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# WHAT IS THE FUTURE OF ENGINEERING GEOLOGY AS A DISCIPLINE IN WESTERN AUSTRALIA, AND AUSTRALIA?

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## ABSTRACT

Engineering geology plays a key role in infrastructure development, risk mitigation, and engineering solutions. However, the discipline faces significant challenges in Western Australia (WA) and across Australia, particularly in workforce sustainability and academic pathways. Unlike New Zealand, where engineering geologists make up a substantial portion of the geotechnical workforce, Australia lacks dedicated tertiary education programs for engineering geology.

This paper examines the current state of engineering geology in WA and Australia and explores factors influencing its future, including the limited availability of specialised university programs, market forces favouring the mining sector, and the declining interest in and teaching of geosciences at secondary and tertiary education levels. Data from LinkedIn and Ground Recruitment Pty Ltd highlights the disparity in proportions of engineering geologists and geotechnical engineers in Australian practice compared to New Zealand. Further, a LinkedIn poll of Australian geotechnical professionals confirms that while geology is widely recognised as fundamental to geotechnical engineering, the number of dedicated engineering geologists remains low in Australia.

We discuss the implications of this workforce gap, questioning whether geotechnical engineers can adequately fulfill engineering geology roles and whether industry trends undervalue the contribution of engineering geologists. Additionally, we assess ongoing initiatives, including university-led field courses and industry collaborations aimed at fostering interest in engineering geology among students.

The paper highlights the apparent benefits of increased industry engagement, education reform, and professional development opportunities to secure the future of engineering geology in Australia. Without targeted efforts, the discipline risks further decline, potentially impacting the quality and safety of geotechnical engineering practices in the region.

## 1 INTRODUCTION

The engineering geologist plays a key role in the planning and design of commercial, industrial, and public developments, by conveying the impact geology and geomorphology has on engineering projects. The engineering geologists' understanding of the interaction between the earth and the proposed structure assists in the development of a safe and cost-effective design.

Sourcing of engineering geologists to work in consultancy and engineering practice in WA is currently difficult. There are no industry ready engineering geologists born and educated in WA. Graduate engineering geologists are generally degree qualified geologists who are then upskilled and trained on the job or are degree qualified engineering geologists who migrate temporarily or permanently to WA from overseas.

A large proportion of the experienced engineering geologists practicing in WA were born and educated in other countries e.g. New Zealand, United Kingdom and South Africa. For example, the University of Auckland offers a Master of Engineering Geology allowing for further training of geology graduates in the engineering geology discipline. In Australia, the University of NSW offers a Master of Engineering Science (Geotechnical Engineering & Engineering Geology). There are currently no masters courses dedicated purely to Engineering Geology in Australia. During nationwide economic booms, consultants and engineering companies have been able to import skilled engineering geologists from overseas with relative ease (via skilled migrant visas). However, outside of a booming economy, relocating engineering geologists from overseas is not a simple task if skilled migrant visas require the satisfaction of a more rigorous assessment criteria to obtain a visa.

Sourcing of engineering geologists to sustain our discipline in WA is now proving to be a serious challenge. This paper will detail what is currently happening in WA to deliberately encourage geologists into the engineering geology discipline.

It is noted that there are pathways for engineers to undertake postgraduate training in geology and practice engineering geology (Paul, 2024), however this paper focusses on geologists, reflecting the authors own journeys into the discipline.

Parts of the discussion and interpretation presented in this paper represent the opinions of the authors, informed by our experiences and observations. The paper will explore how we may maintain the discipline in the future and if there is anything practitioners can do to support this. The paper will present data and statistics that may provide a better understanding of the problem and therefore assist in achieving the objective.

## 2 IS THERE A PROBLEM?

There are currently no WA based Tertiary academic avenues, e.g. Master of Science courses, available for specialist engineering geology study. It is generally thought that this is because Tertiary education is primarily focussed on the State's large mining sector and therefore exploration and mining geology. To illustrate, this paper provides data from Curtin University that demonstrates the career destinations of graduates completing Curtin's Applied Geology undergraduate degree course. This may also be reflective of global trends where there has been a general shift away from geoscientific research.

The problem with encouraging young geologists may be linked to starting salaries for graduate engineering geologists, which are much lower than starting salaries for geologists working directly in the mining sector. But if that is the case, why haven't market forces closed this gap?

Is it possible that some projects are still being progressed without the involvement of an engineering geologist at all? Or is the engineering geology part of these projects being completed by individuals that lack the necessary background to do the tasks properly? Not every organisation who executes engineering projects employ an engineering geologist, so how are geological hazards identified and appropriately assessed?

Are we doing enough to:

- promote our discipline to young people considering a career in science;
- demonstrate our value to the industries we serve;
- market ourselves to other disciplines within our industry?

