

# **Aura of a staghorn: an intensive course designed to transform the engineering students' perspective of Country**

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## **ABSTRACT**

### **CONTEXT**

Rebuilding ecosystems is one of the major responsibilities of the next generation of engineers and built environment professionals. It is therefore essential that our disciplines begin to develop the skills, expertise and worldview needed to support high-quality ecological outcomes as part of rebuilding ecosystems in alignment with Sustainable Development Goal 15: Life on Land.

### **PURPOSE OR GOAL**

The aim of this project was for students to develop a deeper relationship, connection and experience of land, as part of building their future professional foundation within engineering. Essential to this, was the progression of understanding of land as physical, as biological and as spiritual, and exposure to ecological and Indigenous worldviews and perspectives. This work resonates with Learning From Country (LFC) and Country as Teacher pedagogies. An ecological worldview was incorporated into the learning fabric of the course (ecopedagogy).

### **APPROACH OR METHODOLOGY/METHODS**

This semi-intensive course included an orientation and preparation block (4 weeks), a full-time intensive (5 days) and a consolidation and finalisation block (4 weeks). Three field trips were designed to progress student understandings of land from the physical -> biological -> spiritual. Understandings of land were further explored through project-based assessments and interaction with industry partners from private, local government, community and Indigenous organisations.

Data was collected via an end-of-course reflection where students explored the course structure, assessments and relationships and their personal transformations before and after the course, as well as providing an overall synthesis of their experience.

### **OUTCOMES**

Most students in the course (83%, n=30/36), elected to share their reflection responses. Students were from 12 countries and 21 different professional engineering, science and miscellaneous backgrounds. The majority of students in the study (83%, n=25/30) preferred the intensive over a traditional mode of delivery using words like “etched in my memory” and “unforgettable”. Rich reflections had an engineering focus, but contextual and professional factors were well integrated and understood, including well-developed ecological and cultural perspectives.

### **CONCLUSIONS/RECOMMENDATIONS/SUMMARY**

Extended time together on Country, meaningful relationships with course partners including traditional owners, and opportunities for authentic reflection are all valuable building blocks for facilitating a lasting transformation in the engineering student's relationship to land.

**KEYWORDS** Rebuilding ecosystems, Engineering relationship to land, Learning from Country

## Introduction

Rebuilding ecosystems is one of the major responsibilities of the next generation. Within this global project, there is a call for engineers and built environment professionals to contribute their professional capacity towards the restoration of our most devastated natural and urban landscapes. To support high-quality environmental and ecological outcomes in alignment with Sustainable Development Goal 15: Life on Land, it is essential that engineers and built environment professionals explore and cultivate their skills, expertise and relationship to country.

This work resonates with Learning From Country (LFC) and Country as Teacher pedagogies. Country as Teacher employs Country-centred learning with a focus on reciprocity in relating to Country for social and ecological balance and wellness (Burgess et al., 2022a). Country is recognised as a 'living entity' with agency, understood relationally as 'more than human being' (Burgess et al., 2022b).

Previously the authors have explored embedding Indigenous perspectives into first-year engineering design, and developed a series of principles to apply more generally to our engineering courses (Campbell et al., 2020; Campbell et al., 2022; Michael, 2019; Michael et al., 2019). These include maintaining a safe space, privileging Indigenous voices, creating authentic assessments, bringing a contemporary view of Indigenous engineering, and engaging a spirit of curiosity. These principles are all underpinned by relationships nurtured over time, and recognise that one of the most important relationships for us to nurture is our relationship to Country (Michael et al., 2022).

With extended time on Country, participants become better able to listen to and learn from Country (Emmanouil, 2016). This course was intentionally designed as an intensive to nurture that connection. The focus was not solely on embedding Indigenous perspectives, but on creating a living relationship to Country through many layers, including through: i) the physical aspects of working on a mine rehabilitation monitoring project and observing and measuring Country, through ii) the biological enquiry and relationship to selecting plants to bring back life to a denuded and failed green asset as part of Country, to iii) exploring more spiritual and personal connections and intentions, listening to each other, considering being non-extractive and giving to Country, responding to what is needed in the moment alongside Traditional Owners and Aboriginal rangers.

