ONLY

CERTIFICATES, SIGNATURES AND SEALS Sheet 1 of 1 sheet(s)

PLAN OF

LAND TO BE ACQUIRED FOR THE PURPOSES OF THE LOCAL GOVERNMENT ACT 1993.

* DP1104402

Registered: 8/11/2006

* OFFICE USE ONLY

Surveying Regulation 2001

I, ...STEPHEN MICHAEL ROBINSON.....
of .....SHOALHAVEN CITY COUNCIL.....
PO. BOX 42 NOWRA 2541
a surveyor registered under the *Surveying Act 2002*, certify that the survey represented in this plan is accurate, has been made in accordance with the *Surveying Regulation 2001* and was

completed on:...20/07/2006.....

The survey relates to...LOT 1.....

.....

(specify the land actually surveyed or specify any land shown in the plan that is not the subject of the survey)

Signature .....*Dated: 20/7/2006*
Surveyor registered under the Surveying Act 2002

Datum Line:.....*"X"-"Y"*.....
Type: ~~Urban~~/Rural

Department of Lands Approval

I.....PETER GILSON.....in approving this plan certify
(Authorised Officer)
that all necessary approvals in regard to the allocation of the land shown herein have been given

Signature:.....
Date:.....10 October 2006.....
File Number:.....NA 86 H 141.....
Office:.....NOWRA.....

Subdivision Certificate

I certify that the provisions of s.109J of the Environmental Planning and Assessment Act 1979 have been satisfied in relation to:

the proposed..... set out herein
(insert 'subdivision' or 'new road')

.....
* Authorised Person/General Manager/Accredited Certifier

Consent Authority: .....
Date of Endorsement: .....
Accreditation no: .....
Subdivision Certificate no: .....
File no: .....1056.....

Note:
When the plan is to be lodged electronically in Land and Property Information, it should include a signature in an electronic or digital format approved by the Registrar-General.

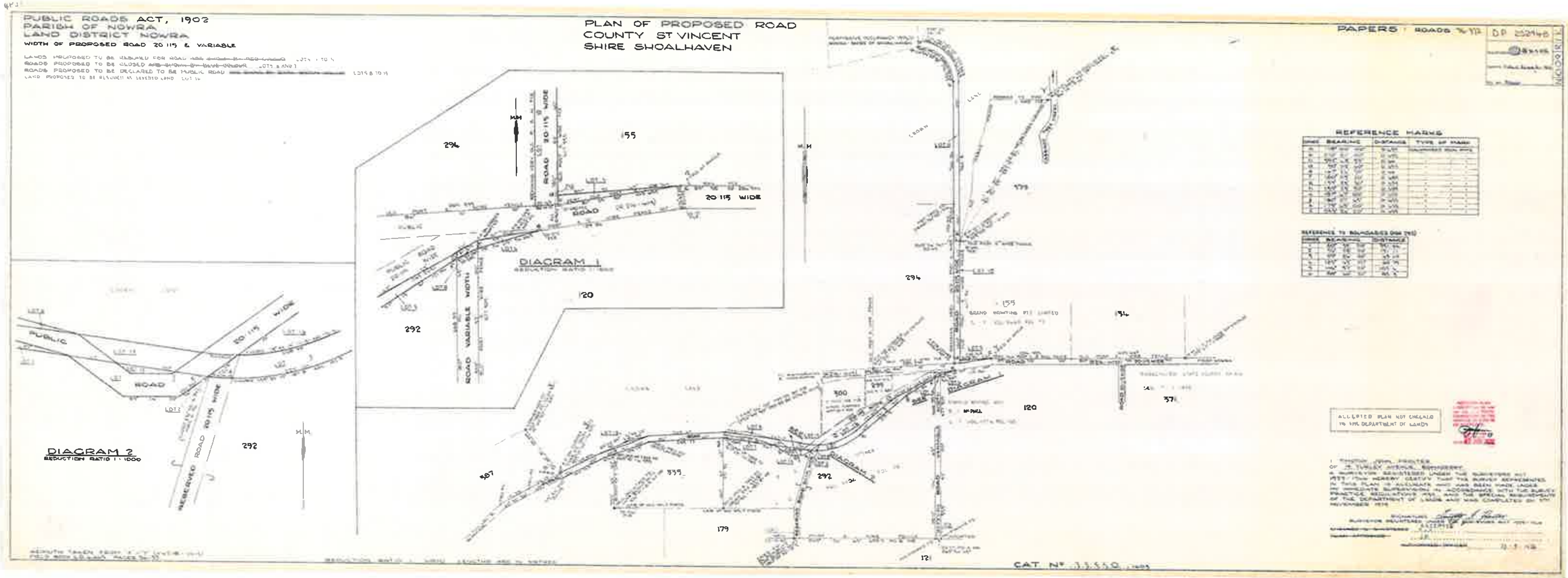
* Delete whichever is inapplicable.

SIGNATURES, SEALS and STATEMENTS of intention to dedicate public roads or to create public reserves and drainage reserves.

LOT 1 IS TO BE ACQUIRED.

Use PLAN FORM 6A for additional certificates, signatures and seals

SURVEYOR'S REFERENCE: SR17-2006


PUBLIC ROADS ACT, 1902
PARISH OF NOWRA
LAND DISTRICT NOWRA
WIDTH OF PROPOSED ROAD 20.115 & VARIABLE
PLAN OF PROPOSED ROAD
COUNTY ST VINCENT
SHIRE SHOALHAVEN
PAPERS ROADS
DP 252948
DIAGRAM 1
DIAGRAM 2
REDUCTION RATIO 1:1000
ROAD VARIABLE WIDTH
ROAD 20.115 WIDE
20.115 WIDE
RESERVED ROAD 20.115 WIDE
PUBLIC ROAD
REFERENCE MARKS
ALLEGED PLAN NOT CHECKED IN THE DEPARTMENT OF LANDS
CAT Nº 33550

Division
Resumed Area No.
Pastoral Holding

90/4572

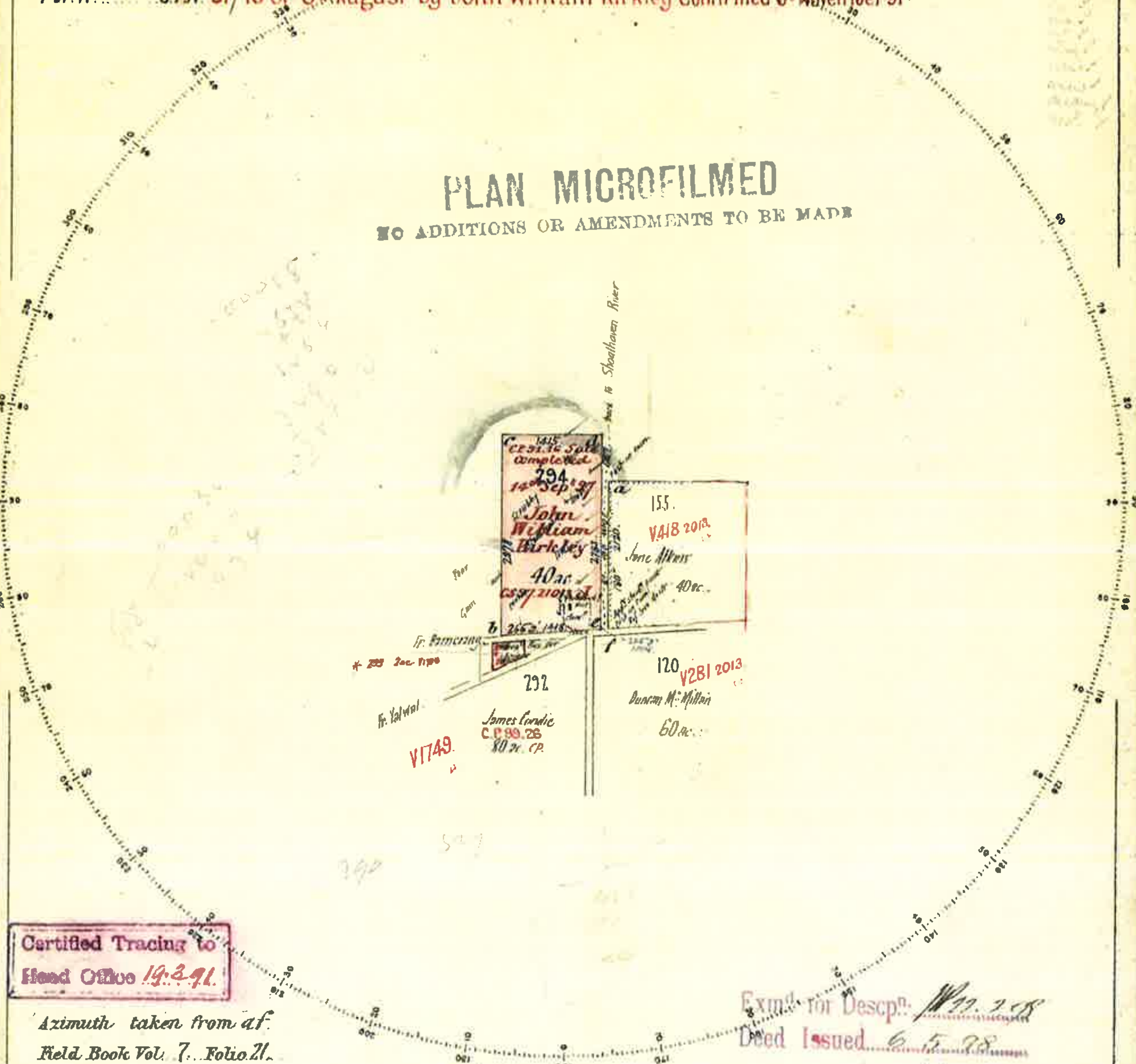
PLAN OF PORTION 294

County of St Vincent   Parish of Nowra

LAND DISTRICT OF NOWRA   LAND BOARD DISTRICT OF GOULBURN

Applied for under the 26th Section of the Crown Lands Act of 1884 by ~~J.R.H Webster~~
John Richard Henry Webster

Por: No. C.P. No 90/16 of 14th August. Disallowed 30th July, 1891.
Por: No. C.P.No 91/16 of 6th August by John William Kirkley Confirmed 6th November 91



PLAN MICROFILMED
NO ADDITIONS OR AMENDMENTS TO BE MADE

Certified Tracing to Head Office 19.3.91.

Exmd for Descpn. W. 11.2.98
Deed Issued 6.5.98

Azimuth taken from a f.
Field Book Vol. 7. Folio 21.

Reference to Corners

Corner	Bearing	From	Links	No. on Tree
a	55°40'	Red Gum	40¼	155
b	33°0'	Gum	60¾	294
c	33°0'	Bloodwood	31	294
d	54°0'	Bloodwood	36½	294
e	268°45'	Telegraph Pole	47	294

1783-2013

Reference to Traverse

Line	Bearing	Distance
	Acs. 80.14 80.00 4.94 1.00 4 corners 100% increase Passed 24.1.91	

Situated in the
Value of Improvements Hut, frame £1.
Felling 10/-

I hereby certify that I in person made and on the 15th Sept. 1890 completed the survey represented on this plan, on which are written the bearings and lengths of the lines measured by me, and I declare that the survey has been executed in accordance with the regulations published for the guidance of Licensed Surveyors and the practice of the Departments of Lands.

Fred Anderson Licensed Surveyor

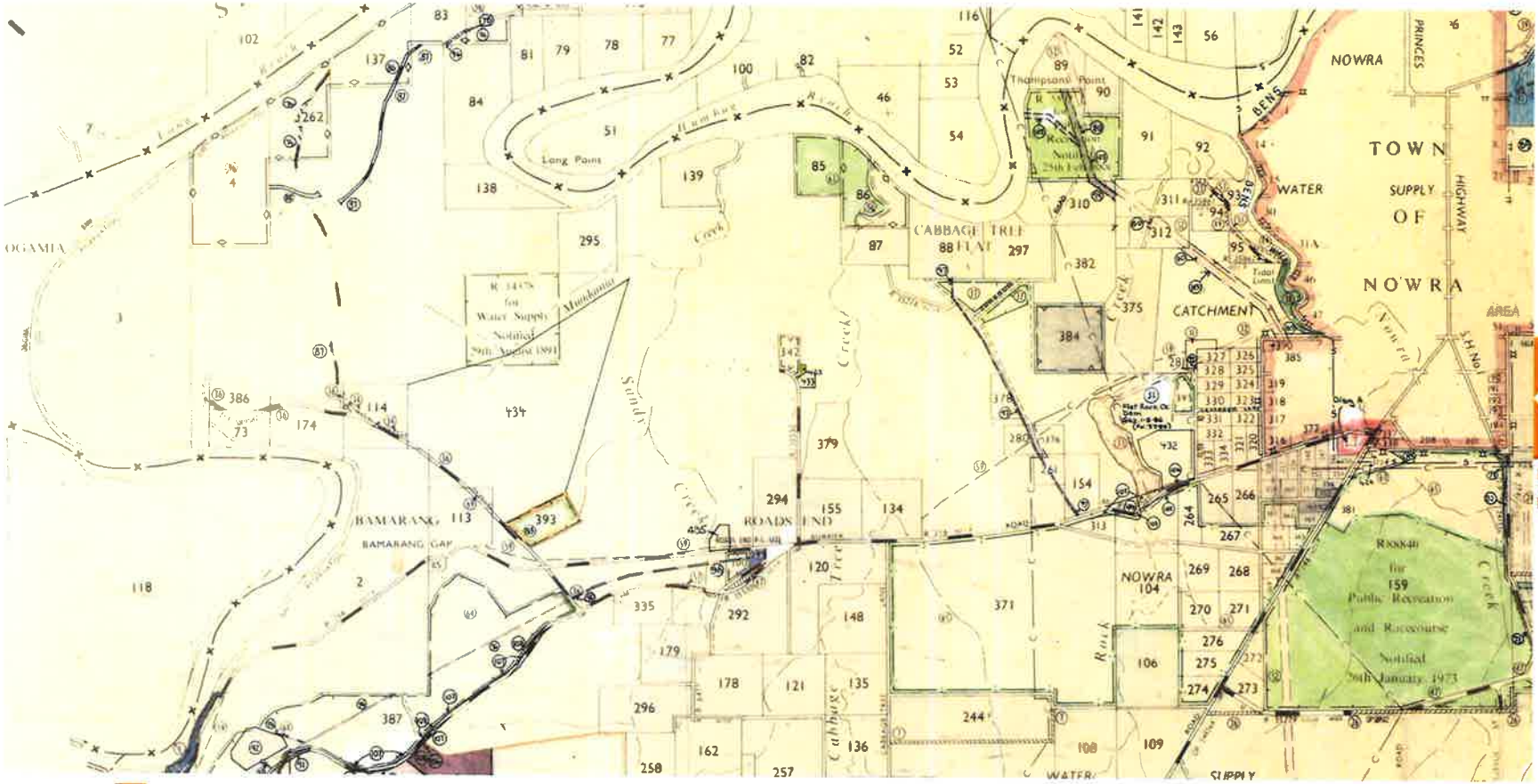
Transmitted to the District Surveyor with my letter of 25th September 1890 No. 60

Voucher No. Passed
Calculation Book No 1386 Folio 43
Checked and Charted C.W. Balthausen 31st Jany, 1891.
Examined

Plan approved 25 Feb. 1891.