This paper uses data provided by Ground Recruitment Pty Ltd. for geotechnical professionals (made up of engineering geologists and geotechnical engineers) in consultancy and engineering across Australia and New Zealand. The data highlights the vast differences in the proportions of geotechnical engineers compared to engineering geologists in the workforce in WA, across Australia and New Zealand and opens a discussion as to why this is the case. The LinkedIn data on the geological workforce in Australia and New Zealand supplied by Ground Recruitment Pty Ltd reveals some interesting trends:

- In Australia, only 9% of all geologists work as engineering geologists, whereas in New Zealand, this figure is significantly higher at 67%.
- A significant portion of geologists in Australia, just over half, are in WA, although only 3% of geologists in WA identify as engineering geologists on LinkedIn.
- The data shows that engineering geologists make up 41% of geotechnical professionals in New Zealand, compared to an average of 12% across Australia.
- In Australia, Tasmania stands out with the highest ratio of engineering geologists working as geotechnical professionals in Australia at 23%, while Victoria has the lowest mix at 8%.

These findings indicate a notable disparity in the distribution and specialisation of geological professionals choosing to be engineering geologists between Australia and New Zealand, as well as within different regions of Australia. The differences highlighted by this data are significant. The authors of this paper are all based, and work, in Perth, WA. It is therefore difficult to accurately address the questions around this topic. However, there is clearly something fundamentally different about New Zealand and Australia.

The LinkedIn data provided by Ground Recruitment Pty Ltd demonstrates the vast differences between the geotechnical workforce in New Zealand compared to Australia. The authors of this paper believe this is driven by the severity and frequency of geological hazards present in New Zealand (e.g. seismicity, active volcanoes, landslide hazards etc.) compared to Australia. The relative size of the mining and civil industries in these countries may be a factor resulting in more investment in mining in Australia compared to more investment in geohazard mitigation in New Zealand. And in support of the New Zealand geotechnical workforce, a Masters in Engineering Geology is available in New Zealand. Some questions that could be asked include:

- Are the different proportions between Australia and New Zealand more workplace or salary driven?
- Is the role of the engineering geologist typically the same in New Zealand as it is in WA? In New Zealand, are engineering geologists performing what would traditionally be considered geotechnical engineering tasks in the Australian workplace?
- Are the differing proportions simply because of the array of geological hazards present in New Zealand that must be well understood and addressed by the engineering solution / design, i.e. the engineering community is more aware of the benefits of engineering geology and therefore employ a greater proportion into their geotechnical teams?
- Is the requirement for a chartered engineer to sign off on designs influencing any shift in focus away from the importance of engineering geology in design in some Australian states? It is noted that New Zealand has a body of registered Professional engineering geologists (PEngGeol) which is assessed and governed by Engineering New Zealand (the equivalent to Engineers Australia). Accreditation pathways are available to Australian professional engineering geologists; however, some are not discipline specific or recognised by state legislation (Packer, M. et al., 2024),

This paper also presents School Curriculum and Standards Authority (SCSA) data that shows the decline in teaching of earth science in WA high schools over the last ten years. It also discusses the support provided to earth science education by Australian Earth Science Education (AusEarthEd) across WA.

There is a decline in enrolments in earth sciences based higher education at a global scale, which indicates that this issue spans much further than just engineering geology (Vafeas, N., 2023 and Rogers, S. L., et al., 2024).

## 3 UNDERVALUED OR NOT NEEDED?

There is considerable overlap in the skills, expertise and perspectives both engineering geologists and geotechnical engineers bring to ground engineering projects. Their roles complement each other.

The engineering geologist is typically on-site during site investigations, coordinating ground intrusive works and in situ testing, logging to AS1726-2017 and sampling, and all the while thinking about a geological model for the site, possible geohazards, environmental impact and possible sustainability wins. You could argue a geotechnical engineer could do all this site work, and in addition, return to the office to focus on the engineering design of foundations, retaining walls and other built-environment structures.

So, maybe engineering geologists aren't needed at all?

Engineering tasks are increasingly commoditised and perhaps this philosophy can be extended to include geotechnics. For some projects, such as straightforward developments at locations where the geotechnical risks are low due to relatively homogenous or well understood ground conditions, an engineering geologist is not likely to provide much added value compared to a geotechnical engineer. Afterall, the engineering properties of a soil are derived from particle size and how those particles interact; particle mineralogy plays only a minor role. For rock, is it necessary to understand the lithology provided rock mass characteristics and strength are logged accurately?

