Attachment AK

Geological Fossil Study

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5 March 2021
Our ref: JM/C11596

Doma Group
via email: alex@domagroup.com.au

Attention: Mr Alex Moulis

CANBERRA BRICKWORKS REDEVELOPMENT - BLOCKS 1, 7, & 20, SECTION 102, YARRALUMLA
BACKFILLING OF OLD QUARRY AREA

GEOLOGICAL FOSSIL STUDY

1 INTRODUCTION

At the request of Doma Group, ACT Geotechnical Engineers Pty Ltd carried out a geological fossil study in the old quarry area of the Canberra Brickworks, in Yarralumla, ACT.

It is understood that the old Canberra Brickworks are being redeveloped into a residential development. As part of this redevelopment, some areas of the old quarry area are being backfilled to turn it into a parkland. This will involve up to 6m of fill being placed to return the surface levels to their pre-quarry levels. As this will bury some of the exposed quarry faces, the client has requested a geological study of these quarry faces be carried out to establish if any fossils are present in these quarry faces, and if so, what is their quality and significance. A copy of the earthworks plan, showing the areas and depths of the proposed filling, is presented in Figure 4. The aim of the geological study was to:

i) Inspect the quarry and infill area to look for fossil remnants and other geological features of significance within the proposed infill zone.
ii) Review existing geological information.
iii) Provide a statement of significance of the area and the geology.
iv) If fossils or significant features are noted, provide mitigation measures.
v) Provide advice on buffer zone for works in close proximity to known listed features – especially formation Feature C where the works are close to the feature zone.

"Geological Monuments in the ACT" by the Geological Society of Australia documents the Yarralumla Brickpits as being a site of scientific value, and notes that at a location within the brickpits (designated as Feature 12C), there are "abundant fossils preserved as molds on a bedding plane. The main types are barchiopods with rarer trilobites, corals, and a simple crinoid belonging to the genus Pisocrinus. Most fossils have been distorted by the pervasive cleavage". It notes that other areas within the brickpits show good examples of anticlinal folding. An extract from this document is attached.

2 SITE DESCRIPTION

The old Canberra Brickworks site is located on Block 1, Section 102, in Yarralumla, ACT. The eastern portion of the site was used as the quarry, where shale rock was excavated to provide the raw material for bricks production, while the western portion of the site included the buildings and kilns used to make the bricks. A recent aerial photo of the site is presented in Figure 1, which shows the present site layout, as well as the two proposed fill areas (designated as Fill Area 1 and Fill Area 2).

The natural topography of the eastern side of the site comprised a knoll, that was excavated by up to 10m depth to source rock for brick production. The quarry is an irregular shape, as seams of better brick-making rock were sought. The quarry faces are generally near vertical, but appear to have weathered over time, with some soil and rock wedges that have fallen from the face and are now at the toe of

the batter faces. There are trees along the top edges of the quarry faces, and some of the rock faces have become over-grown with vegetation. It is understood that rock was excavated from the quarry between 1913 and the mid-1930's.

3 GEOLOGY

The 1:100,000 Canberra Geology Map indicates the area to be underlain by Silurian age Yarralumla Formation bedrock, which includes siltstone, sandstone, mudstone, limestone, and tuffaceous sediments. A description of the Yarralumla Formation from "BMR Bulletin 233 - Geology of the Canberra 1:100,00 Sheet Area" is provided in the following section.

The Yarralumla Formation occurs in two main outcrop belts; one extends from Red Hill ridge to Lake Burley Griffin and the other from Woden Valley towards the Molonglo River. There has been some lateral displacement of the two belts by faulting. The sigmoidal outcrop pattern indicates deformation along north-northwest trending fold axes.

The shallow-water marine transgression represented by the Yarralumla Formation is indicated by limestone and fine clastic sediments containing a shelly fauna of brachiopods, trilobites and corals. Local current-bedded quartz sandstone, probably derived from adjacent volcanic terrain, suggests deltaic environments were temporarily established at the basin margin. The overall marine environment indicates a temporary waning of volcanic activity at the end of the Wenlockian. However, the coeval deposition of some volcaniclastic sediments suggests sporadic volcanism at centres marginal to the site of marine deposition.

The Yarralumla Formation formation consists of a sequence of calcareous and tuffaceous mudstone and siltstone with minor interbeds of limestone and quartz sandstone. Airfall tuff and a few rhyodacitic units were also deposited coevally with the marine sequence.

At the Canberra Brickworks locality, well-bedded, olive-green calcareous mudstone and siltstone with minor tuffaceous sandstone and dark-grey cherty limestone are exposed. The bedding is denoted by major partings, sometimes accentuated by fossiliferous horizons, spaced up to a few metres apart or on a smaller scale as laminations and graded tuffaceous units up to 2 cm thick. The sequence is folded into open symmetrical anticlines with a shallow plunge southwards. A spaced, almost vertical cleavage is axial planar to the folds and also forms a well defined lineation where it intersects the bedding. It is reported that fossils such as brachiopod fauna, favositid and heliolitid tabulate corals and the microcrinoid, Pisocrinus, have been identified. Fossils are distorted and flattened in the plane of the cleavage and along bedding plane partings.

Around the northern side of Red Hill ridge, the assemblage has been locally contact-metamorphosed to calc-silicate hornfels and marble, and is well exposed in an abandoned quarry southeast of the Red Hill Kiosk.

Also, fresh, laminated olive-green mudstone and siltstone containing graded beds of tuff up to 5 cm thick are well exposed in a disused brickpit at Deakin Oval. At this locality two anticlines show a widely spaced axial plane cleavage which intersects and disrupts the bedding. A prominent lineation defines a southward plunge to the folds.