The aim of this project was for students to develop a deeper relationship, connection and experience of Country as a future professional foundation. Essential to this, was the progression of understanding of land as more than physical, more than biological, and by design to take them through a series of landscape experiences and a pedagogy that supported relationship to Country as spiritual. An ecological worldview was incorporated into the learning fabric of the course (ecopedagogy) and was explored through dominant, engineering, technical, ecological and Indigenous perspectives (Leigh et al., 2014).

## Approach or methodology/methods

This engineering Masters-level environmental engineering course was run in semi-intensive mode over 9 weeks (instead of the standard 12-week teaching term). The 9 weeks included a 4 week orientation and preparation block, a 5-day full-time face-to-face intensive in the mid-term break, and a 4-week consolidation and finalisation block. Aside from the 5-day intensive, all other parts of the course were conducted online which enabled students to travel to the University campus for the week from interstate if they wished to participate. The intensive consisted of three field trips designed to transition student understandings of land from the physical -> biological -> spiritual. (Figure 1). Additionally, two workshop days provided context and training for these experiences.



**Figure 1: Intentional design of course to transition perspectives of land from physical (structure), to biological (life), and finally to spiritual (home).**

**Day 1 (Workshop)** provided context and training for the first two field trips on Day 2 and Day 3. In the morning students were briefed by two industry partners, a mining officer and a local government officer, on their respective project briefs. In the afternoon the students undertook intensive training in the forest ecosystem near campus on field techniques for mine rehabilitation.

**Day 2 (“Physical” field trip)** students engaged in a full-day of field work at a commercial sand mine 1 hour North of the University campus. At the mine they worked in small groups of 3-4 students on transects to undertake Landscape Function Analysis (LFA), plant and weed surveys, acid sulphate soil and water quality testing. The assessment was a 40% commercial ‘Land Rehabilitation’ consulting report to guide the mine’s rehabilitation response.

**Day 3 (“Biological” field trip)** was spent visiting green infrastructure assets including bioretention basins, a rewilded creek, a phytocap, green roofs and an urban permaculture farm with local government, private industry and community not-for profit partners. The designed output was a ‘Plant Design’ consulting report on a failed bioretention basin to inform local government on renewing this green infrastructure asset for success.

**Day 4 (Workshop)** was spent preparing for visiting Country, reflecting on our own connections to land from childhood, discussing concepts and intentions of the visit with yarning methodologies. The teaching team also participated in the sharing of their own experiences and intentions to build relationships, to listen, to be open, to give, and to ‘care for Country’.

**Day 5 (“Spiritual” field trip)** was spent with a Traditional Owner family and Aboriginal rangers on Country. Students weeded lantana in the morning as an act of caring for Country, pulling the lantana and crushing it underfoot on a steep slope. They were then invited down from the hill to listen to a Traditional Owner share rich and varied perspectives and experiences of her culture and land. Afterwards, as the eucalyptus leaves smoked, the students were invited to have their faces and arms painted and to say their name to her ancestors: the women painted by the female Traditional Owners and the boys given permission to paint each other as no senior man was present. Afterwards, students were able to interact organically with the landscape, and broke off into groups, some spending time at the river, some helping one of the rangers find a sick koala, some continuing with some weeding, some standing around talking. From a teaching perspective, the intention was for them to relax and enjoy their time on Country, knowing that they were taking all their experiences of the previous days on the land with them “... *on that smoky afternoon, the mountains taught the students and the students taught the teacher*” (Kimmerer, 2013). The output was a 25% ‘Perspectives of Country’ Creative Synthesis assessment with openness in format of expression to allow students to communicate their experiences as a creative work or essay.

The assessments were submitted in reverse order of the field trips they were associated with. First, the ‘Perspectives of Country’ assessment worth 25% associated with the ‘Caring for Country’ field trip was submitted within one week. This was followed by the ‘Plant Design’ consultancy report worth 25% submitted by the end of the next week, and finally the major ‘Land Rehabilitation’ consultancy report which was submitted two weeks later, worth 40%.