An appreciation of geomorphology and geology becomes more valuable the larger and more complex the project is. With increasing project size (footprint area or linear length, for example) and complexity comes an increased likelihood of variability in ground conditions and exposure to geohazards, and opportunities for sustainability wins. This is where engineering geology comes to the fore.

A recent acknowledgment of the importance of understanding the engineering geology of a site comes from the Global Industry Standard on Tailings Management (ICMM, 2020) which emphasises the importance of robust site characterisation including detailed geological and hydrogeological assessments. This acknowledgement is partly in response to high profile failures of tailings storage facility embankments including, Los Frailes, Spain, 1998, and Mount Polley, Canada 2014. In the case of Los Frailes, the embankment was constructed on a layer of marl (clay containing calcium carbonate), which deteriorated over time. The deterioration was primarily due to acid (in the tailings) dissolving calcium carbonate reducing the strength (strain weakening behaviour) of the clay which contributed to a foundation failure and subsequent collapse of part of the embankment (Eptisa, Servicios de Ingeniera S.A., 1998). One of the conclusions of the independent expert engineering and review panel for the Mount Polley failure (Independent Expert Engineering Investigation and Review Panel, 2015) was "the design did not take into account the complexity of the sub-glacial and pre-glacial geological environment associated with the Perimeter Embankment foundation…site characterisation failed to identify a continuous glaciolacustrine layer…and failed to recognise it was susceptible to undrained failure when subject to the stresses associated with the embankment".

As the world shifts to a low-carbon emissions future, there is an increasing investment in renewable energy projects across Australia. In the Pilbara region of WA, tier-one resources companies such as BHP, Rio Tinto and Fortescue are investing

heavily in decarbonising their operations. Solar and wind farms have large footprints, and in addition, these power generating assets need to be connected to an integrated power grid meaning hundreds of kilometres of transmission line infrastructure, substations and battery storage facilities are needed. As Baynes, Fookes and Kennedy, 2005 point out, the "total engineering geology" approach requires involvement of engineering geologists in investigation, risk management, design and construction supervision that relate to ground engineering. Engineering geologists are best placed to identify and assess geohazards that could impact construction; in the Pilbara these include rockfalls, karst (and non-karst near-surface cavities), collapsible soils, reactive soils, and asbestiform minerals.

While the above examples highlight the importance of engineering geology in mitigating geohazards, having engineering geologists involved in projects is not just about reducing risk and mitigating geohazards. Through their unique perspectives of the interfaces between the natural and built environments, engineering geologists can play an important role in sustainable development and in delivering the United Nations (UN) Sustainability Development Goals (SDGs) (Lagesse et al, 2022).

According to Lagesse et al, 2022, engineering geologists can contribute to all 17 of the UN SDGs with the strongest overall contributions to SDG 7 (Affordable and clean energy), SDG9 (Industry, innovation and infrastructure), SDG 12 (Responsible consumption and production) and SDG11 (Sustainable cities and communities). The most significant contribution to these SDGs comes through engineering geologists' involvement in infrastructure development through:

- site characterisation (including engineering geological model development), assessing geohazards and informing the planning, efficient design and construction of infrastructure;
- reducing costs and time overruns during construction due to unforeseen ground conditions;
- assessing the re-use of excavation spoil and developing material treatment and remediation strategies to minimise transportation of, and importation of materials, and minimising construction waste.

It is difficult to quantify the potential cost savings of sustainability wins and the dollar value of risks mitigated by employing an engineering geologist with the necessary years of experience in site characterisation, geotechnics and construction support. Paradoxically, society finds it much easier to assign a dollar value to the economic impact of the damage caused by a high-profile catastrophic failure(s). Perhaps the engineering geology community needs to do more to self-promote its contributions to engineering projects, not just in terms of reducing the risk of catastrophic failures and geohazards, but also the benefits of engineering geologists working with engineers throughout the project lifecycle not just in the geotechnical site investigation / characterisation phase but being involved through to the engineering and construction phases of projects.

Projects with a significant geotechnical component, are typically those projects where the engineering requires interpretation and judgement, and the best outcomes for such projects generally do not come from thinking of engineering as a commodity. This is particularly true for a field such as geotechnical engineering where experience and judgement is required to assess and manage risk; and that judgement is called upon from scoping and safely executing the geotechnical site investigation(s), through to interpreting the factual data, applying that data appropriately to creating geotechnical models, undertaking engineering design, preparing technical specifications for construction, and supporting construction by observing and responding to as-encountered ground conditions and facilitating modifications to design as needed.

So, what do Australian based geotechnical practitioners think about the importance of geology in geotechnical engineering practice?