4 INVESTIGATION METHODS

The field investigation was carried out on 22 February 2021, by Mr Dennis Dyer, a senior engineering geologist with over 50 years experience, with assistance from Mr Jeremy Murray, a Chartered senior geotechnical engineer with over 20 years experience. Copies of their respective CV's are attached.

The fieldwork comprised a walk-over of the site to assess the general geological conditions, as well as a close inspection and geological mapping of the exposed quarry faces in the areas of proposed infilling.

The geological mapping included logging of the defect sets (bedding, cleavage/foliation, and jointing), logging of the rock type and weathering, and a close visual inspection of any exposed bedding planes for the presence of fossils.

Detailed geological mapping of the exposed quarry faces was conducted at approximately 20m spacing along the quarry faces, designated as 1A to 8A for Fill Area 1, and 1B to 5B for Fill Area 2. Detailed geological mapping was also conducted at Feature 12C, where the presence of fossils has previously been reported. The locations of Fill Area 1, Fill Area 2, and Feature 12C are shown in Figure 1, while Figures 2 and 3 show the locations of geological mappings 1A to 8A and 1B to 5B. A copy of the earthworks plan, showing the areas and depths of the proposed filling, is presented in Figure 4.

Photos 1 to 16 are presented in Figures 5 to 20, which show some of the quarry faces that were mapped, as well as typical exposed bedding planes.

A desk-top study of available geology maps and literature was also conducted, with geological information relevant to this site reviewed. These sources included the "1:100,000 Canberra Geology Map", "BMR Bulletin 233 - Geology of the Canberra 1:100,00 Sheet Area", and "Geological Monuments in the ACT".

5 INVESTIGATION RESULTS

5.1 Geological Mapping

Fossils occur where animals or plants are deposited on sediment and covered and preserved by deposition of more sediment. Therefore, fossils are usually found on bedding planes within sedimentary bedrock. Despite a close examination of exposed bedding planes within the rock of the quarry faces, our geological inspection of 22 February 2021 did not find any fossils within Fill Areas 1 and 2.

The majority of the exposed quarry faces comprise weak to medium strong, highly weathered (HW) and moderately weathered (MW) mudstone bedrock that displays strongly developed foliation and hence is described as phyllitic mudstone in this report. The regional metamorphism that formed the anticlines and synclines exposed at this site has caused the micaceous minerals to recrystalise and align and thereby develop a phyllitic texture to the rock. There were some sections of extremely weak, extremely weathered (EW) rock, as well as some sections of stronger, moderately to slightly weathered (MW/SW) rock. The phyllitic mudstone is occasionally inter-bedded with sandstone, siltstone, and tuff.

The folding has resulted in the foliation/cleavage being a more prominent feature of the rock than the original bedding, and the bedding has been distorted by this pervasive foliation. If any fossils were present (we did not find any within Fill Areas 1 and 2), then this foliation would likely have either destroyed or distorted the fossils. In areas where the bedding planes are exposed, the bedding is folded, as in Photos 8, 10, 12, and 14. In addition, most bedding planes are weathered and clay infilled (Photo 15). Given this, fossils that may be present are likely to be of poor quality and low scientific value.

A possible crinoid stem fossil less than 1cm long was observed in weathered siltstone at Feature 12C, which is not within the proposed filling areas.

5.2 Fill Area 1

Results of the geological mapping of the exposed quarry faces in Fill Area 1 and Feature 12C are summarised in Table 1 below.

TABLE 1
Results of Geological Mapping - Area 1

Feature N0.	Description	Rock Profile	Defect Mapping	Presence of Fossils & Comments
1A	Start of cut, some dumped rock piles	N/A	N/A	No fossils found
2A	~1.5m high cut	HW to MW SILTSTONE, with some fine-grained SANDSTONE	Foliation - 63°/250° 5mm to 70mm spacing Bedding - 11°/165° - 30mm to 70mm spacing Joints - 90°/190° - 10mm to 20mm spacing	No fossils found. Photo 2
3A	~1.5m high cut	MW TUFF, with 20mm/70mm mudstone xenoliths	Foliation - 81°/085° 20mm to 90mm spacing Bedding - 16°/236° - 30mm to 300mm spacing Joints - 88°/189° - 10mm to 20mm spacing	No fossils found. Possible fault, with fracturing and weathering of the rock. Photo 3.
4A	~4m high cut	HW/MW PHYLLITIC MUDSTONE, with MW SANDSTONE seam from ~0.5m to 2m depth	Foliation - 87°/085° 50mm to 100mm spacing Bedding - 30°/180° - 40mm to 300mm spacing Joints - 60°/350° - ~100mm spacing	No fossils found. Photo 4.
5A	~4.5m high cut	HW to MW PHYLLITIC MUDSTONE, with thin beds of EW MUDSTONE	Foliation - 75°/080° 50mm to 100mm spacing Bedding - 20°/100° - 70mm to 300mm spacing Joints - 76°/163° - ~100mm spacing	No fossils found. Some evidence of normal faulting - ~100mm of displacement. Photo 5.
6A	~2.5m high cut	MW PHYLLITIC MUDSTONE	Foliation - 79°/069° 80mm to 500mm spacing Bedding - 09°/229° - 30mm to 300mm spacing Joints - 81°/355° - 70mm to 150mm spacing	No fossils found. Photo 7.
7A	~4m high cut	~3m of overburden fill, then MW/SW PHYLLITIC MUDSTONE	Foliation - 73°/260° 80mm to 500mm spacing Bedding - 38°/235° - 30mm to 300mm spacing	No fossils found. The exposed bedding planes are masked by the foliation. Photo 8.
8A	~2.5m high cut	MW/SW PHYLLITIC MUDSTONE	Foliation - 88°/260° 80mm to 500mm spacing Bedding - 39°/247° - 30mm to 300mm spacing	No fossils found. The exposed bedding planes are masked by the foliation. Photos 9 and 10.
Feature 12C - Not in the proposed filling areas				
12C	~4m high cut	MW PHYLLITIC MUDSTONE	Foliation - 88°/260° 80mm to 500mm spacing Bedding - 35°/215° - 30mm to 300mm spacing	Possible crinoid stem fossil. Photo 1.

