Preliminary Site Investigation for Contamination

Proposed Marulan Quarry at No. 16501 Hume Highway, Marulan, NSW

Global Quarries Australia Pty Ltd

23 December 2025

→ The Power of Commitment

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Executive summary

Global Quarries Australia Pty Ltd (Global Quarries) proposes to develop a hard rock (tuffaceous ignimbrite) quarry in Marulan, in the Southern Tablelands of NSW (the project). The project also includes upgrades to intersections with the Hume Highway and Winfarthing Road and a left turning lane into the quarry from the Hume Highway to improve access for heavy vehicles. The proposed development is located at No. 16501 Hume Highway, Marulan, NSW (Lots 3 and 4 of DP 247199, Lot 7001 of DP 1025585 and road reserve) (the site).

The Department of Planning, Housing and Infrastructure (DPHI) has requested a Preliminary Site Investigation (PSI) for contamination to be undertaken as part of supporting documentation prior to the project proceeding to the Independent Planning Commission.

The objectives of the PSI for Contamination were to:

– Assess the likelihood for contamination to exist on the site from past or present activities.
– Provide recommendations for further investigation and/or contamination management in relation to the proposed extractive industry (if applicable).

The scope of work developed to meet these objectives included a desktop study of site history and a site walkover, and conclusions and recommendations in relation to the above objectives.

The site is situated in a rural area primarily used for livestock grazing. The site has remained generally undeveloped except for a borrow pit in the north-eastern corner of Lot 4, which also included three dams, a dam in the south-western corner of Lot 3, a trigonometry station on Lot 7001, vegetation clearance (road reserve, Lot 4 and western side of Lot 3), numerous access tracks, ground disturbance along the road verge and installation of underground services. No other structures were constructed at the site.

Based on investigation results, potential for contamination was identified in four Areas of Environmental Concern (AECs), comprising the following:

– On-site:
    - AEC 1 - fill of unknown quality and origin
    - AEC 2 - sediment quality within on-site dams
    - AEC 3 - fly tipping
– Off-site:
    - AEC 4 - application of pesticides and / or herbicides and other chemicals

The likelihood for contamination to exist within the identified AECs was assessed as low to very low. Potential Source-Pathway-Receptor (SPR) linkages were assessed incomplete due to the likely of contamination associated with the AECs be present was low or very low. The residual plastics associated with soil / rock samples identified as part of AEC 1, present an aesthetic impact to the site and should be removed, along with any fly tipping.

Based on the results of this assessment, further investigation is not warranted, as the likelihood of contamination occurring at the site is low to very low. Unexpected occurrences of contamination (e.g. asbestos containing materials (ACM), staining, odours) can be managed at the time of development. It is recommended that the site remain secure to reduce further instances of fly tipping in the future. It is also recommended that a Construction Environmental Management Plan (CEMP) be prepared to manage the potential contaminant exposure risks during earthworks / construction activities. The CEMP should also include an Unexpected Finds Protocol (UFP) and site-specific Work Health Safety and Environment (WHSE) plan.

* * *

This report is subject to, and must be read in conjunction with, the limitations set out in Section 1.5 and the assumptions and qualifications contained throughout the Report.

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Abbreviations and definitions

Abbreviation	Definition
ACM	Asbestos containing material
AEC	Area of environmental concern
ANZG	Australian and New Zealand Guidelines
ASS	Acid sulfate soils
BTEX	Benzene, toluene, ethyl benzene, xylenes
CASS	Coastal acid sulfate soils
CEMP	Construction Environmental Management Plan
CLM Act	Contaminated Land Management Act 1997(incorporating amendments made by the Contaminated Land Management Amendment Act 2003)
COPC	Contaminant of potential concern
CSM	Conceptual Site Model
DO	Dissolved oxygen
DP	Deposited Plan
DPHI	Department of Planning, Housing and Infrastructure
EC	Electrical conductivity
EIS	Environmental Impact Statement
EMP	Environmental Management Plan
EPL	Environmental Protection Licence
<	Less than (laboratory reporting limit)
GHD	GHD Pty Ltd
GMR WSP	Greater Metropolitan Region Groundwater Sources Water Sharing Plan
Ha	Hectare
LEP	Local Environmental Plan
LOR	Limit of reporting
LTEMP	Long Term Environmental Management Plan
m AHD	Elevation in metres from Australian Height Datum
m bgl	Metres below ground level
NOA	Naturally occurring asbestos
NSW EPA	New South Wales Environmental Protection Authority
OCP	Organochlorine pesticide
OPP	Organophosphorus pesticide
PAH	Polycyclic aromatic hydrocarbons
PCB	Polychlorinated Biphenyl
PFAS	Per- and polyfluoroalkyl substances
POEO	Protection of the Environment Operations Act 1997
ppm	Parts per million
PSI	Preliminary Site Investigation
SEED	Sharing and Enabling Environmental Data

Abbreviation	Definition
SPR	Source Pathway Receptor
SWL	Standing water level
TEQ	Toxicity Equivalence Quotient
TRH	Total recoverable hydrocarbons
TSI	Targeted Site Investigation
TSS	Total suspended solids
UFP	Unexpected Find Protocol
VENM	Virgin Excavated Natural Material
VOC	Volatile organic compound
WHSE	Work Health Safety and Environment

1. Introduction

1.1 General

Global Quarries Australia Pty Ltd (Global Quarries) proposes to develop a hard rock (tuffaceous ignimbrite) quarry in Marulan, in the Southern Tablelands of NSW (the project). The project also includes upgrades to intersections with the Hume Highway and Winfarthing Road and a left turning lane into the quarry from the Hume Highway to improve access for heavy vehicles. The proposed development is located at No. 16501 Hume Highway, Marulan, NSW (the site). The site location is shown on Figure 1 (Appendix A).

Global Quarries has commissioned GHD to carry out this Preliminary Site Investigation (PSI) for Contamination. This assessment has been carried out in general accordance with GHD's proposal ref: 2127708, dated 9 December 2025.

1.2 Purpose of this report

The Department of Planning, Housing and Infrastructure (DPHI) has requested a PSI for Contamination to be undertaken as part of supporting documentation prior to the project proceeding to the Independent Planning Commission.

Therefore, the purpose of this report is to document the findings of the PSI for Contamination, which will support the state significant development application for the hard rock quarry as described above.

1.3 Objectives

The objectives of the PSI for Contamination were to:

– Assess the likelihood for contamination to exist on the site from past or present activities.
– Provide recommendations for further investigation and/or contamination management in relation to the proposed extractive industry (if applicable).

1.4 Scope of work

To meet the above objectives, the following scope of work was carried out:

– Review of published information (e.g., topographic, geological, soil landscape and acid sulfate soil maps).
– Specific information reviewed for assessing the potential for contamination to exist at the site included historical title records, historical aerial photographs, Goulburn Mulwaree Council (Council) records, and search of WaterNSW groundwater bores and NSW Environment Protection Authority (EPA) databases.
– Review of reports previously prepared for the site.
– A site walkover to visually assess potential sources of contamination, observe surrounding land uses, topography, drainage, nearby sensitive environments, and consider details of the site history and desktop study to further assess potential areas of environmental concern (AEC) and contaminants of potential concern (COPC).
– Prepare a preliminary conceptual site model (CSM).
– Preparation of this report summarising results of the desktop study and site walkover, and providing conclusions and recommendations with respect to the objectives outlined in Section 1.3.

1.5 Limitations

This report has been prepared by GHD for Global Quarries Australia Pty Ltd and may only be used and relied on by Global Quarries Australia Pty Ltd for the purpose agreed between GHD and Global Quarries Australia Pty Ltd as set out in Section 1.3 of this report.

GHD otherwise disclaims responsibility to any person other than Global Quarries Australia Pty Ltd arising in connection with this report. GHD also excludes implied warranties and conditions, to the extent legally permissible.

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 conditions encountered and information reviewed at the date of preparation of the report. GHD has no responsibility or obligation to update this report to account for events or changes occurring subsequent to the date that the report was prepared.

The opinions, conclusions and any recommendations in this report are based on assumptions made by GHD described in this report. GHD disclaims liability arising from any of the assumptions being incorrect.

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.

GHD has prepared this report on the basis of information provided by Global Quarries Australia Pty Ltd and others who provided information to GHD (including Government authorities), which GHD has not independently verified or checked beyond the agreed scope of work. GHD does not accept liability in connection with such unverified information, including errors and omissions in the report which were caused by errors or omissions in that information.

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

2. Environmental setting

2.1 Site identification

The current site layout information and surrounding areas are shown on Figures 1 and 2 in Appendix A. Site identification details and surrounding land uses are summarised in Table 2.1.

Table 2.1 Site identification summary

Identification item	Detail
Site address:	No. 16501 Hume Highway, Marulan, NSW, 2579
Site identification	– Lot 3 DP247199 (privately owned) – Lot 4 DP247199 (privately owned) – Lot 7001 DP1025585 (Crown Land) – Road Reserve (portions of the site adjoining the Hume Highway and Winfarthing Road)
Site dimensions (approximate):	2.1 km by 1.3 km (irregularly shaped)
Site area (approximate):	95 ha
Local government area:	Goulburn Mulwaree Council
Parish / County:	Nattery / Argyle
Current zoning:	C3 – Environmental Management (under the Goulburn Mulwaree Council Local Environment Plan 2009 (LEP, 2009)
Current land use:	Rural bushland
Surrounding land use:	– North: Hume Highway, bushland and grass paddocks – South: Narambulla Creek, remnant bushland and cleared areas – East: Narambulla Creek, remnant bushland and cleared areas – West: Rural residential, remnant bushland and cleared areas
Grid coordinates (GDA 2020):	215880 E; 6150985 N (at the intersection of Hume Highway and Winfarthing Road)

2.2 Topography and drainage

The topography of the project site is gently to moderately undulating. Google Earth indicates the site elevation ranges from 635 m Australian Height Datum (AHD) in the north-east to 698 m AHD in the south. The highest point is 698 m AHD. This peak (trigonometrical station TS4083) is located on Lot 7001 DP1025585 (216293 E; 6150373 N) with a gradual fall towards the north. On the southern side of the peak, it is steeper, dropping approximately 80 m over a 200 m distance (GHD, 2024b).