As part of this paper, a LinkedIn poll was completed. The poll comprised a single question with a choice of four answers. The question was: "As a Geotechnical Professional in Australia – what role does geology play in geotechnical engineering practice". The answer choices were deliberately picked to provide a range of responses to the question without specific 'for' or 'against' answers. The four possible answers were:

1. Fundamental for all sites
2. Depends on the complexity
3. Importance is overstated
4. Geotech testing is sufficient

The poll was run for a period of two weeks with a focus on gaining input from both geotechnical engineers and engineering geologists. In total there were 315 respondents. Figure 1 provides the summary responses for all respondents. It indicates that 73% (231) of respondents feel that geology is fundamental for all sites and 25% (79) voted depends on the complexity.

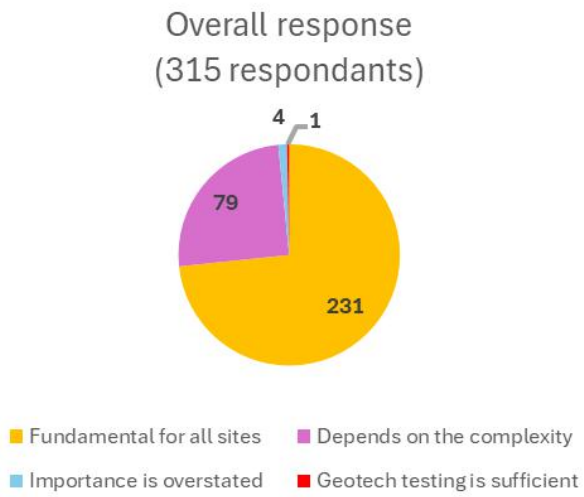


**Figure 1: Overall Response Summary**

Figure 1 clearly shows that geology is important to all those who responded, with only five respondents not picking either answer 1 or 2.

Of the 315 respondents, the primary job title discipline has been derived. This has been completed by using their current LinkedIn profile job title. Where their title includes the word 'geotechnical' or 'engineer' they have been designated an 'engineer' and where the word 'geologist' is included they have been designated a 'geologist'. Where their current position is less clear, they have been designated 'other'. These include titles such as Technical Director, Practice Director, Branch Lead, Director etc. Using these designations, Figure 2 depicts the breakdown of respondents. It is noted that the respondents included a variety of experience levels from graduates to experienced directors and senior principals. However, a specific breakdown of the experience levels has not been included in this paper given the limited nature of using LinkedIn polls.

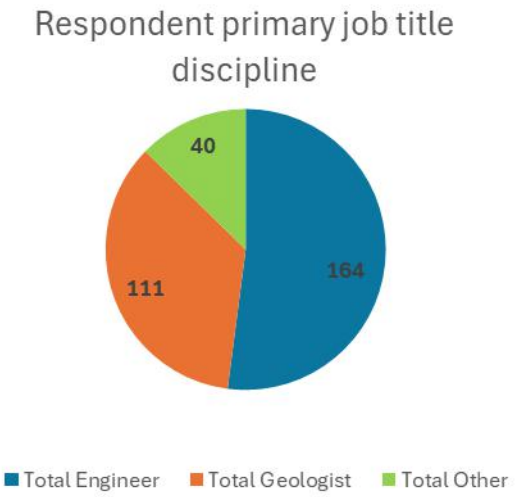


**Figure 2: Summary of Respondent Primary Job Titles**

The breakdown of respondents provides a good dataset from both the engineering and geology disciplines. This indicates that both geotechnical engineers and engineering geologists value the importance of geology in geotechnical practice. This is further demonstrated in Figures 3 and 4 which provide the breakdown of responses for answers 1 and 2 by job title designation.