5.3 Fill Area 2

Results of the geological mapping of the exposed quarry faces in Fill Area 2 are summarised in Table 2 below.

TABLE 2
Results of Geological Mapping - Area 2

Feature No.	Description	Rock Profile	Defect Mapping	Presence of Fossils & Comments
1B	~4m high cut	HW/MW PHYLLITIC MUDSTONE	Foliation - 81°/102° 5mm to 70mm spacing Bedding - 42°/213° - 30mm to 70mm spacing Joints - 68°/146° - 10mm to 20mm spacing	No fossils found. The exposed bedding planes are masked by the foliation. Photos 11 and 12.
2B	~6m high cut	HW to HW/MW PHYLLITIC MUDSTONE	Foliation - 88°/062° 5mm to 70mm spacing Bedding - 42°/260° - 30mm to 70mm spacing	No fossils found. The exposed bedding planes are masked by the foliation. Bedding also infilled with clay. Photos 13, 14 and 15.
3B	~6m high cut	HW PHYLLITIC MUDSTONE, then SW PHYLLITIC MUDSTONE	Foliation - 88°/074° 20mm to 90mm spacing Bedding - 45°/245° - 30mm to 300mm spacing	No fossils found.
4B	~3m high cut	HW/MW PHYLLITIC MUDSTONE	Bedding - 22°/169° - 100mm to 200mm spacing Foliation - not clear due to disturbed nature and weathering	No fossils found.
5B	~3m high cut	HW/MW PHYLLITIC MUDSTONE	Very disturbed and weathered face. Several large boulders on face (from quarrying or wedge failures)	No fossils found. Photo 16.

5.4 Other Geological Issues

The brick pits have been excavated to provide raw material for brick production over a number of years and subsequently been left with little maintenance undertaken. This has resulted in much of the quarry excavation faces consisting of steep to sub-vertical rock cuts. This rock is highly fractured by bedding, jointing, and foliation, as well as having been weathered. Some areas of erosion and/or slumping are present, with some large boulders present at the toe of cut batter having apparently toppled from the face. There are areas where fractured rock os located on the steep faces, and is likely to fall at some point in the future. Given the apparent slope instability, it is recommended that a slope stability risk assessment be carried out to identify all rock fall hazards and provide risk mitigation measures.

6 CONCLUSIONS

6.1 Presence & Quality of Fossils

Fossils usually are preserved when plants or animals are deposited on sediment and covered by more sediment. In these circumstances, fossils are found on bedding planes within sedimentary bedrock. Despite a close examination of exposed bedding planes within the rock of the quarry faces, our geological inspection of 22 February 2021 did not find any fossils within Fill Areas 1 and 2.

The regional folding of the bedrock has resulted in some of the minerals being recrystallised to develop foliation/cleavage that on exposure appears more prominent than the original bedding. If any fossils were present (we did not find any within Fill Areas 1 and 2), then the development of the foliation would likely have destroyed or distorted the fossils. Here, where the bedding planes are exposed, the bedding dip and weathering has occurred and the bedding planes are often clay infilled. Given this, any fossils that may be present are likely to have been degraded and of low scientific value.

Therefore, it is our assessment that there are no fossils of scientific value in the proposed Fill Areas 1 and 2, and hence is no geological reason to prevent the filling to occur.

However, at Feature 12C it is reported that there are "abundant fossils preserved as molds on a bedding plane. The main types are barchiopods with rarer trilobites, corals, and a simple crinoid belonging to the genus Pisocrinus". Therefore, it is recommended that the area around Feature 12C be preserved and protected from future development.

The "Geological Monuments in the ACT" by the Geological Society of Australia also documents the Yarralumla Brickpits as being a site of scientific value. In particular there are areas within the brickpits that show good examples of anticlinal folding, and it is recommended that these areas be preserved and protected from future development. These anticlinal folding features are outside the proposed Fill Areas 1 and 2.

5.2 Mitigation Measures

To protect Feature 12C from damage during the earthworks for Fill Areas 1 and 2, it is recommended that the area is fenced off and an exclusion zone established. There should be a minim 5m buffer around the perimeter of this feature.

As discussed in Section 5.4, it is advisable that a slope instability risk assessment be carried out to ensure that there are no risks from falling rocks within the old quarry areas.

Should you require any further information, please contact our office.

Yours faithfully
ACT Geotechnical Engineers Pty Ltd

Jeremy Murray
Director
Senior Geotechnical Engineer
FIEAust CPEng EngExec RPEQ NER APEC Engineer IntPE(Aust)

DOMA GROUP
CANBERRA BRICKWORKS – GEOLOGICAL FOSSIL STUDY
SITE LOCALITY & BRICKWORKS LAYOUT

ACT Geotechnical Engineers Pty Ltd	C11596	FIGURE 1

LEGEND

○ - Location of Geological & Fossil Mapping

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AERIAL PHOTOGRAPH – FILL AREA 1

ACT Geotechnical Engineers Pty Ltd	C11596	FIGURE 2

LEGEND

○ - Location of Geological & Fossil Mapping

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AERIAL PHOTOGRAPH – FILL AREA 2