There are four dams on-site: one on Lot 3, east of Winfarthing Road, and three Lot 4, south of the Hume Highway (borrow pit area). Narambulla Creek flows east and north-east and flanks the southern and eastern boundaries of the site. The topographic map on NSW Explorer shows tributaries flowing from the site and discharging into Narambulla Creek. Narambulla Creek appears to continue north, flowing below the Hume Highway to where it is dammed to form Narambulla Lake.

Stormwater that is not absorbed into the ground is expected to follow the topography of the site and be directed into on-site dams and tributaries of Narambulla Creek, or flow directly into Narambulla Creek.

2.3 Soil landscape

The Lotsearch report indicates that the site is situated primarily on the Midgee soil landscape (Lotsearch, 2025, p. 51). However, relatively small areas at the eastern extent of the site fall within the Blakney Creek soil landscape. These soil landscapes are described as:

– Midgee:
  - Rolling low hills on Ordovician and some Devonian and Silurian metasediments; frequent folding and faulting. Relief 30 to 100 m; slopes 10 to 30%. Commonly acid stony yellow earths (Gn2.1) and yellow podzolic soils (Dy2) on sideslopes and crests in association with lithosols (Um5), red podzolic soils (Dr2) and red earths (Gn2.1); Soloths (Dy3.41) on lower slopes.

– Blakney Creek:
  - Footslopes and valley floors of undifferentiated Ordovician and early Silurian metasediments. Relief 20 to 50 m; slopes less than 10%. Acid to neutral yellow duplex soils with bleached A2 horizons (Dy3.4) similar to soloths; minor stony yellow earths (Gn2.2) and red podzolic soils (Dr2) on uplands. Extensive gullying and some saline areas.

2.4 Acid sulfate soil occurrence

Acid sulfate soil (ASS) is naturally occurring soil and sediment containing iron sulfides that can generate sulfuric acid upon exposure to oxygen.

The SEED database (SEED, 1998) indicates no known occurrence of coastal acid sulfate soils (CASS) at or near the site.

The CSIRO Atlas of Australian Acid Sulfate Soils indicates the site as having an ‘low’ probability of occurrence of non-coastal (i.e. upland) ASS (Lotsearch, 2025, p. 54).

It should be noted that some geological formations such as shales can have sulfidic ores present. Parts of the proposal site pass through the Warbisco Shale (Obew) (refer to Section 2.5 below). The Warbisco Shale contains laminated to medium bedded pyritic carbonaceous shale. Pyrite contains iron sulfides and upon exposure to oxygen could generate acid. The Warbisco Shale occurs in the north-eastern corner of the site near the Hume Highway and in the south-western part of the site, immediately north of Narambulla Creek.

The presence of sulfidic ores may require further consideration as part of waste classification assessments, in particular for Virgin Excavated Natural Material (VENM) classification.

2.5 Geology

The 1:100,000 Goulburn Geological Map (Thomas, et al., 2010) indicates that the site is underlain by six geological formations (refer to Figure 2.1). Two faults, indicated by the thick black line on Figure 2.1, occur in the north-eastern portion of the site near the Hume Highway. The description of each geological formation is summarised in Table 2.2 below. There is no identified naturally occurring asbestos (NOA) at or near the site.

Table 2.2 Summary of geological formations at the site (Lotsearch, 2025, p. 45)

Formation ID	Formation name	Description	Dominant Lithology
Oada	Abercrombie Formation	Brown and buff to grey, thin- to thick-bedded, fine- to coarse-grained mica-quartz (feldspar) sandstone, interbedded with medium-grained quartz mudstone. Sporadic chert-rich units.	Sandstone
Oadan	Nattery Chert Member	Honey-coloured, brown to grey, medium-bedded to laminated chert, interbedded with cherry siltstone, mudstone and minor graded cross-laminated fine-grained quartzose sandstone.	Siltstone
Obew	Warbisco Shale	Black, laminated to medium-bedded pyritic carbonaceous shale, commonly strongly foliated and folded. Minor quartzose sandstone.	Shale

Formation ID	Formation name	Description	Dominant Lithology
Q_a	Alluvium	Unconsolidated grey to brown to beige humic (±micaceous silty clay, quartz-±lithic silt, fine- to medium-grained quartz-rich to quartz-lithic sand, polymictic pebble to cobble gravel (as sporadic lenses); occasional palaeosol horizons.	Clastic sediment
Q_c	Colluvium	Poorly sorted, weakly cemented to unconsolidated colluvial lenses of polymictic conglomerate with medium- to very coarse-grained sand matrix; interspersed with unconsolidated clayey and silty red-brown (aeolian) sand layers, modified by pedogenesis.	Clastic sediment
Q_r	Residual deposits	A weakly-consolidated regolithic residuum such as soil or saprolite mostly developed in-situ as a result of advanced weathering and/or pedogenesis.	Saprolite

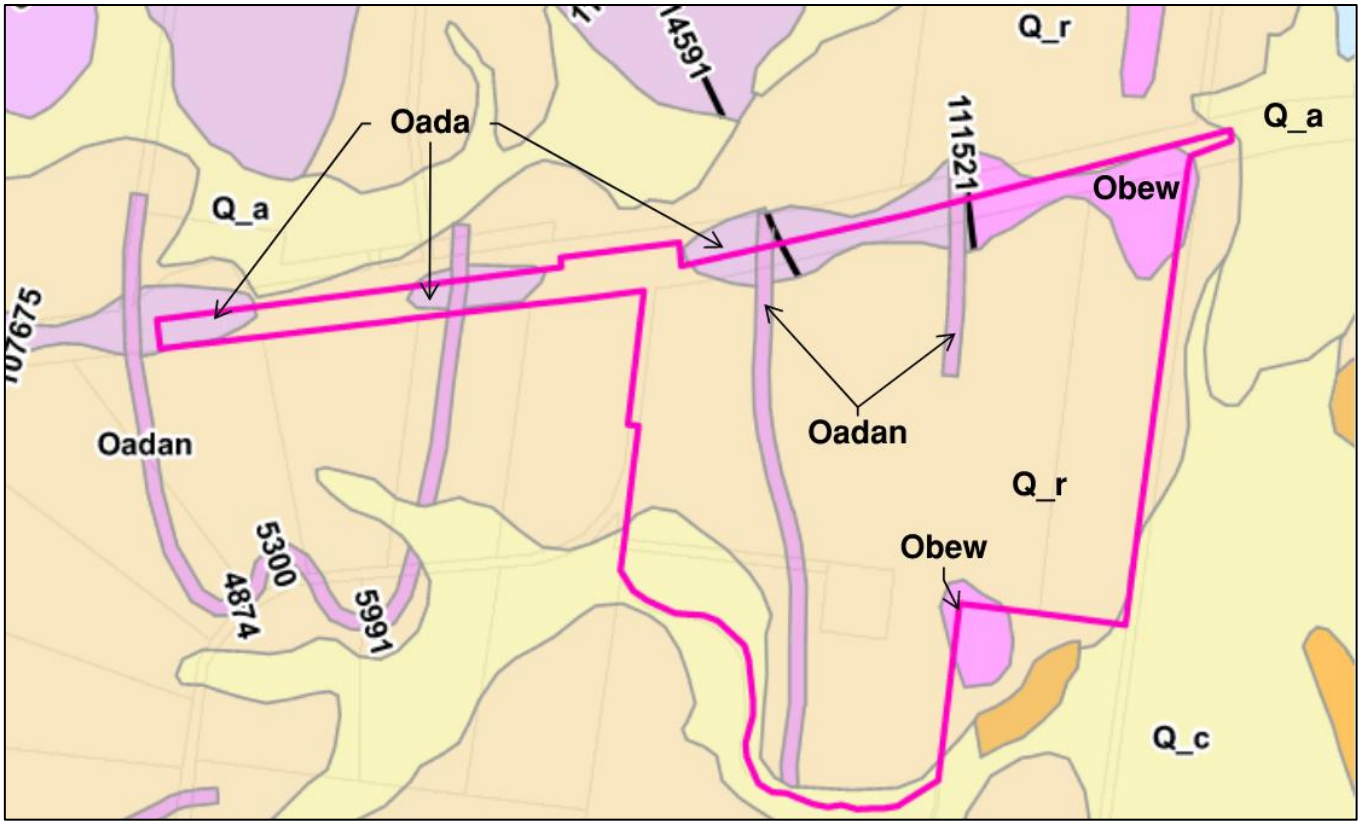

Figure 2.1 Geological formation relative to the site (Lotsearch, 2025, p. 44)

2.6 Hydrogeology

2.6.1 Regional

A groundwater bore search indicates that there are no registered bores on-site (GHD, 2024a) (Lotsearch, 2025). WaterNSW records indicate that nine groundwater boreholes are registered within 2 km the site (refer to Figure 2.2), four of which occur within 500 m of the site. A summary of the work summary sheets for these groundwater bores is provided in Table 2.3 below.

