Honeymoon Uranium Mine - Program for Environment Protection and Rehabilitation

Honeymoon Uranium Mine

Mining Lease 6109, Miscellaneous Purposes Licences 15 & 92

Honeymoon Uranium Mine is wholly owned and operated by Uranium One Australia Pty Ltd, a member of the Uranium One Inc. Group of Companies.

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1 Introduction

Uranium One Australia Pty Ltd (Uranium One) proposes to operate the Honeymoon Uranium Mine (Honeymoon mine) in northeast South Australia. The mine will use in-situ recovery (ISR) methods to produce approximately 400 tonnes of uranium per year (measured in U_3O_8 equivalent), in the form of uranium peroxide ($UO_4 \cdot 2H_2O$). The uranium peroxide will be exported for use by the electric power generation industry.

Honeymoon mine is located on the arid plains between the Olary Ranges and Lake Frome, approximately 490 km north by road from Adelaide and approximately 119 km northwest by road from Broken Hill (see Figure 1.1).

The Honeymoon uranium mineralisation is a secondary uranium deposit contained within unconsolidated sands at a depth of approximately 90 to 120 m. The mineralisation is covered by Mining Lease (ML) 6109; which is situated within the Kalkaroo pastoral lease.

This Program for Environmental Protection and Rehabilitation (PEPR) includes Mining Lease (ML) 6109 and two Miscellaneous Purposes Licences (MPLs), shown in Figure 1.2. The proposed usage of the MPLs during mine operations is as follows:

- MPL 15 is 2.5 km^2 and contains the Honeymoon mine airstrip, which will be primarily used by private charter aircraft to transport personnel to and from the mine.
- MPL 92 covers a transmission line corridor approximately 50 m wide and 50 km long, extending from the Barrier Highway to Honeymoon mine.

The mine will operate 24 hours a day, 365 days a year on a fly-in, fly-out basis. The Honeymoon mine will employ approximately 70 people.

1.1 Background

Ore-grade uranium was first discovered in Tertiary paleochannel sediments at the location of what is now Honeymoon mine in 1972 by the Minad-Teton-CEC Joint Venture. However, as ISR mining methods were not fully developed in the early 1970s it was not until the mid to late 1970s that the feasibility of uranium extraction at Honeymoon mine was improved through a series of laboratory and ISR technology.

In 1982, following the Commonwealth and State governments' approval of an Environmental Impact Statement (EIS) for the mine, Minad established a demonstration ISR operation at the location of what is now Honeymoon mine. The demonstration or trial leach operation included:

- A 6 L/s wellfield.
- A liquid disposal well.
- A demonstration processing plant designed to treat pregnant leach solution (PLS) at a rate of 25 L/s.
- Supporting infrastructure.

Before the wellfield or the demonstration plant could be commissioned, there was a change of State government in South Australia and shortly after that a change in Commonwealth government. Due to the change in governments, in March 1983, the final 'Approval to Mine' was deferred and the project was placed under 'care and maintenance'.

During the period of inactivity from 1983 to 1997, infrastructure associated with the plant, such as support buildings and accommodation facilities were removed. Well casings in the pilot wellfield were cut off below ground level and sealed, and most of the area including the airstrip was allowed to return to its natural state. Only the demonstration plant and warehouse remained, enclosed by a 2.4 m high security fence.

In May 1997, ownership of the Honeymoon mine was passed to Minad's parent company MIM Holdings, and in the same year acquired by Southern Cross Resources. Associated Miscellaneous Purpose Licences 14, 15 and Retention Leases 10, 11 and 12 were also acquired by Southern Cross Resources in 1997. Southern Cross Resources later became Uranium One.

In 1998, following the granting of State and Commonwealth approvals, Southern Cross Resources conducted a second field leach trial (15 March 1999 and 9 August 2000). This ISR field leach trial utilised five connected well patterns, with several injection wells common to more than one recovery well (11 injection wells and five recovery wells).

In May 2000, an EIS was prepared by Southern Cross Resources to satisfy State and Commonwealth legislative requirements in granting a Mining Lease (ML) over Retention Leases 10, 11 and 12 and Mineral Claims 3075, 3077, 3078 and 3079. A ML 6109 was granted in 2001, followed by Miscellaneous Purposes Licence (MPL) 15 in 2002, and finally MPL 92 in 2008.

In 2007, the Honeymoon Project Construction Mining and Rehabilitation Program (MARP) was prepared and submitted for assessment under the South Australia Mining Act 1971 (Mining Act). The Construction MARP was approved by Primary Industries and Resources SA (PIRSA) in early 2008. All subsequent changes to the design and layout of project infrastructure have been detailed and assessed through supplementary information submissions and amendments of the Construction MARP.

Construction of the Honeymoon mine began in the second quarter of 2009 and was scheduled for completion in the first quarter of 2011.

In order for the Honeymoon mine to move from construction into an operational phase, an Operations MARP was prepared under the South Australian Mining Act 1971 with reference to MG2, Guideline for miners: Preparation of a mining lease proposal or mining and rehabilitation program in South Australia, Version 4.10 (PIRSA, 2010). The Operational MARP was approved by the Department for State Development (DSD) in April 2011.

Following the identification of hydrocarbon entrainment within the process and disposal fluid during 2011, extensive groundwater monitoring, modelling and risk assessments were undertaken to adequately assess the risk during operation and post closure. These revisions have been incorporated into PEPR which replaced the requirement for a MARP, following amendments to the Mining Act 1971 and associated regulations in July 2011.

The PEPR provides a background to the project, details of constructed project infrastructure, description of operational activities, an assessment of the environmental social and economic risks resulting from the operations of the mine, management, mitigation and control measures to ameliorate residual risk, and details of mine closure.