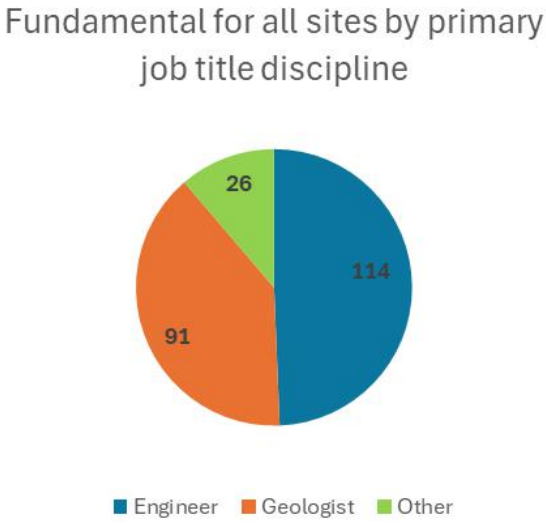


**Figure 3: Summary of Respondent Primary Job Titles for Answer 1 (Fundamental for all sites)**

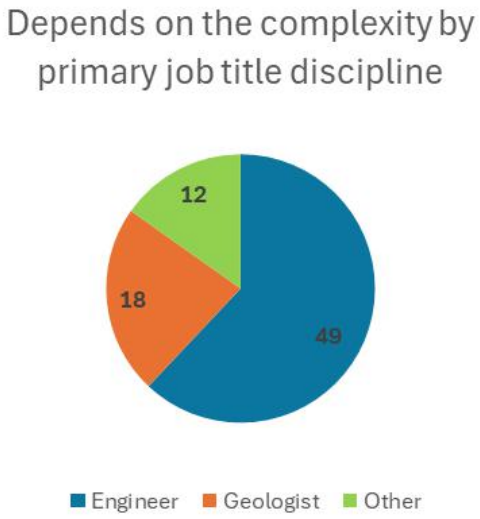


**Figure 4: Summary of Respondent Primary Job Titles for Answer 2 (Depends on complexity)**

Based on Figures 3 and 4, 82% of the geologist designation respondents indicate that geology is fundamental for all sites (answer 1), compared to 70% for the designated engineers. Further to this, 16% of the geologist designation respondents indicate that it depends on the complexity (answer 2), whilst 30% of the engineers indicate this answer. Note, that answers 3 and 4 only received 5 responses of a total of 315 (~1.5%) and these have not been further analysed.

Perhaps unsurprisingly, the geologists have a higher percentage of respondents indicating that geology is fundamental for all sites, compared to engineers. However, the number and percentages of engineers also indicating the importance of geology is perhaps unexpected, given the premise of this paper.

Clearly (at least based on a small poll of industry peers) the wider community of geotechnical professionals across a range of experience levels value the importance of geology in geotechnical practice. Therefore, common sense would suggest that engineering geologists are important for every project. This appears to be in contrast to the data presented in Section 2 which indicates that engineering geologists make up only 8% (Victoria) to 23% (Tasmania) of the Australian geotechnical professional workforce. Why do we appear to have such a small contingent of engineering geologists in Australia given the value of geology that has been indicated? Are engineering geologists undervalued or not needed? Perhaps the poll question of whether *geology* is important can assist in answering this question. Do geotechnical engineers realise the importance of geology, butnot appreciate the inherent importance of engineering geologists to understanding the geology? Do geotechnical engineers feel comfortable undertaking the role of an engineering geologist? Should this be an acceptable practice? Could geotechnical engineers be upskilled and trained in engineering geology? This paper presents the facts and

data to support the necessity of incorporating geology in geotechnical practice, while also exploring who is best placed to provide that input – engineering geologists or suitably trained geotechnical engineers.

# 4 PERSPECTIVES FROM SECONDARY EDUCATION

If we assume that there is a continued need for geology as applied to ground engineering, we must ensure a supply of new skilled specialist talent. A good place to begin our effort is with the development of an interest in earth science and engineering in our younger population. We cannot hope to attract new geoscientists to the engineering industry if there is a lack of awareness of the need, or a recognized value placed on the pursuit. All Australian states and territories offer Earth and Environmental Science (EES) as a senior secondary ATAR (Australian Tertiary Admission Rank) subject (except for Victoria, which offers environmental science) (ACARA, 2024). Western Australia offers a 4-unit, two-year EES ATAR that addresses most sub-disciplines in geology and environmental science, including a brief introduction to geological hazards and seismic design. These courses are excellent places to encourage young people to join our craft.

Data available online from the School Curriculum Standards Authority (SCSA, 2024) shows that only 10 out of about 400 secondary schools in WA offered EES in 2023. Only 115 students sat the EES ATAR Western Australian Certificate of education (WACE) examination in the WA in 2024, down from 167 in 2020. Andrew Shuckstes has been teaching EES to secondary students in Perth WA since 2016. During this time, he has made several observations including:

- Students attending high school are largely unaware or misinformed about engineering as a technical discipline and are totally unaware of geology as an applied skill for engineering.
- Senior secondary science educators in WA lack experience, subject knowledge and skills necessary for EES education. These teachers are sparsely resourced for practical and other educational opportunities for interested students.
- Experienced professionals rarely transition to teaching from engineering or geology. There are likely several reasons for this observation including the perceived challenges of working with young people and the significant reduction in remuneration resulting from the transition.
- For those of us teaching EES, there are several government and privately supported organizations that support pre-Tertiary EES education across Australia. These organizations include AusEarthEd (Australian Earth Science Education), TESEP (Teacher Earth Science Education Program), GA (Geoscience Australia), GSA (Geoscience Australia). These organizations aim to provide teacher professional development, publications and resources up to Year 12 ATAR EES.
- EES WACE scores are scaled down by WA SCSA, resulting from a calculated relative simplicity compared to other ATAR sciences like Physics and Chemistry. This makes EES less attractive to those candidates wanting to maximize their ATAR score because they know they will lose some of their marks in EES for their ATAR score.
- EES is often chosen by students who want to experience practical and tactile science without the challenge of Physics and Chemistry. Students who choose EES are often less academic with less developed mathematics and language skills than those pursuing other science ATAR subjects.
- EES WACE results in WA are low (average score was not above 60% since 2016, and below 50% in 2024) and have been getting lower for the last 10 years. This data is available to the public and discourages many students from considering the subject.
- EES is not a prerequisite or a recommended secondary subject for any university course in WA. This makes it less attractive to strategic subject choice for senior secondary school.