Table 2.3 Results for registered groundwater bores

NSW Bore ID	Drilled Date	Purpose	Status	Bore Depth (m)	Standing Water Level (SWL)	Yield (L/s)	Salinity (mg/L)	Latitude	Longitude	Distance from site (direction)
GW104643.1.1	2003-01-09	Water Supply	Functioning	49	19	0.78	580	-34.7458	149.8862	118 m (west)
GW100054.1.1	1995-05-22	Water Supply	Functioning	36.5	11	5.0	82	-34.7464	149.8926	233 m (west)
GW043985.1.1	1975-05-01	Water Supply	Functioning	43.8	Unknown	Unknown	Unknown	-34.7426	149.884	287 m (west)
GW043984.1.1	1975-06-01	Water Supply	Unknown	28.9	Unknown	Unknown	Unknown	-34.7426	149.8826	395 m (west)
GW110530.1.1	2003-09-22	Water Supply	Unknown	102	30	2.0	2.44	-34.7428	149.8751	1048 m (west)
GW114844.1.1	2014-08-12	Water Supply	Functioning	54	28	Unknown	Unknown	-34.7424	149.8744	1121 m (west)
GW110805.1.1	2010-03-24	Water Supply	Proposed	109	29	0.64	700	-34.7514	149.8697	1705 m (west)
GW113270.1.1	2013-05-06	Water Supply	Functioning	72	19	0.19	Unknown	-34.7496	149.9267	1833 m (east)
GW111783.1.1	2009-12-10	Water Supply	Functioning	48	8	0.76	Unknown	-34.7661	149.8865	1877 m (south-west)

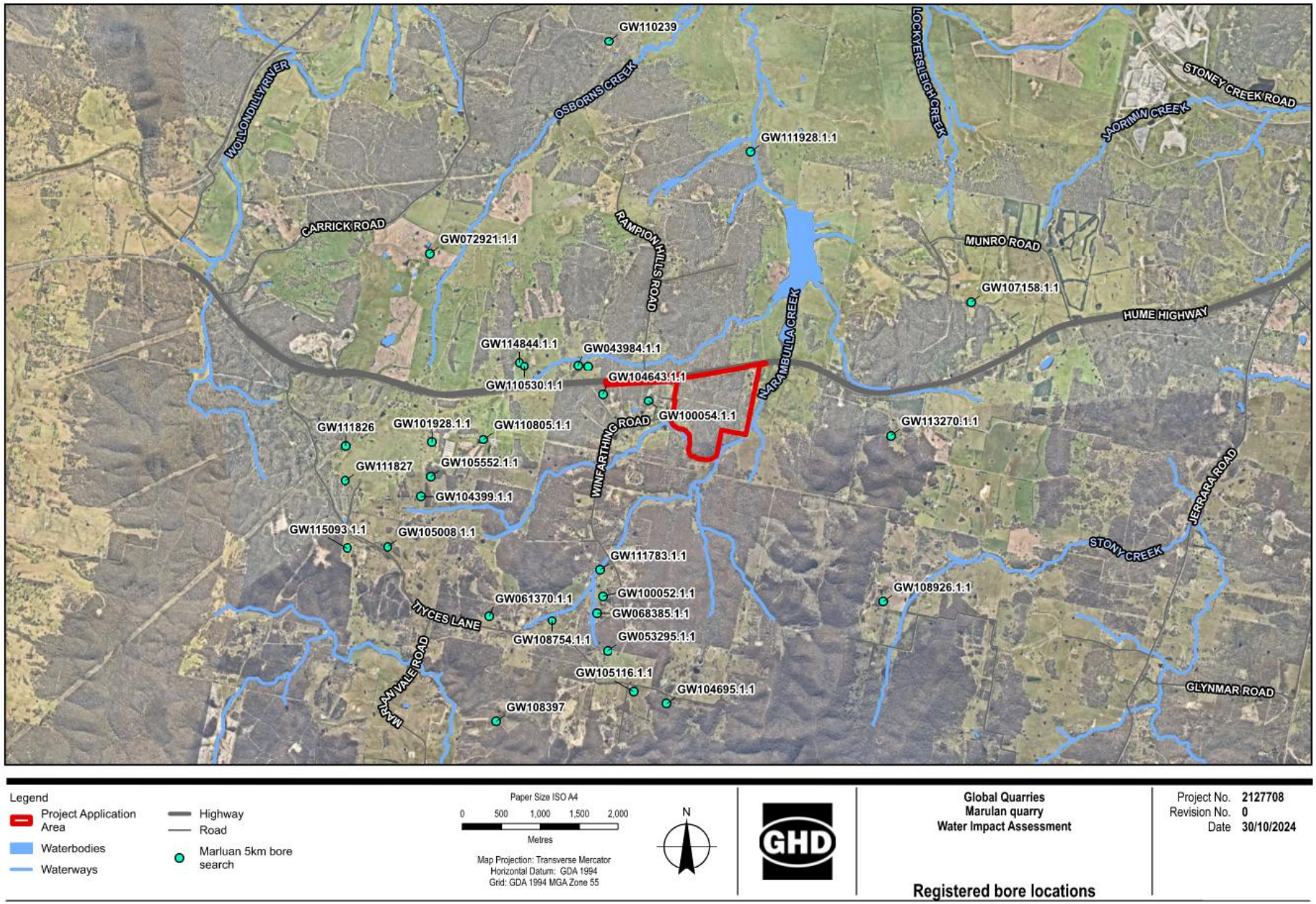

Figure 2.2 Registered groundwater bores relative to the site (defined by the red outline) (GHD, 2024a)

2.6.2 Site specific

The project is located within the Lachlan Fold Belt Greater Metropolitan Groundwater Source which is managed under the replacement Greater Metropolitan Region Groundwater Sources Water Sharing Plan (GMR WSP) which commenced in July 2023. Rock types within this source are a mixture of Palaeozoic rocks which are mainly volcanic in origin (NOW, 2011).

Three piezometers (Hole 1 / PZ01, Hole 2 / PZ02 and Hole 3 / PZ03) were drilled at and / or in the immediate vicinity of the site in September 2019. Piezometer location, water strike and standing water level (SWL) observations are summarised in Table 2.4. Sedimentary strata were encountered to depths of approximately 30 to 40 m and were overlying fresh volcanic rocks. Water strike was observed at 51 m to 106 m depth (570 to 580 m AHD), however the standing water level stabilised at 3.8 m to 5.2 m depth (627.2 to 628.8 m RL), suggesting a confined aquifer. Piezometer locations are shown in Figure 2.3 below and also in Figure 3 (Appendix A).

Table 2.4 Piezometer location, water strike and standing water level observations (GHD, 2024a)

ID	Easting	Northing	Bore depth (m)	Surface (m RL)	Depth to Strike Water (m)	Depth to Standing Water (m)	Strike Water (m AHD)	Standing Water (m AHD)
PZ01	765533	6151088	109	677	106	NA	571	NA
PZ02	766026	6150809	55	631	51	3.8	580	627.2
PZ03	766170	6151504	76	634	64	5.2	570	628.8

Table 2.4 notes: NA – No casing installed in PZ01.

The Water Impact Assessment (GHD, 2024a, p. 14) indicated that *'groundwater underlying the project* [site] *occurs within a confined fractured rock aquifer. The aquifer is managed under the Lachlan Fold Belt Greater Metropolitan Groundwater Source. Based on available information, the top of the confined aquifer is at approximately 580 m RL* [m AHD]. *Groundwater use is relatively low in the vicinity of the project* [site]*. Also, it is unlikely that there is hydraulic connection between surface water and groundwater in the vicinity of the project* [site] *due to the depth of the confined aquifer* [Narambulla Creek (approx. 630 m AHD)]*, and therefore the potential GDEs* [groundwater dependent ecosystems] *identified will have low dependence on groundwater'*.

The Water Impact Assessment (GHD, 2024a, p. 9) expected that groundwater flow reflects topography, with groundwater flowing from topographic highs towards lowing lying areas, such as creeks and lakes. Regionally it is expected that groundwater flows to the north-east and discharges into the Wollondilly River (located approximately 6.9 km north of the site).

Groundwater quality is discussed in Section 3.8.2.

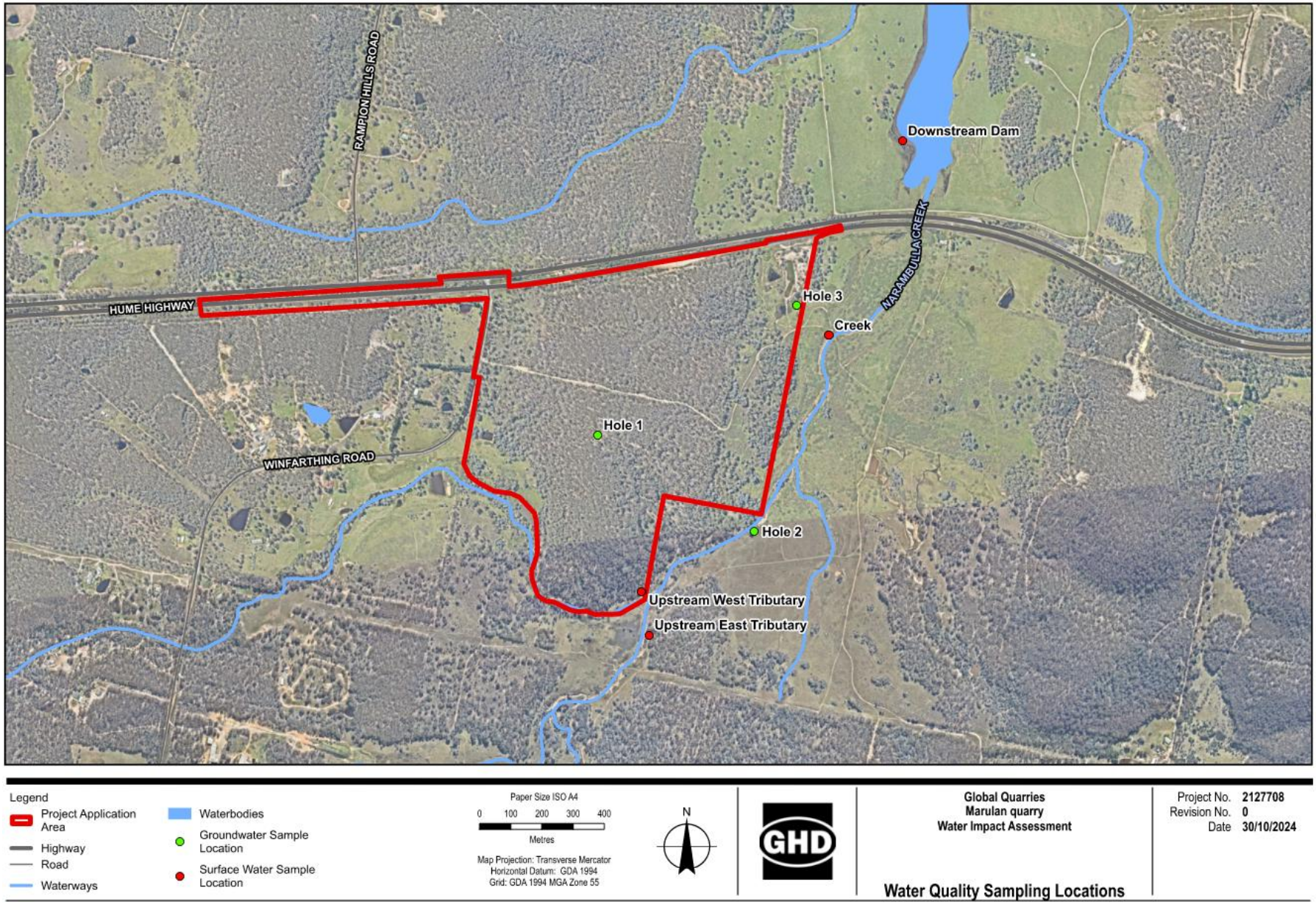

Figure 2.3 Groundwater and surface water quality sampling locations relative to the site (defined by the red outline) (GHD, 2024a)