Data on the student experience was collected as a 10% end of course PebblePad reflection which explored students’ background, experience of the course structure, assessments and relationships, and their transformations in three self-selected areas in 3 x 100 words. The transformation question enabled students to highlight and contrast what they believed had changed for them before and after the course. Finally, they provided an overall synthesis of their experience in 100 words to bring their reflection together as a cohesive whole. Each of the reflective questions is stated as part of the *Results* sections below. This study was conducted in accordance with Griffith University’s ethics code, GU ref no: 2017/1023. Written informed consent was obtained and students were provided with an information sheet and informed consent form prior to data collection.

## Results

The majority, 83% of students (n=30/36), chose to participate and share their reflection responses. To begin, they were asked a relatively open-ended question: “*Describe some of your background,*

as much or as little as you wish for the purpose of giving context to your reflection". Most students mentioned the country they were from (93%) and their educational background (87%). Many mentioned their childhood experiences or influences (60%), deeper motivations connected to environmental protection (60%) or their prior professional experience (50%). Students were from 12 countries: India (8); Australia (6); Hong Kong (4); Fiji (2); Indonesia (2); Nigeria (2), with one student each from: Rwanda, Germany, Peru, Bahrain, China and Morocco. They were also from diverse disciplines backgrounds: 11 from Engineering (Mechanical, Mechatronics, Chemical, Agricultural, Electrical, Civil, Biotechnology, Biochemical and General), 5 from Science (Geology, Physics, Marine Biology, Chemistry and Environmental Science); and 8 from other backgrounds (Physiotherapy, Linguistics, Environmental health, Environmental management, Pharmacology and Toxicology, and Finance) and 4 with unknown background. Students were then asked "What brought you to study this course?" with a high proportion stating they were interested to clean up contaminated land (70%) and to rehabilitate abandoned lands, especially from mining. Some also shared professional aspirations, and a desire to build knowledge and skills, tackle issues and problems and gain practical and hands-on experience. There were a few students who intentionally took the course to gain knowledge and skills to apply to their place of work (10%).

### Reflection on the course elements (structure, assessments, relationships)

Students were given the task: "Reflect on your experience of the three field trips on Mine Rehabilitation, Green Infrastructure and Caring for Country". The majority of students (80%) identified a favourite field trip experience including 27% who mentioned all field trips as an interconnected whole, 23% Green Infrastructure (Biological) field trip, 20% Caring for Country (Spiritual) field trip and 10% Mine Rehabilitation (Physical) field trip. Some did not identify a favourite (20%). Overall, there was evidence of students changing their perspective as they reflected on three trips including: a shift from a technical to holistic understanding; from specific techniques to broader applications and from individual components to integrated systems (Table 1). "Despite its relatively limited technical content, it imparted a priceless lesson—dedicating one's entire life to protecting the environment" – Student perspective on Caring for Country field trip.

**Table 1: Shifting perspectives through student participation in the three field trips.**

<b>Shift</b>	<b>Mine Rehabilitation</b>	<b>Green Infrastructure</b>	<b>Caring for Country</b>
<b>Technical to holistic</b>	<i>"hands-on immersion in data collection, manual testing, soil analysis through tactile inspection"</i>	<i>"..visiting bioretention systems, I had an extra pair of lens on – thinking about what worked well and what didn't work so well."</i>	<i>"..a time of reflection for me. It made me understand the First People culture more but also reminded me of the importance of keeping my own culture alive."</i>
<b>Individual experiences to reflecting on the role of the whole community</b>	<i>"I had the opportunity to undertake an acid sulfate soil test and slake test myself."</i>	<i>"..the garden near the city with green roofing really made me feel that the world needs more engineers similar to our teaching team."</i>	<i>"..the significant impact individuals can have by dedicating themselves to the cause of preserving their homeland and the planet as a whole."</i>
<b>Individual components to integrated systems</b>	<i>"Mine Rehabilitation was interesting to see rehabilitation in action."</i>	<i>"GI is a network of natural and semi-natural features, processes, &amp; systems that are intentionally planned, designed, and managed"</i>	<i>"Caring for Country is at the core of all land rehabilitation, it is a connection to land and reminds me that nature guides successful rehabilitation."</i>

Students were asked to "Reflect on your experience of the assessments on Perspectives of Country, Plant Design and Land Rehabilitation". Students found the field trips to contain the themes of protecting and caring for nature, rehabilitating and greening land, use of native plants and practical problems like weeding. Many students appreciated completing the assignments in reverse order of the field trips, especially the Perspectives of Country field trip.