The WA economy is a resource export economy, dominated by metals, fuels and foods. Geology at our universities has traditionally focussed on metals and hydrocarbons (Kalgoorlie has the Curtin School of Mines), along with the academic geology we are all familiar with like palaeontology and mineralogy. Secondary students are largely unaware that there are alternative pathways for geologists such as civil engineering and environmental science. If we take the observations above at face value and apply them to our analysis of enrolments at university, it gives clear reasoning as to why we have limited interest in engineering geology as a career choice.

The lack of interest in EES, and thus geology as a secondary school subject is dependent on several factors:

- A lack of exposure and emphasis for EES during primary and junior secondary schooling.
- The perceived difficulty of technical subjects like geology, physics and chemistry.
- The strategic aspect of ATAR scores for students who wish to achieve higher ATAR scores irrespective of the subject by choosing "easier" subjects.
- Opportunities that are endorsed by the school community that offer a perceived easier and more certain ATAR that allows entry to university through alternative pathways.

If we want to encourage Australian students to consider geology or more specifically engineering geology, we must begin at the primary and secondary stages of education. We must, as a professional community, offer assistance and encouragement to institutions that deliver education to young people about the appeal of geotechnical pursuits. Government and industry supported organization like AusEarthEd, TESEP, GA and GSA or even Engineers Australia are a good place to start. A slightly different approach is to convince schools to encourage geology as a subject in secondary and tertiary education through advertising or voluntary school visits. Another possibility is for engineering consultancies to hire interested geologists, and to use workplace education to train junior geologists to apply their craft to engineering. There are many engineering geologists who were developed in this way resulting in many years of valuable geological input to engineering. In short, it is up to us to initiate the change and either grow talent from young children or grow talent from older interested professional people.

# 5 MOVING INTO GEOLOGY CAREERS AFTER GRADUATION

Besides looking at the secondary education angle, it is important to understand where geology students end up after finalising their tertiary degree. To this end, we reviewed publicly available and internally gathered data from Curtin University (Bentley Campus). It is one of the few Australian campuses still offering a specialised Bachelor of Applied Geology program (mind, not a BSc with a major in geology) and two associated double degrees (Geology and Finance and Geology and Environmental Science). Curtin also offers a BSc majoring in Earth Science and is about to launch an additional major in Environmental Sciences. In recent years, several Australian campuses have reduced or restructured their geology programs due to financial or institutional changes. Some standalone geology departments have been closed or consolidated into broader earth science or environmental science schools at institutions such as Australian National University (ANU), University of Melbourne, University of Sydney, University of Newcastle and Macquarie University.

Finding out where geology graduates end up is elusive as there is no official repository for this kind of information. At Curtin, the data that are available go back to voluntary reporting from graduates who inform the course coordinator of their starting position. Records of destinations have been kept systematically since 2019 and allow a glimpse into the predominant first employment industries.

As per the pie chart given in Figure 5, 75% of Curtin graduates start out in the 'minerals' sector. This is a broad definition and includes all aspects of the mineral resources sector. The 2nd largest batch goes on to do an Honours degree. This is not strictly a starting position, so once graduated, this cohort enters any of the other categories, inflating their numbers. Assuming a similar distribution, it means that the minerals sector takes up close to 90% of all the geologists from Curtin. This is not surprising given the economic importance of mining in WA.

Of the remaining numbers, twice as many geologists end up in the environmental sector (i.e. consultancy) compared to the energy sector (mostly oil and gas exploration). This impression that the environmental sector attracts more graduates than the oil and gas sector (O&G) is skewed because a certain (unknown) number of respondents are double degree graduates (geology and environmental science) and thus from the onset focussed to work in the environmental field. It should also be noted that some of those marked down in the Minerals and Environment category find positions as hydrogeologists or engineering geologists and not all noted under Minerals are in exploration or mining geology but work for resource companies in different roles (anecdotal evidence via email communication with graduates after entering the workforce).

Finally, numbers may be further skewed because one group/category may report back to the course coordinator preferentially compared to the other sectors (e.g. reticence to report entering the O&G sector given the situation around climate change or keenness to share first working experiences in a mining environment).