3. Site history

3.1 General

Site history information was reviewed for the site and obtained from the following sources:

– Review of selected aerial photographs (1941 to 2025).
– Review of historical title search results.
– A search of NSW EPA register for listings of the site and nearby properties.
– Council records including Section 10.7 Planning Certificates.
– Historical business directory records between 1950 and 1991.
– Historical topographic maps.

A summary is provided below. Relevant historical information is shown in Figure 3 (Appendix A).

No personnel familiar with the history of the site were available to interview. General information was obtained from the GHD project team who have been involved with the project since 2018. Their recollections are included in Section 4.

3.2 Historical aerial photography

The review of aerial photography is summarised in Table 3.1. Aerial photographs from 1941 to 2023 are included in the Lotsearch report (Lotsearch, 2025) presented in Appendix B. Additional aerial photographs were accessed via Nearmap and Google Earth.

Table 3.1 Historical aerial photography review

Date	On-site	Off-site
1941 (black & white)	The area where the site is located comprises remnant bushland and cleared areas. The majority of Lots 3 and 7001 is occupied by remnant bushland whilst the majority of Lot 4 and road reserve have been cleared. Tributaries of Narambulla Creek and possible access tracks are evident on Lots 3 and 4.	Areas surrounding the site were of similar appearance to the site with relatively large areas of bushland and cleared areas evident. Narambulla Creek is evident and flanks the southern and eastern boundaries of the site. The Hume Highway is also noted.
1953 (black & white)	A relatively large area of possible ground disturbance is evident in the north-eastern corner of the site and could be associated with a borrow pit. An access track is evident on the southern side of the borrow pit area and continues in a south-westerly direction through bushland area of Lot 3 terminating within a cleared area within the south-western corner of the site. A relatively small area of ground disturbance is evident within the western extent of the site, immediately south of the Hume Highway. Previously the western extent of the site (the section parallel to the Hume Highway) was mostly cleared of vegetation, however significant regrowth is evident in 1953. A third area of ground disturbance is located on the northern boundary of Lot 4 immediately south of the Hume Highway. Several access tracks extend south and south-west from this disturbed area passing through the bushland areas of Lot 4.	Ground disturbance is evident within the road verges of the Hume Highway north of the site. It is unclear if Lake Narambulla has been formed. Winfarthing Road has not yet been constructed however an access track is evident extending south and south-west from the Hume Highway. Apart from changes to vegetation and formation of access tracks, areas surrounding the site remain relatively unchanged.
1967 (black & white)	At the western section of the site, a distinct access track is evident parallel to the Hume Highway. At the western extent of the site, another access track extends south from this access track to a cleared area located approximately 520 m south of the site. A relatively large area within the north-western corner of Lot 3 has been cleared. Some vegetation regrowth is evident within Lot 4, in particular, around the perimeter of the borrow pit area.	Lake Narambulla has been formed north-east of the site. Extensive vegetation clearing has occurred north of the Hume Highway. Some access tracks appear more distinct. A dam is located approximately 330 m south of the western part of the site parallel to the Hume Highway.

Date	On-site	Off-site
		Remaining areas surrounding the site appear relatively unchanged.
1971 (black & white)	The site appears relatively unchanged since the previous aerial photograph.	Possible structures (i.e. shed or a dwelling) are evident approximately 430 m south of the western part of the site parallel to the Hume Highway. Remaining areas surrounding the site appear relatively unchanged.
1984 (black & white)	At the borrow pit in the north-eastern corner of the site, the area of ground disturbance has increased, and vegetation regrowth removed. The borrow pit area appears to have three dams. Vegetation in the western part of the site, parallel to the Hume Highway, has been cleared and some ground disturbance evident in the road verge. Vegetation appears to have been cleared on Lot 3 along the northern site boundary. Remaining areas of the site appear relatively unchanged.	The Hume Highway appears to have been duplicated, and Winfarthing Road has been constructed. A relatively small dam has been constructed near the south-western corner of the Hume Highway and Winfarthing Road intersection, immediately adjoining the site. The area south of the western part of the site parallel to the Hume Highway appears to have been subdivided into small parcels of land, which front Winfarthing Road. Remaining areas surrounding the site appear relatively unchanged.
1989 (black & white)	An access track appears to have been formed within the previously cleared area parallel to the northern boundary of Lot 3. Another access track, orientated east-west, passes through bushland in the northern part of Lot 3 and connects with the southern end of the borrow pit area in Lot 4. The access track appears to also connect to Winfarthing Road in the west. However, it continues beyond the road, towards the north-west, passing through the western portion of the site. A medium sized, rectangular shaped dam has been constructed in the south-western corner of Lot 3, east of Winfarthing Road. Remaining areas of the site appear relatively unchanged.	Development of properties, south of the western part of the site parallel to the Hume Highway, has continued with the construction of buildings and dams, and land clearing evident. Remaining areas surrounding the site appear relatively unchanged.
1997 (colour)	The second access track discussed in the 1989 aerial photograph, appears to have been duplicated with two lanes evident. Most of track appears to be servicing the western portion of Lot 3. The track also extends further east beyond the Lot 4 boundary. Some ground disturbance is noted along the northern boundary of Lot 3 within the Hume Highway road verge. Remaining areas of the site appear relatively unchanged.	Development of properties, south of the western part of the site parallel to the Hume Highway, continues. A possible orchard is evident approximately 100 m west of the site and Winfarthing Road. An area immediately north of the Hume Highway has a grey appearance, suggesting possible filling. Remaining areas surrounding the site appear relatively unchanged.
2004 (colour)	A relatively large, elongated area has been cleared near the centre portion of Lot 3. The clearing is generally oriented east-west and contains several stockpiles [these stockpiles comprise felled trees – see 2025 aerial photograph description and refer to Section 4]. Several new access tracks have also been formed on Lot 3. Refer to image below. Remaining areas of the site appear relatively unchanged.	Development of properties, south of the western part of the site parallel to the Hume Highway, continues. Rampion Hills Road has been constructed north of the site and connects with the Hume Highway. The possible orchard west of Winfarthing Road is no longer evident. The remaining areas surrounding the site appear relatively unchanged.

Date	On-site	Off-site
		
2013 (colour)	Vegetation regrowth has occurred in the western portion of Lot 3, and the previously cleared area in the centre portion of Lot 3. Some vegetation regrowth has occurred in Lot 4 and within the western portion of the site parallel to the Hume Highway. Remaining areas of the site appear relatively unchanged.	Development of properties, south of the western part of the site parallel to the Hume Highway, continues. The remaining areas surrounding the site appear relatively unchanged.
2023 (colour)	A new access track has been formed through the centre of Lot 3. The access track passes through the previously cleared area as shown in 2004 above and connects Winfarthing Road to the southern side of the borrow pit area. Previously formed access tracks have either faded or are no longer apparent. Vegetation regrowth within Lot 4 and the western portion of Lot 3 continues. Remaining areas of the site appear relatively unchanged.	Development of properties, south of the western part of the site parallel to the Hume Highway, continues. The remaining areas surrounding the site appear relatively unchanged.
2021 to 2025 (colour) Nearmap	The stockpiles observed in the 2004 aerial photograph are still evident on-site. A close up of one of the stockpiles is provided in the image below.  Green items were observed at four locations within the southern portion of Lot 3 and north, east, south-east and north-east of Lot 7001, as indicated by the green markers in the image below. A close up view of one of the green items is also provided below. [The green items are understood to be soil / rock samples associated with exploratory drilling that was undertaken by another consultant – refer to Section 4].	The orchard is again evident, in 2021, west of Winfarthing Road. The remaining areas surrounding the site appear relatively unchanged.

Date	On-site	Off-site
	  Additional access tracks have been formed in the western portion of Lot 3, generally orientated north-south and connect with the main access track in the centre of Lot 3. In the borrow pit area (Lot 4), several grey items were evident west of the largest dam. The grey items resemble felled trees. The location and close up of these items are shown in the images below. Remaining areas of the site appear relatively unchanged.	

Date	On-site	Off-site
		
		

3.3 Historical titles

The historical title information indicates the registered proprietors for Lots 3 and 4 were:

– 1935 to 1942: Commonwealth Bank of Australia.
– 1942 to 1973: various individuals with an occupation of grazier.
– 1973 to date: various companies appear to be for land holding and investment. A Google search and ABN Lookup search was unable to confirm other company details.

From 2017, Lots 3 and 4 have been leased, with the current lease holder Global Quarries Australian Pty Ltd.

Lot 7001 is Crown Land acquired in 1983, with a designated purpose of trigonometrical and occupied by Shelly Trig Station. The land is affected by an Aboriginal Land Claim.

The results of the historical title search are included in Appendix C.