*The completion of these assessments in reverse order was rather clever. Since the perspectives of country field trip was the last one we experienced and it was the most emotional in nature, it made sense to have it be the first to be submitted since data tends to make more sense the longer you sit on it, but emotions can be fleeting so one shouldn't let too much time pass – student reflection*

The Land Rehabilitation and Plant Design assessments were both presented as consultancy reports responding to tailored briefs. The openness in format of the Perspectives of Country provoked a variety of responses. Some students chose to write essays, some informational, some reflective and some poetic. Many chose creative formats such as sculpture, visual diaries, paintings and poems. Table 2 is a textual analysis of the sentiments for each of the assignments.

**Table 2: Summary of sentiment analysis on reflections of assessments**

Land Rehabilitation	Plant Design	Perspectives of Country
Informative	Practical	Personal
Challenging	Exciting	Refreshing
Complexity	Beneficial	Uplifting
Extensive	Enjoyable	Spiritual
Intensive	Clear	Thought provoking
Brainstorming		Emotional

Students' approached the technical and comprehensive nature of the Land Rehabilitation assessment with a sense of apprehension and uncertainty often describing the task as challenging and extensive. With the Plant Design assignment, their sentiments shifted towards a more positive and enthusiastic outlook. The practical and real-world applications of designing bioretention systems were described as exciting and beneficial, enjoyable and clear.

The Perspectives of Country assignment provoked deeper sentiments, becoming reflective and emotionally connected. Descriptions such as refreshing, uplifting, and thought-provoking highlighted a deeper understanding and personal connection to the cultural, personal, emotional and spiritual dimensions. Overall, students had apprehension around the more challenging tasks, and responded with more enthusiasm as their reflections became more personal.

*The art of restoring a piece of land, rejuvenating its resources, and contributing to the planet's long-term well-being struck me as both profoundly valuable and inherently noble. It's not just about environmental health; it's about the ethical and personal fulfillment that comes from playing a part in the stewardship of our precious planet. – student reflection*

In reflecting on the delivery method of the class, largely positive feedback was given. The majority of students (83%) preferred the intensive mode of delivery compared to traditional delivery modes using words like “enduring” and “etched in my memory” and “unforgettable”. Students with a preference for the traditional where lectures and assessments are spread evenly over 12 weeks, generally had competing commitments with work and family that were challenging to negotiate.

## Reflection on transformations

One of the key themes of the pedagogical approach used in this research was to see how student's perspectives would transform over the course. Students were asked to reflect on this theme in their workbook and were given an open-ended question on what had transformed for them over the course. The question was phrased as: “*What was your conception of \*INSERT WORD\* before and after the course*”. Students self-selected 1-3 topic areas of which 30 were around their conception of green assets linked to their assessments; 16 related to Indigenous conceptions of land, 12 related to professional and personal transformations and 11 related to their conception of their discipline. There was an engineering focus, but contextual and professional factors were well integrated and understood, including ecological and cultural perspectives. The themes have been summarised in Table 3 and include cultural awareness, spiritual connection, professional scope, professional development, professional ethics and personal development.

**Table 3: Key themes of transformation based on student reflections.**

<b>Cultural Awareness</b>	A newfound awareness of traditional land management practices and stewardship.
<b>Spiritual Connection</b>	Understanding the spiritual connection to land in a traditional and contemporary context.
<b>Professional Scope</b>	Expanding the scope of environmental engineering from pollution management to incorporate ecological and community perspectives, mine rehabilitation and green infrastructure.
<b>Professional Development</b>	Developing specific skills and an interdisciplinary perspective.
<b>Professional Ethics</b>	Strengthening a commitment to sustainable development and community engagement.
<b>Personal Development</b>	Reflecting on the meaning of 'home', 'Country', 'profession'.

We can see the areas where the course was transformative for students based on their before and after reflections in their self-selected topic areas (Table 4). Again, attention is drawn to the increased level of holism within the student worldview.