Scale 20 Chains to an Inch. J.W. Deering District Surveyor

V1783 2013



roperty
on

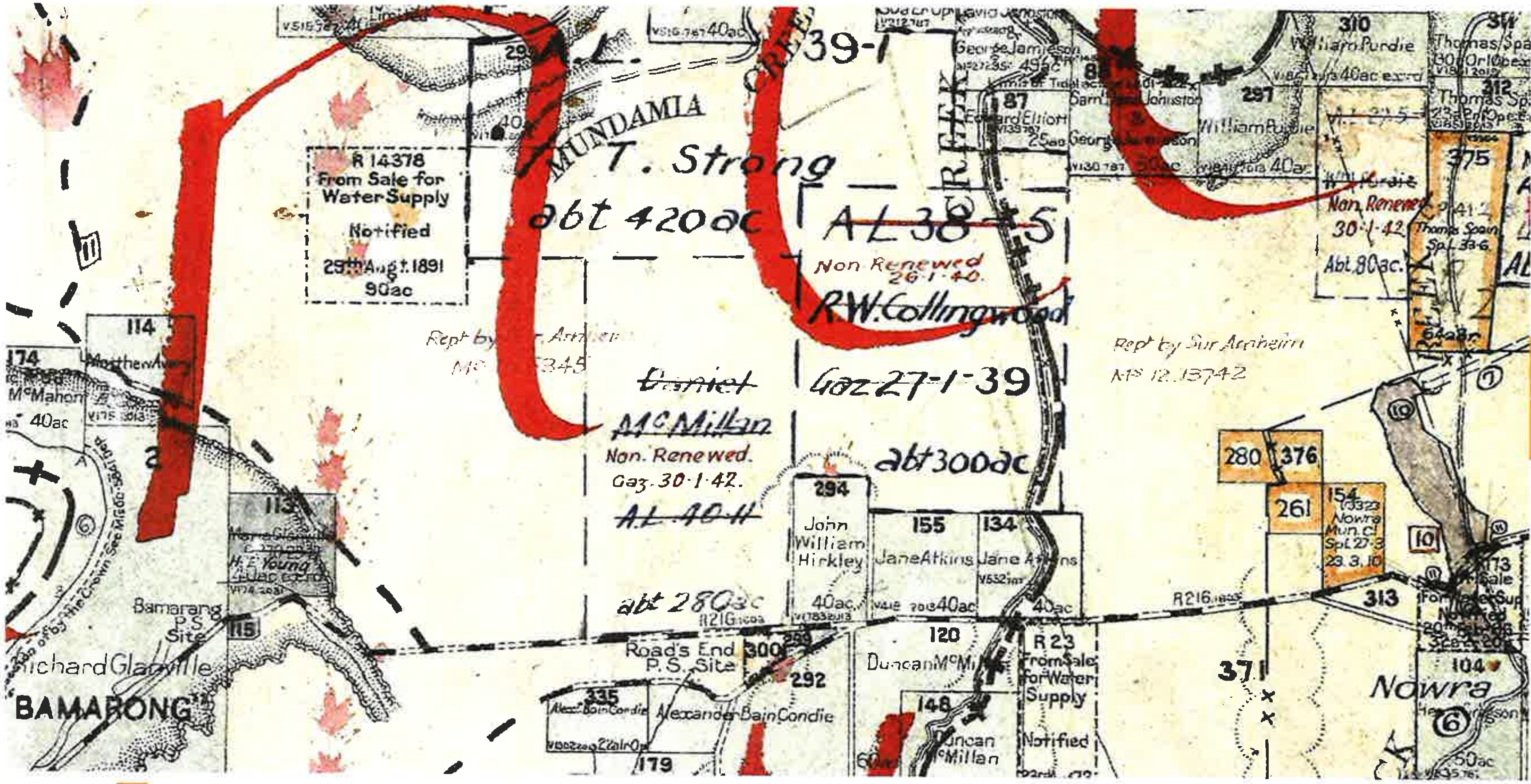
Search By:
Keyword
Attribute
Lot
Plan Lodgement Book

Search By: Parish name
For: nowra
Nowra
Nowranie
Get results

Search For: HIDE
- All Collections
- Charting Maps
- Old Form Torrens Register
- Plan Lodgement Book
- Historical Parish Maps
- Old System Records
- Torrens Purchasers Index 1863-1971
- General Register of Deeds (Old System Deeds)

Zoom 1

Search results: (10 documents found)
Image name: County of St Vincent Parish of... Res: 1:2.68 More information: Progress:



Search results: (10 documents found)

Image name: Parish of Nowra Res: 1:0.26

More information: Progress:

roperty
on

Search By:

Keyword
Attribute
Lot
Plan Lodgement Book

Search By: Parish name

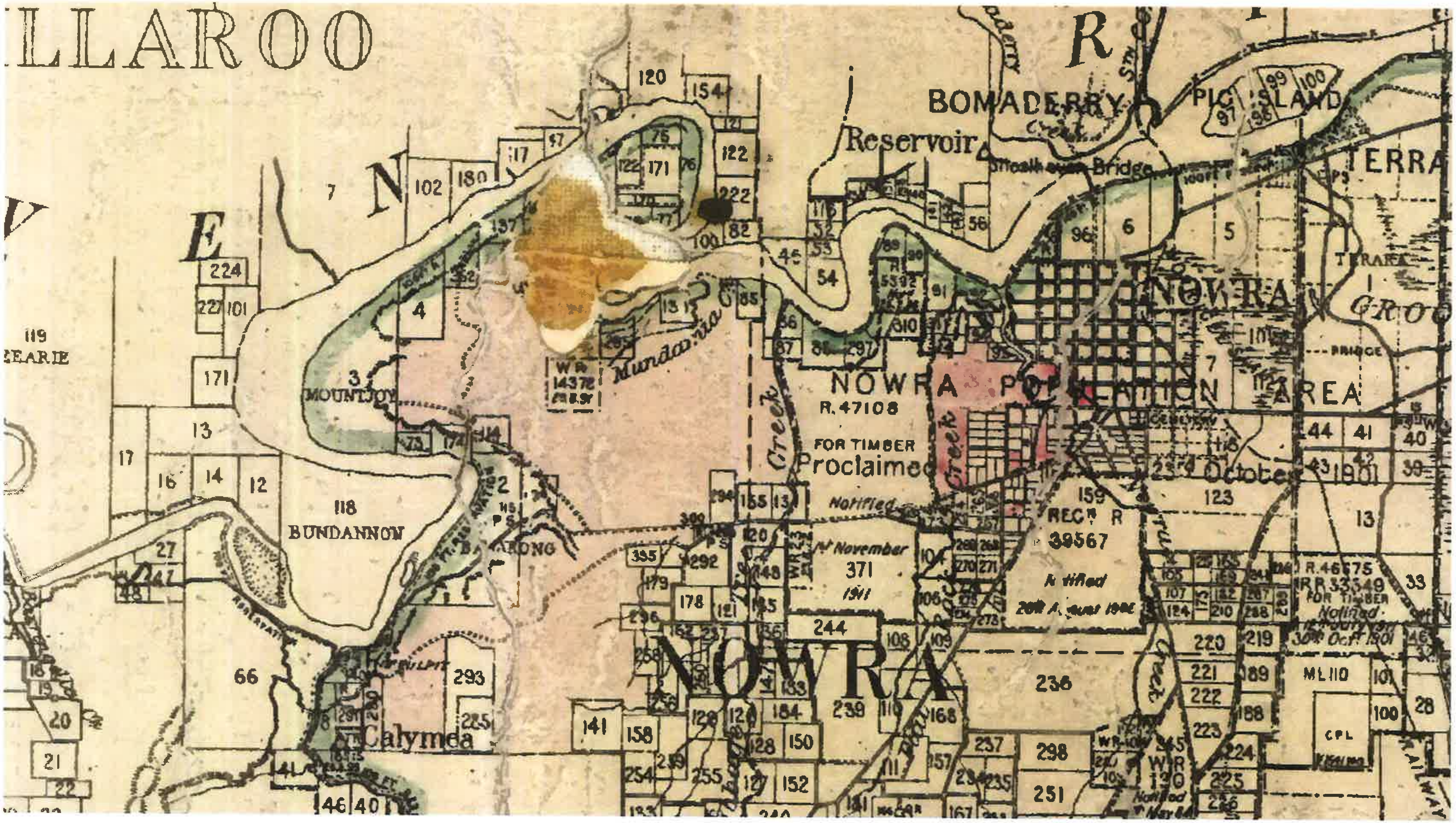
For: nowra

Nowra
Nowranie

Get results

Search For:

- All Collections
- Charting Maps
- Old Form Torrens Register
- Plan Lodgement Book
- Historical Parish Maps
- Old System Records
- Torrens Purchasers Index 1863-1971
- General Register of Deeds (Old System Deeds)


LLAROO
BOMADERRY
Reservoir
Shoalhaven Bridge
PIG ISLAND
TERRA
NOWRA
NOWRA POPULATION AREA
R. 47108
FOR TIMBER
Proclaimed
Notified
1st November
371
1911
RECN R
39567
Notified
20th August 1905
R.46575
RR 33549
FOR TIMBER
Notified
30th Oct. 1901
Mundamia Ck
Creek
MOUNTJOY
BUNDANNON
BARRENGARRY
Calymea
REARIE
ML 110
CPL
RAILWAY
BRIDGE
Cemetery
October 1901

APPROVAL OF ANNUAL LEASE APPLICATIONS.

(472) Sydney, 27th January, 1939.

NOTICE is hereby given that the applications for Annual Leases hereunder specified have been approved.

No rights will accrue to the applicants until the rents as hereunder specified shall have been paid, but upon payment of such rent they will be entitled to leases, subject to the provisions of the Crown Lands Consolidation Act, 1913, and Regulations thereunder, and particularly to the following conditions, provisions, reservations, and covenants:—

The amounts called for to 31st December, 1939, must be paid into the Treasury, or to the Land Agent of the District, within one month from this date. For the year 1940, and any subsequent year, the rents must be paid during the month of September of the year preceding. As the leases are annual, terminating on the 31st December in each year, the renewal rents must be paid in advance, otherwise the lands will, immediately after the 31st December, become and be liable to be dealt with as vacant Crown Lands.

Any amount which has been paid in excess will be refunded upon application to the State Treasury.

The leases are subject to the provisions of Regulation 101 under the Crown Lands Consolidation Act, 1913, and in certain cases to the special conditions set out in footnotes indicated in the last column of the appended Schedule by letters opposite the leases affected.

COLIN A. SINCLAIR, Minister for Lands.

No. of Application and Land District.	Name of Lessee.	Address.	Area of Lease.	Parish.	County and Shire.	Annual Rent.	Amount already paid as Deposit.	Date of Payment.	Amount now required, being the rent from 1st Feb., 1939, to 31st Dec., 1939, less deposit lodged with Application.	Amount to credit of lessee after deducting rent for period 1st Feb., 1939, to 31st Dec., 1939, fr. m deposit lodged with Application	Index to Special Conditions at foot of Schedule.
			a. r. p.			£ s. d.	£ s. d.		£ s. d.	£ s. d.	
1938-1, Bellingen..	Greenhalgh, Francis Albert	Meldrum, via Dorrigo.	21 2 12 Acres.	Meldrum Downs,	Fitzroy; Dorrigo	1 5 0 Per. acc.	1 10 0 at 2s. 1d.	3 Mar., 1938 per month from	0 1 3 1 Oct., 1938.	.....	A
1938-8, Braidwood.	O'Heir, James	Major's Creek... ...	320	Tallaganda ...	St. Vincent; Tallaganda...	1 6 8 Per. acc.	1 10 0 at 2s. 3d.	15 Aug., 1938 per month from	0 5 7 1 Sept., 1938.	....	A
1938-2, Inverell ..	Taylor, David Francis ..	Box 2, Tingara ...	15	Cope's Creek and Swinton.	Hardinge; Guyra	1 0 0 Per. acc.	1 10 0 at 1s. 8d.	10 June, 1938 per month from 4 Oct., 1938	.... 4 Oct., 1938.	0 5 1	AB
1938-3, ,, ..	O'Brien, Edward and O'Brien, William Walter..	Inverell	900	Mayo... ...	Hardinge; Guyra... ..	7 10 0 Per. acc.	3 0 0 at 12s. 6d.	14 June, 1938 per month from	5 17 6 26 Oct., 1938.	....	ABC
1938-65, Lithgow..	McMullen, Henry ...	11 Grosvenor-crescent, Summer Hill.	500	Lett	Cook; Blaxland	2 1 8 Per. acc.	3 0 0 at 3s. 6d.	22 Aug., 1938 per month from	.... 1 Jan., 1939.	0 18 4	ADEF
1938-8, Mudgee ...	Morgan, Charles Allen ..	Cooyal	50	Moolarben ...	Phillip; Cudgegong ...	1 0 0 Per. acc.	1 10 0 at 1s. 8d.	1 Sept., 1938 per month from	..... 24 Sept., 1938.	0 4 7	A
1938-4, ,, ...	James, George William ...	Lofty Ranges, Yarrabin-road, via Mudgee	8	Werocata ...	Wellington, Cudgegong ...	1 0 0 Per. acc.	1 10 0 at 1s. 8d.	11 Oct., 1938 per month from	..... 31 Oct., 1938.	0 6 7	A
1938-5, Nowra ...	Collingwood, Robert William.	Oak Flats, Nowra ...	30)	Nowra ...	St. Vincent, Clyde and Nowra.	2 10 0 Per. acc.	1 10 0 at 4s. 2d.	25 Sept., 1938 per month from	1 5 11 19 Nov., 1938.	.....	A
1938-5, Rylstone ...	Hutchison, William Ernest.	Ben Bullen ...	22)	Coco ...	Roxburgh, Blaxland ...	1 6 8 Per. acc.	1 10 0 at 2s. 3d.	28 Oct., 1938 per month from	..... 1 Dec., 1938.	0 1 1	A
1938-3, ,, ...	Hutchison, William Ernest.	Do ...	640	do ...	do ...	2 13 4 Per. acc.	3 0 0 at 4s. 5d.	7 Nov., 1938 per month from	..... 1 Dec., 1938.	0 2 2	A