3.4 NSW EPA registers

GHD reviewed information provided in the NSW EPA registers on 8 December 2025 and also information presented in the Lotsearch report (Lotsearch, 2025) (Appendix B). A summary of these records is provided in Table 3.2 below and presented in Appendix D.

Table 3.2 Summary of NSW EPA records as at 8 December 2025

Search	Result
Contaminated Land Record of Notices	No record for site or up to 2 km surrounding the site.
Notified Sites under the *Contaminated Land Management Act* 1997 (CLM Act, 1997)	No record for site or up to 2 km surrounding the site.
Environmental protection licenses under the *Protection of the Environment Operations Act* 1997 (POEO, 1997)	There are no current licences recorded for the site. There are three records of former licenced activities on-site for the purpose of application of herbicides to waterways. These licences were surrendered in 2000. One current Environmental Protection Licences (EPL) under the POEO Act (1997) exists within 1 km of the site, which includes EPL (No. 21312) issued for the mining of minerals. Located 779 m east of the site. The licence was issued 9 October 2019 to The Austral Brick Co Pty Ltd. Three former licences, now surrendered, existed at a property 436 m south of the site for the following activities: – Hazardous, Industrial or Group A Waste Generation or Storage – Composting and Related Reprocessings – Mushroom Substrate Production
Penalty Notices and s. 91 Clean Up Notices issued under the Protection of the Environment Operations Act 1997 (POEO, 1997)	There are no Penalty or Clean up notices listed for the site.
EPA PFAS Investigation Program	No record for site or up to 2 km surrounding the site.

3.5 Section 10.7 Planning Certificates

The Section 10.7 Planning Certificates pertaining to Lot 3 DP247199 and Lot 4 DP247199 were reviewed, and results are summarised in Table 3.3 and included in Appendix E. No Section 10.7 Planning Certificate is available for the section of Crown Land (road reserve). It is understood that a Section 10.7 Planning Certificate is available for Lot 7001 DP1025585, however it was not received prior to finalising this report.

Table 3.3 Summary of Section 10.7 regarding contamination matters

Section	Result
Part (2) matters under section 59 (2) of the Contaminated Land Management Act 1997	Council has not been advised that the land is significantly contaminated, subject to a: management order; voluntary management proposal; ongoing maintenance order or site audit statement.
Part (5) Former land use identification	No records for current planning certificates. However, Council has adopted a Contaminated Land Policy for this site, which provides a framework to manage land contamination through the land use planning process.
Loose-filled asbestos insulation Division 1A of Part 8 of the Home Building Act 1989	No, the land has not been identified in the Loose-Fill Asbestos Insulation Register as containing loose-fill asbestos ceiling insulation.

3.6 Historical business directories

The general business directory records between 1950 and 1991 show no business recorded at or within 1 km of the site. There were no records of dry cleaner, motor garage or service station related businesses within 1 km of the site for the same period. However, the Lotsearch report (Lotsearch, 2025) identified several businesses as a 'road match'. These businesses were located in the Marulan CBD or associated with the roadside service station located greater than 8 km north-east of the site.

3.7 Historical topographic maps

The 1981 topographic map presented in the Lotsearch report (Lotsearch, 2025) indicates a borrow pit in the north-eastern corner of the site and trigonometry station with elevation of 698 m AHD.

3.8 Previous reports

3.8.1 Non-Aboriginal Heritage (GHD, 2024b)

GHD has prepared an EIS to support the development application for the quarry, which included a Non-Aboriginal Heritage assessment. The assessment indicated the following historical activities relevant to the site:

– The site occurs within an area used primarily for grazing purposes.
– The site is largely undeveloped except for:
  - Graded tracks.
  - A trigonometry station (Shelly Trig Station) located on Lot 7001 and established in 1893.
  - Several areas of ground disturbance associated with the construction and maintenance of graded tracks and their road reserves, the establishment of a dam within the south-western portion of Lot 3.
  - Quarrying activities in the north-eastern corner on Lot 4.
  - Installation of underground services (location not identified in report).

3.8.2 Water Impact Assessment (GHD, 2024a)

A Water Impact Assessment report was prepared and formed part of the EIS for the development application.

Sampling and analysis of groundwater and surface water was undertaken to establish existing water quality conditions at the project site and surrounds. Sampling occurred over three monitoring rounds on 22 February 2022, 7 June 2024 and 15 August 2024.

Groundwater was sampled from Hole 2, which was located approximately 60 m south of the site (refer to Figure 2.3 above). Surface water samples were collected from four locations: two samples from upstream tributaries on Narambulla Creek located immediately south-east of the site, one sample from Narambulla Creek located 140 m south-east of Hole 3 and one sample from a location downstream and north-east of the site at Narambulla Lake (refer to Figure 2.3 above).

The samples were analysed for total recoverable hydrocarbons (TRH) benzene, toluene, ethylbenzene and xylenes (BTEX), polycyclic aromatic hydrocarbons (PAH), heavy metals (arsenic, cadmium, chromium, copper, nickel, lead, zinc, mercury), aluminium, iron, manganese, ammonia (as N), chloride, dissolved organic carbon, nitrate (as N), nitrite (as N), phosphate total (as P), phosphorus reactive (as P), sulphate (as SO_4), total kjeldahl nitrogen (as N), total nitrogen (as N), total suspended solids (TSS), cations and anions. Field water quality parameters including pH, electrical conductivity (EC), temperature, dissolved oxygen (DO) and redox were measured at the time of sampling with a calibrated water quality meter.

Concentrations of the above water quality parameters were compared to relevant default guideline values (DGVs) from the Australia and New Zealand Water Quality Guidelines (ANZG, 2018) for 95% species protection of aquatic ecosystems for freshwater. Physical and chemical stressors were compared to DGVs from (ANZECC/ARMCANZ, 2000) (tables 3.3.2 and 3.3.3). *The author of the report indicated that DGVs were not corrected for hardness (pers. comms. S. Gray, 17/12/2025).* Hardness was not analysed in water samples and therefore, DGVs cannot be retrospectively corrected.

The report provided the following summary of results:

– *'Groundwater (Hole 2) is near neutral, fresh and calcium bicarbonate dominant. Dissolved metal concentrations are low, with only copper and zinc exceeding the DGV. Hydrocarbons were below the limit of reporting. Based on the water quality data available, the beneficial uses of groundwater at the site include domestic, environment and agricultural. Based on the major ion chemistry, there appears to be minimal similarity between surface water and groundwater, suggesting no connection between the creek and confined aquifer which is consistent with the conceptual model* [refer to Section 2.6.2 of this PSI report].
– *Surface water is slightly alkaline to slightly acidic and fresh. Samples were sodium bicarbonate dominant in 2022, however have moved to less bicarbonate dominance in 2024. The water quality generally reflects the natural quality of catchment runoff (including elevated aluminium and iron concentrations) as well as some agricultural influence potentially raising organic nitrogen concentrations. Hydrocarbons and metals are generally at low or undetectable levels (only dissolved cadmium, copper and zinc concentrations slightly exceeding DGVs)'.*

During the August 2024 sampling event, foam was observed within Narambulla Creek at coordinates -34.750824, 149.904646 (refer to Photo 1 and Photo 2 below). During the February 2022 monitoring event, iron precipitation was observed at coordinates -34.743569, 149.908124 (refer to Photo 3 and Photo 4 below). The location of the foam and iron precipattion is indicated by the blue and red markers in Figure 3.1, respectively and are located off-site and down-gradient of the site. Foam and iron precipitation was only observed once in the four site visits that have been undertaken since 2022 suggesting the occurrence may be transient coinciding with high rainfall events (refer to Section 4). Foam and iron precipitation can occur naturally (e.g. bacteriological activity, change in pH due to natural oxidation of soil or rock, etc.).

Figure 3.1 ***Location of foam within Narambulla Creek indicated by the blue marker and iron precipitation indicated by the red marker (Nearmap image 1/3/2025)***

Photo 1: View looking upstream at Narambulla Creek. Note foam on the water within upstream sections of the creek (15/8/2024)

Photo 2: Close up view of the foam within Narambulla Creek (15/8/2024)

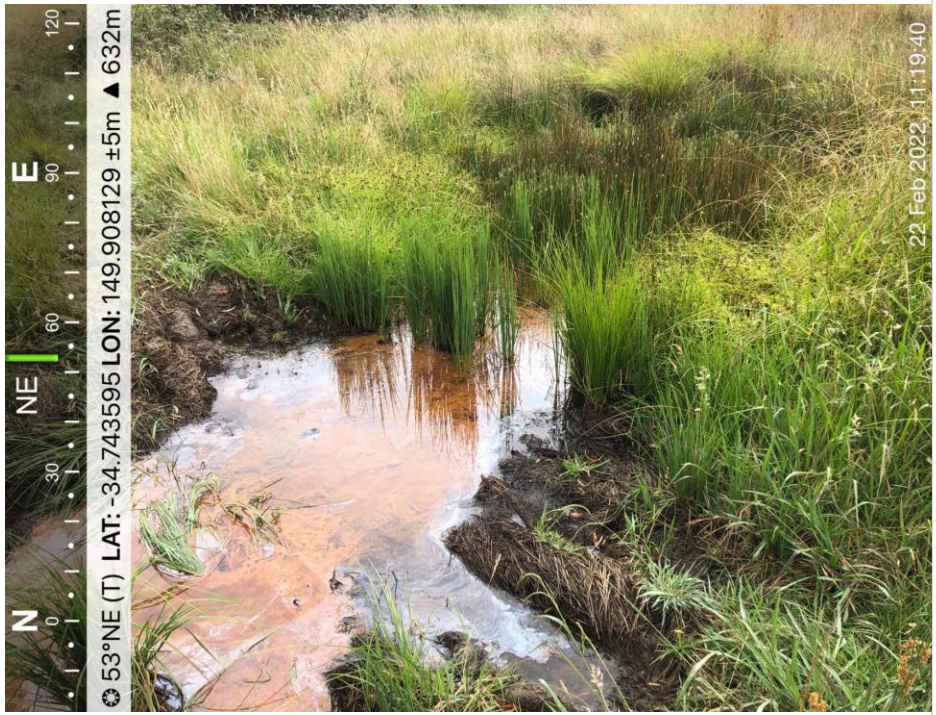

Photo 3: View looking north at iron precipitation in pooled water located approximately 65 m south-east of the borrow pit area (22/2/2022)

Photo 4: Close up view of iron precipitation in pooled water located approximately 65 m south-east of the borrow pit area (22/2/2022)

3.9 Gaps in site history

The following gaps in the site history were identified:

– Limited information on the activities associated with the borrow pit in the north-eastern corner of the site (on Lot 4) and whether filling has occurred within this area of the site.
– Limited information on potential illegal dumping / fly tipping.
– The source of foam within Narambulla Creek is unknown.
– The cause of the iron precipitation in areas of pooled water observed approximately 65 m south-east of the borrow pit is unknown.
– Limited information is available of potential application of herbicides / pesticides. Herbicide application may have occurred within Narmbulla Creek or its tributaries prior to 2000. It cannot be precluded that herbicides may have been applied to areas of the site which form part of the road verge.