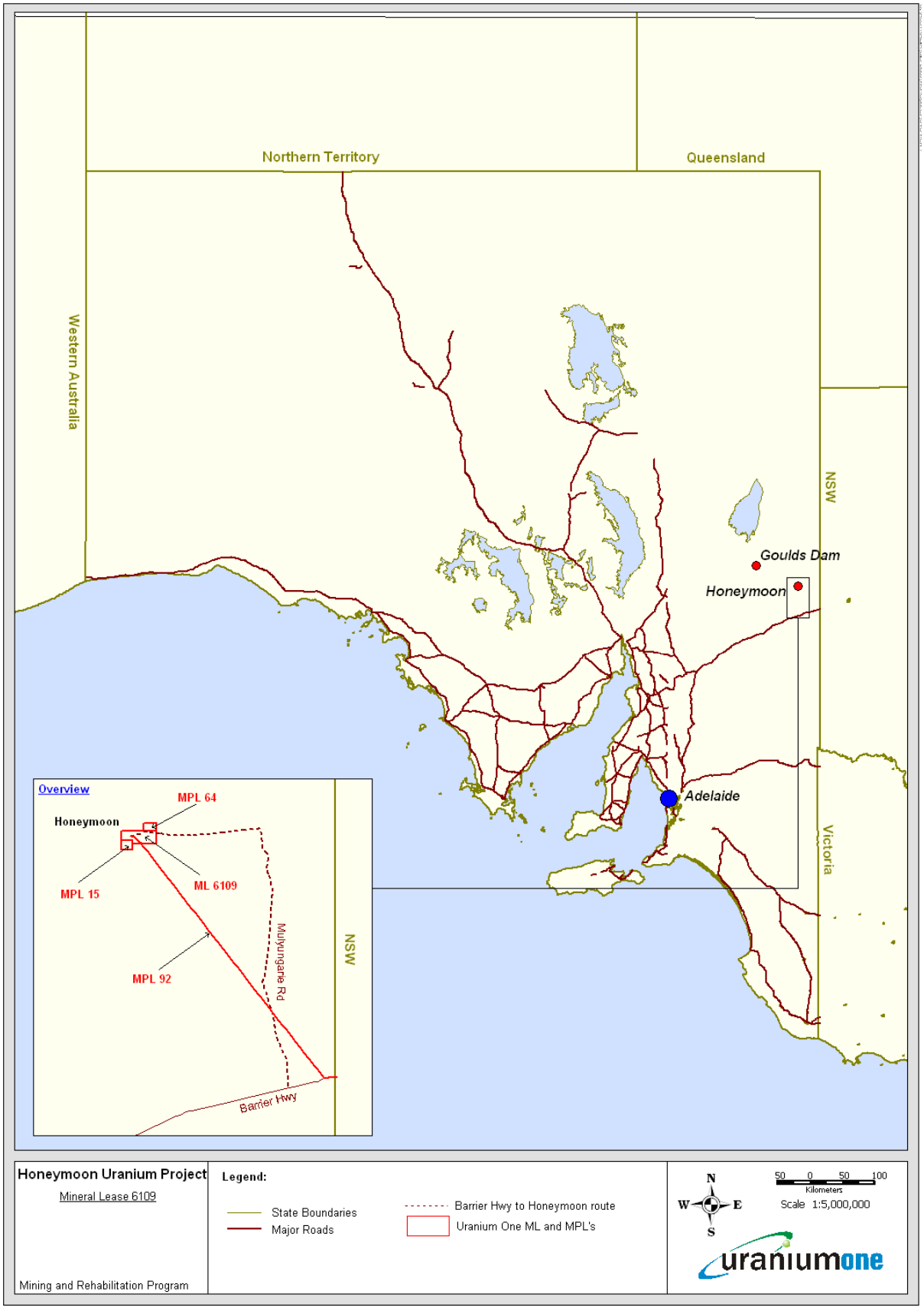

Figure 1.1 Location of Honeymoon mine

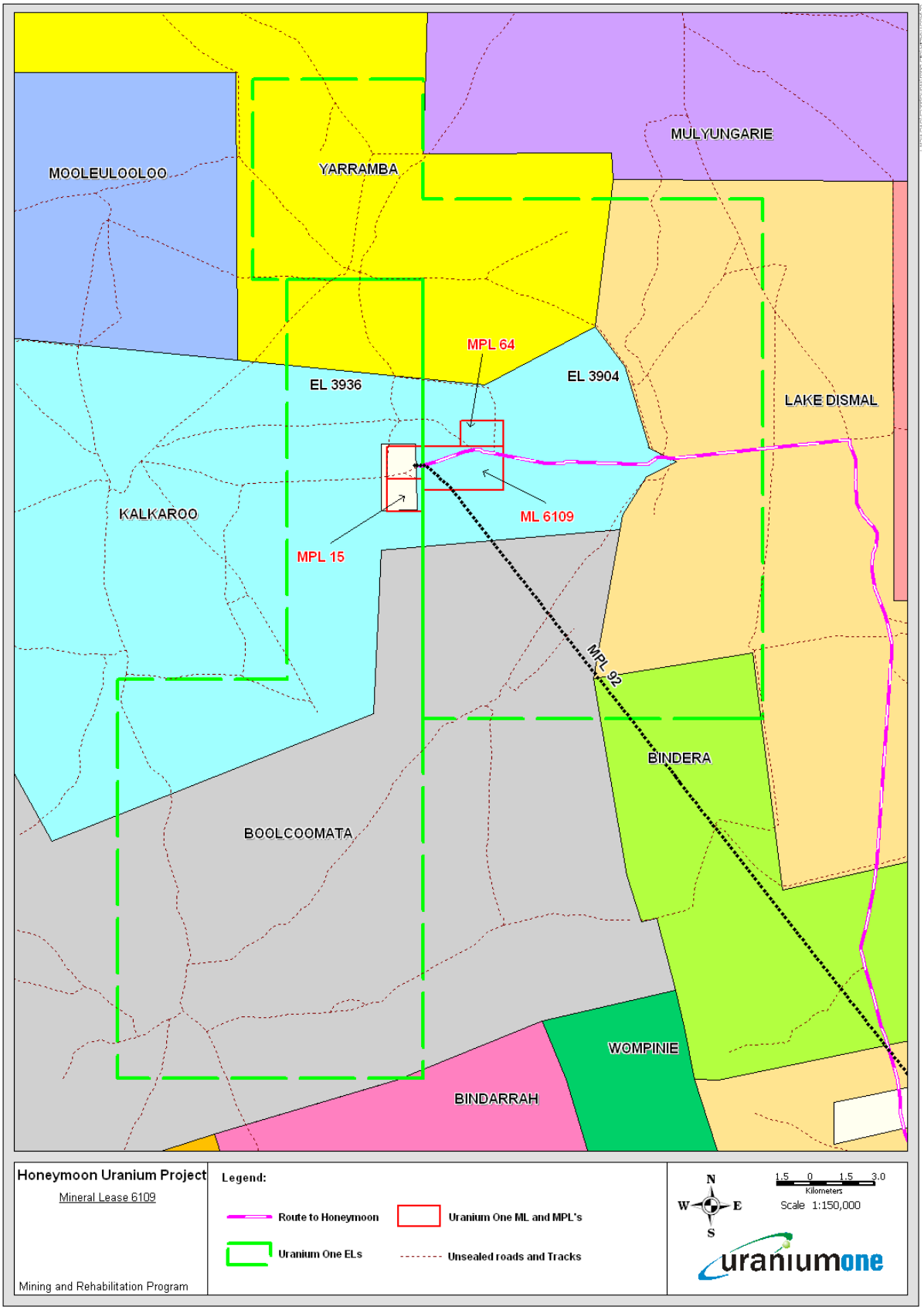

Figure 1.2 Land title and tenements

1.2 Summary of the Land and Environment Description

The region surrounding the Honeymoon mine is sparsely populated and dominated by pastoral activities. Wool production is the primary economic industry with a number of stations also running cattle. The Kalkaroo pastoral lease has been used exclusively for pastoral activities for many years, resulting in degradation and modification of the existing vegetation communities. Due to overgrazing and prevailing drought conditions in the area, Uranium One destocked the Kalkaroo pastoral lease in October 2009. Following destocking and unseasonal summer rainfall, the regeneration of local flora species has been evident, with 15 additional native flora species recorded during a flora survey in 2010 that had not been recorded in the two years previous.

The Honeymoon mine is situated in gently undulating broad alluvial plains between the Olary Ranges and Lake Frome. Elevations fall continuously from approximately 150 m Australian Height Datum (AHD) near the Barrier Highway, 50 km south of Honeymoon mine, to less than 10 m AHD near Lake Frome, 90 km northwest of Honeymoon mine.

The region has an arid climate with hot, very dry summers and low annual rainfall. Rainfall is highly variable and can often be in the form of heavy showers associated with thunderstorms during the summer months. These thunderstorms generally result from tropical low pressure systems in the northwest of Australia.

Two ephemeral creek lines, Oonarta Creek and Mingary Creek, lie 7 km west and 11 km east of Honeymoon mine, respectively. While both creeks are usually dry, they can swell to widths of 1 km following intense rainfall events.

The Honeymoon mine is located outside the flooding zone of influence of both the Oonarta and Mingary Creeks; however, traffic can be restricted on the main access road, which crosses Mingary Creek, following heavy rainfall events due to flooding.

The Honeymoon uranium deposit lies at a depth of approximately 90 to120 m and there are no surface radiological indications of its presence. The background radionuclide concentration of soil in the area is similar to global background levels.

The Honeymoon mineralisation exists in Tertiary-age sands of the Eyre Formation, deposited in the Yarramba paleochannel, one of several similar channels in the southern part of the Frome Embayment. Local groundwater is contained within two Tertiary-age sand units; however use of the Basal Member of the Eyre Formation aquifer is limited due to the water quality being unsuitable for potable, irrigation or stock watering use (based on an assessment against Environment Protection (Water Quality) Policy 2003, and the Australian and New Zealand Environment and Conservation Council (ANZECC)) (see Section 3.10.4, and Section 8.9). Similarly, the Upper Member aquifer has identical water chemistry which precludes the beneficial use of groundwater within the region to industrial uses.

The main soils present in the mine site are brown calcareous earths with some irregular shallow depression-type gilgai (small ephemeral lakes). These soils are known to be generally saline with relatively high shear strength which can be reduced after periods of heavy rain.

1.2.1 Vegetative Communities

The main vegetative communities surrounding Honeymoon mine represent a mix of low open shrub land interspersed with patches of scrub land and low woodland which are typical of the region. The vulnerable purple-wood wattle (*Acacia carneorum*) is the only species of national significance under Commonwealth legislation recorded in the vicinity of the Honeymoon mine. Only a single patch of *Acacia carneorum* has been recorded in the mining lease and is located away from any proposed development areas.

A number of introduced plant species exist in the Honeymoon region; however activity levels around the Honeymoon mine (since the early 1980s) do not appear to have increased the incidence or abundance of these species.

1.2.2 Fauna Species

Although not recorded in field surveys at Honeymoon mine, three bird species listed under Commonwealth and State legislation are known to occur in the wider region, these include:

1. Plains-wanderer (*Pedionomus torquatus*) - Endangered (SA), Vulnerable (Aust).
2. Thick-billed grasswren (*Amytornis modestus*) - Vulnerable (Aust).
3. Slender-billed thornbill (western subspecies) (*Acanthiza iredalei iredalei*) - Rare (SA) and Vulnerable (Aust).

No mammals, reptiles or amphibians of national conservation significance have been recorded in the ML; however two State significant bat species (both Microchiropteran bats) have been recorded 10 km east of Honeymoon mine at Mingary Creek:

1. Yellow-bellied sheathtail bat (*Saccolaimus flaviventris*) - Rare (SA).
2. Little pied bat (*Chalinolobus picatus*) - Endangered (SA).

There is no suitable habitat for these species in the ML.

Other native mammal species present in the ML include:

1. Stripe-faced dunnart (*Sminthopsis macroura*).
2. Fat-tailed dunnart (*Sminthopsis crassicaudata*).
3. Red kangaroo (*Macropus rufus*).
4. Western grey kangaroo (*Macropus fuliginosus*).
5. Euro (*Macropus robustus*).
6. Bolam's mouse (*Pseudomys bolami*).
7. Lesser long-eared bat (*Nyctophilus geoffroyi*).
8. Gould's wattle bat (*Chalinolobus gouldii*).
9. Inland forest bat (*Vespadelus baverstocki*).
10. White-striped mastiff bat (*Tadarida australis*).
11. *Mormopterus sp.*

Exotic mammal species recorded in the ML include:

1. European red fox (*Vulpes vulpes*).
2. Rabbit (*Oryctolagus cuniculus*).
3. House mouse (*Mus musculus*).
4. Feral cat (*Felis catus*).

Eighteen reptile species have been observed in the ML. These species are dominated by central netted dragon (*Ctenophorus nuchalis*) and barred wedge-snouted ctenotus (*Ctenotus schomburgkii*).

Two amphibian species have been observed in the ML:

1. Painted burrowing frog (*Neobatrachus pictus*).
2. Spotted marsh frog (*Limnodynastes tasmaniensis*).

These species are found near to standing water following rainfall, and have also been retrieved from sumps around the mine site.

No significant Indigenous sites or objects of cultural value are located within the Honeymoon mine ML. There are no recorded artefacts of European historical value on any of Uranium One's ML or MPLs.

The nearest conservation areas to Honeymoon mine are Boolcoomatta Station and Bimbowrie Station located approximately 28 km south and 68 km southwest of Honeymoon mine, respectively.

1.3 Summary of Proposed Operations

The Honeymoon mine is designed to produce approximately 400 tonnes of uranium per year (measured in U_3O_8 equivalent), in the form of uranium peroxide ($UO_4 \cdot 2H_2O$). The uranium is extracted from the area of mineralisation using ISR methods and then processed to produce uranium peroxide for export.

Prior to mining commencing, groundwater extracted from the ore-bearing zone is conditioned to remove the naturally high levels of calcium. High calcium levels are detrimental to the ISR process as the calcium converts to calcite and gypsum, which increases the risk of blockages within the aquifer, wells and process equipment.

Following calcium removal from the Basal Member aquifer (ore zone), the groundwater is reinjected and acidified to dissolve the uranium mineralisation. The resulting uranium-rich solution, called pregnant leach solution (PLS), is pumped back to the surface via extraction wells and piped to the processing plant.

Once the PLS enters the process circuit, solvent extraction technology is used to concentrate and refine the uranium in solution. The solution is then precipitated into semi-solids, which are de-watered and dried to produce the final product – uranium peroxide (yellowcake). The dried yellowcake is packaged into steel drums for transport to an export market.

A small amount of liquid waste is generated from the operations phase of the Honeymoon mine, and this will be reinjected back into the Basal Member aquifer unit via liquid disposal wells, situated in the eastern portion of ML 6109. All reinjected liquid waste will be monitored and modelled to ensure it returns to a chemical composition in keeping with natural groundwater levels, through a process of dilution and natural attenuation. Modelling undertaken by Uranium One, combined with years of monitoring data, has demonstrated that water quality will attenuate to ambient levels through time (ARPANSA 1992).

Solid non-radioactive and low-level radioactive waste will be produced in small amounts by the Honeymoon mine operations. Non-radioactive and low-level radioactive wastes will be segregated and disposed of in adjacent, but separate disposal facilities at the mine site. These facilities and the disposal of these wastes are described in detail in Section 1, and have been approved by the South Australian Environment Protection Authority (EPA), Radiation Protection Branch, and comply with the 'Code of Practice for the Near Surface Disposal of Low-Level Radioactive Wastes' (ARPANSA 1992).

The Honeymoon mine has an anticipated mine life of seven years; during this time, Uranium One will continue exploration activities near to the mine to identify additional deposits which may extend the mines life.

1.4 Key Environmental Impacts and Management Strategies during Operations

All environmental, social and economic impacts likely to be created during the operational phase of the Honeymoon mine, requiring active control and management measures, are termed 'aspects'.

Key environmental, social and economic aspects identified at Honeymoon mine include:

- Landscape (soil and soil contamination).

- Flora (native vegetation, weeds and plant pathogens).
- Fauna (native species and pest vertebrates).
- Hydrology.
- Hydrogeology.
- Environmental air quality.
- Radiological.
- Visual amenity.
- Indigenous heritage.
- Local and regional community.
- Site safety and security.

For each environmental, social and economic aspect identified, an impact assessment has been undertaken to identify potential credible impacts (both positive and negative) resulting from the operation of the mine. The corresponding avoidance, mitigation or management measures are then described followed by an assessment of the residual risk, with an assumption that management and control measures are implemented.

Following the impact assessment the desired management outcomes, measurement criteria and monitoring program is described for each aspect where a credible environmental, social or economic risk was identified. Specific measureable criteria are then detailed, which will be used to evaluate ongoing management and control initiatives implemented by Uranium One at the Honeymoon mine (see Section 6).

1.5 Environmental Impacts and Management during Periods of Care & Maintenance

In order to provide a system to support identified environmental, social and economic impacts during any periods of care and maintenance, key impacts have been identified and utilised to identify ongoing care and maintenance monitoring and management activities (see Section 7).

