How Geosynthetics have Fast Tracked the Rehabilitation of One of the World's Largest Uranium Mines

By GNA Editor

Energy Resources of Australia (ERA) is currently undertaking a comprehensive rehabilitation program for the **Ranger Uranium Mine**, located in the Northern Territory. The mine ceased processing operations in 2021, and ERA has committed to restoring the site to its natural state by 2027. The company expects to spend approximately $1.2 billion on rehabilitation activities up until the end of 2027. This is a bonanza for geosynthetic suppliers and geotechnical engineering consultants.

In this endeavour, ERA has engaged **WSP**, a global engineering and environmental consultancy, to provide specialized services in mine closure and rehabilitation.

The recent focus of the rehabilitation works with geosynthetics has been Pit 3. Mining from Pit 3 concluded in November 2012. ERA has been actively rehabilitating Pit 3 at the Ranger Uranium Mine since the conclusion of mining operations in November 2012.

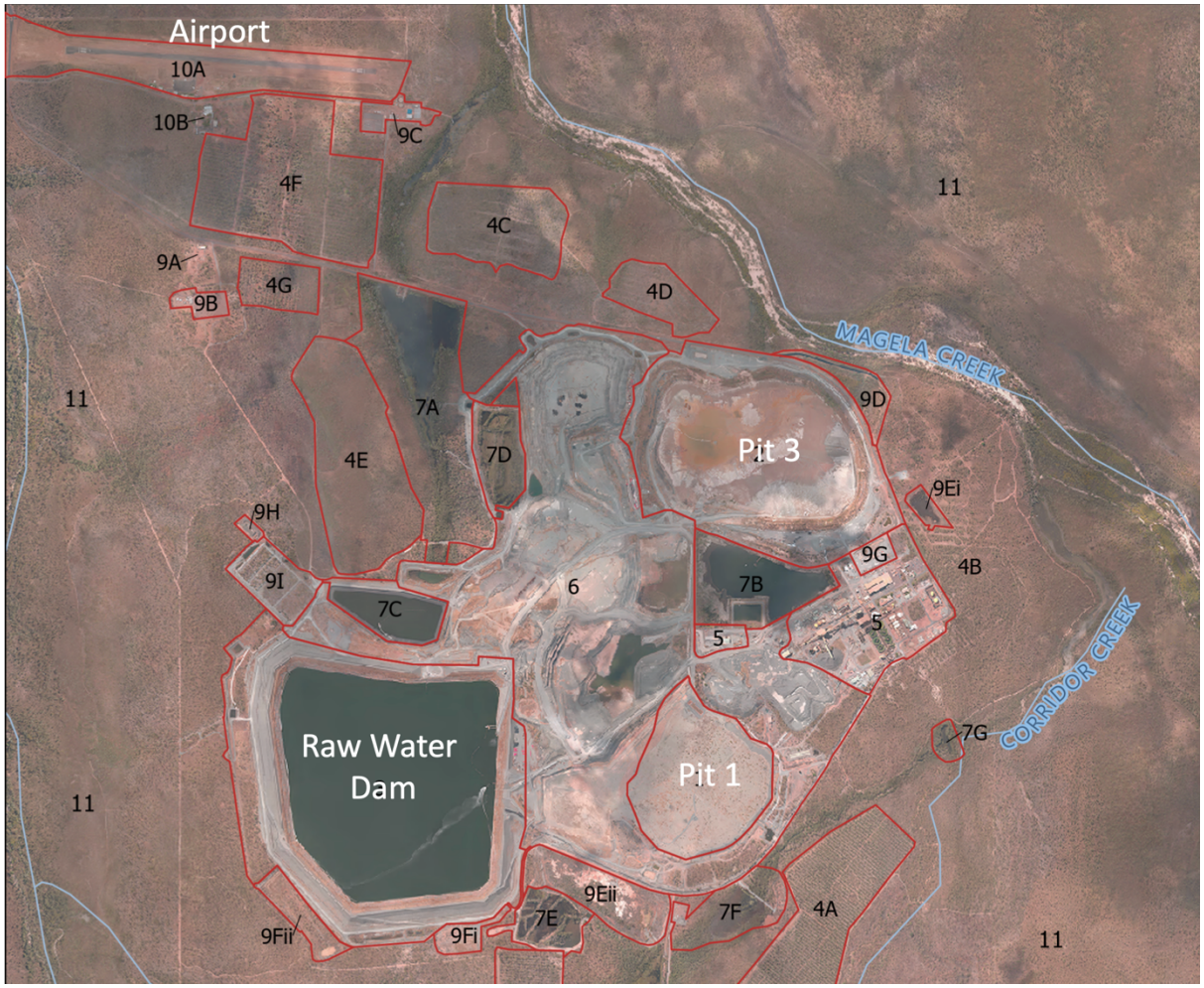

Figure 1 map of site

A significant milestone in this process was the completion of the wicking program in March 2023, which involved inserting approximately 41,000 geosynthetic wicks into the tailings of Pit 3. An impressive 1,268,650 LM of PVD material was installed.

Geosynthetic Wick Drains (GWD), or prefabricated vertical drains (PVDs), are geosynthetic products designed to expedite the consolidation of soft, compressible soils like clay and silt. They consist of a plastic core wrapped in geotextile fabric (see photo below), which allows water to flow while preventing soil particles from clogging the drain.

Figure 2 Composition of a Prefabricated Vertical Drain (PVD)

The wicks used for Pit 3, each ranging between 25 to 40 meters in length, facilitate the extraction of water from the tailings material, supporting its consolidation and enabling subsequent rehabilitation activities.

Following the consolidation of the tailings, the covering layer of water was removed, allowing the tailings to dry in preparation for initial capping. This phase includes the installation of geotextile fabric to stabilize the area. The successful completion of the wicking program has led to a substantial reduction in the tailings surface across Pit 3, marking a critical step toward the overall rehabilitation of the Ranger Project Area.

PVDs are defined in ISO 18325, 2015 as drainage composites with a rectangular cross-section, typically 100 mm wide, installed vertically into soil to provide drainage for accelerated soil consolidation. They usually consist of a central core with a channel system surrounded by a filter jacket or with a filter adhered to it. Sometimes PVDs are also referred to as wick drains, band drains, strip drains, etc.