APPROVAL OF ANNUAL LEASE APPLICATIONS—*continued.*

No. of Application and Land District.	Name of Lessee.	Address.	Area of Lease.	Parish.	County and Shire.	Annual Rent.	Amount already paid as Deposit.	Date of Payment.	Amount now required, being the rent from 1st Feb., 1939, to 31st Dec., 1939, less deposit lodged with Application.	Amount to credit of lessee after deducting rent for period 1st Feb., 1939, to 31st Dec., 1939, from deposit lodged with Application.	Index to Special Conditions at foot of Schedule.
			Acres.			£ s. d.	£ s. d.		£ s. d.	£ s. d.	
1939-1, Tenterfield.	Harte, Philip Percy ...	Boonoo Boonoo, Tenterfield.	1220	Carroll ..	Buller; Tenterfield ...	5 2 6	6 0 0	31 Mar., 1938	2 1 9	....	A
						Per. acc.	at 6s. 7d.	per month from	4 June, 1938.		
1939-2, „ ...	Cubbleston, John	Kyoomba, via Stanthorpe, Queensland.	220	Ruby	do	2 10 0	1 10 0	8 Apr., 1938	1 19 7	.....	A
						Per. acc.	at 4s. 2d.	per month from	11 Aug., 1938.		
1939-6, Tumbarumba.	Mullins, George Arthur John	Adelong-road, Tumbarumba.	12	Tumbarumba	Selwyn; Tumbarumba ..	1 0 0	1 10 0	19 Aug., 1938	.....	0 7 6	G
						Per. acc.	at 1s. 8d.	per month from	17 Nov., 1938.		
1939-7, „ ...	Wells, Alexander Jacob ...	Tumbarumba	5½	do ...	do	1 0 0	1 10 0	5 Sept., 1939	.....	0 7 6	G
						Per. acc.	at 1s. 8d.	per month from	16 Novr, 1938.		

SPECIAL CONDITIONS.

(a) An average of not less than five (5) matured or semi-matured trees of honey-producing value shall be left to each acre for shade, shelter, and honey provision.

(b) Permission to fence shall not be granted without reference to the Mines Department.

(c) The lessee shall keep the area free of prickly-pear during the term of the lease.

(d) The lease is limited to the surface and to a depth of fifty (50) feet below the surface.

(e) Mining operation may be carried on upon and in the lands below the land leased, and upon and in the lands adjoining the land leased, and the lands below the same and metals and minerals may be removed therefrom, and His Majesty the King and the Government of New South Wales, and any lessee or lessees under any Mining Act or Acts of the said State shall not be subject to any proceedings by way of injunction or otherwise in respect of or be liable for any damage whatsoever occasioned by the letting down subsidence or lateral movement of the land hereby leased or any part thereof, or otherwise howsoever by reason of the following acts and matters that is to say, by reason of His Majesty or the said Government or any person on behalf of His Majesty or the said Government or any lessee or lessees aforesaid, having worked or now or hereafter working any mines or having carried on or now or hereafter carrying on mining operations, or having searched for, worked, won, or removed, or now or hereafter searching for, working, winning or removing any metals or minerals under, in, or from the lands lying beneath the land hereby leased or any part thereof, or on, in, under, or from any other lands situated laterally to the land hereby leased or any part thereof, or the lands lying beneath the same, and whether on or below the surface of such other lands and by reason of the acts and matters aforesaid or in the course thereof His Majesty the King reserves the liberty and authority for himself and the Government of the said State, and any person on behalf of His Majesty or the said Government, and any lessee or lessees as aforesaid from time to time let down without payment of any compensation whatsoever any part of the land hereby leased and/or of the surface thereof.

(f) The right of free access at all times to the railway lands and power transmission lines adjoining the land leased is reserved.

(g) No timber on the land shall be interefered with by ringbarking or otherwise.

RESUMPTION APPLICATION affecting land NOT under the provisions of the Real Property Act 1900 New South Wales Section 31A(2) Real Property Act 1900	Form: 00RA Release: 2.1 www.lands.nsw.gov.au	PA82444W	top *the* *tion*

PRIVACY NOTE: Section 31B of the Real Property Act 1900 (RP Act) authorises the Registrar General to collect the information required by this form for the establishment and maintenance of the Real Property Act Register. Section 96B RP Act requires that the Register is made available to any person for search upon payment of a fee, if any.

(A) **LODGED BY**

Document Collection Box	Name, Address or DX, Telephone, and LLPN if any	Reference
	35D LLPN: 123005 B OCB00826 SHOALHAVEN MORRIS, HAYES & EDGAR DX [illegible] SYDNEY PH: 9232-2411 AS AGENTS FOR	

(B) **LAND DESCRIPTION**

Lot No.	Plan No.	Location
1	1104402	Bamarang

(C) **DESCRIPTION OF EASEMENT (if applicable)**

Torrens Title	Whole or Part of Easement	Location

(D) **APPLICANT**

THE COUNICL OF THE CITY OF SHOALHAVEN

(E) In consequence of the resumption notified in Government Gazette dated 07 December 2007 folio 9523 , a true copy of which is attached hereto as annexure "A" , the applicant applies to the Registrar General for creation of a folio of the Register for the land resumed. and for the issue of a Certificate of Title for the land resumed

(F) I, ALEX EDWARD LOVE , the authorised officer of the applicant signing below, certify that—

1. I am authorised to sign this application on behalf of the applicant;
2. the land has not been divested from the applicant and no estate or interest in the land has been created in favour of any other person;
3. the land is not under the provisions of the Real Property Act 1900 and no sale, lease or other transaction affecting it is intended to be completed prior to the issue of the folio of the Register; and
4. this application is correct for the purposes of the Real Property Act 1900.

DATE 20 December 2007

I certify that the person named above, an authorised officer of the applicant with whom I am personally acquainted or as to whose identity I am otherwise satisfied, signed this application in my presence.

Signature of witness:

Signature of authorised officer:

Name of witness : Richard Creasy

Address of witness : 34 Carrington Park Drive
Nowra NSW 2541

APPLICATION DATED 20TH DECEMBER MADE BY SHOALHAVEN CITY COUNCIL

GREAT LAKES COUNCIL

Roads Act 1993, Section 162

Roads (General) Regulation 2000

Naming of Roads

NOTICE is hereby given that Great Lakes Council, pursuant to the aforementioned Act and Regulation, has named the roads described hereunder. KEITH O'LEARY, General Manager, Great Lakes Council, Breese Parade, Forster, NSW 2428.

The notice published by Great Lakes Council in the *Government Gazette* No. 192 on 29 December 2006, folio 2866 requires amending.

The road name "Lillipilli Close" was described as being located 700m west of Washpool Creek Road/Moxeys Road intersection. As Moxeys Road is not an official Council road name, it is now clarified that Lillipilli Close is located 700m west of the intersection of Washpool Creek Road with Washpool Road, Booral.

This erratum now amends that error. [3678]

SHOALHAVEN CITY COUNCIL

Local Government Act 1993

Land Acquisition (Just Terms Compensation) Act 1991

Notice of Compulsory Acquisition of Land

SHOALHAVEN CITY COUNCIL declares, with the approval of Her Excellency the Governor, that the land described in the Schedule below, excluding any mines or deposits of minerals in those lands, are acquired by compulsory process in accordance with the provisions of the Land Acquisition (Just Terms Compensation) Act 1991 for the purposes of a landfill site and recycling centre.

Dated at Nowra this 5th day of December 2007.

RUSSELL PIGG,
General Manager

SCHEDULE

Lot 1, DP 1104402.

[3681]

GREAT LAKES COUNCIL

Roads Act 1993, Section 162

Roads (General) Regulation 2000

Naming of Roads

NOTICE is hereby given that Great Lakes Council, pursuant to the aforementioned Act and Regulation, has named the roads described hereunder. KEITH O'LEARY, General Manager, Great Lakes Council, Breese Parade, Forster, NSW 2428.

Description	*Name*
The existing road that runs south off Booral-Washpool Road, Booral which has been referred to as Washpool Creek/Moxeys Road is, according to Council's records, officially named Washpool Creek Road, Booral. Moxeys Road is not an official Council road name, it does not appear on topographical maps and there is no signage indicating this road name.	Washpool Creek Road, Booral

[3679]

GREATER TAREE CITY COUNCIL

Roads Act 1993

Roads (General) Regulation 2000

Part 2 – Roads, Division 2 – Naming of Roads

NOTICE is hereby given that Greater Taree City Council, in pursuance of the above act and regulations, has named the following road:

- Waitpinga Court, Redhead.

GERARD JOSE, General Manager, Greater Taree City Council, PO Box 482, Taree NSW 2430.

[3680]

PORT STEPHENS COUNCIL

Roads Act 1993 Section 162 (1)

Road Naming

PURSUANT to section 162 (1) Council has assigned the road names as described below:

Descriptions	
AT MEDOWIE – Council file – PSC2006-0250 Parish Stowell, County Gloucester Being two new roads within the Pacific Dunes Estate at Medowie. Known as The Links Estate as per Council subdivision plan DP 280006.	AUGUSTA PLACE (private access) CHAMPIONSHIP DRIVE
AT HEATHERBRAE – Council file – PSC2007-3341 Parish Eldon, County Gloucester Being two new roads northwards off Masonite Road into the new Industrial Estate as per Council subdivision plan DP 1092660.	CAMFIELD DRIVE ORTON CLOSE
AT HEATHERBRAE – Council file – PSC2007-3341 Parish Eldon, County Gloucester Being two new roads southwards off Masonite Road. As shown in subdivision plan DP 1035298 (Archibald) and Community Plan DP 270478 (Clayton)	ARCHIBALD PLACE CLAYTON ROAD (private access)
AT TOMAGO – Council file – PSC2007-3343 Parish Stockton, County Gloucester Being two new roads off Old Punt Road at Tomago. Part of Hunter Industrial Park as per subdivision plan DP 270494.	KENNINGTON DRIVE ABBOT LANE
AT NELSON BAY – Council file – PSC2007-3342 Parish Tomaree, County Gloucester Being four new roads within new subdivision know as Lagoon Estate off Dowling Street. As shown in Community plan DP 270468	LAGOONS CIRCUIT COVENTRY PLACE ALIDA CLOSE LAMANDRA CRESCENT

Historical Title

LAND AND PROPERTY INFORMATION NEW SOUTH WALES - HISTORICAL SEARCH

SEARCH DATE
1/3/2017 1:30PM

FOLIO: 1/1104402

First Title(s): OLD SYSTEM
Prior Title(s): GZ 07122007 FOL 9523

Recorded	Number	Type of Instrument	C.T. Issue
8/11/2006	DP1104402	DEPOSITED PLAN	LOT RECORDED FOLIO NOT CREATED
24/1/2008	PA82444	PRIMARY APPLICATION	FOLIO CREATED EDITION 1

*** END OF SEARCH ***

west nowra PRINTED ON 1/3/2017

Title Search

LAND AND PROPERTY INFORMATION NEW SOUTH WALES - TITLE SEARCH

FOLIO: 1/1104402

SEARCH DATE	TIME	EDITION NO	DATE
1/3/2017	1:29 PM	1	24/1/2008

LAND

LOT 1 IN DEPOSITED PLAN 1104402
AT BAMARANG
LOCAL GOVERNMENT AREA SHOALHAVEN
PARISH OF NOWRA COUNTY OF ST VINCENT
TITLE DIAGRAM DP1104402

FIRST SCHEDULE

THE COUNCIL OF THE CITY OF SHOALHAVEN (PA82444)

SECOND SCHEDULE (1 NOTIFICATION)

1 LAND EXCLUDES MINERALS - T447400

NOTATIONS

UNREGISTERED DEALINGS: NIL

*** END OF SEARCH ***

APPENDIX C

Environmental Protection Agency Search Results

List of NSW Contaminated Sites Notified to EPA as of 21 June 2016

Background

A strategy to systematically assess, prioritise and respond to notifications under Section 60 of the *Contaminated Land Management Act 1997* (CLM Act) has been developed by the EPA. This strategy acknowledges the EPA's obligations to make information available to the public under *Government Information (Public Access) Act 2009*.

When a site is notified to the EPA, it may be accompanied by detailed site reports where the owner has been proactive in addressing the contamination and its source. However, often there is minimal information on the nature or extent of the contamination.

For some notifications, the information indicates the contamination is securely immobilised within the site, such as under a building or carpark, and is not currently causing any offsite consequences to the community or environment. Such sites would still need to be cleaned up, but this could be done in conjunction with any subsequent building or redevelopment of the land. These sites may not require intervention under the CLM Act, but could be dealt with through the planning and development consent process.