1.6 Mine Closure and Rehabilitation Strategies

The long-term objective for the closure and rehabilitation of the Honeymoon mine is to ensure that all land within the mining tenements disturbed by mining and exploration activities is rehabilitated. The main rehabilitation objective is to achieve a stable and regular land-formation that is suitable for pastoral use.

Key rehabilitation strategies are detailed in the conceptual closure plan (Section 8) and include:

1. Removal of all plant and man-made structures from the site.
2. Reinstatement of stable soil surfaces.
3. Regeneration or revegetation of cleared areas with native flora species and creating faunal habitat.
4. Regular groundwater monitoring within the Basal aquifer to ensure the successful attenuation of impacted groundwater.

Remedial activities are divided into three closure domains:

1. Closure Domain 1 – all process related infrastructure within ML 6109, i.e., the process plant and wellfield.
2. Closure Domain 2 – all supporting infrastructure within ML 6109, i.e., camp and administration buildings.

3. Closure Domain 3 – all supporting infrastructure within ML 15 and 92, i.e., airstrip and electricity transmission line.

Closure activities (aside from progressive activities that take place during the operating life of the mine) are anticipated to begin with remedial works in the first year following cessation of operation.

Monitoring the success of closure activities will continue from the cessation of operation, for a period of up to seven years post decommissioning. Prior to successful lease relinquishment, Uranium One will provide DSD with a 'Mine Completion Report' in accordance with the guidelines approved by the Director of Mines.

2 Mine Details

2.1 Mine, Tenement and Commodity

The Honeymoon mine is located on mining lease (ML) 6109, which is completely contained within the pastoral property of Kalkaroo, Pastoral Block 1121, Section 1417 OOH Curnamona. For the purposes of this document, the term 'mine', 'mine site' or 'site' refers to the area within the ML that includes the wellfield, processing plant and associated areas (e.g., administration area, laboratories), liquid disposal zone, waste repository and accommodation areas (see Figure 2.1). The Honeymoon mine also includes Miscellaneous Purposes Licences (MPLs) 15 and 92. Details on the location of the Honeymoon ML and associated MPLs, including the supporting infrastructure contained within each MPL, were provided in Section 1.

The mineral to be mined at Honeymoon mine is uranium. Uranium One Pty Ltd (Uranium One) the mine owner and operator will accurately record the quantity, value and manner in which all minerals are mined, and whenever required to do so by the Director of Mines or a delegate authorised by the Director of Mines, will submit the records for inspection by the authorised person.

Uranium One also hold the nearby 452 km^2 Exploration Licence (EL) 3904 and the adjacent 379 km^2 EL 3936 and interests in all minerals on the 334 km^2 EL 3905 surrounding Gould's Dam.

2.2 Location of the Operation – Direction and Distance from the Nearest Town

Honeymoon mine is located on the arid plains between the Olary Ranges and Lake Frome, approximately 490 kilometres north by road from Adelaide and approximately 119 kilometres northwest of Broken Hill. The nearest communities to Honeymoon mine consist of a number of pastoral properties, including Boolcoomata, Bundera, Lake Dismal, Mulyungarie, Yarramba, Strathearn, Kalabity and Mooleulooloo. Figure 2.1 shows the location of the Honeymoon ML with distances to the closest towns.

The closest township to Honeymoon mine is Cockburn (67 km southeast of the mine) with a population of approximately 25. The nearest regional centre is Broken Hill in New South Wales (119 km) with a population of around 23,000. The nearest Indigenous community is Nepabunna, located between the northern Flinders Ranges and Lake Frome, approximately 260 km northwest of Honeymoon mine.

2.3 Land Tenure

Uranium One was the owner of the Kalkaroo pastoral lease between 2007 and 2014. The pastoral lease is now owned by Havilar Resources NL. ML 6109 and MPL 15 are wholly contained within the Kalkaroo pastoral lease. MPL 92 (which contains the electricity transmission line) traverses the Kalkaroo, Boolcoomatta, Lake Dismal, Mulyungarie and Wompinie pastoral leases. Boolcoomatta pastoral lease is operated as a conservation reserve by Bush Heritage (Bush Heritage Fund). Lake Dismal and Mulyungarie pastoral leases are owned by the Mutooroo Pastoral Company, and Wompinie pastoral lease is owned by Auction Services Pty Ltd.

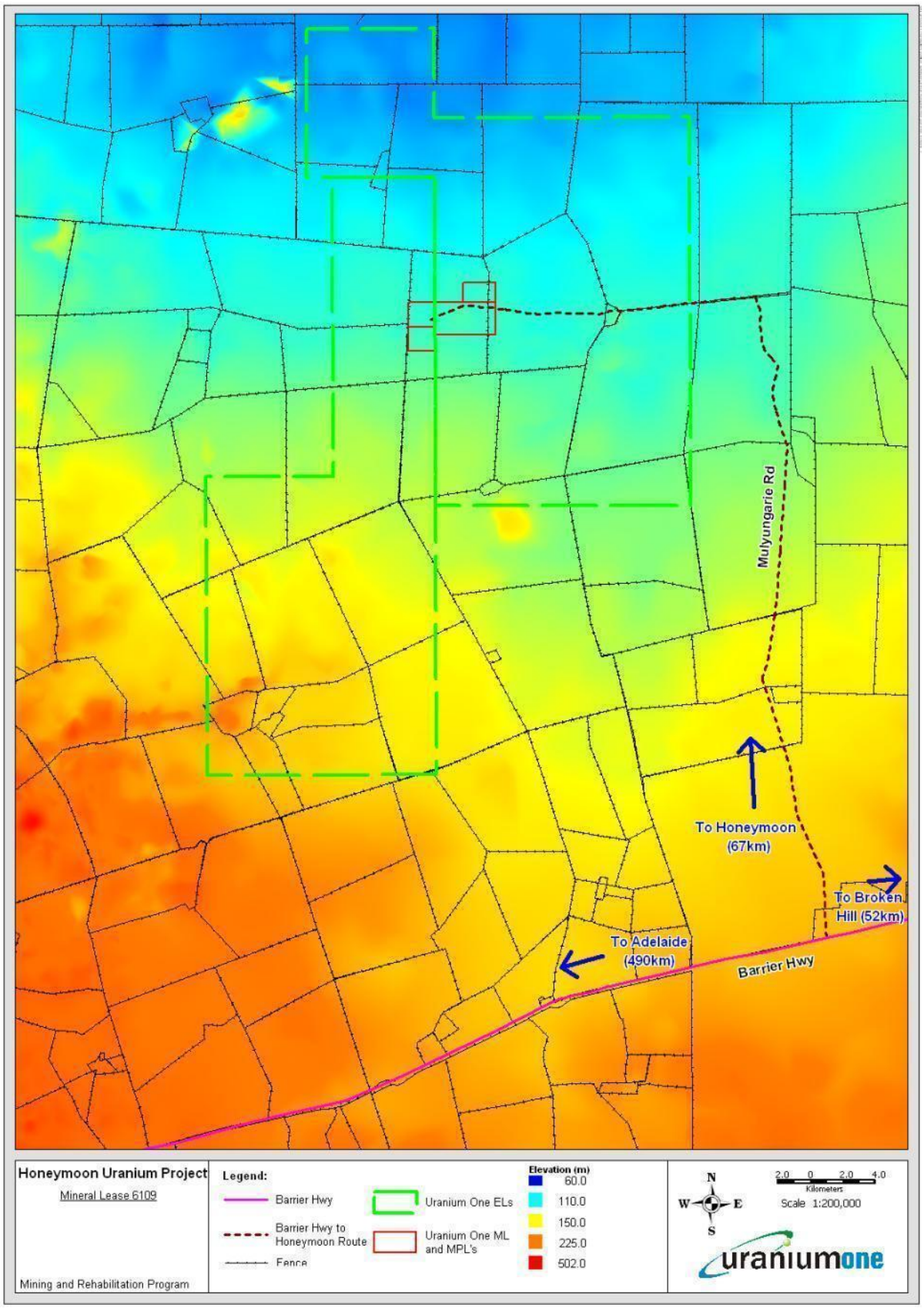

Figure 2.1 Location of the Honeymoon mine

2.4 Mining Lease and Miscellaneous Purpose Licences Conditions

Conditions associated with ML 6109, MPL 15 and MPL 92 are detailed in Section 9.9.

2.5 Certificate of Title

The Certificates of Title relevant to the Honeymoon mine are as follows:

1. ML 6109 and MPL15 are situated over the following leases:
   a) 'Kalkaroo' Crown Lease Pastoral No. 2278, Register Book Volume 1285, Folio 21.
   b) 'Miscellaneous' Crown Lease 18063, Register Book Volume 1592, Folio 74.

Note *Native Title has been extinguished on Crown Lease 18063. Figure 1.2 shows the boundaries and location of the Crown Lease Pastoral title.*

2. MPL 92 traverses the following lease areas:
   a) 'Kalkaroo' Crown Lease Pastoral No. 2278, Register Book Volume 1285, Folio 21.
   b) 'Miscellaneous' Crown Lease 18063, Register Book Volume 1592, Folio 74.
   c) 'Boolcoomatta' Crown Lease Pastoral No. 2216, Register Book Volume 1276, Folio 36.
   d) 'Bundera' Crown Lease Pastoral No. 2371, Register Book Volume 1312, Folio 5.
   e) 'Lake Dismal' - no Crown Lease information was available from the Land Services Department of the South Australian Department for Transport, Energy and Infrastructure.

2.6 Mine Owner and Operator

Owner:	Uranium One Australia
Operator and Agent:	Uranium One Australia Pty Ltd
Address:	PO Box 5075 Broken Hill South, NSW 2880
Contact Person:	Kathryn Levingstone, Care & Maintenance Manager Honeymoon Mine
Telephone:	(08) 8080 0900

2.7 District Council or Corporation

The Kalkaroo pastoral lease is not within a District Council or Corporation Area. The Outback Areas Community Development Trust provides services to the region that may otherwise be undertaken by a Council.

3 Description of Environment

3.1 Topography and Landscape

The Honeymoon mine is located between the Olary Ranges and Lake Frome, and forms part of the south-eastern extremity of the Lake Eyre drainage system. Broad, gently undulating alluvial plains dominate the region, representing sedimentary deposition since the beginning of the Tertiary period, approximately 65 million years ago.

The modern landscape has been modified by Pleistocene glacial and interglacial periods, resulting in cyclical deposition of finer sediments and subsequent soil formation. Recent periods of Holocene aridity have only superficially modified the landscape through aeolian redistribution of soil, and the formation of low irregular sand dunes. Local elevations fall continuously from approximately 150 m Australian Height Datum (AHD) near the Barrier Highway 50 km south of the Honeymoon mine to less than 10 m near Lake Frome, approximately 90 km northwest of Honeymoon mine.

3.2 Population, Housing and Infrastructure

The area surrounding Honeymoon mine is characterised by a sparse population of less than 400 inhabitants, occupying an area of more than 37,000 km^2. This represents approximately one person for every 100 km^2. As with much of rural Australia, the local population has declined steadily, halving over the past 20 years.

Local communities surrounding the Honeymoon mine consist of small pastoral properties, mines, exploration camps, Barrier Highway towns and the city of Broken Hill. The pastoral community is made up of isolated family homesteads connected by unsealed roads, telephones and radios. Basic services are provided to these homesteads from small towns such as Manna Hill, Olary and Cockburn, which were originally established to service the Barrier Highway.