ACT Geotechnical Engineers Pty Ltd	C11596	FIGURE 3

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EARTHWORKS PLAN

ACT Geotechnical Engineers Pty Ltd	**C11596**	**FIGURE 4**

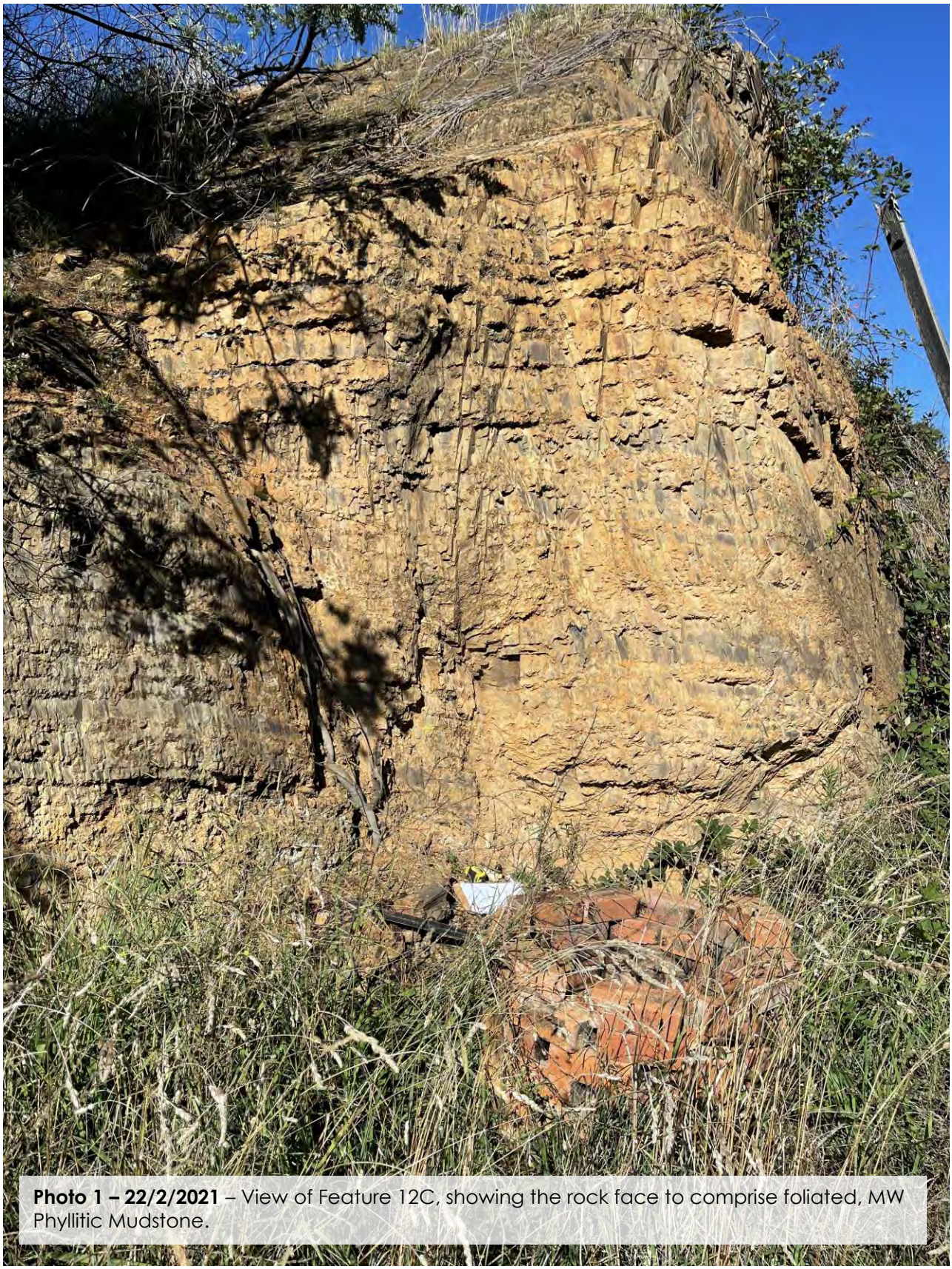

Photo 1 – 22/2/2021 – View of Feature 12C, showing the rock face to comprise foliated, MW Phyllitic Mudstone.

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ACT Geotechnical Engineers Pty Ltd	**C11596**	**FIGURE 5**

Photo 2 – 22/2/2021 – View of Location 2A, showing the rock face to comprise foliated, HW to MW Siltstone.

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SITE PHOTO

ACT Geotechnical Engineers Pty Ltd	**C11596**	**FIGURE 6**

Photo 3 – 22/2/2021 – View of Location 3A, showing the rock face to comprise foliated, MW Tuff, with xenoliths of mudstone.

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SITE PHOTO

ACT Geotechnical Engineers Pty Ltd	**C11596**	**FIGURE 7**

Photo 4 – 22/2/2021 – View of Location 4A, showing the rock face to comprise foliated, HW to MW Phyllitic Mudstone, with some beds of Sandstone.

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SITE PHOTO

Photo 5 – 22/2/2021 – View of Location 5A, showing the rock face to comprise foliated, HW to MW Phyllitic Mudstone, with some beds of Mudstone.

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SITE PHOTO

ACT Geotechnical Engineers Pty Ltd	**C11596**	**FIGURE 9**

Photo 6 – 22/2/2021 – View of Locations 4A and 5A, showing the rock face to comprise foliated, HW to MW Phyllitic Mudstone, with some beds of Sandstone & Mudstone.