Where indications are that the nominated site is causing actual harm to the environment or an unacceptable offsite impact (i.e. it is a "significantly contaminated site"), the EPA would apply the regulatory provisions of the CLM Act to have the responsible polluter and/or landowner investigate and remediate the site.

As such, the sites notified to the EPA and presented in the following table are at various stages of the assessment and/or remediation process. Understanding the nature of the underlying contamination, its implications and implementing a remediation program where required, can take a considerable period of time. The tables provide an indication, in relation to each nominated site, as to the management status of that particular site. Further detailed information may be available from the EPA or the responsible landowner.

The following questions and answers may assist those interested in this issue:

Frequently asked questions

What is the difference between the "List of NSW Contaminated Sites Notified to the EPA" and the "Contaminated Land: Record of Notices"?

A site will be on the Contaminated Land: Record of Notices only if the EPA has issued a regulatory notice in relation to the site under the *Contaminated Land Management Act 1997*.

The sites appearing on this "List of NSW contaminated sites notified to the EPA" indicate that the notifiers consider that the sites are contaminated and warrant reporting to the EPA. However, the contamination may or may not be significant enough to warrant regulation by the EPA. The EPA needs to review and, if necessary, obtain more information before it can make a determination as to whether the site warrants regulation.

Why my site appears on the list?

Your site appears on the list because of one or more of the following reasons:

- The site owner and/or the person partly or fully responsible for causing the contamination notified to the EPA about the contamination under Section 60 of the *Contaminated Land Management Act 1997*. In other words, the site owner or the "polluter" believes the site is contaminated.
- The EPA has been notified via other means and is satisfied that the site is or was contaminated.

Does the list contain all contaminated sites in NSW?

No. The list only contains contaminated sites that the EPA is aware of, with regard to its regulatory role under the CLM Act. An absence of a site from the list does not necessarily imply the site is not contaminated.

The EPA relies upon responsible parties to notify contaminated sites.

How are these notified contaminated sites managed by the EPA?

There are different ways that the EPA manages these notified contaminated sites. First, an initial assessment is carried out by the EPA. At the completion of the initial assessment, the EPA may take one or more than one of the following management approaches:

- The contamination warrants the EPA's direct regulatory intervention either under the *Contaminated Land Management Act 1997* or the *Protection of the Environment Operations Act 1997* (POEO Act), or both. Information about current or past regulatory action on this site can be found on EPA website.
- The contamination with respect to the current use or approved use of the site, as defined under the *Contaminated Land Management Act 1997,* is not significant enough that it warrants EPA regulation.
- The contamination does not require EPA regulation and can be managed by a planning approval process.
- The contamination is related to an operational Underground Petroleum Storage System, such as a service station or fuel depot. The contamination may be managed under the POEO Act and the Protection of the Environment Operation (Underground Petroleum Storage Systems) Regulation 2008.
- The contamination is being managed under a specifically tailored program operated by another agency (for example the Department of Industry and Investment's *Derelict Mines Program*).

I am the owner of a site that appears on the list. What should I do?

First of all, you should ensure the current use of the site is compatible with the site contamination. Secondly, if the site is the subject of EPA regulation, make sure you comply with the regulatory requirements, and you have considered your obligations to notify other parties who may be affected.

If you have any concerns, contact us and we may be able to offer you general advice, or direct you to accredited professionals who can assist with specific issues.

I am a prospective buyer of a site that appears on the list. What should I do?

You should seek advice from the vendor to put the contamination issue into perspective. You may need to seek independent expert advice.

The information provided in the list is meant to be indicative only, and a starting point for your own assessment. Site contamination as a legacy of past site uses is not uncommon,

particularly in an urbanised environment. If the contamination on a site is properly remediated or managed, it may not materially impact upon the intended future use of the site. However, each site needs to be considered in context.

List of NSW Contaminated Sites Notified to the EPA

Disclaimer

The EPA has taken all reasonable care to ensure that the information in the list of contaminated sites notified to the EPA (the list) is complete and correct. The EPA does not, however, warrant or represent that the list is free from errors or omissions or that it is exhaustive.

The EPA may, without notice, change any or all of the information in the list at any time.

You should obtain independent advice before you make any decision based on the information in the list.

The list is made available on the understanding that the EPA, its servants and agents, to the extent permitted by law, accept no responsibility for any damage, cost, loss or expense incurred by you as a result of:

1. any information in the list; or
2. any error, omission or misrepresentation in the list; or
3. any malfunction or failure to function of the list;
4. without limiting (2) or (3) above, any delay, failure or error in recording, displaying or updating information.

Site Status	Explanation
Under assessment	The contamination is being assessed by the EPA to determine whether regulation is required. The EPA may require further information to complete the assessment. For example, the completion of management actions regulated under the planning process or *Protection of the Environment Operations Act 1997*. Alternatively, the EPA may require information via a notice issued under s77 of the *Contaminated Land Management Act 1997* or issue a Preliminary Investigation Order.
Regulation under CLM Act not required	The EPA has completed an assessment of the contamination and decided that regulation under the *Contaminated Land Management Act 1997* is not required.
Regulation being finalised	The EPA has completed an assessment of the contamination and decided that the contamination is significant enough to warrant regulation under the *Contaminated Land Management Act 1997*. A regulatory approach is being finalised.

Contamination currently regulated under CLM Act	The EPA has completed an assessment of the contamination and decided that the contamination is significant enough to warrant regulation under the *Contaminated Land Management Act 1997* (CLM Act). Management of the contamination is regulated by the EPA under the CLM Act. Regulatory notices are available on the EPA's Contaminated Land Public Record.
Contamination currently regulated under POEO Act	The EPA has completed an assessment of the contamination and decided that the contamination is significant enough to warrant regulation. Management of the contamination is regulated under the *Protection of the Environment Operations Act 1997* (POEO Act). The EPA's regulatory actions under the POEO Act are available on the POEO public register.
Contamination being managed via the planning process (EP&A Act)	The EPA has completed an assessment of the contamination and decided that the contamination is significant enough to warrant regulation. The contamination of this site is managed by the consent authority under the *Environmental Planning and Assessment Act 1979* (EP&A Act) planning approval process, with EPA involvement as necessary to ensure significant contamination is adequately addressed. The consent authority is typically a local council or the Department of Planning and Environment.
Contamination formerly regulated under the CLM Act	The EPA has determined that the contamination is no longer significant enough to warrant regulation under the *Contaminated Land Management Act 1997* (CLM Act). The contamination was addressed under the CLM Act.
Contamination formerly regulated under the POEO Act	The EPA has determined that the contamination is no longer significant enough to warrant regulation. The contamination was addressed under the *Protection of the Environment Operations Act 1997* (POEO Act).
Contamination was addressed via the planning process (EP&A Act)	The EPA has determined that the contamination is no longer significant enough to warrant regulation. The contamination was addressed by the appropriate consent authority via the planning process under the *Environmental Planning and Assessment Act 1979* (EP&A Act).
Ongoing maintenance required to manage residual contamination (CLM Act)	The EPA has determined that ongoing maintenance, under the *Contaminated Land Management Act 1997* (CLM Act), is required to manage the residual contamination. Regulatory notices under the CLM Act are available on the EPA's Contaminated Land Public Record.

Suburb	Site Name	Address	Contamination Activity Type	Management Class	Latitude	Longitude
MORPETH	Telstra Cable Installation and RTA Bridge work	Northumberland STREET	Other Petroleum	Regulation under CLM Act not required	-32.72489729	151.6266795
MORPETH	Former Service Station	Swan STREET	Service Station	Regulation under CLM Act not required	-32.72477413	151.6250642
MORTLAKE	Former Petroleum Storage Site	108-116 Tennyson ROAD	Other Petroleum	Regulation under CLM Act not required	-33.83979033	151.1064889
MORTLAKE	Former AGL site	Tennyson ROAD	Gasworks	Contamination formerly regulated under the CLM Act	-33.84287407	151.1109313
MORTLAKE	Kendall Bay Sediments		Gasworks	Contamination currently regulated under CLM Act	-33.83905999	151.1120458
MORUYA	Former Fuel Depot Moruya	11 to 13 Ford STREET	Other Petroleum	Under assessment	-35.9112243	150.0826475
MORUYA	Caltex Service Station	26 Campbell STREET	Service Station	Under assessment	-35.9104985	150.0711419
MORUYA	Caltex Service Station	80-84 Campbell STREET	Service Station	Under assessment	-35.91195596	150.0824213
MOSMAN	7-Eleven Mosman	162A Spit Road Corner Mitchell ROAD	Service Station	Under assessment	-33.81747016	151.2433633
MOSMAN	BP Service Station	175 Ourimbah ROAD	Service Station	Under assessment	-33.82106757	151.233291
MOSMAN	7-Eleven Service Station Mosman	45 Spit ROAD	Service Station	Under assessment	-33.82302718	151.2435627
MOSS VALE	Shell Service Station	579 Argyle STREET	Service Station	Under assessment	-34.55313422	150.364684
MOSS VALE	Moss Vale Refuelling Facility	Lackey ROAD	Other Petroleum	Under assessment	-34.54662421	150.3721525
MOUNT ANNAN	Great Southern Railways Aqueduct	Off Narellan ROAD	Unclassified	Regulation under CLM Act not required	-34.07308479	150.7707436
MOUNT COLAH	Caltex Service Station	603 Pacific HIGHWAY	Service Station	Under assessment	-33.67034662	151.1151861
MOUNT DRUITT	Caltex (former Mobil) Service Station	17 Mount STREET	Service Station	Under assessment	-33.76567994	150.8244544
MOUNT DRUITT	BP Service Station	Corner Great Western Highway and Archibold ROAD	Service Station	Under assessment	-33.78211857	150.8244185
MOUNT HUTTON	Woolworths Service Station	46 Wilsons ROAD	Service Station	Under assessment	-32.98506321	151.671559
MOUNT PRITCHARD	7-Eleven Service Station	352 Elizabeth DRIVE	Service Station	Under assessment	-33.90260656	150.8963326
MOUNT THORLEY	Mount Thorley Depot (Reliance Petroleum)	74 Mount Thorley ROAD	Other Petroleum	Under assessment	-32.62443074	151.1025122
MOUNT VICTORIA	Caltex Service Station	36a Great Western HIGHWAY	Service Station	Under assessment	-33.58436517	150.2465528
MOUNT VICTORIA	Former Mobil Service Station	81 Great Western HIGHWAY	Service Station	Regulation under CLM Act not required	-33.5889727	150.2511783
MUDGEE	Caltex Service Station	114-116 Church STREET	Service Station	Regulation under CLM Act not required	-32.59428029	149.5876199
MUDGEE	Country Energy Depot	29-31 Ingliss STREET	Other Industry	Under assessment	-32.60073	149.585658
MUDGEE	Shell Coles Express Service Station	47 Church STREET	Service Station	Under assessment	-32.59347493	149.5884623
MUDGEE	BP Mudgee (Reliance Petroleum)	77 Church STREET	Service Station	Under assessment	-32.59545872	149.588123
MUDGEE	Mobil Depot	Cnr Inglis Street & Douro STREET	Other Petroleum	Contamination currently regulated under CLM Act	-32.60023979	149.5823448
MUDGEE	Former Caltex Depot Mudgee	cnr Nicholson Street & Atkinson STREET	Other Petroleum	Regulation under CLM Act not required	-32.60125298	149.5851398
MUDGEE	Mudgee Gasworks	Mortimer Street and Court STREET	Gasworks	Regulation under CLM Act not required	-32.59168859	149.5817705
MULGRAVE	Mobil Service Station	Corner Windsor Road and Mulgrave ROAD	Service Station	Regulation under CLM Act not required	-33.61687781	150.8341809
MULWALA	Mulwala ADI Explosives Factory	Bayly STAIRS	Other Industry	Regulation being finalised	-35.97572689	145.9809786
MURWILLUMBAH	Matilda Murwillumbah	182 Tweed Valley WAY	Service Station	Regulation being finalised	-28.3263681	153.4103824
MURWILLUMBAH	Caltex Service Station	204 Tweed Valley WAY	Service Station	Under assessment	-28.32687988	153.4093274
MURWILLUMBAH	Former Norco Butter Factory	230 Tweed Valley WAY	Other Petroleum	Under assessment	-28.32791359	153.4073052
MURWILLUMBAH	Murwillumbah Ambulance Depot	27 Queen STREET	Other Petroleum	Regulation under CLM Act not required	-28.32552576	153.4000182
MURWILLUMBAH	Caltex Service Station	32 Lundberg DRIVE	Service Station	Under assessment	-28.33246149	153.4195721
MURWILLUMBAH	Caltex Service Station	39-41 Lunderg DRIVE	Service Station	Under assessment	-28.33274114	153.4215186
MURWILLUMBAH	Former Mobil Depot	45 Wardrop STREET	Other Petroleum	Under assessment	-28.33421395	153.3993772
MUSWELLBROOK	Caltex Service Station	12-16 Sydney STREET	Service Station	Under assessment	-32.26789925	150.8879263