The two closest Indigenous communities to the Honeymoon mine are:

- Nepabunna, located between the Flinders Ranges and Lake Frome, approximately 260 km northwest of Honeymoon mine
- Copley, a predominantly Indigenous settlement 320 km west of Honeymoon mine

All infrastructure inside ML 6109 and MPL 15 is owned by Uranium One.

3.3 Land Use

The area surrounding Honeymoon mine has a strong historical association with the pastoral industry, with settlement patterns aligned with service centres along major transit routes. Wool production is the primary economic activity, with some stations running cattle. Pastoral stations are also known to provide secondary contracting and equipment hire services to the mining and exploration industry, with evidence of a partial complementary relationship between mining and pastoral production. The economic viability and environmental sustainability of pastoral activities in this area is however limited by regional climatic extremes.

The Honeymoon mine site is completely contained within the Kalkaroo pastoral lease. Kalkaroo was destocked in October 2009 to improve the condition of the land. Following destocking, and unseasonal high summer rainfall, significant flora regeneration and increased numbers of small native fauna species have been recorded.

3.4 Amenity

The Honeymoon mine is located on gently undulating broad alluvial plains with few elevated viewing points within 20 km of the mine.

The closest sensitive receptor to visual impacts to the mine site is the Yarramba homestead, located 10 km north of the mine site. The raised topographical profile at Yarramba and the distance between the mine site and the homestead ensure minimal impact on visual amenity. No other sensitive receptors (homesteads or frequently visited public roads) exist in the vicinity of Honeymoon mine. The mine infrastructure is well screened by the natural contours of the landscape and prevents visual impacts at distances greater than 10 km at each compass point.

The purpose-built power transmission line for Honeymoon mine (contained within MPL 92) that traverses the Boolcoomata, Lake Dismal, Wompinie and Mulyungarie pastoral leases has a degree of impact on local amenity for the nearby pastoralists, however the visual impact of the transmission line is considered to be no more significant than structures normally associated with a pastoral station.

3.5 Noise, Dust and Air Quality

The Honeymoon mine is remote from major external sources of artificial noise and air emissions, with the exception of those associated with operating pastoral stations (e.g., farm machinery and other vehicles).

Intense dust storms during the late spring to summer months of October to February are common. The site has recorded a higher prevalence of dust storms in 2009 compared with nearby urban centres, with four storms occurring during the second half of 2009. An example of the scale of such a dust storm is shown in Plate 3.1.

The severity of dust storms and associated fugitive dust deposition in the local area are derived from climatic extremes coupled with intensive pastoral activities. The dramatic loss of native vegetation and local soil crusts through grazing has led soils and sub-soils to erode easily and disperse during high wind events. This has resulted in poor background air quality and has potentially affected the health of native vegetation.

Plate 3.1 Dust storm at Honeymoon mine

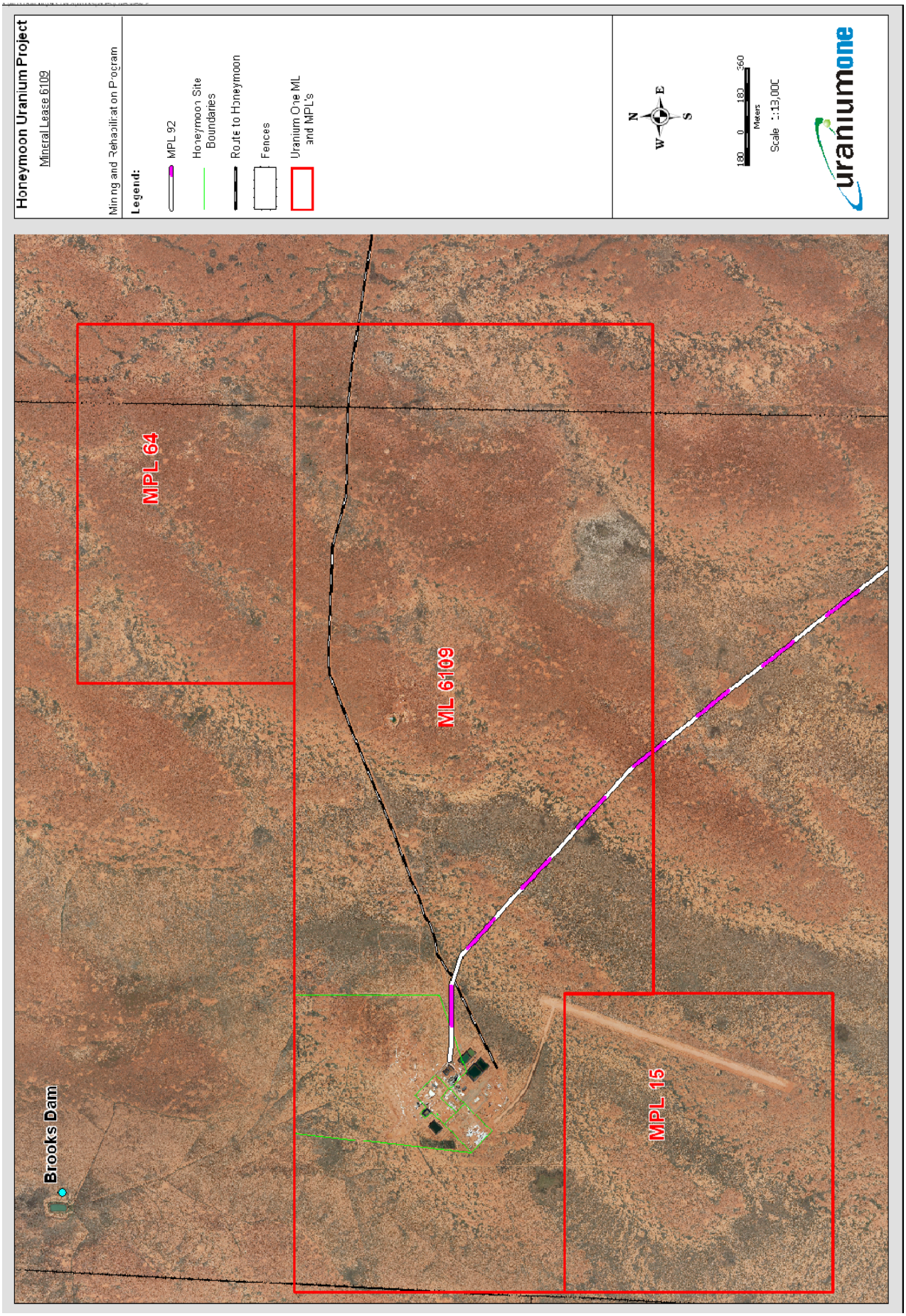

Figure 3.1 Honeymoon mine area showing Mining Lease and Miscellaneous Purpose Licence boundaries.

The closest sensitive receptors to noise, dust and air emissions include:

- Yarramba homestead (10 km north of the mine).
- Kalkaroo homestead (14 km west of the mine).
- Mulyungarie homestead (25 km northeast of the mine).
- Boolcoomata homestead (27 km southwest of the mine).
- Wompinie (42 km south of the mine on the main access road).

No other sensitive receptors to noise, dust and air (homesteads or frequently visited public roads) exist in the vicinity of Honeymoon mine.

3.6 Climate

The areas surrounding the Honeymoon mine have an arid climate, with hot dry summers and cool to mild winters. In the hotter parts of the year, from late November to March, maximum temperatures exceed 30°C and daily temperatures over 40°C have been recorded in each month between October and March. Average minimum temperatures for the period from November to March are between 15°C and 20°C (BOM 2010).

During the cooler months of May to September, average maximum daily temperatures range from 20°C, down to the mid-teens. In the coolest months of June and July, average minimum temperatures are between 5°C and 10°C. Minimum temperatures below 0°C have been recorded in each month between April and October at Yunta (140 km southwest of Honeymoon mine), and between June and August at Broken Hill.

During the warmer part of the year, November to March, the broad-scale surface winds over most of the area are from the southeast. During autumn and from June to September, the prevailing air-stream is from the northwest to southwest. Figure 3.2 shows the wind roses at 9 am and 3 pm for Yunta and Broken Hill (Southern Cross Resources 2000).

Local rainfall is highly variable, but fairly uniform over the wider area, with few and infrequent large rainfall events. Rainfall is most likely to result from low-level moist tropical inflow in summer or from slow moving cut-off low-pressure systems or northwest cloud bands at any time of the year. Rainfall in the warmer months is most often in the form of heavy showers associated with thunderstorms.

The mean annual rainfall in the area surrounding Honeymoon mine decreases from approximately 200 mm at Yunta to the southwest, to approximately 175 mm at Mulyungarie, 25 km to the north of the Honeymoon mine. Figure 3.3 shows the mean annual rainfall for the Honeymoon site and surrounding areas (Southern Cross Resources 2000).

Average annual pan-evaporation rates vary from around 2,200 mm south of Honeymoon to around 3,000 mm in the north.