When subjected to a compression load, excess pore water pressure builds up. Depending on the thickness of the soil, it can take years for this excess pore

water to dissipate through these low-permeable soils. The main purpose of using PVDs is to reduce the drainage path, so that the time taken for the dissipation of excess pore water or consolidation of soft soil can be reduced.

Advantages of PVDs (according to BS EN 15237, 2007):
• Accelerate the consolidation process and reduce construction time.
• Reduce post-construction settlement.
• Increase stability by increasing effective stresses in the soil.
• Lower groundwater level.

PVDs are usually considered sufficiently durable for a minimum service life of 5 years, as stated in BS EN 13252, 2016. It is also common to use recycled materials to produce the core of PVDs, helping to manage excess recycled materials and promote sustainability. Most of the global standard properties/requirements can be achieved, despite the inclusion of recycled materials.

Figure 3. The PVD's were installed from a barge by Ventia https://www.ventia.com/

The Stages of the Pit 3 Rehabilitation

The stabilization and capping play a pivotal role in isolating the tailings and preventing the leaching of potentially harmful materials into the surrounding environment. This ensures that the local ecosystem, particularly the sensitive Kakadu National Park nearby, remains protected from contamination.

The rehabilitation of the Pit 3 liner includes the following steps:

1. **Tailings Stabilization**:
    - A major preparatory step involved the installation of approximately **41,000 wicks** into the tailings material to facilitate the extraction of water. This process, completed in March 2023, was critical for consolidating the tailings and preparing them for the liner installation.
2. **Geotextile Layer**:
    - After removing excess water and achieving the necessary consolidation of tailings, a **geotextile fabric** layer is applied. This fabric serves as a stabilizing barrier, enhancing the integrity of the liner system and providing a foundation for subsequent rehabilitation layers.
3. **Capping and Containment**:
    - Once the geotextile layer is in place, a multi-layered capping system is added. This includes clay or other impermeable materials to seal the tailings, as well as a topsoil layer to support vegetation and natural ecosystem restoration.
4. **Long-Term Monitoring**:
    - ERA plans to implement robust monitoring systems to ensure the liner's performance over time. This includes tracking seepage rates, water quality, and the structural integrity of the rehabilitated pit.