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SITE PHOTO

ACT Geotechnical Engineers Pty Ltd	**C11596**	**FIGURE 10**

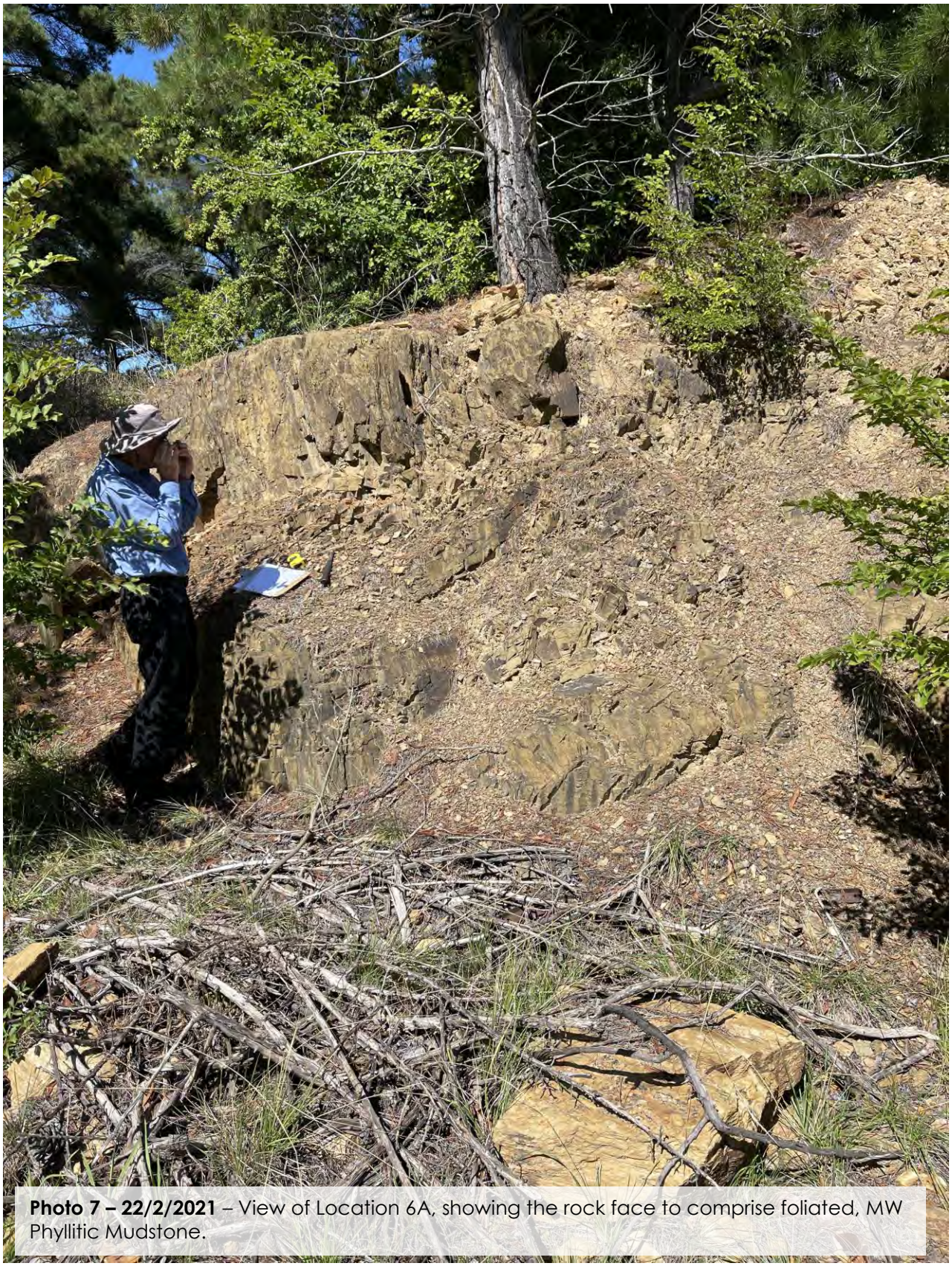

Photo 7 – 22/2/2021 – View of Location 6A, showing the rock face to comprise foliated, MW Phyllitic Mudstone.

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SITE PHOTO

ACT Geotechnical Engineers Pty Ltd	**C11596**	**FIGURE 11**

Photo 8 – 22/2/2021 – View of Location 7A, showing the exposed bedding plane on the foliated, MW/SW Phyllitic Mudstone. There are no signs of any fossils. The foliation has distorted the bedding planes considerably, and would likely have destroyed most fossils (if

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ACT Geotechnical Engineers Pty Ltd	**C11596**	**FIGURE 12**

Photo 9 – 22/2/2021 – View of Location 8A, showing the rock face to comprise foliated, MW/SW Phyllitic Mudstone.

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SITE PHOTO

ACT Geotechnical Engineers Pty Ltd	**C11596**	**FIGURE 13**

Photo 10 – 22/2/2021 – View of Location 8A, showing the exposed bedding plane on the foliated, MW/SW Phyllitic Mudstone. There are no signs of any fossils. The foliation has distorted the bedding planes considerably, and would likely have destroyed most fossils (if present).

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ACT Geotechnical Engineers Pty Ltd	**C11596**	**FIGURE 14**

Photo 11 – 22/2/2021 – View of Location 1B, showing the rock face to comprise foliated, HW/MW Phyllitic Mudstone.

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SITE PHOTO

ACT Geotechnical Engineers Pty Ltd	**C11596**	**FIGURE 15**

Photo 12 – 22/2/2021 – View of Location 1B, showing the exposed bedding plane on the foliated, HW/W Phyllitic Mudstone. There are no signs of any fossils. The foliation has distorted the bedding planes considerably, and would likely have destroyed most fossils (if present). The bedding is also extremely weathered, also limiting the quality of any fossils.

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Photo 13 – 22/2/2021 – View of Location 2B, showing the rock face to comprise foliated, HW/MW Phyllitic Mudstone.

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SITE PHOTO

ACT Geotechnical Engineers Pty Ltd	**C11596**	**FIGURE 17**

Photo 14 – 22/2/2021 – View of Location 2B, showing the exposed bedding plane on the foliated, HW/W Phyllitic Mudstone. There are no signs of any fossils. The foliation has distorted the bedding planes considerably, and would likely have destroyed most fossils (if present). The bedding is also extremely weathered, also limiting the quality of any fossils.

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SITE PHOTO

Photo 15 – 22/2/2021 – View of Location 2B, showing the rock face to comprise foliated, HW/MW Phyllitic Mudstone. The foliation has distorted the bedding planes considerably, and would likely have destroyed most fossils (if present). The bedding is also extremely weathered, also limiting the quality of any fossils.