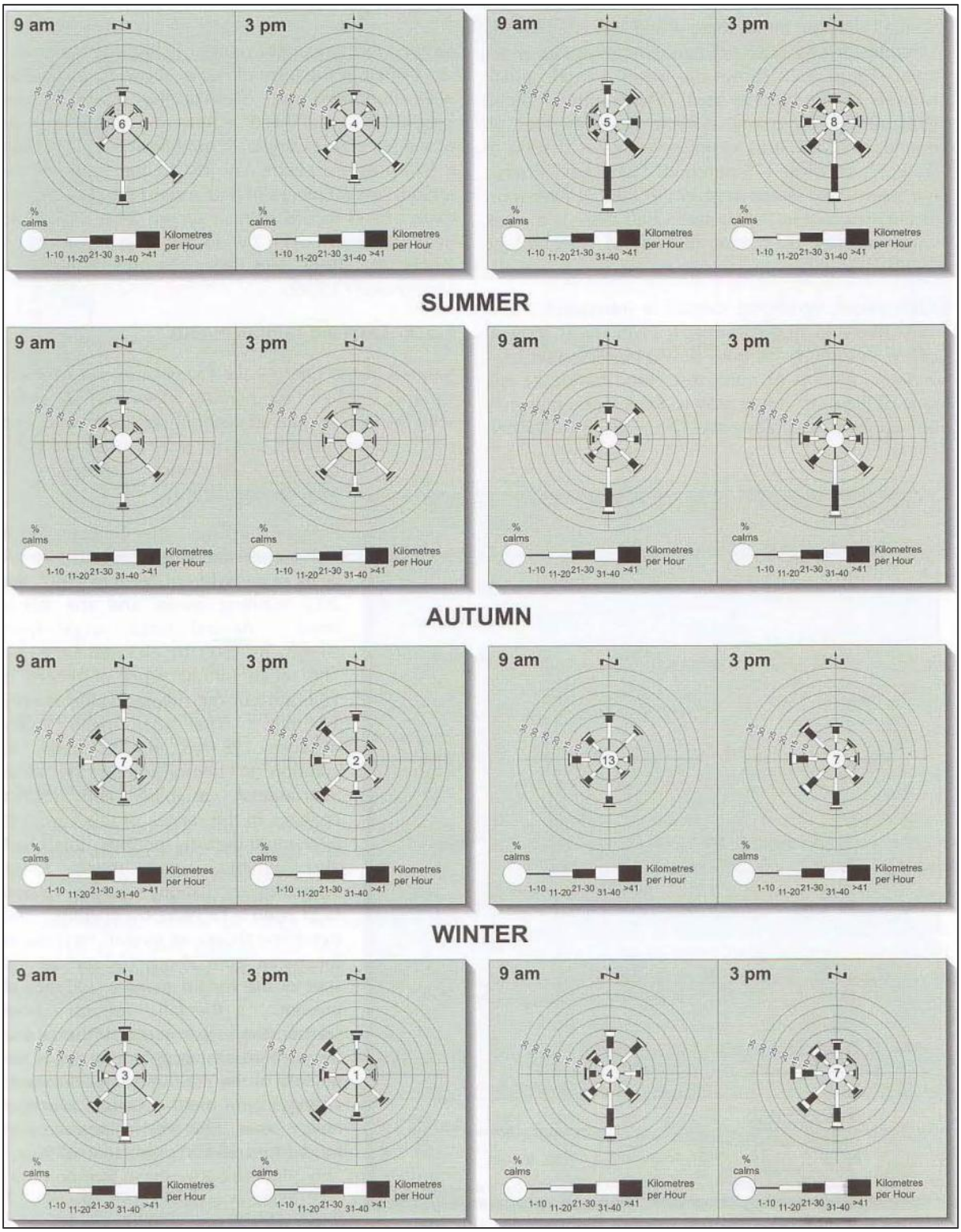

Figure 3.2 Wind roses at 9am and 3pm for Yunta and Broken Hill

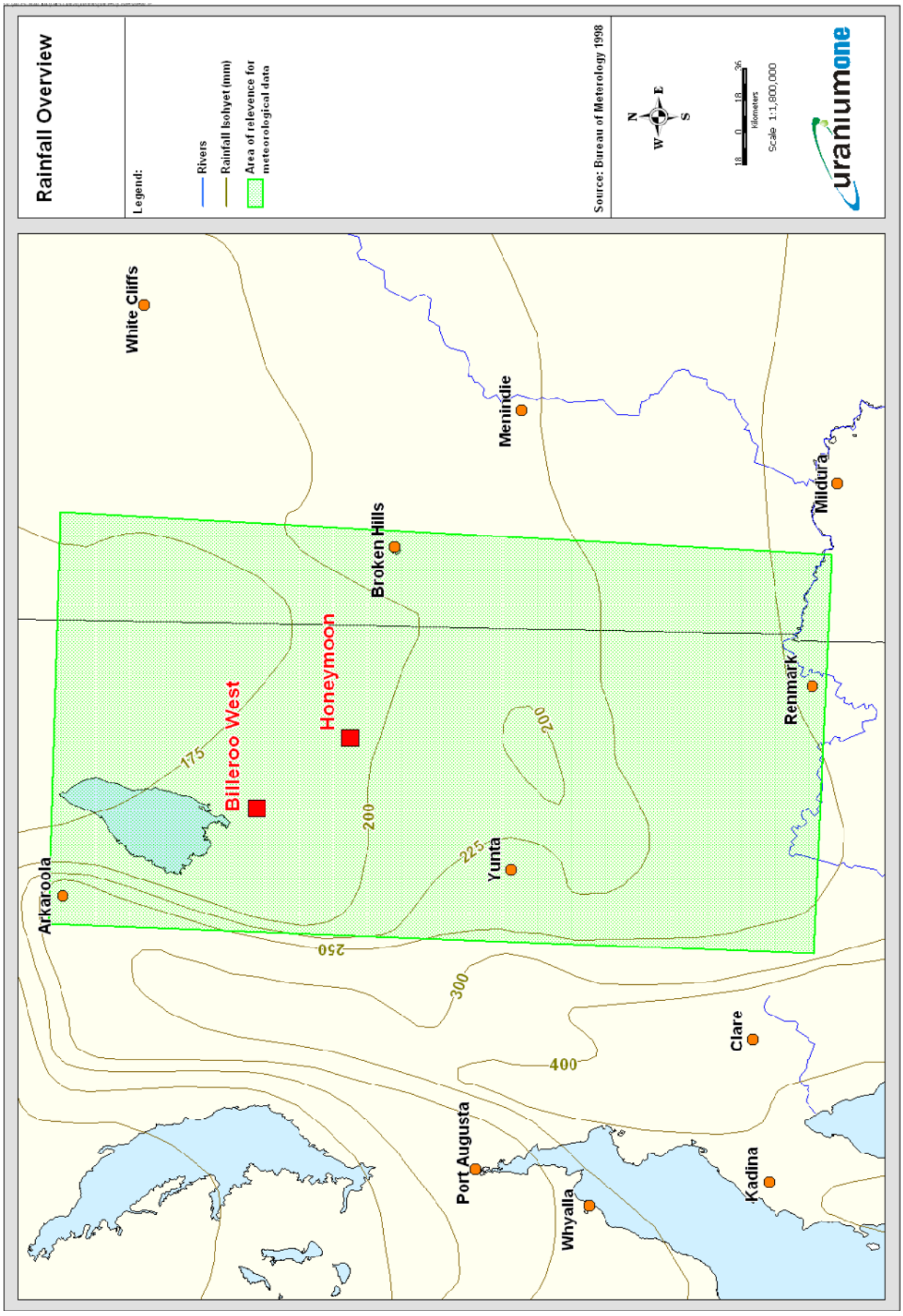

Figure 3.3 Mean annual rainfall isohyets for the Honeymoon mine and surrounding areas

3.7 Geohazards

The mineralised areas of the region are located within the Frome Embayment to the east of the Adelaide Geosyncline, the seismically active zone that includes the Flinders Ranges and Adelaide.

No significant earthquakes have been recorded or reported within the area surrounding Honeymoon mine. Two small earthquake swarm events were recorded in 1969 and 1971 along the western margin of the Willyama Block, approximately 70 km to the south and west of Honeymoon mine.

Seismic risk at Honeymoon mine has been assessed using Cornell-McGuire and Seismic Moment hazard assessment. These methods indicate that the Honeymoon mine has a 20 mm/s to 30 mm/s peak ground velocity for a 500 year return period, which corresponds to a Mercalli Magnitude level of V to VI with a 400 to 1,000 year recurrence interval. This represents a significantly lower risk than that observed in Adelaide where the velocity is estimated to be 50 mm/s to 70 mm/s for a 500 year return period.

There is a very low risk of significant disruption to operations from an earthquake during the operating life of the mine. The expected damage at an operating plant by a Mercalli Magnitude V to VI earthquake is minimal because engineering design provisions have accommodated such an event. Damage to an operating plant or wellfield is unlikely to be sustained, unless a Mercalli Level VII or higher earthquake occurred. The likelihood of such an event is low, given the 400 to 1,000 year recurrence interval for a Mercalli Level V to VI event described above.

The potential for earthquake damage within the wellfield has been minimised by the use of flexible polyvinyl chloride (PVC) bore casings and high-density polyethylene (HDPE) surface piping. In the event of a seismic event, integrity testing of all production and injection bores and piping will be undertaken.

The process plant and other structures constructed as part of the Honeymoon mine comply with the Australian Standard AS 1170.4 – 2007 ‘Minimum design loads on structures’ Part 4: Earthquake loads (known as the SAA Loading Codes) (Standards Australia. 2007).

3.8 Radiological Environment

As in all terrestrial environments, the area surrounding the Honeymoon mine contains naturally occurring radionuclides within the surface and sub-surface sedimentary sequences. These radionuclide concentrations have been demonstrated to be similar to or below typical continental values. There are no mineralised radioactive surface expressions within 15 km of the deposit, with the Honeymoon uranium deposit between 100 to 120 m below the surface.

A pre-operational baseline environmental radiation monitoring program was carried out by the Australian Atomic Energy Commission in the 1980s and subsequent surveys were carried out by Southern Cross Resources during the late 1990s. Baseline surveys illustrate the radiological characteristics of the region and set a background against which the impacts of the mining operation can be measured. These baseline radiological conditions are explained in Sections 3.8.1 to 3.8.5.

3.8.1 Airborne Radiation

Airborne radiation can be divided into two potential sources:

1. Radon and radon decay products.
2. Dust.

Radon and Radon Decay Products

Radon and radon decay products are generated through the decay of natural radionuclide concentrations (U-238 radioactive decay chain) found in the soil and sub-soils of the area surrounding the Honeymoon mine. Radon and radon decay products are released from the sediments into the air at the interface between the earth's surface and the atmosphere. The concentrations are dependent on atmospheric and environmental variables, such as wind velocity, temperature gradient, soil moisture content and atmospheric inversions.

An extensive radon and radon decay product monitoring program was carried out at Honeymoon mine during April to June 1980 (AAEC 1980 in Southern Cross Resources 2000). This program included radon and radon decay product measurements in a variety of weather conditions. Results demonstrated a strong qualitative correlation between radon and radon decay product concentrations and meteorological parameters, in particular, the wind speed near ground level. At wind speeds greater than 2 m/s (approximately 7 km/h), radon concentrations were below 10 Bq/m^3 and radon decay product concentrations were less than 0.06 µJ/m^3. In addition, the continuous radon decay product monitoring results point to large diurnal variations, where the average potential alpha energy concentration (PAEC) of radon decay products was measured at 0.31 µJ/m^3 for the 24 hours between 29 and 30 April 1980. A maximum concentration of 1.1 µJ/m^3 was measured in the early morning of 30 April 1980.

The monitoring program recorded an average radon activity and PAEC of 56 Bq/m^3 and 0.06 Bq/m^3 respectively. Subsequently, radon monitoring has been carried out from 2000 to 2011.

Dust

Levels of airborne dust in the area are typically high due to the arid climate, seasonal winds and pastoral practices. As outlined previously, there is no surface exposure of the Honeymoon ore body, and this is demonstrated by soil radionuclide concentrations within the range of global averages.

Baseline high volume dust sampling was conducted as part of the EIS [Southern Cross Resources 2000] and continued through trial leach operations and care and maintenance. The results of this sampling showed a dust concentration of 15 µg/m^3 and a uranium concentration in dust of 0.05 µBq/m^3.

The United Nations Scientific Committee on the Effects of Atomic Radiation (UNSCEAR, 2000) reported the global average for uranium concentration in dust is 0.5 µBq/m^3 - ten times higher than that measured at Honeymoon mine.

3.8.2 Soil

Three series of soil samples were taken from the Brooks Dam catchment area, upwind and downwind of Honeymoon mine in 1980 (Gutteridge, Haskins & Davey 1981 in Southern Cross Resources 2000) and along the northern wellfield fence line in June 1998. These soil samples were tested for radium-226, radium-228, thorium-230, uranium-238 and lead-210. The average results show that the radionuclide concentration in the soil around Honeymoon mine is lower than the global averages reported in (UNSCEAR, 2000) (see Table 3.1 Radionuclide concentrations in soil samples [Southern Cross Resources, 2000]

The aerial survey for radionuclide concentrations and gamma radiation was undertaken over what was formerly known as EL2310 (now EL3936) adjacent to the mine site.

Radionuclide	Brooks Dam (Bq/kg)	North/South of Mine Site (Bq/kg)	Wellfield Fence Line (Bq/kg)	Global Average [UNSCEAR 1997]
Radium-226	26	25	22	35
Thorium-230	46	38	38	30
Uranium-238	Not Analysed	25	25	35
Lead-210	38	38	38	Not Reported

Table 3.1 Radionuclide concentrations in soil samples [Southern Cross Resources, 2000]

3.8.3 Gamma Dose Rate

The background external gamma dose rate above ground depends on the U-238/Ra-226, Th-232 and K-40 specific activity in topsoil and the intensity of the secondary cosmic radiation component (Kvasnicka 1998 in Southern Cross Resources 2000).