2: Pit 3 (~107 ha)	• Mining started in 1997 and ended in November 2012 (Photo 9). • Underfill, underdrain and dewatering systems completed 2012–2014 (Photo 10). • Tailings deposition from mill processing started in 2015 and ended 2021 (Photo 11). • Tailings transfer from TSF started in 2016 and ended 2021. • Tailings floor transferred via truck and dozer. • Wicking to assist dewatering and consolidation of tailings (Photo 13). • Dewatering of the pit to accelerate the drying out of the tailings.	• Brine injection into the underfill zone via pit wall directional drilling (Photo 12). • Dust suppression activities and crusting the tailings surface (amphibious excavator, water spray, amphiroller).	• Installation of geotextile and then initial and secondary capping (standalone approval application for Pit 3 backfill lodged September 2023 and approved August 2024). • Placement of demolished plant and other infrastructure / materials into Pit 3 (standalone approval application to demolish plant will be submitted). • Progressive waste disposal and bulk backfill (standalone approval application for Pit 3 backfill). • Final 6 m of landform and revegetation (standalone approval application for Final Landform will be submitted).

Challenges and Innovations

High-strength PET geotextile has already been supplied to site but is now awaiting for the installation contractor to be selected. Bechtel was involved in the procurement of this geotextile.

Challenges include -

- placing large area of high-strength geotextile in a cost-effective way from a material and installation perspective
- a remote work site, with stringent CQA regime for offshore product supply chains
- commercial risk around volatility in forex, resin prices, freight rates etc.

Rio Tinto/ERA have already finished the closure of Pit 1 before - see this article Ranger uranium mine open cut pit capped as part of ongoing site rehabilitation - ABC News

PIT 1 STAGE 2 PRELOAD WORKS RANGER MINE | NRW Civil & Mining

Commitment to Sustainability

ERA's work on the Pit 3 rehabilitation is a testament to its commitment to sustainability and its role as a responsible steward of the environment. By prioritizing advanced technologies and rigorous standards, ERA continues to set benchmarks for the mining industry's approach to site rehabilitation.
As the project progresses, Pit 3's rehabilitation will serve as a model for large-scale environmental restoration efforts, showcasing how innovation and dedication can restore and protect sensitive ecosystems.

Rio Tinto subsidiary Energy Resources of Australia (ERA) has released its March 2024 quarterly report, detailing progress made towards rehabilitating the Ranger project area in the Northern Territory.

While ERA recorded no mining, production and development expenditure for the period, rehabilitation activities for the Ranger project area equalled about $42 million.

“Preparation for the dry capping of Pit 3 continued to progress,” the company said. “Upon the successful dewatering of Pit 3, the next step will be to lay geofabric which will protect the tailings during capping activities followed by initial capping activities.”

“Progress was made during the quarter to complete the manufacture of equipment to be used to accelerate the drying of Pit 3 tailings within the completed wicked zone,” ERA said. “Mobilisation of this equipment is planned for the second quarter of 2024.”

ERA has confirmed it holds sufficient capital to fund planned rehabilitation expenditure through to the third quarter of 2024. The company expects to spend approximately $1.2 billion on rehabilitation activities up until the end of 2027.

However, ERA said Ranger rehabilitation activities and their cost estimates after 2027 remain uncertain.

“These activities remain subject to a number of studies and are potentially sensitive to external events, as such, estimates of expenditure beyond 2027 are subject to further study work,” the company said.

References and Further Reading

https://www.energyres.com.au/uploads/2024-RMCP-Executive-Summary.pdf

https://iea-es.org/task-39/