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Photo 16 – 22/2/2021 – View of Location 5B, showing the rock face to comprise foliated, MW Phyllitic Mudstone.

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SITE PHOTO

ACT Geotechnical Engineers Pty Ltd	**C11596**	**FIGURE 120**

YARRALUMLA BRICKPITS

ITEM: Type locality of the Yarralumla Formation.

LOCATION: In the disused quarries associated with the old Canberra Brickworks (fig. 67). A.C.T. 1:10 000 Planning Series, sheet 200-600, G.R. 9010 9057 A.M.G.

DESCRIPTION: The abandoned Brickworks in Yarralumla were closed down in the mid-1970's with quarrying having ceased some time before that. The quarries are the type locality of the Yarralumla Formation, a marine unit within the mostly volcanic mid-Silurian sequences of the Canberra region. The unit is formed of tuffaceous sandstone, siltstone, mudstone and minor limestone, and at this locality has been strongly folded and cleaved.

Four sites have been selected within the quarry area as being representative of the lithology and structure of the Yarralumla Formation at its type locality (see fig. 67). Sites A and D (fig. 69) show good examples of anticlinal folding within the Yarralumla Formation, and, like the Deakin Anticlines site, show the relationship between folding and cleavage. Site B (fig. 68) shows a good section typical of the lithology of the Yarralumla Formation, and should be regarded as the type section for the Formation. Site C contains abundant fossils preserved as molds on a bedding plane. The main types are brachiopods with rarer trilobites, corals and a simple crinoid belonging to the genus *Pisocrinus*. Most fossils have been distorted by the pervasive cleavage.

ACCESS: The locality is situated at the end of Denman Street, Yarralumla. Access is uncertain however; the old brickwork buildings are currently (early 1987) occupied by art and craft studio workshops, and access is easy to obtain, but the long term plans for the area by the Department of Territories is uncertain.

GEOLOGICAL VALUE: The site is of scientific value as the type locality of the Yarralumla Formation. It could also be of considerable educational value both to the schools and the general public if some interpretive programme was developed for the area.

STATE OF PRESERVATION: The area is in general in a good state of preservation, apart from some weed growth.

RECOMMENDATIONS: As an important scientific and educational locality the individual sites selected within the quarry area need to be preserved. Future development plans for the area should take account of their value, and a plan of management for the quarry area formulated.

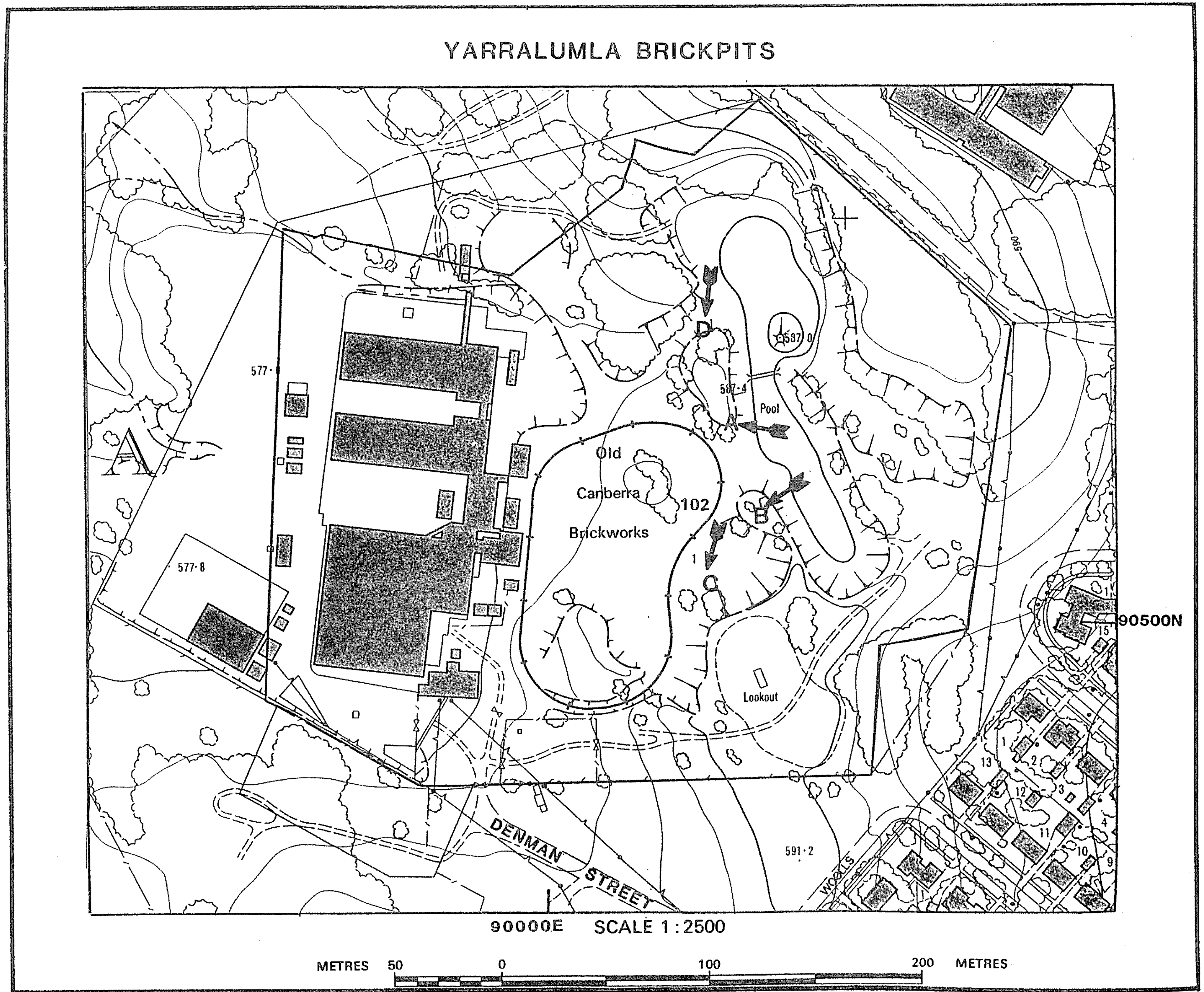

Fig.67 Locality Map, Yarralumla Brickpits.