A ground-based radiometric soil survey was undertaken over the Honeymoon mine and EL2310 areas using hand held and vehicle mounted monitoring devices (Jurza 1998 in Southern Cross Resources 2000). The average gamma dose rate detected in the vicinity of the demonstration plant was 0.06 µSv/h. In addition to the ground-based survey described above, the background external gamma rate at the Honeymoon mine was measured in 1980 and 1998. Average results of 0.09 µSv/h were reported in 1980 approximately 1.25 km southwest of the demonstration plant and 0.07 µSv/h at the Yarramba Homestead in 1998 (AAEC 1980 in Southern Cross Resources 2000). These locations gave an average external gamma dose rate of 0.1 µSv/h (Kvasnicka 1998 in Southern Cross Resources 2000). An aerial survey was also conducted over the EL2310 for external gamma radiation. The calibrated data from the aerial survey are presented in Table 3.2. The average gamma dose rate detected for the Honeymoon mine was 0.06 µSv/h, while a maximum of 0.161 µSv/h was recorded at the location of the 1980s test. The values are consistent with the radionuclide concentrations in soil for the area.

These average gamma dose rates confirm that, except for a few locations already referred to above, the background external dose rate for the site is low and reflects the low background radionuclide content in topsoil for the area [Jurza 1998 in Southern Cross Resources 2000].

Parameter	Unit	Minimum	Maximum	Average
Gamma Dose Rate	µSv/h	0.05	0.161	0.06

Table 3.2 Radioactivity of the mine site (Southern Cross Resources, 2000)

3.8.4 Surface Water

Samples of Brooks Dam water (Brooks Dam is shown in Figure 3.1), used for stock watering purposes, and drinking water collected from roofs at Yarramba homestead, were tested for radium-226, thorium-230 and lead-210. The results obtained are presented in Table 3.3, Brooks Dam that receives its water as run-off from the area including the wellfield and north of the mine site. Radionuclide concentrations were found to be consistent with global averages.

3.8.5 Biota

Vegetation sampled from Brooks Dam was dried and analysed for radium-226, thorium-230 and lead-210 (AAEC 1980 in Southern Cross Resources 2000). The results are presented in Table 3.3.

Two sheep from Brooks paddock were tested for radium-226, thorium-230 and lead-210 (AAEC 1980 in Southern Cross Resources 2000). The results are shown in Table 3.3.

Sampling Location	Unit	Radium-226	Thorium-230	Lead-210
Yarramba Homestead Water Tank	Bq/L	<0.02	<0.1	0.083
Brooks Dam	Bq/L	0.046	0.053	1.8
Saras Dam		0.114	0.059	2.9
Cummins Dam		0.057	0.320	<0.1
Eagle Hawk Dam		0.080	0.140	3.3
Terrestrial Average[1]		Not Analysed	Not Recorded	Not Recorded
Yarramba Rainwater		0.034	0.012	0.07
Honeymoon Vegetation	Bq/kg	<7	8.2	36
Vegetation Terrestrial Average[1]		0.05	0.02	0.03
Vegetation ODO (1982)		0.11-15	0.1-1.2	26-62
Sheep Viscera Honeymoon	Bq/kg	<2	0.12	1.2
Sheep Viscera ODO (1997)		0.02-0.08	Not Analysed	4.1-9.0
Sheep Meat Honeymoon	Bq/kg	<2	0.11	0.14
Sheep Meat Terrestrial Average[1]		0.015	0.002	0.08
Sheep Meat ODO (1997)		0.08-0.11	Not Analysed	0.05-0.68

Table 3.3 Radionuclide analysis

3.9 Geology

3.9.1 Regional Geology

The Honeymoon uranium deposit is located in the southern portion of the Frome Embayment, a southern lobe of the Eromanga Basin. The basement rocks in the region consist of the Precambrian metamorphic sequences of the Curnamona Cratonic Nucleus (including the Benagerie Ridge) and the Willyama Complex (Callen 1990 in Southern Cross Resources 2000). The Precambrian basement is overlain to the west and east of the Benagerie Ridge by metamorphosed Cambrian sediments of the Arrowie Basin and Yalkalpo Sub-basin respectively (Callen 1990 in Southern Cross Resources 2000). While there is no surface expression of the Precambrian basement or overlying Cambrian successions in the region, outcrops do occur to the west, south and east in the Flinders, Olary and Barrier Ranges respectively.

The Frome Embayment of the Eromanga Basin is a shallow marine basin formed during the Upper Jurassic and Cretaceous. The embayment is bound by the Curnamona and Willyama basement sequences to the west, south, and east (Drexel and Preiss, 1995). The Eromanga Basin extends from central Queensland into New South Wales, Northern Territory and South Australia. The Frome Embayment comprises the major part of the Great Artesian Basin (GAB).

Lithostratigraphic units of the Eromanga Basin in the southern Frome Embayment consist of the Marree and Cadna-owie Formation, both of which were deposited in the Cretaceous. These shoreline to shallow marine sediments were deposited over Cambrian and Proterozoic rocks as described above and are unconformably overlain by sediments of the Cainozoic Callabonna Sub-basin, which forms part of the larger and more extensive Lake Eyre Basin (Drexel and Preiss, 1995 in Southern Cross Resources 2000). The Callabonna Sub-basin is a generally flat-lying sequence of terrestrial sediments that reaches a maximum thickness of approximately 300 m. In the southern Curnamona area (and elsewhere), it is represented by the fluviatile Palaeocene-Eocene Eyre Formation, which is

[1] UNSCEAR, 2000.

host to uranium deposits including Honeymoon, Kalkaroo, and Goulds Dam. The Callabonna Sub-basin is disconformably overlain by both the Neocene Callabona Basin, represented by the essentially lacustrine Miocene-Pliocene Namba Formation, and undifferentiated Quaternary terrestrial units.

A major structural high, the Benagerie Ridge, has been identified in the Precambrian basement rocks and extends north from the Olary Block (Willyama Supergroup) toward Lake Frome. This ridge controlled sedimentation during the Lower Tertiary period (Callen 1990 in Southern Cross Resources 2000). To the east of the ridge, the fluviatile sands of the Eyre Formation were deposited in the Yarramba, Beefsteak and Lake Charles Paleochannels which are incised into the underlying Precambrian rocks. To the west and north, the similar Curnamona, Billeroo and Lake Namba Paleochannels occur. The paleochannel gradients are generally towards the north with uranium-rich granites within the Willyama Supergroup as infill sediment source areas.

The paleochannels emanating from the Olary Ranges appear to be contiguous with the widespread Eyre Formation blanket fluviatile sands that occur to the north. Uranium mineralisation occurs predominantly within the Yarramba and Billeroo Paleochannels. Palynological analysis of drill core from the Honeymoon deposit area confirmed the presence of the Eyre Formation within the Yarramba Paleochannel (Rowett, 1999 in Southern Cross Resources 2000).

Yarramba Paleochannel

The buried Yarramba Paleochannel, which hosts the Honeymoon, East Kalkaroo and Yarramba uranium deposits, has no surface expression and has incised into the Willyama Precambrian basement for over 100 km in a sinuous course adjacent to the eastern side of the Benagerie Ridge. The paleochannel occurs at an average top depth of 70 m below ground and typically contains a sequence of uncemented, poorly consolidated, interbedded sands and clays, which in the Honeymoon area is approximately 55 m thick. The paleochannel averages 3 km in width and is up to 6 km wide east of Honeymoon mine. The geology and structure of the underlying rocks, as evidenced by drilling results and regional aeromagnetic interpretations, control its shape and sinuosity.

Morphology

In the Honeymoon area, the Yarramba Paleochannel is characterised by steep southern banks and relatively shallow northern banks. Other morphological variances observed within the Yarramba Paleochannel include the localised deposition of dominant clay units along channel margins, channel-fill clays along paleochannel margins, rapid facies variation within the Eyre Formation, the presence of tributary channels and cross-bedded units indicative of a high energy braided stream depositional environments.

The Yarramba Paleochannel morphology appears variable, in the Honeymoon area, the channel is characterised by steep southern banks and relatively shallow northern banks, a broad, flat valley floor bounded by steep sided valley walls that are typical of incised valleys that have undergone valley widening after initial incision (Hansen 1999 in Southern Cross Resources 2000). The absence of terraces in the incised valley indicates that incision and subsequent widening occurred as a single, major erosional event. Paleomorphology of the Yarramba Paleochannel and internal stratigraphic features of the Eyre Formation within it indicate the presence of two incised valley systems that are informally referred to as the Yarramba Incised Valley and the East Kalkaroo Incised Valley (Hansen 1999 in Southern Cross Resources 2000).

The Yarramba Incised Valley deepens northward from Honeymoon toward the Yarramba Deposit and beyond, while the East Kalkaroo Incised Valley deepens eastward toward Mingary Creek. The drainage divide between the two incised valleys is situated near the eastern edge of the Honeymoon Deposit. The continuations of the two incised valleys are

poorly defined and currently not resolvable beyond 10 km from the Honeymoon mine. A significant tributary channel, the Southern Tributary, enters the main Yarramba Paleochannel near the eastern end of the Honeymoon Deposit. This tributary was defined for approximately 1.5 km south from the Honeymoon mine and is up to 500 m wide. The stratigraphy and sedimentology of the Southern Tributary appear to be consistent with that of the Yarramba Paleochannel. This tributary displays similar morphological features to the main channel.

3.9.2 Honeymoon Geology

Within the Honeymoon and East Kalkaroo region, the Yarramba Paleochannel trends roughly northeast to southwest and is filled with up to 50 meters of sands, silts and clays of the Eyre Formation. Variations in depositional conditions have resulted in the Eyre Formation sand and clay units lensing out or becoming truncated in areas. This has led to significant variations in thickness, distribution, and properties of units, and possibly resulting in the establishment of direct hydraulic connection between aquifers at some locations. Eyre Formation sediments are overlain with 40 m of Namba Formation clays, and 30 m of Quaternary clays.

The course sand units of the Eyre Formation form a multi-layered aquifer system, historically subdivided into three sand units: the Basal Sands, Middle Sands and Upper Sands, separated by three clay units: the Middle Clay, Upper Clay and Top Clay (Brunt,1978 and Green,1998 in Southern Cross Resources, 2000). Later intensive drilling programs within the Honeymoon Mine ISL wellfield and associated monitor wells identified a high degree of variability within sands and only two consistently recognisable sand units. These two units are described as the Eyre Formation Upper Member aquifer unit (in short, Upper Member) and Basal Member aquifer unit (also referred to as Basal Member).

The Upper Member occurs at depths between 75 m and 90 m in a series of thin compartmentalised channel and bar sands, typically 1 to 2 m thick and bounded by a series of internal stratigraphic surfaces. The Upper Member is not considered a significant aquifer unit to store or transmit useful quantities of water due to its fine grained composition. The Basal Member occurs at a depth of over 90 m, typically extending for up to 120 m below ground level. The unit grades from gravelly sheet-like sand deposits at the base to finer-grained, meandering shoestring channel sands in the middle of the paleochannel, by sheet-like, coarse grained sands.

3.9.3 Depositional Environment and Mineralogy

The Honeymoon uranium deposit is located within the Basal Member of the Eyre Formation sediments, of the Yarramba Paleochannel. The deposit has been formed through the precipitation of dissolved uranium in groundwater, previously mobilised under oxidising conditions, precipitating out on contact with a reducing environment, i.e., organic materials. This style of uranium deposit is known as a Roll Front, a sub-group of Uranium Sandstone deposits, and is characterised by medium to coarse-grained sandstone lenses, deposited during a continental fluvial sedimentary environment. These sedimentary packages are typically inter-bedded with impermeable mudstone units, which occur immediately above and below the uranium mineralisation.