It is thus hard to pin down how many graduates move into engineering geology. Yet, inasmuch as this crude statistic can give a wider picture of the situation in WA, it indicates that, conservatively, less than 10% of Curtin graduates start in environmental consultancy, the category to which engineering geology consultancy belongs. Personal communication with interested 3rd year students who are asking for contacts and possibilities to do internships in this field (while taking the unit 'Hydrogeology and Engineering Geology') is consistent with this low percentage but suggestive of a mark closer to ≤5%. Whatever the true numbers, it is hard not to infer that the Minerals sector is siphoning off the bulk of graduate geologists (including double degrees with economy) that are vital for other areas, among them consultancy in engineering

geology, hydrogeology, and/or environmental contaminant remediation. And while genuine interest in exploration and resources geology may play its legitimate role in this imbalance, other factors may well contribute to this monopoly on human resources, not least the disproportionate entry salaries (and their propagation).

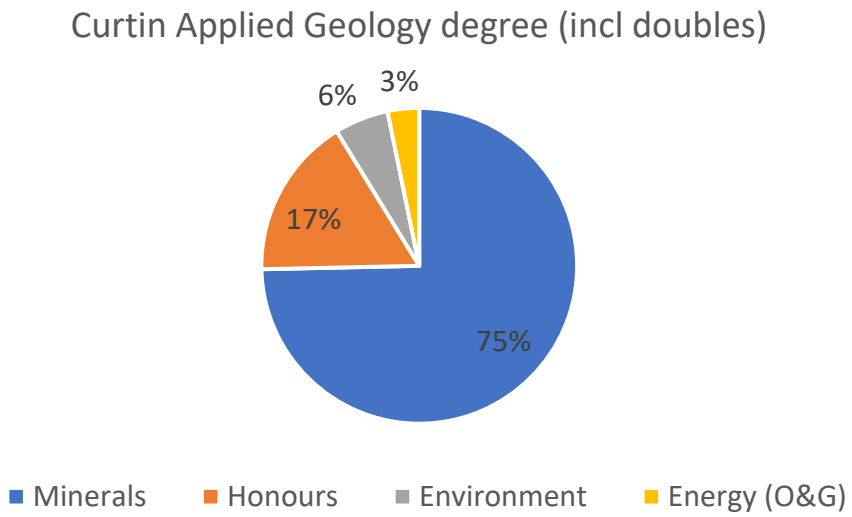


**Figure 5: Different industry sectors taking up BSc Geology single and double degree graduates (n=217) from the School of Earth and Planetary Sciences at Curtin from 2019-2024. (Note, these are not all graduates but only those who voluntarily report back where they found their first employment)**

## 6 CONCLUSIONS

The data presented in the paper indicates that engineering geologists form a relatively small proportion of the geotechnical workforce in Australia when compared with other countries including New Zealand. The paper recognises that market forces have driven the contrast between Australia (which has a large resource sector particularly in WA) compared to New Zealand (which is home to numerous geological hazards). But the paper highlights that there is very limited earth science education in Australian schools, and limited tertiary education available for engineering geologists in Australia. Interest in geosciences as a career is declining globally. We could continue to source engineering geologists from overseas, but we may be missing the opportunity to incorporate locally trained geologists with a good knowledge of Australia's vast and sometimes unique geological domains. There is therefore justification for attempting to increase the number of Australian trained engineering geologists.

We know that geology is important in geotechnical practice. This is demonstrated by several high-profile catastrophic engineering failures attributed, at least in part, to poorly understood ground conditions. The LinkedIn poll data indicates that geotechnical practitioners in Australia value the importance of geology, and the vast majority (73%) believe it is fundamental for all sites. It is therefore clear that geological knowledge, and engineering geology, is an important engineering discipline. If this is the case, who is currently performing the geological work in geotechnical practice? Based on the proportion of geologists in the Australian geotechnical workforce indicated by the Ground Recruitment Pty Ltd data, geotechnical engineers may be performing a geological role on their projects. Can engineers identify where they have more complex or hazardous geological conditions without having the geological training and experience that a geologist would contribute? There is a fundamental difference between engineering and science. Is this well understood?

Given the resource driven market conditions in Australia, and particularly in WA, it seems unlikely that Master of Engineering Geology program will be offered by WA universities in the near future, A program of this kind is currently under development at UNSW. This raises the question, will geologists from other states consider relocating or enrolling remotely to pursue further qualifications in engineering geology? Perhaps we need to upskill geotechnical engineers in geology? Could that be a solution? Offering a university micro credential for interested geologists, or more courses on engineering geological themes for geotechnical engineers to complete may also be beneficial. Could the expanding set of courses organised and operated by the AGS plug this gap going forwards?