Dennis Dyer

Senior Engineering Geologist

QUALIFICATIONS

- B.Sc. (Hons), Sydney University, 1966, majoring in Geology, Mathematics and Physics, and specialising in Engineering & Economic Geology
- B.A. University of Canberra 1984, specialising in Teaching Geology

KEY SKILLS & FIELDS OF COMPETENCE

- Geotechnical Site Investigations
- Borehole Drilling and Logging
- Geological Mapping
- Geotechnical Engineering Report Writing
- Supervision & Certification of Controlled Fill (Level 1 & 2)
- Footing Certification
- Slope Stability Assessment

PROJECT EXPERIENCE

1993 - Present Consulting Engineering Geologist for ACT Geotechnical Engineers Pty Ltd. Provision of specialised geological expertise for small and major geotechnical engineering projects.

Projects included: Risk analyses for numerous lodges in Kosciusko National Park, rood stability investigations in the Snowy M'ts including for the Alpine Way, bridge investigations, hydro-geological studies in the ACT, rood studies, deep drilling investigations for high-rise buildings, geotechnical stability assessment of major quarries in NSW and ACT, construction overviews, suburban infrastructure development.

1988 - 1993 - Consulting Engineering Geologist for Peter J Burgess & Associates Pty Ltd. Consulting Geologist for Horizon Resources on Fiery Creek Exploration Lease.

1969 - 1982 - Electricity Commission of New South Wales. Geological work associated with structures (dams, tunnels, power stations, roods, railways) for the generation and transmission of electricity. Investigation of Coal Mines

1967 - 1969 - Snowy Mountains Hydro Electric Authority. Geological work associated with major engineering structures (dams, tunnels, power stations, roods) in the Snowy Mountains area, NSW and Victoria.

1966 - Study of stability and causes of landslides of Razorback Range, NSW (BSc Hons Thesis).

CAREER HISTORY

1993	-	Present	ACT Geotechnical Engineers	Senior Engineering Geologist
1982	-	2007	Canberra Institute of Technology	Senior Lecturer in Geology
1969	-	1982	Electricity Commission of New South Wales	Engineering Geologist
1967	-	1969	Snowy Mountains Hydro Electric Authority	Engineering Geologist

Jeremy Murray

Director, Senior Geotechnical Engineer

QUALIFICATIONS

- B.E. (Hons), University of New South Wales, 2000, Civil Engineering, majoring in Geotechnical Engineering.
- Masters in Engineering Science (MEngSc), University of New South Wales, 2013 – majoring in Geotechnical Engineering, including courses in Slope Stability & Stabilisation, Pavement Engineering & Analysis, Advanced Geomechanics, Geotechnical Models, Rock Engineering, Geotechnical Engineering of Dams, Advanced Foundation Engineering, and Environmental Management.

KEY SKILLS & FIELDS OF COMPETENCE

- Planning, conducting and reporting Geotechnical Site Investigations;
- Supervision of earthworks and substructure construction;
- Instrumentation installation and monitoring for settlement and groundwater;
- Slope stability and analysis, soil and groundwater contamination assessments;
- Highways, roads and bridges;
- Multi-storey commercial and residential buildings;
- Warehouses, schools and supermarkets;
- Residential subdivisions and site classifications;
- Quarries; and
- Earth and Rock Fill dams.

PROFESSIONAL AFFILIATIONS

Fellow of the Institute of Engineers Australia (FIEAust)

Chartered Professional Engineer (CPEng)

Engineering Executive (Eng Exec)

APEC Engineer in Australia

National Engineering Register

Registered Professional Engineer of Queensland

Registered Building Practitioner of Victoria

Member of the Australian Geomechanics Society

Chairman of the Canberra Sub-Group of the Australian Geomechanics Society

CAREER EXPERIENCE

Jeremy started his engineering career in 1999 as a graduate geotechnical engineer at ACT Geotechnical Engineers. The primary tasks and responsibilities including planning and conducting geotechnical investigations and subsequently analysing the field data and preparing geotechnical reports for the projects. These projects also required Jeremy to perform inspections and certifications during the construction phase. Such construction certifications included confirming bearing capacity for footings, assessment of excavations for stability, assessment of pavement subgrades, and cut and fill earthworks supervision. The types of projects included site classifications for new houses, medium density residential units, multi-storey office and commercial developments, warehouses and retail developments, residential subdivisions, new roads and highways, and bridges.

Jeremy was promoted to Senior Geotechnical Engineer within ACT Geotechnical Engineers, with an associated increase in responsibilities. Generally, this involved working on more critical and larger projects and projects with a where a higher technical ability was required. Examples include the HQJOC Defence Headquarters, high-rise apartment buildings, earthfill/rockfill dams, and forensic geotechnical investigations. For these projects, Jeremy had to coordinate all of the sub-contractors, as well as the engineering fieldwork team. Extra responsibilities in the senior engineering role included preparation of quotes/proposals and project procurement. This required identify the scope of works and then estimating costs.

In 2010 Jeremy became the Principal of ACT Geotechnical Engineers, and so having combined the responsibilities of Senior Geotechnical Engineer along with running the company. The role of Principal required Jeremy to take responsibility for all aspects of running the company, including managing staffing resources and levels, all aspects of business finance including accounting and book keeping, ensuring WHS, environmental, and QMS compliance across the company, fleet management, insurance and workers comp compliance, staff welfare, staff training and certification, testing and equipment procurement, business development, client liaison, and final review of all reports before issuing to clients.