Within the Honeymoon and East Kalkaroo area, uranium mineralisation occurs in both the Upper and Basal Member units of the Eyre Formation. Within the Basal Member, mineralisation occurs in four distinct ‘zones’ at depths of over 90 m to 120 m (see Figure 3.5-3.7).

The four zones are defined by different depths within the Basal Member. The following details the depths of the four uranium bearing zones in the Basal Member:

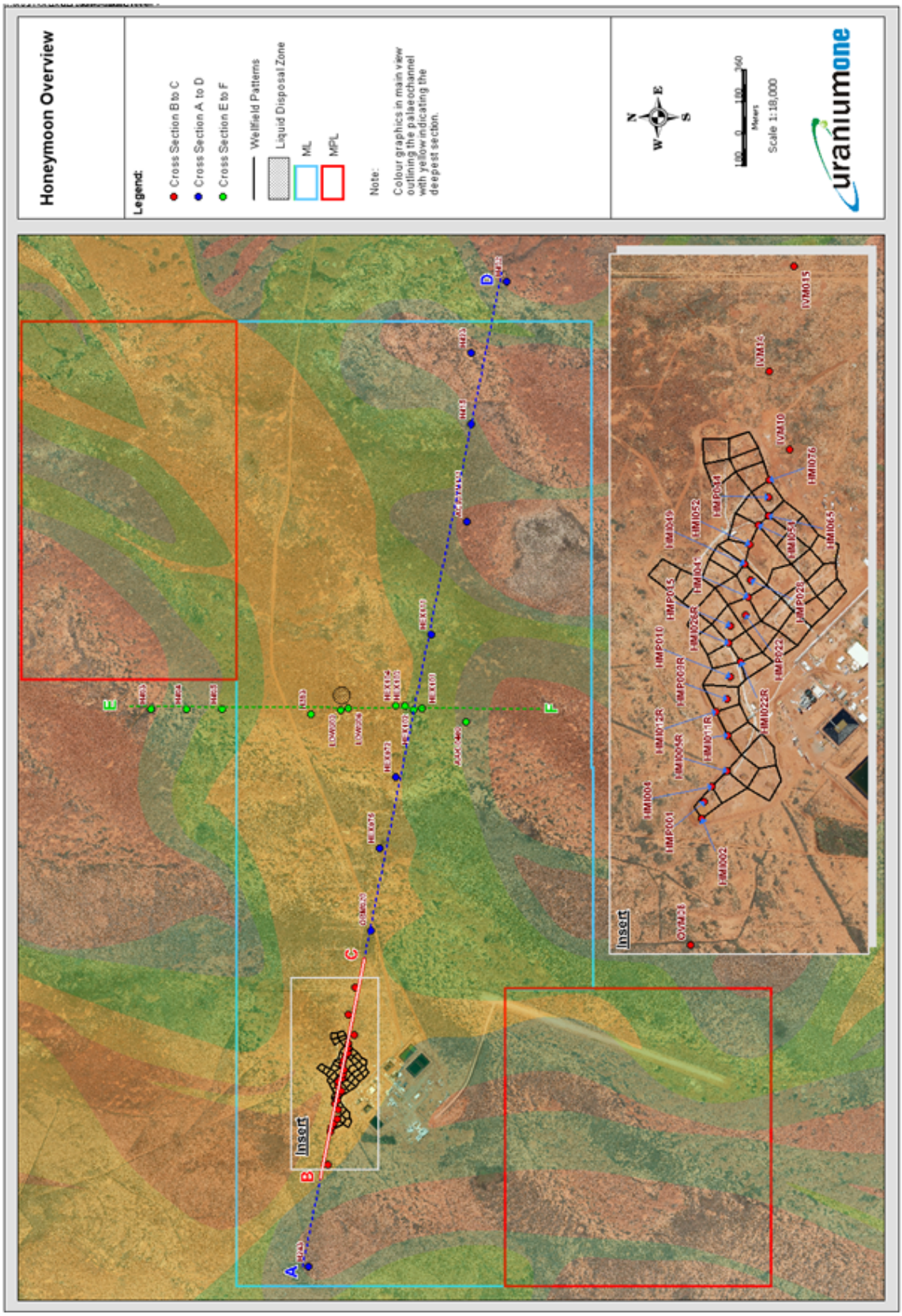

Figure 3.4 Cross-sections within the Yarramba Paleochannel, ISR Wellfield and liquid disposal zone at East Kalkaroo

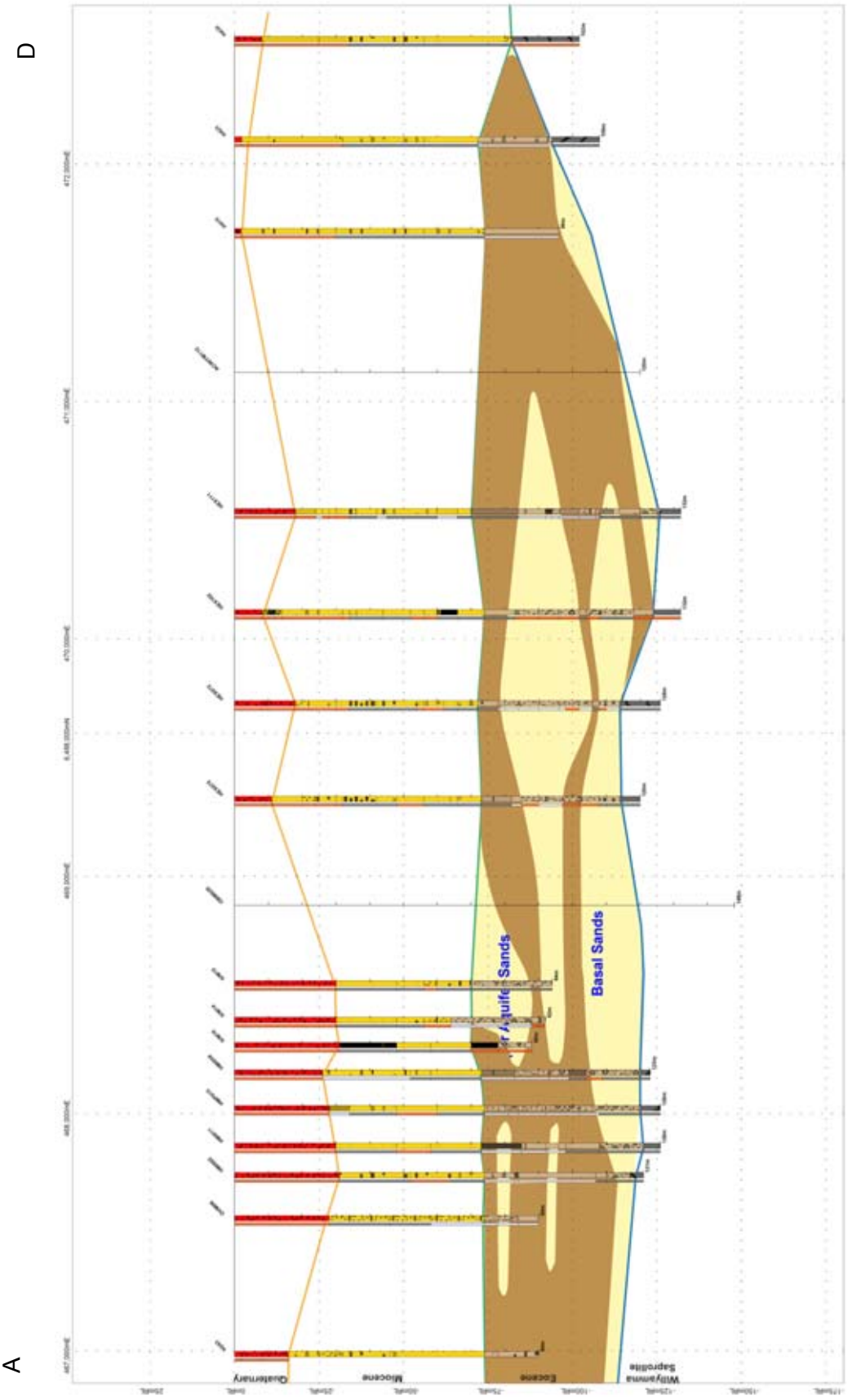

Figure 3.5 Cross-sections A-D within the Yarramba paleochannel at Honeymoon (see Figure 3.4 for section locations)

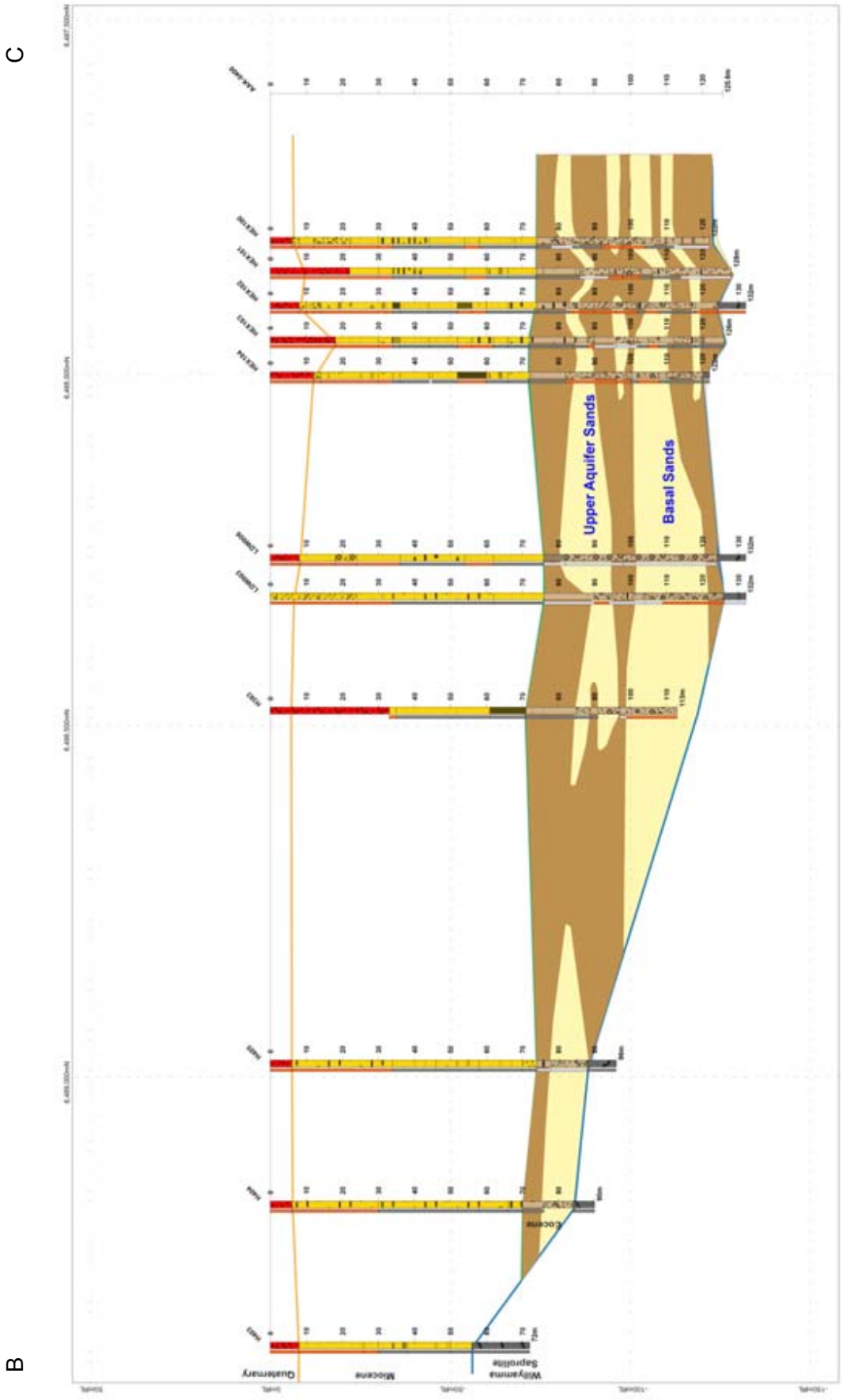

Figure 3.6 Cross-sections B to C within the Yarramba paleochannel within the Honeymoon wellfield and the site of the liquid disposal wells at East Kalkaroo (see Figure 3.4 for section locations).