Suburb	Site Name	Address	Contamination Activity Type	Management Class	Latitude	Longitude
MUSWELLBROOK	Caltex Service Station	1-9 William STREET	Service Station	Under assessment	-32.26564196	150.8866925
MUSWELLBROOK	SRA Site	27 Brook STREET	Unclassified	Regulation being finalised	-32.26346086	150.8873181
MUSWELLBROOK	Former Mobil Depot	43-51 Ford STREET	Other Petroleum	Under assessment	-32.2599725	150.887573
MUSWELLBROOK	Caltex Service Station	47-50 Victoria STREET	Service Station	Under assessment	-32.26788823	150.8930609
MUSWELLBROOK	Former Mobil Service Station	49-51 Maitland STREET	Service Station	Under assessment	-32.27218162	150.8900206
MUSWELLBROOK	Woolworths Petrol	72 Brook STREET	Service Station	Under assessment	-32.26325377	150.8905966
MUSWELLBROOK	Caltex Service Station	84-86 Maitland ROAD	Service Station	Under assessment	-32.27793094	150.8980938
MUSWELLBROOK	Former Gasworks	Cnr Carl St and Foley STREET	Gasworks	Regulation under CLM Act not required	-32.26672337	150.8935982
MUSWELLBROOK	Former Industrial Site	Lot 89 rathmore STREET	Other Industry	Regulation under CLM Act not required	-32.30544071	150.8823657
MUSWELLBROOK	Bayswater Power Station	New England HIGHWAY	Other Industry	Under assessment	-32.3954046	150.9502683
NABIAC	Caltex Service Station	Pacific Hwy Cnr Krambach ROAD	Service Station	Under assessment	-32.09864883	152.3754346
NAMBUCCA HEADS	Former Mobil Service Station	6 Bowra STREET	Service Station	Under assessment	-30.64282127	153.0035884
NARELLAN	Former Landfill	1 Elyard STREET	Landfill	Regulation under CLM Act not required	-34.043474	150.7393256
NARELLAN	Caltex Service Station	31 The Northern ROAD	Service Station	Under assessment	-34.03811272	150.7334458
NARELLAN	Caltex Service Station	Narellan Rd Cnr Maxwell PLACE	Service Station	Under assessment	-34.03963992	150.7432386
NAROOMA	Narooma Service Station	60 Princes HIGHWAY	Service Station	Regulation under CLM Act not required	-36.21617955	150.126261
NAROOMA	Former Caltex - Narooma	82 Princes HIGHWAY	Service Station	Contamination formerly regulated under the CLM Act	-36.21711766	150.1279305
NARRABEEN	7-Eleven Service Station	1234 Pittwater ROAD	Service Station	Under assessment	-33.71958892	151.298272
NARRABEEN	Shell Coles Express Service Station	1418 Pittwater ROAD	Service Station	Regulation under CLM Act not required	-33.70013931	151.3002782
NARRABEEN	Caltex Service Station	1509-1511 Pittwater ROAD	Service Station	Regulation under CLM Act not required	-33.70455756	151.2969352
NARRABEEN	Narrabeen Shotgun Range, Sydney Academy of Sport	Wakehurst Parkway PARK	Unclassified	Ongoing maintenance required to manage residual contamination (CLM Act)	-33.72138423	151.2642798
NARRABRI	Caltex Service Station	12 Reid STREET	Service Station	Under assessment	-30.32282764	149.7901182
NARRABRI	Caltex Service Station	13 Doyle STREET	Service Station	Regulation under CLM Act not required	-30.3239182	149.7843052
NARRABRI	Lowes Petroleum (Former Mobil) Narrabri Depot	3 Old Gunnedah ROAD	Other Petroleum	Regulation under CLM Act not required	-30.33473586	149.789587
NARRABRI	Caltex Service Station	31-35 Cooma ROAD	Service Station	Regulation under CLM Act not required	-30.33968576	149.7657241
NARRABRI	Caltex Narrabri Service Station	Anne St (Corner of Dangar Street) STREET	Service Station	Under assessment	-30.32989667	149.7756598
NARRABRI	Caltex Service Station	James STREET	Service Station	Under assessment	-30.33016168	149.7940732
NARRABRI	Cargill Soapstock Disposal Site	Westport ROAD	Unclassified	Contamination formerly regulated under the CLM Act	-30.4698458	149.6981931
NARRANDERA	Former Mobil Depot	24 Whitton STREET	Other Petroleum	Regulation under CLM Act not required	-34.7410523	146.5620667
NARRANDERA	Former Mobil Emoleum Depot	5-7 Margaret STREET	Other Petroleum	Regulation under CLM Act not required	-34.74105391	146.5628144
NARRANDERA	Caltex (Former Mobil) Service Station Narrandera	Newell HIGHWAY	Service Station	Under assessment	-34.76124219	146.5398604
NARROMINE	Caltex Service Station	49 Burraway STREET	Service Station	Under assessment	-32.191182	148.261934
NELLIGEN	Former Clay Target Shooting Range	1398 Kings Highway and adjoining land on Old Bolaro Mountain ROAD	Unclassified	Contamination currently regulated under CLM Act	-35.64392469	150.0955224
NELLIGEN	Lot 2 Old Bolaro Road	Old Bolaro ROAD	Unclassified	Contamination formerly regulated under the CLM Act	-35.64485609	150.0937341
NELSON BAY	Shell Coles Express Service Station	23 Stockton ROAD	Service Station	Under assessment	-32.72265762	152.1437317

Number	Name	Location	Type	Status	Issued date
20899	SHOALHAVEN CITY COUNCIL	114 Flatrock Road, MUNDAMIA, NSW 2540	POEO licence	Pending	
5877	SHOALHAVEN CITY COUNCIL	FLAT ROCK ROAD, MUNDAMIA, NSW 2540	POEO licence	Issued	01-Dec-00
1013108	SHOALHAVEN CITY COUNCIL	FLAT ROCK ROAD, MUNDAMIA, NSW 2540	s.58 Licence Variation	Issued	03-Jan-02
1031238	SHOALHAVEN CITY COUNCIL	FLAT ROCK ROAD, MUNDAMIA, NSW 2540	s.58 Licence Variation	Issued	05-Dec-03
1069250	SHOALHAVEN CITY COUNCIL	FLAT ROCK ROAD, MUNDAMIA, NSW 2540	s.58 Licence Variation	Issued	02-May-07
1081780	SHOALHAVEN CITY COUNCIL	FLAT ROCK ROAD, MUNDAMIA, NSW 2540	s.58 Licence Variation	Issued	19-Mar-08
1090155	SHOALHAVEN CITY COUNCIL	FLAT ROCK ROAD, MUNDAMIA, NSW 2540	s.58 Licence Variation	Issued	15-Dec-08
1099238	SHOALHAVEN CITY COUNCIL	FLAT ROCK ROAD, MUNDAMIA, NSW 2540	s.58 Licence Variation	Issued	31-Mar-09
1111694	SHOALHAVEN CITY COUNCIL	FLAT ROCK ROAD, MUNDAMIA, NSW 2540	s.58 Licence Variation	Issued	17-May-10
1115110	SHOALHAVEN CITY COUNCIL	FLAT ROCK ROAD, MUNDAMIA, NSW 2540	s.58 Licence Variation	Issued	06-Aug-10
1124489	SHOALHAVEN CITY COUNCIL	FLAT ROCK ROAD, MUNDAMIA, NSW 2540	s.58 Licence Variation	Issued	03-Feb-11
1129470	SHOALHAVEN CITY COUNCIL	FLAT ROCK ROAD, MUNDAMIA, NSW 2540	s.58 Licence Variation	Issued	05-Jul-11
1500746	SHOALHAVEN CITY COUNCIL	FLAT ROCK ROAD, MUNDAMIA, NSW 2540	s.58 Licence Variation	Issued	23-Sep-11
1506324	SHOALHAVEN CITY COUNCIL	FLAT ROCK ROAD, MUNDAMIA, NSW 2540	s.58 Licence Variation	Issued	11-Jan-13

1513038	SHOALHAVEN CITY COUNCIL	FLAT ROCK ROAD, MUNDAMIA, NSW 2540	s.58 Licence Variation	Issued	22-Mar-13
1520254	SHOALHAVEN CITY COUNCIL	FLAT ROCK ROAD, MUNDAMIA, NSW 2540	s.58 Licence Variation	Issued	28-Aug-15
1535751	SHOALHAVEN CITY COUNCIL	FLAT ROCK ROAD, MUNDAMIA, NSW 2540	s.58 Licence Variation	Issued	23-Nov-15
1537080	SHOALHAVEN CITY COUNCIL	FLAT ROCK ROAD, MUNDAMIA, NSW 2540	s.58 Licence Variation	Issued	11-Jan-16

Healthy Environment, Healthy Community, Healthy Business

Home Contaminated land Record of notices

Search results

Your search for:LGA: Shoalhaven City Council

Matched 6 notices relating to 2 sites.

Search Again

Refine Search

Suburb	Address	Site Name	Notices related to this site
NOWRA	Lamonds LANE	Former gasworks	2 current and 1 former
NOWRA EAST	Lot 3 Kalandar STREET	Mobil Service Station	3 current

Page 1 of 1

8 September 2016

APPENDIX D

GHD Geotechnical Assessment of Leachate Pond Clay Based Liner

Shoalhaven City Council

Geotechnical Services, West Nowra Recycling and Waste Facility, Mundamia

Report

April 2018

Table of contents

Table index

Photo index

Appendices

1. Introduction

GHD Pty Ltd (GHD) is pleased to provide this report on geotechnical assessment works carried out in relation to the existing leachate dam at the West Nowra Recycling and Waste Facility for Shoalhaven City Council (SCC).

SCC has provided additional information in regard to the design and construction of the leachate dam in the 1990's, including a drawing of the elevation which indicates the approximate maximum depth of the dam was about 3.8m. We understand that the base and walls of the leachate dam are sealed by a clay liner overlying a Geosynthetic Clay Liner (GCL). GHD was requested by SCC to carry out sampling and testing of the clay liner to assess its permeability and integrity. The integrity of the leachate dam liner based on the results of this assessment were compared to relevant sections of the Environmental Guidelines: Solid Waste Landfills, 1996.

In addition SCC also requested GHD to install one monitoring well upstream and one well downstream of the leachate dam. Groundwater monitoring and assessment was carried out by others following installation of the wells.

2. Scope of work

The following scope of work was carried out for this assessment: Review information provided by SCC regarding the design and construction of the leachate dam, including design drawings and construction notes.

- Review geological maps of the area.
- Drilling of 2 x boreholes and installation of monitoring wells (1 x upstream of the leachate dam (GW06), and 1 x downstream of the leachate dam (GW07)).
- The boreholes (GW06 and GW07) were drilled at the proposed locations shown in Photo 1 and Photo 2,or as agreed with SCC's representative to a maximum depth of nine (9) and seven (7) metres below ground level (BGL) using a track-mounted drilling rig. At tungsten carbide bit refusal, the boreholes were extended to the target depth by air hammer. Standard penetration tests were carried out at 1.5 m intervals in the soil profile. Approximate borehole locations are shown in Photos 2, 3 and 4.
- A Geotechnical Engineer was onsite during the field investigation to log the boreholes, take soil samples and direct the drilling rig operator.
- Excavation of three shallow test pits within the floor area of the leachate dam and take soil samples from each test pit for permeability testing. Prior to sampling the dam was de-watered and an excavator was supplied by SCC to remove sediment to expose the top of the clay liner.
- Laboratory testing of the clay liner samples including Standard compaction tests and constant head permeability tests (3 samples).

- Reporting including GHD review of the information provided by SCC, the results of the field investigation and laboratory testing and discussion of the results and integrity of the clay liner relative to the Environmental Guidelines: Solid Waste Landfills, 1996.

A site specific safety plan was prepared to assess the potential safety risks associated with carrying out the fieldwork. The plan included (but was not limited to) an emergency contact list, an assessment of the risks associated with the fieldwork prior to going to site, reassessment at the site, personal protective equipment requirements and emergency response. Subcontractors (Driller and underground service) were selected from GHD's approved suppliers list.

A geotechnical engineer supervised drilling and excavation activities. For each sampling location the subsurface conditions was logged and samples collected for further identification.

Approximate easting and northing co-ordinates of test locations were recorded using a hand held Global Positioning System unit. No survey was carried out to record reduced levels of the existing ground surface at the test locations. The engineering logs of the test pits with explanatory notes are provided in Appendix A.

3. Results of investigation

3.1 Review of SCC documentation

As part of this assessment, GHD has reviewed information on the leachate dam provided by SCC comprising:

- Leachate Dam – Design and Construction Notes – West Nowra (Plan No.: 97/20, Sheet 1 of 11)
- Leachate Dam – Plan View and Sections – West Nowra (Plan No.: 97/20, Sheet 1 of 4)
- Leachate Dam – Long Sections A B – West Nowra (Plan No.: 97/20, Sheet 2 of 4)
- Leachate Dam – Long Sections C D – West Nowra (Plan No.: 97/20, Sheet 3 of 4)
- Leachate Dam – Long Sections E F – West Nowra (Plan No.: 97/20, Sheet 4 of 4)
- Leachate Dam – Typical WAE Section Clay – West Nowra

The plan prepared by Watkinson, Apperley Pty Ltd (Plan No.: 97/20, Sheet 3 of 11), dated 3 April 1997 shows the Leachate Dam - Typical WAE Section Clay. A typical section through the dam shows a GCL over the floor and walls of the dam and a 300mm thick cover of select material over the GCL. The GCL and select material extend up the inside walls of the dam to RL35.17. The plan is signed off as Work as Executed Shoalhaven City Council Copy. SCC has advised that the GCL used was equivalent to the Geofabrics product ELCOSEAL X1000 which has a typical hydraulic conductivity of $1x10^{-11}$ m/sec.

3.2 Site surface observations

At the time of drilling the boreholes, the leachate dam was approximately half full. The ground surface was generally firm with no deformation under the excavator/drilling rig.

Photos 1 to 4 show the general site surface conditions at the borehole locations.

Photo 1: View of existing leachate dam looking north.