**Table 4: Summary of student “before” and “after” transformations based on their reflections.**

<b>Topic of transformation</b>	<b>Before</b>	<b>After</b>
<b>Land and Country</b>	Physical and resource-focused perspective	Deepened understanding of cultural and spiritual connections, especially from Indigenous perspectives
<b>Aboriginal Cultural Awareness</b>	Limited understanding of cultural connections	Deeper appreciation for spiritual, cultural, and ecological aspects of land management
<b>Home</b>	Viewed home as a physical dwelling	Broadened to include harmony with the natural environment, involving sustainable living practices
<b>Environmental Engineering</b>	Focused on waste management and pollution control	Broader scope, integrating nature based solutions and sustainability into engineering processes
<b>Land Rehabilitation</b>	Seen as a technical process for restoring land	Recognised as holistic: involving ecosystems, community well-being, and cultural aspects
<b>Green Infrastructure</b>	Viewed as just planting trees	Comprehensive understanding of technologies such as green roofs, permeable pavements, and their benefits
<b>Stormwater Bioretention Systems</b>	Barely aware of their design	Developed interest and understanding in their construction and function of designed urban environments
<b>Professional Contribution</b>	Focused on responding to issues	Proactive approach, involving community outreach and long-term environmental solutions
<b>Ecology</b>	Superficial understanding of plants and animals	Recognised the interconnectedness of systems and importance of holistic environmental management
<b>Plant Design</b>	Saw it as an improvisational art	Recognised the science and systematic planning required for effective ecological design

In addition to the reflections in the formal reflection component of the course, students created a variety of rich creative outputs as part of their Perspectives of Country assignment. Within these assessments were evident transformations too numerous to mention in full here. There were

extraordinary and unexpected benefits derived from the diversity of countries and cultures in our cohort, and the way this led to interconnections with their own culture and Australian Indigenous culture. Below an excerpt where a student's whole professional perspective was shifted.

*I work in the mining sector and one of my secondary job descriptions is cultural heritage. The current wide held view in the mining sector of cultural heritage is more of a nuisance. However, after taking this course, and learning and listening to [our teachers and traditional owners] on the way they were treated by the colonial settlers and the hardships they have gone through since then, I was really saddened and I felt embarrassed...[.]... I have reached out to my landowners after the field study and invited them (2 elders) home for drinks, which they came. I apologized and informed them that as a new migrant, I did not know the suffering they and their ancestors had gone through. They forgave easily and I spent the evening listening to their very interesting and sometimes very sad history. They also helped me with my perspective on country assignment by providing information on the smoking ceremony. They were very interested in my [cultural] background. It was so amazing to note that our traditional practices' and values were not very different and some of our traditional foods and ceremonies were quite similar. I am so grateful for this course, particularly the traditional knowledge aspect, as it changed my mindset on first people, and be more appreciative of them and the knowledge they possess on country. It has also brought me closer to my traditional landowner elders and I know this new friendship will be very beneficial to both my professional and personal life – student reflection*

Another student remarked that the Caring for Country field trip “inspired me to think about the relationship between the nature and us”. Their artwork reflected the delicacy of this reflection and freedom of using art to express this exploration. The students' description of the artwork is below:

*The blue “S” shape is the river/creek, representing the water element. The dots in the water are anything that lives in the water, like fish, water plants, rocks, etc. The big circle with dots around is representing a group of species living together, forming a group, like Indigenous communities. On the right hand-side of the upper part, there is a yellowish circle. It is representing the sun. And the lines in the most upper part, are representing the mountains. All the elements are connected. The water as the mother of lives, gives the energy to the species around it. Others take the gifts from the water, producing their next generations. Land needs water, plants need water, animals also need water. Therefore, water is an important element in the system. The sun also acts as an important character in here. The sun provides energy to the earth, allowing different species to work and reproduce. The bird in the circle is representing the spirit of the Indigenous people. The sun is also representing hope and the future. The bird flying into the sun means the thoughts, the culture and the knowledge will keep passing to the next generation, with hope and a bright future. We have taken a lot from the earth/the land, what we need to do next is show some of our love to the land as a reward. We are different but at the same time we are the same. We are somehow connected in different ways. We need to think more about the land, care about it. A little action to express our love will make an unexpected result. – student reflection*

Many international students found similarity with the sense of landscape from their childhood experiences in other countries, where they felt at home and joyful on the land.