# 7 DO WE ALREADY HAVE THE ANSWER?

The AGS has been running geotechnical and geological mapping courses in Perth for many years. These courses are actively supported by local practising engineering geologists willing to share their knowledge and expertise. These initiatives are crucial for providing the specialist engineering geology skills and knowledge to individuals working in the discipline in WA. The skills and knowledge offered on these courses are necessary for any WA engineering geologist to learn. These mapping courses would be vital to those who are isolated from other practitioners because they are the only engineering geologist in their company or WA office location, and also for engineering geologists who qualified elsewhere and may not be familiar with WA geology. It is clearly important that these courses continue.

Over the last few years, a few additional things have been happening in WA that may be assisting in encouraging geologists into the engineering geology discipline.

Final year students undertaking the Bachelor of Applied Geology at Curtin University, Perth study a Hydrogeology and Engineering Geology unit (Unit 3003). Domenik Wolff-Boenisch is the Unit Coordinator for this unit and maintains. strong industry links and resources. Paul Baker, GHD Pty Ltd has been collaborating with Dom as an Adjunct Associate Lecturer to contribute to this unit for the past six years. During those six years, Paul and Dom have overhauled the course content to align it with the latest standards and guidelines and adjusted the content so it is relevant to current industry needs. For example, an introduction to tailings storage facilities has been added. Paul prepares and delivers some lectures, but the main contribution is being present for the weekly workshops where students work through practicals on desktop studies and geological models, soil and rock mechanics as well as introducing hazards such as rockfalls, sinkholes and landslides to the undergraduates. He also introduces site investigation techniques and the importance of understanding groundwater and aquifer systems. During the practical sessions, it is apparent that approximately 20% of the students have an aptitude for engineering geology and for many it comes as a revelation that being an engineering geologist is a viable career path. However, the discrepancy between starting salaries in the resources industry (exploration and mining) and engineering/consulting gives graduates a very difficult choice between the two irrespective of how much the applied aspects of engineering geology may appeal to them.

In 2021, Paul Baker published his LinkedIn article ‘It’s hard to find home-grown engineering geologists in Perth’. The article asked if there were any engineering geology topics that potential employers of engineering geologists would like to see included in a university course. In response to this article, Julia Bota (HATS Consulting) and Alex Petty (PTG Consulting Pty Ltd) contacted Paul to discuss supporting the Applied Geology Unit GEOL3003. Dom had been considering introducing a field course as part of the unit, and Julia and Alex were able to contribute to the planning and preparation of the field course. A half day engineering geology field course was subsequently held in 2023 and 2024 as part of Unit GEOL3003. It was hoped that by showcasing the role of the engineering geologist to the students and providing them with more industry connections that some may show an interest in pursuing a career in engineering geology.

It may be too early to state that this course has had a significant impact on encouraging students to follow engineering geology as a career. It should be noted that the two graduates who attended the Curtin University field course that have entered the profession in Perth have joined GHD Pty Ltd. (with Paul Baker) and PTG Consulting Pty Ltd (with Alex Petty), two of the three engineering geologists who lectured at the field trip. More time is needed to demonstrate the effectiveness of this kind of engagement. However, with support from individual volunteer practitioners, a short introductory field course is something that could be extended to other universities who provide Geology degrees across WA and Australia.

Whilst all the initiatives presented above are certainly helping to raise the profile of engineering geology at a higher education level, it is important to note that, once students reach university, they have already chosen their overall subject. There are currently no specific programmes or initiatives for engaging high school students with engineering geology as a discipline. This issue is discussed further in the Australian Geoscience Council’s Australian Tertiary Geoscience Education Profile 2022 report, which states that the lack of exposure and awareness of geosciences in Australian secondary schools remained one of the significant contributary factors with the low number of students entering geosciences higher education programs in Australia.

If we are to encourage Australian students to consider geology or more specifically engineering geology or geological engineering, we must begin at the primary and secondary stages of education. We must, as a professional community, offer assistance and encouragement to institutions that deliver education to young people about the appeal of geotechnical pursuits. Government and industry supported organization like AusEarthEd , CORE, TESEP, GA and GSA or even Engineers Australia are a good place to start. This could be supplemented by members of our community visiting schools and talking about careers in engineering geology.

It is positive to see that a couple of graduates have already been placed in roles who have recently completed the Curtin University Applied Geology Bachelor GEOL3003 Unit (Hydrogeology and Engineering Geology). Perhaps a few more individuals getting involved with mentoring potential engineering geologists and supporting universities in maintaining strong industry links will assist in maintaining, or even increasing, representation of engineering geologists within the geotechnical community in Australia.

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