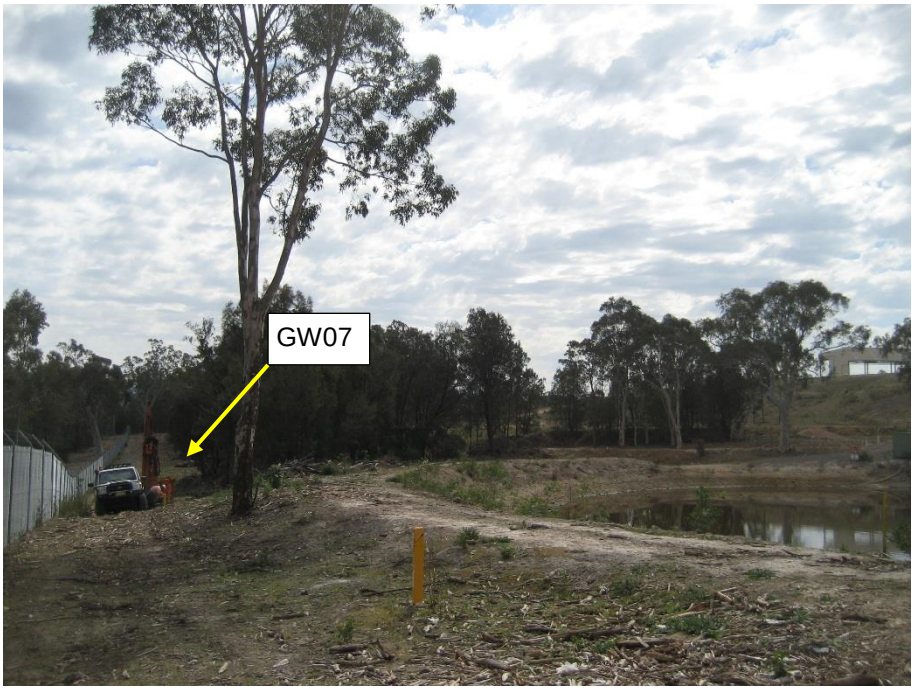


Photo 2: View of location of downstream borehole (GW07) adjacent to existing leachate dam.

Photo 3: View of the first flush dam with existing leachate dam in the background.

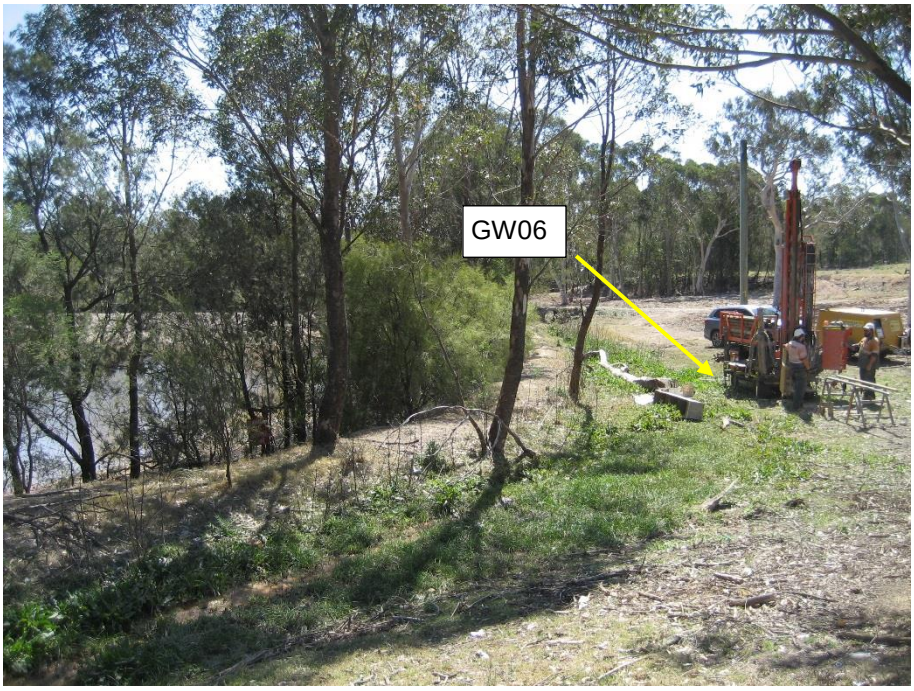


Photo 4: View of location of upstream borehole (GW06) adjacent to existing leachate dam.

3.3 General site geology

Reference to the 1:250,000 Wollongong Geological Series Sheet (SI 56-9), second edition prepared by the NSW Department of Mines (1966) indicates that the site is underlain by the Megalong Conglomerate of the Shoalhaven Group described as quartz sandstone with particular reference to Nowra Sandstone.

Reference to the 1:100,000 Kiama Soil Landscape Series Sheet (9028) prepared by the Department of Conservation and Land Management of NSW (1993) indicates that the Project area is located within the Nowra Depositional Landscape grouping with Disturbed Terrain. The Nowra Depositional Landscape is described as moderately to gently undulating rising to low hills on Nowra Sandstone with broad ridges and crests, benched sandstone outcrops and extensive to moderately cleared tall open-forest. Disturbed Terrain is generally described as varying topography ranging from level plains to undulating terrain which has been disturbed by human activity.

3.4 Investigation methodology

The drilling of boreholes and installation of monitoring wells was carried out on 27 September 2017. Two boreholes, including one upstream (GW06) and one downstream (GW07) of the leachate dam were drilled. Standpipe wells were installed in GW06 and GW07 to maximum depth of 9.0m.

Groundwater inflow was observed in GW07 at about 2.5m below ground surface, which was approximately the water level in the leachate dam. In GW06 groundwater inflow was observed at depth of about 8.0m below ground surface.

Following de-watering of the leachate dam to lower the water level, three shallow test pits were excavated in the exposed liner material to collect samples (TP01 to TP03) for permeability testing on 18 October 2017. The samples from the liner were generally described as sandy to gravelly clay, yellow to orange brown, firm and moist to wet. Photos 5 to 7 show typical materials encountered in the test pits during sampling for permeability testing.

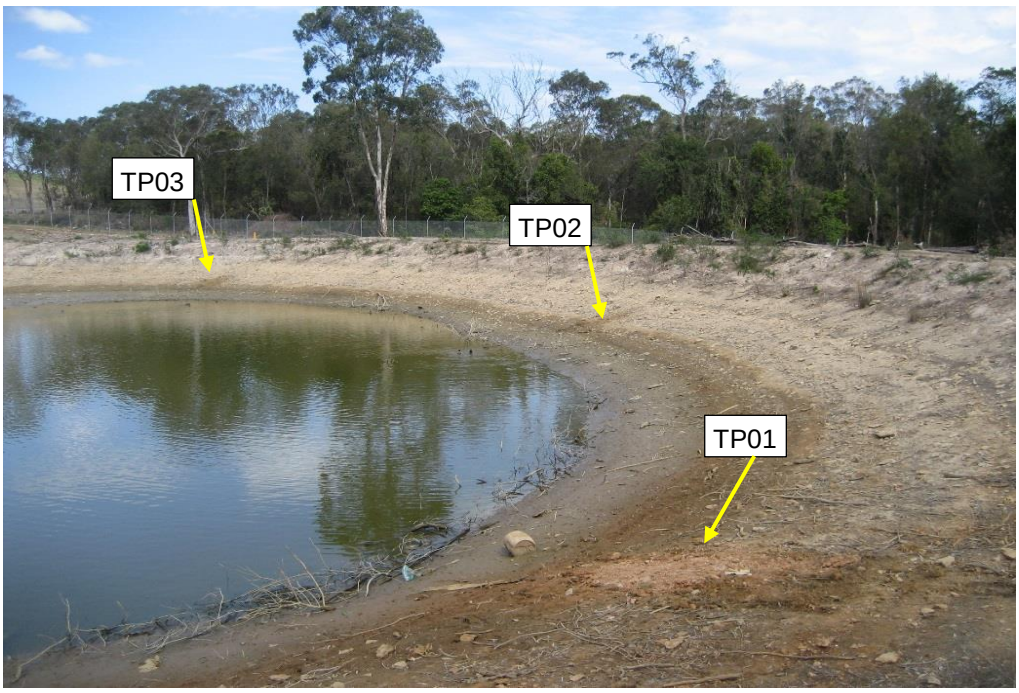


Photo 5: View of approximate locations of test pits within the liner of leachate dam (permeability testing).

Photo 6: View of clayey material encountered during test pit excavation along leachate dam.

Photo 7: Bentonite used to backfill test pits in leachate dam liner.

3.5 Subsurface conditions

The general subsurface conditions encountered in boreholes GW06 and GW07 are summarised in Table 1. Engineering logs of the boreholes are presented in Appendix A.

The soil profile encountered in boreholes GW06 and GW07 generally comprised:

- Topsoil, generally occurring as Silty Sandy Clay, overlying.

- Residual, described as firm to stiff Sandy Clay becoming soft to firm in GW07 and then becoming stiff to very stiff, overlying.
- Extremely weathered material described as very stiff Sandy Clay/Clayey Sand, overlying.
- Highly to moderately weathered rock.

The soil profile encountered in test pits TP01 to TP03 generally comprised:

- Clay/sandy clay, yellow brown and grey, some fine to coarse gravel.

3.6 Laboratory test results

Three samples of the liner material above the water surface were collected from test pits TP01 to TP03, and tested in our NATA registered laboratory for permeability (constant head).

Testing was carried out at a GHD NATA registered laboratory. The laboratory test reports are presented in Appendix B. A summary of the laboratory test results is presented in Table 1.

Table 1: Summary of Permeability (constant head) test results

Test location	Depth (m)	SMDD (t/m^3)	SOMC (%)	Hydraulic Conductivity (m/sec)
TP01	**0.1 to 0.3**	**1.81**	**16**	**1 E-10**
TP02	**0.1 to 0.3**	**1.92**	**13.5**	**4 E-10**
TP03	**0.1 to 0.3**	**1.86**	**14.5**	**1 E-10**

Note:

1. SMDD: Standard Maximum Dry Density
2. SOMC: Standard Optimum Moisture Content

3.7 Integrity of the clay liner

Our assessment of the integrity of the clay liner within the leachate dam shown in Photo 5 was based on the following:

- A review of the Work as Executed drawings with cross sections showing a GCL over the floor and walls of the leachate dam and a 300mm thick cover of select material over the GCL.
- Reference to product specifications for the GCL liner, ELCOSEAL X1000.
- Recent observations of the portion of exposed liner not covered by leachate.
- Observations of the clayey materials exposed to a depth of at least 300mm in the shallow test pits excavated in the clay liner as per Photo 6.
- Results of laboratory permeability test results on three samples of the clay liner material indicating permeability lower than the specified maximum.
- Discussion of monitoring of groundwater wells downslope of leachate dam.

The Work as Executed (WAE) drawings show that a GCL was placed over the floor and walls of the leachate dam and that a select material was placed over the GCL to a thickness of at least 300mm. Testing of the select material for permeability indicates that the material has a high clay content with a hydraulic conductivity (k) of at least $4x10^{-10}$ m/sec. When combined with a GCL having a typical k of $1.9x10^{-11}$ m/sec, we are satisfied that the permeability of the clay liner and GCL provides a barrier at least equivalent to a 1,000 mm thick compacted clay liner with k of less than $1x10^{-9}$ m/sec.

In relation to our site observations of the general integrity of the leachate dam, the dam walls and floor exhibit no evidence of erosion or deformation that would influence the performance of the dam to contain leachate.

We note also, as a further indicator of the integrity of the leachate dam liner, that testing of groundwater samples taken from monitoring points downstream of the leachate dam have not revealed any evidence of leakage of leachate from the dam.

3.8 Conclusion

Based on our discussions with Shoalhaven City Council, the existing leachate dam is used for the storage of landfill generated leachate from existing landfill stages 1, 2 and 3, and is also intended for storage of landfill generated leachate from the proposed landfill stage 4 extension area.

The existing Environmental Protection Licence (EPL number 5877) for the Facility allows for the storage of landfill generated leachate from landfill stages 1, 2 and 3. The existing EPL will be varied to also include the storage of landfill generated leachate from the stage 4 landfill extension area, subject to relevant agency approval for the proposal. Leachate stored within the dam, from stages 1, 2, 3 and 4, will be managed under the existing EPL and in accordance with the existing site procedures manual.

The existing leachate dam has been constructed to the standard and quality required by the Environmental Guidelines: Solid Waste Landfills, 1996. The WAE drawings for the leachate dam, from 1997, demonstrate that the existing leachate dam is suitable for purpose and has been licenced to store landfill generated leachate from landfill stages 1, 2 and 3. Sampling and testing of the clay liner as reported above has concluded that the clay base liner is at least 300mm thick and has a coefficient of permeability lower than the limit specified in the Environmental Guidelines: Solid Waste Landfills, 1996.

The Environmental Guidelines: Solid Waste Landfills, 1996 requirements refer to new dams and landfill base liners which are not relevant to the scope of this investigation. The proposed storage of landfill generated leachate from stage 4 will be within existing appropriately licenced leachate management infrastructure.

4. Limitations

The comments provided within this report have been made on the basis of the available site details. If details of information provided differ from those assumed in the preparation of this report, GHD should be contacted for further geotechnical advice.

This report has been prepared by GHD for Client and may only be used and relied on by Client for the purpose agreed between GHD and the Client as set out in section 1 of this report.

The services undertaken by GHD in connection with preparing this report were limited to those specifically detailed in the report and are subject to the scope limitations set out in the report.

The opinions, conclusions and any recommendations in this report are based on information obtained from, and testing undertaken at or in connection with, specific sample points. Site conditions at other parts of the site may be different from the site conditions found at the specific sample points.

Investigations undertaken in respect of this report are constrained by the particular site conditions, such as the water in the leachate dam. As a result, not all relevant site features and conditions may have been identified in this report.

Site conditions (including the presence of hazardous substances and/or site contamination) may change after the date of this Report. GHD does not accept responsibility arising from, or in connection with, any change to the site conditions. GHD is also not responsible for updating this report if the site conditions change.

Attached documents titled General Notes should be read in conjunction with this report.

Appendix A – Bore Hole Logs with notes on Soil and Rock Descriptions

SOIL DESCRIPTION

GHD
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This procedure involves the description of a soil in terms of its visual and tactile properties, and relates to both laboratory samples and field exposures as applicable. A detailed soil profile description, in association with local geology and experience, will facilitate the initial (and often complete) site assessment for engineering purposes.

The method involves an evaluation of each of the items listed below and is in general agreement with both Australian Standard AS 1726 (the Site Investigation Code) and ASTM D2487 and D2488.

MOISTURE

The moisture condition of the soil is most applicable for cohesive soils as a precursor to the assessment of consistency and workability. The moisture condition is described as:-

Dry (dusty, dry to the touch) ***Slightly Moist*** ***Moist*** (damp, no visible water) ***Very Moist*** or ***Wet*** (visible free water, saturated condition)

In addition, the presence of any seepage or free water is noted on the testhole logs.