*Even though I was miles away from my country, the land and it's resemblance to my hometown made me feel calm and carefree. Being out there, far away from all the rush and haste of urban life could have caused this and it felt really good to be a bit more connected to the land. Another thing to be noted was that all these feelings endured, it began immediately as we disembarked and could be felt even after getting back home. It even brought back some of my childhood memories involving planting my first seedling, my first hike and some moments related to rainy days at our playground. As time passed, I came to realise that, besides my hometown, the thing I missed most was my friends. They were the ones who brought joy into my life, and it was this feeling of brotherhood that the nation had returned to me. The country had instilled a kind of relief and joy which cannot be described with words. – student reflection*

## Discussion

Engineering tends towards specialisation and focus, but there are many instances where a holistic and more integrated view is necessary. Engagement with 'land' in engineering necessitates development of an ecological worldview and a cultural understanding and/or experience of land as

Country. This paper outlines a course designed to guide an authentic transformation of the student worldview from the physical, to the biological, to the spiritual.

The intensive format of the course, with three field trips and three assessments was well-received by students. The immersive experience allowed for deep engagement with knowledge and skills, with each other and with the land which they interacted with through theory and practice in a meaningful way. The feedback suggests that these immersive, hands-on learning experiences foster a deeper or broader understanding of complex issues such as relationship to land. Also there were clear transformations across all six cultural dimensions of engineering education described by Godfrey and Parker (2010): an Engineering Way of Thinking, An Engineering Way of Doing, Being an Engineer, Acceptance of Difference, Relationships, and Relationship to the Environment.

While many students reported success in navigating their transformation in their understanding of land, this process was not without difficulty. Some students struggled with the shift from technical, to more holistic ecological perspectives and beyond to consider cultural, and spiritual understandings of land, finding the integration of these new perspectives challenging intellectually and emotionally. This resistance or difficulty highlights the complexity of the learning journey, especially when it involves deeply ingrained worldviews and requires significant personal reflection and adaptation. Overall, the reflections were positive with most students reporting a change in their worldview and evidencing this through examples. Approaching new territory and new ways of thinking while challenging for many, were also met with sentiments of excitement and adventure.

By the time students started their *Perspectives of Country*, directly after the intensive, they already demonstrated a more integrated worldview from being exposed to a wide range of experiences of land. Their reflections and creative works demonstrated a strong understanding of Country, Culture, Journey and Connectedness, and also for some, reflection on Kinship responsibilities, family and home (Goldfinch et al., 2017). This shift in perspective was not just academic but a meaningful transformation that could influence their future professional practice and careers.

*The course has reshaped my perception of this field from a narrow, technical process to a broad, interdisciplinary endeavour encompassing ecological, social, and cultural dimensions. It [made] me realize the far-reaching impact of land rehabilitation on our environment and society. This newfound understanding has deepened my commitment to pursuing environmentally responsible practices and considering the broader implications of land use in my future endeavours – reflection*

This paper presents a case for an immersive experience and exploration of land from multiple dimensions (physical, cultural, ecological and professional) as a supportive environment for engineers to develop their personal professional foundation and worldview. This includes alignment with the Engineering Code of ethics responsibilities of sustainability and respect for the dignity of all people (Engineers Australia, 2022), as well as a foundation for rebuilding ecosystems as a key area of focus in the decades to come. Authentic assessments portraying current professional realities, time on the land and building relationships with the teaching team, course partners and each other, as well as space for reflection and creativity in exploring cultural and personal dimensions were keys to success. The integrated nature of the course was received well by students who reported positively, both for enjoyment as well as insight and personal transformation. Cultural diversity enriched discussion with interconnections and enhanced insights. As we approach the next iteration, we will continue to pare back and streamline the delivery to allow more space for students to integrate their perspectives while building essential knowledge and skills.

This paper is named *Aura of a staghorn* based on the beautiful painting created by one of our engineering students of the same title. This picture is a metaphor for the student transformation and genuine connection felt to the land by the end of the course. We hope that this serves as inspiration for your courses and the positive potential contributions of future engineers. Indeed, transformations in an engineering student's perspective of land can have transformative effects on the profession and our future capacity as engineers to rebuild and restore ecosystems.

*Emerging from the forest, the aura of the Staghorn fern is present and captivating. Emerging from this experience I genuinely felt present and connected to the land. I want to succeed in my career by giving back to Country. – student synthesis of their experience.*



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