3.10 Site history summary

Site history information indicated that the site occurs within a rural area used primarily for livestock grazing. A relatively small orchard was noted some distance west of the site in the 1997 aerial photograph; however, information on the use of herbicides and pesticides on-site and surrounding areas is limited. Based on topography, surface water run from the orchard would likely flow to a small dam located on the property, reducing the likelihood of off-site migration.

The site has remained generally undeveloped except for a borrow pit in the north-eastern corner of Lot 4, which also included three dams, a dam in the south-western corner of Lot 3, a trigonometry station on Lot 7001, vegetation clearance (road reserve, Lot 4 and western side of Lot 3), numerous access tracks, ground disturbance along the road verge and installation of underground services. No other structures were constructed at the site.

Aerial photographs indicated that the borrow pit was formed some time between 1941 and 1953. By 1984, the borrow pit area appeared to have expanded, and three dams were present within the borrow pit area. The fourth dam, located in the south-western corner of Lot 3, was constructed some time between 1984 and 1989. All dams remain on-site.

Access tracks were in different locations throughout time, but were generally oriented east-west, providing access between Winfarthing Road and the borrow pit area through remnant bushland of Lot 3. In 2004, a relatively large access track, passing through the centre of Lot 3, was formed. Vegetation and trees felled to facilitate the construction of the track were stockpiled within adjoining areas. The stockpiles remain on-site.

In the 2025 aerial photograph, green items were observed at four locations within the southern portion of Lot 3 and north, east, south-east and north-east of Lot 7001. The green items are understood to be soil / rock samples associated with exploratory drilling that was undertaken by another consultant – refer to Section 4.

Sampling and analysis of groundwater and surface water was undertaken to establish existing water quality conditions at the project site and surrounds. Groundwater was sampled from Hole 2, and surface water was collected from four locations including upstream tributaries of Narambulla Creek, Narambulla Creek and Narambulla Lake (refer to Figure 2.3 above). Samples were analysed for TRH, BTEX, PAH, TSS, heavy metals, nutrients, anions, cations, and dissolved organic carbon. Field water quality parameters were also measured during sampling. Concentrations of the above water quality parameters were compared to relevant DGVs from the Australia and New Zealand Water Quality Guidelines (ANZG, 2018) (ANZECC/ARMCANZ, 2000) for 95% species protection of aquatic ecosystems for freshwater. Concentrations of cadmium, copper and / or zinc exceeded the DGVs whilst remaining parameters reported concentrations below the DGVs. Foam and iron precipitation were observed during the August 2024 and February 2022 monitoring rounds, respectively. The source of the foam and cause of the iron precipitation are unknown, but can occur naturally (e.g. bacteriological activity, change in pH due to natural oxidation of soil or rock, etc.). The occurrence of foam and iron precipitation was observed once in the four site visits undertaken at the site since 2022.

There are no Contaminated Land Record of Notices, Notified Sites under the Contaminated Land Management Act 1997 associated with the site. The site and nearby areas do not form part of the NSW EPA PFAS Investigation Program. There are no matters arising under Part (2) & (5) of the Section 10.7 Planning Certificate in relation to contamination.

4. Site observations

An Environmental Scientist from GHD carried out a site walkover at the site on 16 December 2025. Observations made during the site walkover are discussed below along with a selection of photographs. Relevant site features are shown on Figure 3 (Appendix A).

The site comprises cleared land and primarily light bushland. A small dam is located on the south-western side of the site. Remnants of historical quarrying activities with a borrow pit likely to be associated with the former construction of the Hume Highway is evident at the north-east portion of the site.

The site was observed to slope away from a central hill and high point on the site (Lot 3), located at the trigonometrical station (Shelly Trig Station) (Photo 5). The land falls steeply from this high point to the east, west and south. Narambulla Creek and its tributaries occur south of the site at the base of the slope (Photo 6 and Photo 7). A ridgeline runs north from the high point towards the Hume Highway, with gently to moderately steep slopes occurring east and west of the ridgeline.

In the southern part of Lot 3 approximately 70 to 120 green bulk bags were observed stockpiled at various locations. The stockpile areas were between 50 and 250 m of the trigonometrical station on Lot 7001 (Photo 8). The bulk bags were labelled with the letters ‘GCRC’ and had depths ranging from one to over 100 (assuming metres) written on them. The bulk bags appear to be associated with site investigations (possibly geological exploration). Two boreholes / piezometers, cased with PVC pipe, were located in the vicinity of these bulk bags (Photo 9). The piezometers were open (i.e. not capped) and each measured depths greater than 30 m. No groundwater was encountered within 30 m of the ground surface.

Creek flats were present around Narambulla Creek, largely occupied by grass, blackberry bushes and sparse trees (Photo 10). Narambulla Creek and its tributaries were not flowing at the time of the site visit. The water was ponded within discontinuous segments of the watercourse. Narambulla Creek appeared slightly cloudy with low turbidity and had an aqua blue tinge (Photo 11). Further upstream, the surface water was pale brown, more cloudy with moderate to high turbidity (Photo 12). No odours, sheen, iron precipitation or foam were noted in the watercourse. The creek was deeply incised into the surrounding land and highly eroded (Photo 13), with the banks approximately 2 m high in some areas.

The borrow pit area was situated in the north-east of the site (Lot 4). The pit is approximately 150 m long and 50 m wide, the pit walls are approximately 5 to 10 m high (Photo 14). A dam has formed within what appears to be the base of the borrow pit and is estimated to be greater than 1.5 m deep. Several haul roads / access tracks down into the pit were present. The haul roads / access tracks appear to have been constructed with quarry material. Remnants of a car body were observed adjacent to one haul road near the borrow pit (Photo 15), no contamination was observed in the vicinity of the car body. No evidence of filling or importing material was observed in or around the borrow pit.

Two dams are located in the areas surrounding the borrow pit, one immediately to the east (Photo 16) and another located immediately south (Photo 17). Both dams had low water levels, with the water described as pale brown, moderately turbid, and no odours, sheen, foam or iron precipitation. A piezometer (Hole 3) was located immediately south of the borrow pit (Photo 18). The monument was in good condition, and the standpipe was measured to be 0.830 m above ground level. The water level was recorded at 1.980 m below top of casing using a water whistle, which is 1.150 m below ground level (bgl). The base depth of Hole 3 was greater than 30 m and could not be gauged with the length of measuring tape available on-site.

A dam is located in the south-west of the site (Lot 3). The construction of the dam wall appeared to be material excavated to form the basin (Photo 22). No evidence of recent use by livestock was observed around the dam. This corner of the site was sparsely vegetated with trees and relatively flat terrain (Photo 23).

A gravel road passes through the centre of Lot 3, from Winfarthing Road to Lot 4 in the east. The road continues in a northerly direction connecting with the borrow pit area in the north-eastern portion of the site (Lot 4). The road appears to have been constructed from on-site material (Photo 24). Trees left over from the clearing of the road were sporadically stockpiled adjacent to the gravel road (Photo 25).

The northern site boundary occurs adjacent to the Hume Highway for approximately 2.2 km (Photo 19). Rubbish was frequently observed scattered along the road shoulder and median strip, and included fast food containers and wrappers, Styrofoam, soft and hard plastics and a tyre (Photo 20). A small pile of bitumen with tyre tread and plastics was dumped near the access gate to site on the northern boundary (Lot 4) (Photo 21). No other fly tipping was observed along the Hume Highway at the time of the site visit.

Winfarthing Road is adjacent to the western boundary of Lot 3 (Photo 26). Relatively small occurrences of rubbish were noted on either side of the road. Three instances of fly tipping were observed, one located immediately inside the northernmost access gate to the site (Lot 3) off Winfarthing Road (Fly tipping 1); the second instance was observed on the road shoulder approximately 150 m south of the southern access gate to Lot 3 off Winfarthing Road (Fly tipping 2) and the third was located approximately 75 m south of the Hume Highway on Lot 3 (Fly tipping 3). Fly tipping 1 comprised a degraded mattress, bottles and jars and ceramics (Photo 27), which appeared to have been dump some time ago. Fly tipping 2 comprised cardboard boxes and a toaster press and appeared to have been placed relatively recently (Photo 28). A pile of wire was also noted within the boundary fence near Fly tipping 2 (Photo 29). Fly tipping 3 comprised four pieces of rusted scrap metal, resembling corrugated iron sheeting and 44 gallon drum (Photo 30).

Photo 5: View looking north at the trigonometrical station, which is also the highest point of the site (16/12/2025)

Photo 6: View looking south-east towards Naramburra Creek from the central hill at the site (16/12/2025)

Photo 7: View looking south-west from the central hill at the site. Steep slopes evident (16/12/2025)

Photo 8: Green bulk bags with soil/rock samples. The plastic has degraded, and the bags are open (16/12/2025)

Photo 9: Cased hole near a green bulk bag location. Greater than 30 m deep (16/12/2025).