COLOUR

Colour is important for correlation of data between testholes and during subsequent excavation operations. The prominent colour is noted, followed by (spotted, mottled, streaked etc.) then secondary colours as applicable. Colour is usually described at as-received moisture condition, though both wet and dry colours may also be appropriate.

CONSISTENCY / DENSITY INDEX

This assessment is based on the effort required to penetrate and/or mould the soil, and is an indicator of shear strength.

Granular soils are generally described in terms of density index as listed in AS 1726. These soils are inherently difficult to assess and normally a penetration test procedure (SPT, DCP or CPT) is used in conjunction with published correlations. Alternatively, in-situ density tests can be conducted in association with minimum and maximum densities performed in the laboratory.

Term	Symbol	Density Index (%)
Very Loose	VL	< 15
Loose	L	15 - 35
Medium Dense	MD	35 - 65
Dense	D	65 - 85
Very Dense	VD	>85

Cohesive soils can be assessed by direct measurement (shear vane, CPT etc), or estimated approximately by tactile means and/or the aid of a geological pick as given on the following table. It is emphasised that a "design shear strength" must take cognisance of the mode of testing and the in-situ moisture content with the possible variations of moisture with time.

Term	Symbol	Tactile Properties	Undrained Strength S_u (kPa)
Very Soft	VS	Extrudes between fingers when squeezed in hand	<12
Soft	S	Easily penetrated by thumb about 30-40 mm. Pick head can be pushed in up to shaft.	12-25
Firm	F	Penetrated by thumb 20-30mm with moderate effort. Sharp end of pick pushed in 30-40mm.	25-50
Stiff	St	Indented by thumb about 5mm with moderate effort. Pick pushed in up to 10mm.	50-100
Very Stiff	VSt	Readily indented by thumb nail. Slight indentation produced by pushing pick into soil.	100-200
Hard	H	Difficult to indent with thumb nail. Requires power tools for excavation.	>200

STRUCTURE/OTHER FEATURES

The soil structure is generally applicable to cohesive soils and mainly refers to the presence or absence of joints and layering. Typical terms use are intact (no joints), fissured (closed joints), shattered (open joints), slickensided (polished joints indicative of movement), and stratified/laminated. In addition, the presence of other features (ferricrete nodules, timber inclusions) should also be noted as applicable.

For granular soils, an assessment of grading (well, uniform or poor), particle size (fine, medium etc.) and angularity and shape may also be given.

SOIL TYPE

The soil is described in terms of its estimated grain size composition and the tactile behaviour (plasticity of any fines (less than *0.06 mm)). This system does not differentiate on grading below 0.06 mm, in accordance with the Unified Soil Classification (USC) procedure.

However, in some situations a soil can exhibit different characteristics between the undisturbed and disturbed/remolded condition (eg. 'sand' sized particles which break down a clay). The Soil Type generally relates to the latter state but the former condition should be noted where applicable.

Furthermore, as most natural soils frequently are combinations of various constituents, the primary soil is described and modified by minor components. In brief, the system is as follows:-

Coarse Grained Soils		Fine Grained Soils	
% Fines	Modifier	% Coarse	Modifier
<5	omit, or use "trace"	<15	omit, or use "trace"
5-12	describe as "with clay/silt" as applicable	15-30	described as "with sand/gravel" as applicable
>12	prefix soil as "silty/clayey" as applicable	>30	prefix soil as "sandy/gravelly" as applicable

(*The 200# sieve (0.075 mm) is commonly used in practice to differentiate between fine and coarse grained soils).

Note: For soils containing both sand and gravel the minor coarse fraction is omitted if less than 15%, or described as "with sand/gravel" as applicable when greater than 15%.

The appropriate USC symbol may also be given after the soil type description in accordance with ASTM D2487 and D2488.

ORIGIN

An attempt is made, where possible, to assess origin (transported, residual, pedogenic, or fill etc.) since this assists in the judgement of probable engineering behaviour. This assessment is generally restricted to field logging activities. An interpretation of landform is a useful guide to the origin of transported soils (e.g. colluvium, talus, slide debris, slope wash, alluvium, lacustrine, estuarine, aeolian and littoral deposits) while local geology and remnant fabric will assist identification of residual soils.

Ref: DS6.5.1.1 Issue 1.7 Date: 13/03/2012

ROCK DESCRIPTION

GHD
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This method is based on Australian Standard AS 1726 and is orientated to the field logging of diamond drill core, but may be used for the profiling of natural exposures and cuttings, as applicable. The procedure involves a visual and tactile assessment of the rock mass and the nature of defects within it in order to facilitate a prediction of engineering behaviour.

DESCRIPTION: Rock Type is described on the basis of origin (sedimentary, metamorphic and igneous) with the common types listed below:-

Sedimentary				Metamorphic	Igneous				
Clastic	**Non clastic (chemical)**	**Non clastic (organic)**	**Pyroclastic**			**Acid**	**Intermediate**		**Basic**
Conglomerate Sandstone Siltstone Shale Claystone	Limestone Chert Gypsum Salt	Coal Some Limestone	Tuff Agglomerate Volcanic Breccia	Slate Phyllite Schist Quartzite Gneiss	Extrusive	Rhyolite	Trachyte	Andesite	Basalt
					Intrusive (medium grained)	Quartz Porphyry	Porphyry	Porphyrite	Dolerite
					(coarse grained)	Granite	Syenite	Diorite	Gabbro

Colour is given to assist in rock identification and the interpolation of field data. Colour is usually described at as-received moisture condition, though both wet and dry colours may also be appropriate.

Texture refers to the degree of crystallinity and granularity (grain size) and the fabric relationship between the constituents of a rock. Often only grain size is given for simplified descriptions of certain sedimentary rocks.

Structure and texture are commonly used synonymously in describing rocks since there is no clear delineation between terms. In general, structure refers to large-scale features recognisable in the field (banding, lineation, massive, porphyritic, schistose etc.). For sedimentary rocks in particular, the thickness of sedimentary layering (bedding) is described as:-

Thinly laminated	<6mm	very thinly bedded	20-60mm	medium bedded	0.2-0.6m	very thickly bedded	>2m
Laminated	6-20mm	thinly bedded	60-200mm	thickly bedded	0.6-2m		

In addition, mineral composition, hardness, alteration, cementation is given as applicable.

WEATHERING: The assignment of weathering is somewhat subjective. Weathering assists identification and does not imply engineering behaviour. No distinction is drawn between chemical weathering and alteration for most engineering purposes. These procedures are collectively described as "weathering" using the following terms which do not describe the related strength change. This system is general, and in this format may not apply to all rock types. Carbonate rocks generally do not conform to this classification.

Term	Symbol	Definition
Completely Weathered	CW	Residual soil with rock fabric not visible.
Extremely Weathered	EW	The rock exhibits soil-like properties though the texture of the original rock is still evident.
Highly Weathered	HW	Limonite staining or colour change affects the whole of the rock mass and other signs of chemical or physical decomposition are evident.
Moderately Weathered	MW	Staining extends throughout the whole of the rock mass and the original colour is no longer recognisable.
Slightly Weathered	SW	Partial staining or discolouration of the rock mass, usually by limonite, has taken place.
Fresh	Fr	Rock mass unaffected by weathering.

ESTIMATED STRENGTH: This refers to the strength of the rock substance and not that of the rock mass. The strength of the rock substance is estimated by the Point Load Strength Index $I_S(50)$ and refers to the strength measured in the direction normal to the bedding for sedimentary rocks. A field guide is given below:-

Term	Symbol	$I_S(50)$ MPa	Field Guide (The core refers to a 150mm long x 50mm dia. sample)
Extremely Low	EL	<0.03	Remoulded by hand to a material with soil properties.
Very Low	VL	0.03-0.1	May be crumbled in the hand. Sandstone is "sugary" and friable.
Low	L	0.1-0.3	The core may be broken by hand and easily scored with a knife. Sharp edges of core may be friable and break during handling.
Medium	M	0.3-1.0	The core may be broken by hand with considerable difficulty. Readily scored with knife.
High	H	1-3	The core cannot be broken by unaided hands, can be slightly scratched or scored with knife.
Very High	VH	3-10	The core may be broken readily with hand held hammer. Cannot be scratched with knife.
Extremely High	EH	>10	The core is difficult to break with hand held hammer. Rings when struck with a hammer.

DEFECTS: This important feature can control the overall engineering behaviour of a rock mass. All types of natural fractures across which the core is discontinuous are noted. These fractures include bedding plane partings, joints and other defects but exclude artificial fractures such as drilling breaks. The nature of the defects (joints, bedding partings, seams, zones and veins) is also noted with description, orientation, infilling or coating, shape, roughness, thickness, etc. given generally in accordance with AS 1726. The spacing of natural fractures excludes bedding partings unless there is evidence that they were separated prior to drilling. This notwithstanding, bedding partings maybe considered as planes of weakness in an engineering assessment.

Ref: DS6.5.2.1 Issue 1.7 Date: 13/03/2012

BOREHOLE LOG SHEET

GEO_BOREHOLE 2316182 WEST NOWRA.GPJ GHD_GEO_TEMPLATE.GDT 20/11/17

Client :	Shoalhaven City Council	**HOLE No. GW06**	
Project :	Geotechnical Services RRP Mundamia		**SHEET 1 OF 2**
Location :	West Nowra, NSW		
Position :	275953.0 E 6137510.0 N MGA94/ 56	**Surface RL:** -	**Angle from Horiz. :** 90°
Rig Type :	Hanjin DB08 **Mounting:** Track	**Contractor :** Total Drilling	**Driller :** CM
Date Started :	27/9/2017	**Date Completed :** 27/9/2017	**Logged by :** MB

Processed : RLDC
Checked : MB
Date: 17/10/2017

Note: * indicates signatures on original issue of log or last revision of log

DRILLING					MATERIAL								BOREHOLE	
SCALE (m)	Drilling Method	Hole Support \ Casing	Water	Samples & Tests	Depth / (RL) metres	Graphic Log	USC Symbol	Description: SOIL TYPE, colour, structure, minor components (origin), and ROCK TYPE, colour, grain size, structure, weathering, strength	Moisture Condition	Consistency / Density Index	Comments/ Observations	BOREHOLE Log	Components
0	AD/T	Nil	GNO		0.00		CI	Silty CLAY, brown, dark brown mottled. medium plasticity, trace of rootlets, trace of fine to medium grained sand (topsoil/fill).	D M	F-St			
				SPT 3/1/4 N=5	0.50		CI-CH	Sandy CLAY, brown, red, grey mottled, medium to high plasticity, fine to coarse grained sand, trace of organics/rootlets (residual).		St			Bentonite
1										St-VSt			
					1.25		CI-CH	Sandy CLAY / Clayey SAND, grey, brown, fine to coarse grained, medium to high plasticity clay (residual).		VSt			
		HQ casing		SPT 6/10 for 40mm N=ref	1.50		SC	Clayey SAND, grey, brown, fine to coarse grained, medium plasticity clay (extremely to highly weathered rock).		H			
	Air Hammer				1.70			SANDSTONE, grey, brown mottled, fine to coarse grained, moderately to slightly weathered.	D		Borehole continued as Air Hammering at 1.70m. Moderately to slightly weathered rock.		50mm PVC casing
2													
3													
4													6m slotted screen
5													

See standard sheets for details of abbreviations & basis of descriptions

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23-16182

BOREHOLE LOG SHEET

GEO_BOREHOLE 2316182 WEST NOWRA.GPJ GHD_GEO_TEMPLATE.GDT 20/11/17

Client :	Shoalhaven City Council	**HOLE No. GW06**	
Project :	Geotechnical Services RRP Mundamia		**SHEET 2 OF 2**
Location :	West Nowra, NSW		
Position :	275953.0 E 6137510.0 N MGA94/ 56	**Surface RL:** -	**Angle from Horiz. :** 90°
Rig Type :	Hanjin DB08 **Mounting:** Track	**Contractor :** Total Drilling	**Driller :** CM
Date Started :	27/9/2017	**Date Completed :** 27/9/2017	**Logged by :** MB

Processed : RLDC
Checked : MB
Date: 17/10/2017

Note: * indicates signatures on original issue of log or last revision of log

DRILLING					MATERIAL								BOREHOLE	
SCALE (m)	Drilling Method	Hole Support \ Casing	Water	Samples & Tests	Depth / (RL) metres	Graphic Log	USC Symbol	Description SOIL TYPE, colour, structure, minor components (origin), and ROCK TYPE, colour, grain size, structure, weathering, strength	Moisture Condition	Consistency / Density Index	Comments/ Observations		BOREHOLE Log	Components
6	Air Hammer		▶					SANDSTONE, grey, brown mottled, fine to coarse grained, moderately to slightly weathered.	D					
7														
8														
9					9.00			End of borehole at 9 metres. .						◄ Base of piezo @ 9m
10														

See standard sheets for details of abbreviations & basis of descriptions

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BOREHOLE LOG SHEET WITH STANDPIPE PIEZOMETER

GEO_BOREHOLE 2316182 WEST NOWRA.GPJ GHD_GEO_TEMPLATE.GDT 20/11/17

Client : Shoalhaven City Council
Project : Geotechnical Services RRP Mundamia
Location : West Nowra, NSW

HOLE No. GW07

SHEET 1 OF 2

Position : 275879.0 E 6137496.0 N MGA94/ 56 **Surface RL:** - **Angle from Horiz. :** 90° **Processed :** RLDC
Rig Type : Hanjin DB08 **Mounting:** Track **Contractor :** Total Drilling **Driller :** CM **Checked :** MB
Date Started : 27/9/2017 **Date Completed :** 27/9/2017 **Logged by :** MB **Date:** 17/10/2017