In 2017, Jeremy started a new geotechnical engineering consultancy based in Sydney called Fortify Geotech (while still owning and running ACT Geotech). This provided the challenge of starting a business from scratch and required all the demands of establishing a new business. Added challenges including working in a new geographical area, needing to find new clients and contacts, and juggling the business and engineering sides of two separate engineering consulting firms.

Jeremy is a strong promoter of women in engineering, and currently employs 3 female engineers out of a total of 7 engineers. Jeremy also dedicates time to helping undergraduate engineering students gain work experience and industrial training, currently providing work experience for 3 undergraduate engineering students, with typically 1 or 2 every year. Jeremy also assists lecturers at UNSW Canberra, conducting guest lectures and field trips for civil engineering undergraduates in the areas of geotechnical investigations and engineering geology.

Jeremy is the Chairman of the Canberra Sub-Group of the Australian Geomechanics Society. This sub-group aims to promote geotechnical engineering in the Canberra region, as well as providing valuable technical information for geotechnical consultants in the area. This is mainly done by arranging 4 seminars per year, with a guest speaker presenting on interesting geotechnical topics or recent innovations.

PROJECT EXPERIENCE

Burrinjuck Dam Road Upgrade

Jeremy carried out construction supervision and certification of remediation works for the failed cut and fill batters along Burrinjuck Road following storm events of 2010. There were 13 features requiring remediation, that included fixing culverts, gabion supports, reno mattresses, fill reinstatement, and erosion protection.

Batemans Bay Coastal Zone Management Plan

Jeremy conducted geotechnical slope instability assessments as part of the Batemans Bay CZMP. The assessments were primarily along the headlands around Batemans Bay (nine headlands in total), where risks included falling boulders, rock slope failure, and erosion. The slope instability risk assessment is based on the landslide risk management concepts and guidelines of “Practice Note Guidelines for Landslide Risk Management 2007" issued by the Australian Geomechanics Journal Vol 42 March 2007.

Major Arterial Roads

Jeremy has conducted geotechnical investigations and provide expert geotechnical advice for many new arterial roads around Canberra and NSW including Conjola Mountain Realignment, Ellerton Drive Extension, Old Cooma Road Stage 2, several stages of Horse Park Drive, Flemington Road, Gungahlin Drive, and Athllon Drive. These investigations included on site investigation, laboratory testing of site soils, and then recommendations such as earthworks, subgrade preparation, CBR design, and drainage.

Residential Estate Subdivisions - ACT

Jeremy conducted geotechnical investigations for many large residential estate subdivisions in the ACT including for Crace, Horse Park Estate & Yerrabi Estate (Gungahlin), Franklin, Bonner, East O’Malley, Conder, Banks, and Gordon. These investigations comprised the excavation and logging of large numbers of test pits to provide advice a recommendations for site earthworks, road design, site classifications, and controlled fill.

ACT Major Road Pavement Rehabilitation

Gungahlin Drive, Anzac Parade, London Circuit, & Pialligo Avenue

Jeremy carried out road pavement investigations to establish existing pavement construction and cause of failure, and provided advice for pavement remediation. Included a visual assessment of the pavement condition in accordance with AUSTROADS “A guide to the visual assessment of pavement condition”, as well as drilling boreholes through the pavement, conducting DCP testing, and carrying out laboratory testing of pavement and subgrade materials.

Coombs Ponds

Jeremy conducted a geotechnical investigation and design of Coombs Ponds A and B. The investigation comprised test pits and boreholes, along with soil classification, permeability, and triaxial laboratory testing of on-site materials to determine the most suitable dam embankment type, and then design of the embankments including material properties, slope angles, filters, and instrumentation.

Residential Estates

Sunshine Bay, Long Beach, & Rosedale

Jeremy carried out a qualitative slope instability assessment of the site, based on the requirements on landslide risk management of the NSW Department of Infrastructure, Planning and Natural Resources, to establish whether the land was suitable for residential development

Denham Prospect & Molonglo Group Centre

Jeremy carried out a preliminary geotechnical assessment for the proposed residential estate of Denham Prospect and the Molonglo Group Centre. This assessment included a desk-top study and site geological assessment of existing road cutting, valleys/erosion gullies, and rock outcrops. The purpose of the assessment was to determine the geotechnical feasibility of developing this land, establishing general subsurface conditions for forward design of earthworks and roads, and identify geotechnical constraints to development.

Department of Defence – HQJOC & HMAS Albatross

Jeremy carried out a geotechnical investigations and certifications during constructions for the Head Quarters Joint Operations Command (HQJOC) complex and the large upgrade to HMAS Albatross. This work included a geotechnical investigation and analysis for roads, large structures, aircraft runways, pavement rehabilitation, and fuel pipelines.

Apartment & Multi-Storey Developments

Jeremy has carried out geotechnical investigations and certifications during constructions for many large, multi-storey apartment developments, including projects in Braddon, Canberra City, Campbell, Kingston, Kingston Foreshore, Gungahlin, Belconnen, Greenway, and Acton. This work included a geotechnical investigation and analysis for deep basement excavations, retaining walls, footings, and groundwater control.

CAREER HISTORY

1999	-	2005	ACT Geotechnical Engineers	Geotechnical Engineer Geotechnical work associated with the investigation and construction of roads, mines, buildings, dams, bridges & quarries
2005	-	2010	ACT Geotechnical Engineers	Senior Geotechnical Engineer
2010	-	Present	ACT Geotechnical Engineers	Principal & Senior Geotechnical Engineer
2017	-	Present	Fortify Geotech	Principal & Senior Geotechnical Engineer