Photo 10: View looking south over the eastern boundary of the site and Narambulla Creek (16/12/2025)

Photo 11: View looking north-east at Narambulla Creek located immediately off-site on the eastern side of the site (16/12/2025).

Photo 12: Narambulla Creek upstream of Photo 11, facing west (16/12/2025)

Photo 13: View looking south at steep and highly eroded creek banks of Narambulla Creek (16/12/2025)

Photo 14: View looking south towards the borrow pit from the northern wall (16/12/2025)

Photo 15: Old vehicle body located near access road to borrow pit (16/12/2025)

Photo 16: View looking west at the dam located just east of the borrow pit (16/12/2025)

Photo 17: View looking north at the dam located immediately south of the borrow pit (Lot 4) (16/12/2025)

Photo 18: View looking north-west at piezometer Hole 3, situated immediately south of the borrow pit (Lot 4), looking north-west (16/12/2025).

Photo 19: View of the Hume Highway, shoulder and median strip, facing north-east (16/12/2025)

Photo 20: Example of the general rubbish found scattered in proximity to the Hume Highway – on road shoulder (16/12/2025)

Photo 21: Bitumen with tyre tread and plastic on Hume Highway road shoulder near Lot 4 access gate (16/12/2025)

Photo 22: View looking west at the dam located in the south-west of the site (16/12/2025)

Photo 23: General view from the cleared land in the south-west of the site (Lot 3). Facing south-east towards the trigonometrical station and hill (16/12/2025)

Photo 24: View looking west along the internal gravel access road that passes through the centre of Lot 3 (16/12/2025)

Photo 25: Example of wood stockpiles left over from the clearing for the internal gravel access road on Lot 3 (16/12/2025).

Photo 26: View looking south towards the access gate to Lot 3 located off Winfarthing Road and at the land adjacent to western boundary of site. Cattle yards visible in the background of the photo (16/12/2025)

Photo 27: Fly tipping evident over fence into property, near northern access gate from Winfarthing Road (16/12/2025)

Photo 28: Fly tipping evident on road shoulder of Winfarthing Road (16/12/2025)

Photo 29: Pile of wire located just inside boundary fence off Winfarthing Road (16/12/2025)

Photo 30: Scrap metal located in the northern portion of Lot 3 (16/12/2025)

5. Preliminary Conceptual Site Model (CSM)

A conceptual site model (CSM) is a representation of site-related information regarding contamination sources, receptors and exposure pathways between those sources and receptors. The CSM is developed using information obtained from previous investigations, site history, site observations, proposed land use and expected ground conditions. The CSM allows the assessor to evaluate the risk posed by the contamination to the identified receptor, whether further investigations are required to adequately assess the risk, and whether remediation is required to manage that risk.

5.1 Potential Sources of contamination

Site history information and site observations indicate a number of potentially contaminating activities that have occurred on or in the vicinity of the site. These activities have been identified as AECs, which are discussed below. The likelihood of contamination to exist at the site has been qualitatively assessed where the likelihood is the probability of contamination being present and subject to exposure as part of future land use, categorised on a scale from high (near 100% probability of being present) to very low (near 0% probability of being present). Approximate locations where potentially contaminating identified are shown on Figure 3 in Appendix A.

5.1.1 On-site sources

5.1.1.1 AEC 1: Fill of unknown quality and origin

Site history information and site observations have not identified any significant placement of fill. Fill comprising rocks, likely from the site, has been used around the base of the trig station. Soil and rock samples from exploratory drilling undertaken at the site (i.e. reworked natural materials) have been stockpiled at various locations within the southern half of Lot 3. The plastic bags containing the samples have degraded and present an aesthetic impact.

Fill (i.e. reworked natural materials) that is present at the site is likely to be from the site and therefore, the likelihood of contamination is assessed as very low.

5.1.1.2 AEC 2: Sediment quality within on-site dams

Dam sediments can accumulate chemicals, such as pesticides, that may have been used within the catchment for the dam. As discussed in Section 5.1.2.1, there is limited information about the use of pesticides and / or herbicides on-site and in surrounding areas. Site history information indicates that minimal development has occurred on-site, and site activities that have occurred (e.g. borrow pit, formation of access tracks, etc.) are not considered to be a potential source of contamination. No evidence of contamination such as odours or sheens on the surface of the water within the dams or in the general vicinity of the dams was observed.

Contamination, if present, is more likely to exist in sediment, however, impacts to surface water quality cannot be precluded. The likelihood of contamination is assessed as very low, as pesticide / herbicide application appears to have been limited an no other potentially contaminating activities have been identified.

5.1.1.3 AEC 3: Fly tipping

Localised fly tipping was observed at the site and included:

– Borrow pit area (Lot 4): remnants of a car (i.e. passenger cab only), rusted and mangled.
– Road verge and median strip: litter (i.e. food wrappers, drink bottles, etc.), hard and soft plastics, Styrofoam, a tyre, and a small pile of asphalt near the northern access gate (Lot 4).

– Winfarthing Road:
    - Fly tipping 1 (on-site): Degraded mattress, bottles and jars, ceramics. Located on-site adjacent to the Lot 3 access gate on Winfarthing Road.
    - Fly tipping 2 (off-site): Cardboard boxes and sandwich toaster press were located within the road shoulder approximately 150 m south of the second access gate on Winfarthing Road. The tipping appears relatively recent. Disused wire was entwined in the site fence near fly tipping 2.
    - Fly tipping 3 (on-site): four pieces of rusted scrap metal, resembling corrugated iron sheeting and 44 gallon drum located approximately 75 m south of the Hume Highway on Lot 3.

There was no evidence of contamination such as oil staining or asbestos containing material (ACM) associated with these instances of fly tipping.

Contamination, if present, would occur in the vicinity of where waste has been placed at the site, potentially impacting near surface soils (i.e. upper 0.1 m). Based on site observations, the likelihood of contamination arising from the localised fly tipping observed is assessed as low. It cannot be precluded that historical fly tipping has occurred and has been since removed.

5.1.2 Off-site sources

5.1.2.1 AEC 4: Potential application of pesticides and / or herbicides and other chemicals

Limited information is available on potential application of herbicides / pesticides. Herbicide application may have occurred within Narambulla Creek or its tributaries prior to 2000 according to NSW EPA records. There is also an orchard located approximately 120 m west and upstream of the site. Typically, pesticides are applied to orchards and other agricultural crops. It is unknown if surface water runoff from the orchard would eventually migrate to site. However, based on topography, surface water run from the orchard would likely flow to a small dam located on the property, reducing the likelihood of off-site migration. It cannot be precluded that pesticides / herbicides may have been applied to areas of the site which form part of the road verge.

Modern pesticides and herbicides are less persistent in the environment and typically break down after several months. However, older pesticides and herbicides that may have been used prior to 1980 were more persistent, remaining in soils several years following application. It is anticipated that the organic component of older pesticides has degraded however heavy metals such as arsenic could still remain in near surface soils.

Foam and iron precipitation were observed during the August 2024 and February 2022 monitoring rounds, respectively. The foam was observed within Narambulla Creek whilst the iron precipitation occurred in area of pooled water approximately 65 m south-east of the borrow pit area on Lot 4 (off-site). The source of the foam and cause of the iron precipitation are unknown. Foam and iron precipitation can occur naturally (e.g. bacteriological activity, change in pH due to natural oxidation of soil or rock, etc.). Foam and iron precipitation was only observed once in the four site visits that have been undertaken since 2022 suggesting the occurrence may be transient coinciding with high rainfall events. Although groundwater and surface water were analysed, this did not include pesticides, herbicides and PFAS. Remaining water quality parameters including petroleum hydrocarbons, nutrients, and heavy metals (except for cadmium, copper and zinc) did not exceed DGVs (ANZG, 2018). Historical activities have not identified an on-site source for cadmium, copper or zinc, suggesting the higher concentration reported in surface water and / or groundwater may be associated with natural sources (i.e. local geology).

Contamination from residual pesticides / herbicides and other chemicals, if present, is expected to occur in the vicinity of the watercourses and road verges / median strips (some of which fall within the site boundary) and occur in the upper 0.2 to 0.4 m of the soil profile depending on the underlying soil type (i.e. clays vs non-cohesive). Chemicals may also be present within surface waters potentially affecting water quality. Surface water flows around and away from the site and does not appear to be hydraulically connected to groundwater (i.e. confined aquifer) at the site (refer to Section 2.6.2); therefore, it is unlikely that groundwater at the site would be impacted.

Therefore, the likelihood of contamination is assessed as very low.

5.2 Contaminants of potential concern

A broad suite of contaminants of potential concern (COPC) is potentially associated with the identified sources, including:

– AEC 1 (fill of unknown quality and origin): total recoverable hydrocarbons (TRH), benzene, toluene, ethylbenzene, xylenes (BTEX), polycyclic aromatic hydrocarbons (PAH), organochlorine pesticides (OCP), organophosphorus pesticides (OPP), polychlorinated biphenyls (PCB), heavy metals (arsenic, cadmium, chromium, copper, nickel, lead, zinc, mercury) and/or asbestos.
– AEC 2 (sediment in farm dams): TRH, OCP, OPP and heavy metals
– AEC 3 (fly tipping): TRH, PAH, heavy metals and asbestos.
– AEC 4 (application and storage of pesticides and chemicals): OCP, OPP and heavy metals (in particular arsenic) (for pesticides); per- and polyfluoroalkyl substances (PFAS) (foam).

5.3 Pathway

The primary pathways by which potential receptors could be exposed to the COPC outlined above are considered to be:

– Exposure pathways:
  - Direct contact with contaminated soil, surface water or groundwater (including dermal contact and ingestion).
  - Inhalation of dust from contaminated soils.
  - Inhalation of vapours/gases generated by soil / groundwater contaminated by volatile and semi-volatile contaminants.
– Migration pathways:
  - Transport of contaminants via groundwater to surface water
  - Leaching of contaminants through the soil profile to groundwater or surface water
  - Transport of contaminants by mechanical disturbance (e.g. earthworks, erosion and sediment transport).