Note: * indicates signatures on original issue of log or last revision of log

DRILLING					MATERIAL								PIEZOMETER	
SCALE (m)	Drilling Method	Hole Support \ Casing	Water	Samples & Tests	Depth / (RL) metres	Graphic Log	USC Symbol	Description: SOIL TYPE, colour, structure, minor components (origin), and ROCK TYPE, colour, grain size, structure, weathering, strength	Moisture Condition	Consistency / Density Index	Comments/ Observations		Piezometer Log	Components
0	AD/T	Nil	GNE		0.20		CI-CH	Silty sandy CLAY, brown, red/grey mottled, medium to high plasticity, fine to coarse grained sand, some rootlets, trace of fine to medium grained sub-rounded gravel (topsoil).	D	St				
							CI-CH	Sandy CLAY, brown red mottled, medium to high plasticity, fine to coarse grained sand (residual).	M	F-St				Bentonite
1				SPT 3/2/2 N=4	1.00		CI-CH	Silty sandy CLAY, grey, dark grey, medium to high plasticity, medium grained sand, trace of fine to medium grained sub-rounded gravel (residual).	<Wp	Fr				
					1.50		CI-CH	Silty CLAY, dark grey, dark brown, red mottled, medium to high plasticity, some fine to coarse grained sand, trace of fine to medium grained, sub-rounded gravel (residual).	<Wl	S-F	PP=20-30kPa			50mm PVC casing
2			▽	SPT 0/0/0 N=0	2.00		CI-CH	Sandy CLAY, dark grey, grey, medium to high plasticity, fine to coarse grained sand (residual).	>Wl	S	Penetrated by rod weight			
									W	S-F	PP=10-30kPa			
					2.75		CI	Sandy CLAY / Clayey SAND, grey, medium plasticity, fine to coarse grained sand (residual).	W	VSt-H				
3		HQ casing		SPT 10 for 110mm N=ref	3.00		SP	SAND, grey, fine to coarse grained, trace of low plasticity clay (extremely weathered to highly weathered rock).						3m slotted screen
	Air Hammer				3.25			SANDSTONE, grey, brown, medium to coarse grained, sub-rounded to sub-angular gravel, moderately weathered.	D		Borehole continued as Air Hammering at 3.25m. MW SANDSTONE			
4					4.00			SANDSTONE, grey, brown, fine to coarse grained, medium to high strength, moderately to slightly weathered rock.						
5														

See standard sheets for details of abbreviations & basis of descriptions

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Job No.
23-16182

BOREHOLE LOG SHEET WITH STANDPIPE PIEZOMETER

GEO_BOREHOLE 2316182 WEST NOWRA.GPJ GHD_GEO_TEMPLATE.GDT 20/11/17

Client : Shoalhaven City Council
Project : Geotechnical Services RRP Mundamia
Location : West Nowra, NSW

HOLE No. GW07

SHEET 2 OF 2

Position : 275879.0 E 6137496.0 N MGA94/ 56	**Surface RL:** -	**Angle from Horiz. :** 90°	**Processed :** RLDC
Rig Type : Hanjin DB08	**Mounting:** Track	**Contractor :** Total Drilling	**Driller :** CM	**Checked :** MB
Date Started : 27/9/2017	**Date Completed :** 27/9/2017	**Logged by :** MB	**Date:** 17/10/2017

Note: * indicates signatures on original issue of log or last revision of log

DRILLING					MATERIAL							PIEZOMETER	
SCALE (m)	Drilling Method	Hole Support \ Casing	Water	Samples & Tests	Depth / (RL) metres	Graphic Log	USC Symbol	Description SOIL TYPE, colour, structure, minor components (origin), and ROCK TYPE, colour, grain size, structure, weathering, strength	Moisture Condition	Consistency / Density Index	Comments/ Observations	Piezometer Log	Components
6	Air Hammer		▼					SANDSTONE, grey, brown, fine to coarse grained, medium to high strength, moderately to slightly weathered rock.	D				
7					7.00			End of borehole at 7 metres. Target Depth.					◄ Base of piezo @ 7m
8													
9													
10													

See standard sheets for details of abbreviations & basis of descriptions

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Job No.
23-16182

Appendix B – Laboratory Test Results

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Aggregate/Soil Test Report

Report No: SYD1702580
Issue No: 1
This report replaces all previous issues of report no 'SYD1702580'.

Client: Shoalhaven City Council

Project: 2316182 W.Nowra Recycling Centre

Accredited for compliance with ISO / IEC 17025 - Testing

NATA Accredited Laboratory Number: 679

Approved Signatory: Jure G Vukovic (Senior Laboratory Technician)

Date of Issue: 13/11/2017

Sample Details

GHD Sample No	SYD17-0507-01
Date Sampled	16/10/2017
Sampled By	Sampled by GHD
Client Location	Mundamia, NSW
BH / TP No.	TP01
Depth (m)	0.1 - 0.3
Soil Description	Gravelly CLAY; red/grey orange/brown with sand

Test Results

Description	Method	Result	Limits
Standard Maximum Dry Density (t/m³)	AS 1289.5.1.1	1.81	
Standard Optimum Moisture Content (%)		16.0	
Retained Sieve 19mm (%)		2	
Compactive Effort		Standard	
Date Tested		1/11/2017	
Coef of Permeability (m/sec)	AS 1289.6.7.3	1 E-10	
Mean Stress Level (kPa)		30	
Permeant Used		Syd tap water	
Length (mm)		76.0	
Diameter (mm)		63.3	
Length/Diameter Ratio		1.20	
Laboratory Moisture Ratio (%)		100.5	
Laboratory Density Ratio (%)		100.0	
CompactiveEffort		Standard	
Method of Compaction		Remoulded	
Surcharge Applied (Kg)		0.0	
Pressure Applied (Kpa)		10	
Oversize Sieve (mm)		9.5	
Percentage Oversize (%)		7.0	
Moisture Content (%)		18.9	
Date Tested		3/11/2017	

Comments

N/A

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Aggregate/Soil Test Report

Report No: SYD1702581
Issue No: 1
This report replaces all previous issues of report no 'SYD1702581'.

Client: Shoalhaven City Council

Project: 2316182 W.Nowra Recycling Centre

Accredited for compliance with ISO / IEC 17025 - Testing

NATA Accredited Laboratory Number: 679

Approved Signatory: Jure G Vukovic (Senior Laboratory Technician)

Date of Issue: 16/11/2017

Sample Details

GHD Sample No	SYD17-0507-02
Date Sampled	16/10/2017
Sampled By	Sampled by GHD
Client Location	Mundamia, NSW
BH / TP No.	TP02
Depth (m)	0.1 - 0.3
Soil Description	Sandy CLAY; red/grey brown with gravel

Test Results

Description	Method	Result	Limits
Standard Maximum Dry Density (t/m³)	AS 1289.5.1.1	1.92	
Standard Optimum Moisture Content (%)		13.5	
Retained Sieve 19mm (%)		3	
Compactive Effort		Standard	
Date Tested		1/11/2017	
Coef of Permeability (m/sec)	AS 1289.6.7.3	4 E-10	
Mean Stress Level (kPa)		30	
Permeant Used		Syd tap water	
Length (mm)		81.5	
Diameter (mm)		73.4	
Length/Diameter Ratio		1.11	
Laboratory Moisture Ratio (%)		100.0	
Laboratory Density Ratio (%)		99.0	
CompactiveEffort		Standard	
Method of Compaction		Remoulded	
Surcharge Applied (Kg)		0.0	
Pressure Applied (Kpa)		10	
Oversize Sieve (mm)		9.5	
Percentage Oversize (%)		5.8	
Moisture Content (%)		15.6	
Date Tested		8/11/2017	

Comments

N/A

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Aggregate/Soil Test Report

Report No: SYD1702582
Issue No: 1
This report replaces all previous issues of report no 'SYD1702582'.

Client: Shoalhaven City Council

Project: 2316182 W.Nowra Recycling Centre

Accredited for compliance with ISO / IEC 17025 - Testing

NATA Accredited Laboratory Number: 679

Approved Signatory: Jure G Vukovic (Senior Laboratory Technician)

Date of Issue: 13/11/2017

Sample Details

GHD Sample No	SYD17-0507-03
Date Sampled	16/10/2017
Sampled By	Sampled by GHD
Client Location	Mundamia, NSW
BH / TP No.	TP03
Depth (m)	0.1 - 0.3
Soil Description	Gravelly CLAY; red/grey brown with sand

Test Results

Description	Method	Result	Limits
Standard Maximum Dry Density (t/m³)	AS 1289.5.1.1	1.86	
Standard Optimum Moisture Content (%)		14.5	
Retained Sieve 19mm (%)		1	
Compactive Effort		Standard	
Date Tested		1/11/2017	
Coef of Permeability (m/sec)	AS 1289.6.7.3	1 E-10	
Mean Stress Level (kPa)		30	
Permeant Used		Syd tap water	
Length (mm)		75.3	
Diameter (mm)		63.5	
Length/Diameter Ratio		1.19	
Laboratory Moisture Ratio (%)		100.5	
Laboratory Density Ratio (%)		100.0	
CompactiveEffort		Standard	
Method of Compaction		Remoulded	
Surcharge Applied (Kg)		0.0	
Pressure Applied (Kpa)		10	
Oversize Sieve (mm)		9.5	
Percentage Oversize (%)		8.1	
Moisture Content (%)		16.8	
Date Tested		3/11/2017	

Comments

N/A

Appendix C – General Notes

GENERAL NOTES

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The report contains the results of a geotechnical investigation or study conducted for a specific purpose and client. The results may not be used or relied on by other parties, or used for other purposes, as they may contain neither adequate nor appropriate information. In particular, the investigation does not cover contamination issues unless specifically required to do so by the client.

To the maximum extent permitted by law, all implied warranties and conditions in relation to the services provided by GHD and the report are excluded unless they are expressly stated to apply in the report.

TEST HOLE LOGGING

The information on the test hole logs (boreholes, test pits, exposures etc.) is based on a visual and tactile assessment, except at the discrete locations where test information is available (field and/or laboratory results). The test hole logs include both factual data and inferred information. Moreover, the location of test holes should be considered approximate, unless noted otherwise (refer report). Reference should also be made to the relevant standard sheets for the explanation of logging procedures (Soil and Rock Descriptions, Core Log Sheet Notes etc.).

GROUNDWATER

Unless otherwise indicated, the water levels presented on the test hole logs are the levels of free water or seepage in the test hole recorded at the given time of measuring. The actual groundwater level may differ from this recorded level depending on material permeabilities (i.e. depending on response time of the measuring instrument). Further, variations of this level could occur with time due to such effects as seasonal, environmental and tidal fluctuations or construction activities. Confirmation of groundwater levels, phreatic surfaces or piezometric pressures can only be made by appropriate instrumentation techniques and monitoring programmes.

INTERPRETATION OF RESULTS

The discussion or recommendations contained within this report normally are based on a site evaluation from discrete test hole data, often with only approximate locations (e.g. GPS). Generalised, idealised or inferred subsurface conditions (including any geotechnical cross-sections) have been assumed or prepared by interpolation and/or extrapolation of these data. As such these conditions are an interpretation and must be considered as a guide only.

CHANGE IN CONDITIONS

Local variations or anomalies in ground conditions do occur in the natural environment, particularly between discrete test hole locations or available observation sites. Additionally, certain design or construction procedures may have been assumed in assessing the soil-structure interaction behaviour of the site. Furthermore, conditions may change at the site from those encountered at the time of the geotechnical investigation through construction activities and constantly changing natural processes.

Any change in design, in construction methods, or in ground conditions as noted during construction, from those assumed or reported should be referred to this firm for appropriate assessment and comment.

GEOTECHNICAL VERIFICATION

Verification of the geotechnical assumptions and/or model is an integral part of the design process - investigation, construction verification, and performance monitoring. Variability is a feature of the natural environment and, in many instances, verification of soil or rock quality, or foundation levels, is required. There may be a requirement to extend foundation depths, to modify a foundation system and/or to conduct monitoring as a result of this natural variability. Allowance for verification by appropriate geotechnical personnel must be recognised and programmed for construction.

FOUNDATIONS

Where referred to in the report, the soil or rock quality, or the recommended depth of any foundation (piles, caissons, footings etc.) is an engineering estimate. The estimate is influenced, and perhaps limited, by the fieldwork method and testing carried out in connection with the site investigation, and other pertinent information as has been made available. The material quality and/or foundation depth remains, however, an estimate and therefore liable to variation. Foundation drawings, designs and specifications should provide for variations in the final depth, depending upon the ground conditions at each point of support, and allow for geotechnical verification.

REPRODUCTION OF REPORTS

Where it is desired to reproduce the information contained in our geotechnical report, or other technical information, for the inclusion in contract documents or engineering specification of the subject development, such reproductions must include at least all of the relevant test hole and test data, together with the appropriate Standard Description sheets and remarks made in the written report of a factual or descriptive nature.

Ref: DS5.5.1 Issue 1.8 Date: 5/10/2012

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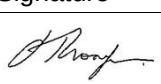
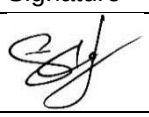
Document Status

Revision	Author	Reviewer		Approved for Issue		
		Name	Signature	Name	Signature	Date
0	M. Biabani	J. Thompson		S. Clark		22/11/2017
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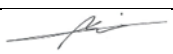
2 draft	M. Biabani / J. Thompson	Dominic Trani		Dominic Trani		21/3/2018
2	J. Thompson	Dominic Trani		Dominic Trani		23/4/2018

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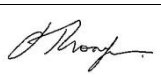
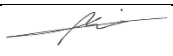
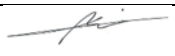
Revision	Author	Reviewer		Approved for Issue		
		Name	Signature	Name	Signature	Date
0	M. Biabani	J. Thompson		S. Clark		22/11/2017
1	M. Biabani / J. Thompson					
2 draft	M. Biabani / J. Thompson	Dominic Trani		Dominic Trani		21/3/2018
2	J. Thompson	Dominic Trani		Dominic Trani		4/4/2018
3	J. Thompson	Dominic Trani		Dominic Trani		23/4/2018
4	J. Thompson	Dominic Trani		Dominic Trani		30/4/2018

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