5.4 Receptors

This assessment focuses on the proposed land use associated with planned quarry development. The project overview (Figure 2 in Appendix A) indicates that the borrow pit area and dams will be modified to accommodate heavy vehicle entrance and stockpiling arrangements. Therefore, it is anticipated that dams within the borrow pit area will be mucked out and backfilled, and remaining areas will involve vegetation clearing and general earthworks to prepare the land for the planned development. Accordingly, the key receptors of interest include:

– Human receptors:
  - Individuals involved in earthworks and construction activities at the site and site visitors, including exposure to dust generated from excavation activities.
  - Intrusive maintenance workers carrying out repairs or installation on subsurface utilities following construction phase. It is expected that minor excavation activity could occur in the future (e.g. road repairs or installation of underground services).
– Groundwater users: there are four groundwater bores within 500 m registered for beneficial use (i.e. water supply). Salinity concentrations recorded for some of the groundwater bores indicate that groundwater would be suitable for potable water. Reticulated water may be limited in this area of Marulan requiring a higher reliance on bore water and rainwater supplies.

– Ecological receptors:
  - Transitory wildlife, such as snakes, various animals (native and introduced) and birds may exist at the site. The proximity of trees, shrubs, grassed areas and water bodies (e.g. creeks, tributaries, dams) at or adjacent to the site would provide suitable habitat and encourage wildlife to occupy these areas periodically.
  - Aquatic species are likely to exist within the water and sediment of water bodies on-site and Narambulla Creek and its tributaries.

5.5 Source-pathway-receptor (SPR) linkages

Potential SPR linkages for on-site and off-site receptors are summarised in Table 5.1 below. Based on this review, potential SPR linkages were assessed incomplete due to the likely of contamination associated with the AECs be present was low or very low. The residual plastics associated with soil / rock samples identified as part of AEC 1, present an aesthetic impact.

Table 5.1 Potential source pathway receptor (SPR) linkages

Potential source	Pathway	Receptor	Potential for completeness
Contaminated soils on-site within excavations or at surface.	Volatilisation to outdoor air and subsequent inhalation	Construction workers/visitors	Unlikely: – A very low likelihood of volatile organic compound (VOC) on-site based on potentially contaminating activities identified. – If contamination is present, volatile compounds are expected to sufficiently disperse. However, volatile compounds could accumulate within excavated trenches or service pits.
		Intrusive maintenance workers in the vicinity of the potentially impacted soil	
		Ecological receptors e.g. invertebrates, transitory wildlife and vegetation	Unlikely – terrestrial receptors are unlikely to be impacted by VOC. No vegetation stress noted during investigations.
	Direct contact, including ingestion	Construction workers/visitors Future site occupants	Unlikely. Direct contact with contamination (if present) could occur: – During earthworks or grubbing activities or mucking out sediment from dams as part of decommissioning activities. – Where fly tipping is encountered. – In areas where pesticide / herbicide (or other chemicals) have been used. No evidence of significant contamination was observed, and the likelihood of contamination present at the site and immediate surrounds has been assessed as low to very low.
		Intrusive maintenance workers in the vicinity of the potentially impacted soil	Unlikely – it is anticipated that these works are likely to occur in relatively shallow soil and following redevelopment of the site. Fill material used as part of redevelopment of the site (e.g. decommissioning the dams within the borrow pit area), is likely to be sourced from other parts of the site. The likelihood of contamination present at the site and immediate surrounds has been assessed as low to very low.
		Ecological receptors e.g. invertebrates, transitory wildlife and vegetation	Unlikely – potential impacts to identified ecological receptors could be caused by exposing contaminated soil during earthworks, or the migration of contaminated soils (sedimentation) into sensitive environments which is more likely to occur during development and operational phases when ground disturbance will occur. However, the likelihood of contamination present at the site and immediate surrounds has been assessed as low to very low.

Potential source	Pathway	Receptor	Potential for completeness
	Inhalation of airborne asbestos fibres from soil	Construction workers/visitors Future site occupants	Unlikely – ACM was not identified during the site walkover and other than the trig station no structures have been constructed on the site. However, fly tipping was observed and may continue to occur in the future. Therefore, it cannot be precluded that ACM will not be encountered in the future, as an unexpected find.
		Intrusive maintenance workers in the vicinity of the potentially impacted soil	Unlikely – it is anticipated that these works are likely to occur in relatively shallow soil and following development of the site. Fill material used as part of redevelopment of the site (e.g. decommissioning the dams within the borrow pit area), is likely to be sourced from other parts of the site. The likelihood of contamination present at the site and immediate surrounds has been assessed as low to very low.
		Ecological receptors e.g. invertebrates, transitory wildlife and vegetation	Unlikely – ecological receptors are unlikely to be affected by this contaminant.
	Migration pathways	Surface water ecology	Unlikely – Earthworks, particularly in the vicinity of watercourses, could mobilise existing contaminants (if present) more quickly into surface water bodies. However, implementation of sediment and erosion controls should sufficiently reduce the likelihood of sedimentation and mobilisation of contaminants. The likelihood of contamination present at the site and immediate surrounds has been assessed as low to very low.
		Groundwater	Unlikely – groundwater exists in a confined aquifer, 50 m below existing ground level, and does not appear to be hydraulically connected with Narambulla Creek or its tributaries. The proposed depth of rock extraction is at 595 m AHD and unlikely to intercept the confined aquifer at 580 m AHD (GHD, 2024a).
Contaminated groundwater on-site within excavations	Volatilisation to outdoor air and subsequent inhalation	Construction workers/visitors Future site occupants	Unlikely – a low to very low likelihood of volatile organic compound (VOC) on-site based on potentially contaminating activities identified.
		Intrusive maintenance workers in the vicinity of the potentially impacted groundwater	
		Ecological receptors e.g. invertebrates, transitory wildlife and vegetation	Unlikely – terrestrial receptors are unlikely to be impacted by VOC. No vegetation stress noted during investigations.
	Direct contact, including ingestion	Construction workers/visitors Future site occupants	Unlikely – as discussed above, based on anticipated depth of rock extraction it is unlikely groundwater will be intercepted.
		Intrusive maintenance workers in the vicinity of the potentially impacted groundwater	
		Ecological receptors e.g. invertebrates, transitory wildlife and vegetation	
	Migration pathways	Surface water ecology	Unlikely – as discussed above, groundwater and surface water do not appear to be hydraulically connected.
		Groundwater	
	Direct contact,	Construction workers/visitors	Unlikely – based on contaminating activities identified and available water quality information.

Potential source	Pathway	Receptor	Potential for completeness
Contaminated surface water present at the site	including ingestion	Future site occupants Intrusive maintenance workers in the vicinity of the potentially impacted surface water	Unlikely – direct contact with surface water bodies post construction is considered unlikely. It is anticipated that the three dams in the borrow pit area will be decommissioned. The fourth dam is outside the development footprint.
		Ecological receptors e.g. invertebrates, transitory wildlife and vegetation	Unlikely – based on contaminating activities identified and available water quality information.

6. Conclusions and recommendations

The site is situated in a rural area primarily used for livestock grazing. The site has remained generally undeveloped except for a borrow pit in the north-eastern corner of Lot 4, which also included three dams, a dam in the south-western corner of Lot 3, a trigonometry station on Lot 7001, vegetation clearance (road reserve, Lot 4 and western side of Lot 3), numerous access tracks, ground disturbance along the road verge and installation of underground services (location unknown). No other structures were constructed at the site.

Groundwater and surface water samples reported concentrations of cadmium, copper and/or zinc exceeding DGVs (ANZG, 2018), while other parameters including petroleum hydrocarbons and nutrients did not exceed DGVs (ANZG, 2018). Foam and iron precipitation were observed during one of the four site visits in Narambulla Creek and pooled water, respectively, in off-site areas. The cause of observed foam and iron precipitation is unknown but could be associated with high rainfall events and / or other natural phenomena. There are no contaminated land notices, notified sites, or NSW EPA PFAS investigations associated with the site or areas in the immediate vicinity of the site, and no matters arising under Part (2) & (5) of the Section 10.7 Planning Certificate in relation to contamination.

Based on investigation results, potential for contamination was identified in four AECs, comprising the following:

– On-site:
    - AEC 1 - fill of unknown quality and origin
    - AEC 2 - sediment quality within on-site dams
    - AEC 3 - fly tipping
– Off-site:
    - AEC 4 - application of pesticides and / or herbicides and other chemicals

The likelihood for contamination to exist within the identified AECs was assessed as low to very low. Potential SPR linkages were assessed incomplete due to the likelihood of contamination associated with the AECs to be present was low or very low. The residual plastics associated with soil / rock samples identified as part of AEC 1, present an aesthetic impact to the site and should be removed, along with any fly tipping.

Based on the results of this assessment, further investigation is not warranted, as the likelihood of contamination occurring at the site is low to very low. Unexpected occurrences of contamination (e.g. ACM, staining, odours) can be managed at the time of development. It is recommended that the site remain secure to reduce further instances of fly tipping in the future.

It is also recommended that a Construction Environmental Management Plan (CEMP) be prepared to manage the potential contaminant exposure risks during earthworks / construction activities, and manage potential unexpected finds (e.g. buried waste, demolition waste, ACM, etc.) that could be encountered. The CEMP should also include an Unexpected Finds Protocol (UFP) and site-specific Work Health Safety and Environment (WHSE) plan. A site-specific WHSE plan should be prepared, to ensure appropriate safety and workplace hygiene practices are implemented to minimise potential risks from exposure to contamination. The WHSE plan must address all relevant regulatory requirements and as a minimum, should consider incorporating the relevant practices set out in CRC Care (2018) *National Remediation Framework: Guideline on health and safety*, Version 0.1: August 2018 (ref: **https://www.crccare.com/files/dmfile/Healthandsafety_Rev0.pdf**).

7. References

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Appendices

Appendix A

Figures

Appendix B

Lotsearch Report

Appendix C

Historical titles search results

Appendix D

NSW EPA search results

Appendix E

Section 10.7 Planning Certificates

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