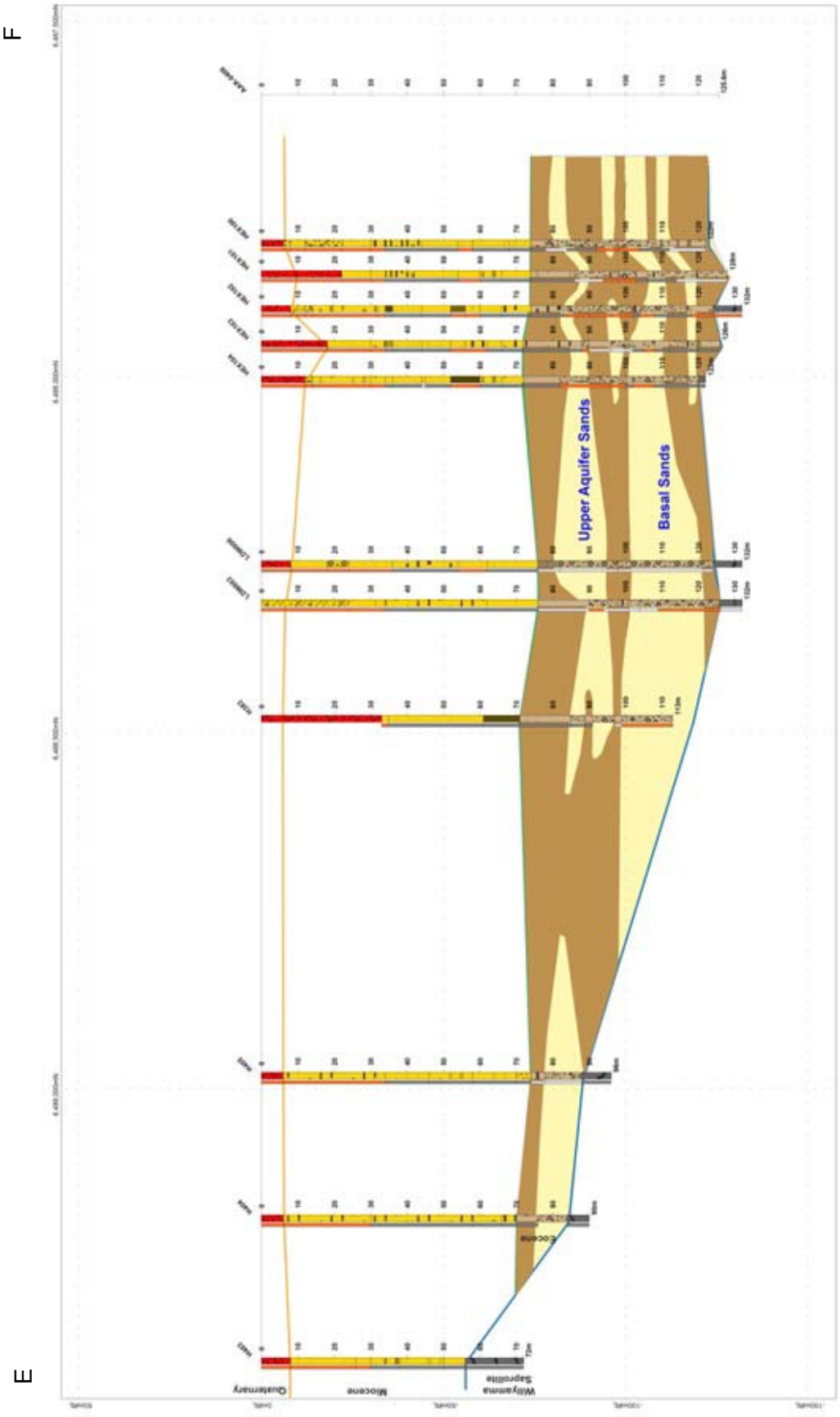

Figure 3.7 Cross-sections E to F within the Yarramba Paleochannel at the Honeymoon ISR Wellfield and the site of the liquid disposal wells (refer for section locations)

Figure 3.8 Honeymoon uranium mineralisation 'zones' within the Yarramba Paleochannel

- Zone 4: 108 – 111 m.
- Zone 3: 111 – 114 m.
- Zone 2: 114 – 117 m.
- Zone 1: 117 – 120 m.

In the Basal Member, uranium mineralisation is typically found within coarse-grained braided fluvial sands and at the interface between braided fluvial sands and overlying organic-rich silts and muds. The deposit extends for nearly 1,000 m along the channel margin, is 400 m wide at its maximum and averages 4.3 m in thickness.

Mineralisation within the Upper Member is sporadic, of lower grade and hosted within clay rich sequences less favourable to in-situ recovery. Based on these facts, mineralisation within the Upper Member has not been considered as part of the Honeymoon resource, however, will be evaluated in the future to determine the potential for development.

The primary uranium mineralogy of the Honeymoon deposit is autunite (hydrated calcium uranyl phosphate ($Ca(UO_2)_2(PO_4)8H_2O$)) with accessory coffinite (uranium bearing silicate mineral $U(SiO_4)_{1-x}(OH)_{4x}$) and uraninite (UO_2).

3.10 Hydrogeology

The following section summarises the findings of hydrogeological studies undertaken to characterise baseline groundwater conditions at the Honeymoon mine site.

Key documents and models developed as part of these hydrogeolgoical studies include:

- Environmental Impact Assessment for the Proposed Honeymoon Mine: groundwater studies (SKM, 2009).
- Field Leach Trial Wellfield Decommissioning - Water Quality Review (SKM, 2010a).
- Beneficial Use Assessment of the Yarramba Paleochannel (Land and Water Consulting, 2012b) (Attachment 10).
- Assessment of Hydrocarbons in Groundwater (Land and Water Consulting, 2012b)
- Honeymoon Uranium Mine Regional Groundwater Model (Groundwater Science, 2012) (Attachment C).

Section 6.5 provides further information related to hydrogeological monitoring and modelling at the Honeymoon mine.

3.10.1 Hydrogeological Investigations

The hydrogeological properties of the local Yarramba Paleochannel aquifers have been estimated through several phases of investigation. The main hydrological test program commenced in the Honeymoon area during the 1980s and was followed by intensive investigations by Coffey Geosciences in 1999 (Southern Cross Resources, 2000). Investigations have been further supplemented with results obtained during the wellfield construction phase and operational monitoring. This detailed work resulted in the revision of the conceptual model to a two layer aquifer system comprising the Basal Member and Upper Member aquifer units

All hydrogeological investigations were designed to obtain aquifer parameters for the Eyre Formation aquifer units and included step drawdown and longer-term constant rate discharge tests. Some test results were used in the modelling of the response to the trial leach operations and also for wellfield pattern design.

The first phase of historical investigations concentrated on pump tests at selected regional observation wells. The tests were designed to:

- Identify possible leakage between aquifer units.
- Obtain transmissivity values for the Basal Member.

- Assess potential leakage through the semi-confining clay layer.
- Obtain groundwater depths and associated flow directions and hydraulic gradients.

Wells were pumped at rates ranging from 3.25 L/s to almost 8 L/s at the main test site. East Kalkaroo Test Pump Site was pumped at 0.1 L/s for several minutes only. The results of these tests are presented in Section 1 of Table 3.5.

The program of short-term testing was followed by step and constant discharge testing in the Honeymoon ISR wellfield. The production wells were pumped at a rate of 8 L/s for 72 hours for the main test, followed by monitoring of residual drawdown for 390 minutes. Summary data is presented in Section 2 and 3 of Table 3.5.

The final pump test program was undertaken between February and March 2010 and pumped at a rate of 6 L/s for 72 hours. Summary data is presented in Section 3 of Table 3.5.

3.10.2 Conceptual Hydrogeological Model Revision

As discussed in Section 3.9.2, the Tertiary-aged Eyre Formation aquifer system hosted within the Yaramba Paleochannel was originally conceptualised as a three layer aquifer system comprising, Basal, Middle and Upper Sands aquifers. Each unit was considered hydraulically isolated by continuous clay horizons separating it from the overlying and underlying units. This conceptual model was based on historical, widely-spaced drilling data, and the interpretation of early pumping tests (Southern Cross Resources 2000).

The conceptual hydrogeological model of the Eyre Formation has since been refined to a two layer aquifer system on the basis of:

- More detailed geological data (particularly in the vicinity of the Honeymoon ISR wellfield where recent drillholes are generally spaced 25 m apart):
  - Detailed drilling shows that the clay layers thought to separate the Basal and Middle Sands units are in fact discontinuous.
- Interpretation of recent pumping tests and re-interpretation of historical pumping tests:
  - Pumping from the Basal Sands unit produced a pressure drawdown response in wells completed in the Middle Sands unit. This demonstrates that there is hydraulic connection between the sediments formerly identified as hydraulically separate.
- The Beneficial Use Assessment of the complete hydro-geochemical dataset collected since project inception (LWC, 2012):
  - Hydrogeochemical data show that wells completed in the Basal Member and Upper Member exhibit similar chemical characteristics.
- Analysis of the hydrostatic pressure response to groundwater pumping during mine commissioning:
  - Pressure fluctuations in the Basal Member were readily transferred to the Upper Member.

The refined conceptual hydrogeological model for the Eyre Formation at Honeymoon mine comprises one hydraulically connected aquifer system, the Eyre Formation Aquifer, which is subdivided into two consistently recognisable stratigraphic units: the Upper Member and the Basal Member (Table 3.4).

Stratigraphic Unit	Description
Upper Member	• Fine grained, moderately low permeability unit. • Aquifer unit is discontinuous; the geological unit exhibits facies changes from sand to silt and clay (Reference Sections A-D see Figure 3.5). • Confined by overlying Namba Formation. • Saline, naturally radioactive. • Host to minor uranium mineralisation.
Basal Member	• Variable, coarse grained highly permeable aquifer unit. • Inter-bedded with discontinuous silt and clay units (Reference Sections B-C (see Figure 3.6). • Confined by underlying basement saprolite. • Saline, naturally radioactive. • Host to the Honeymoon uranium orebody.

Table 3.4 Overview of Basal and Upper Member Aquifer Units Characteristics

The fundamental conceptual model of the Tertiary Eyre Formation aquifer on a larger scale remains unchanged. The Eyre Formation aquifer:

- Is vertically confined by the overlying low permeability Namba Formation and the underlying low permeability Basement Saprolite.
- Exhibits a natural pressure gradient from east to west along the orientation of the paleochannel, which is inferred to drive a maximum natural groundwater flow velocity ranging around 10 to 15 m per year in the Basal Member.
- Is naturally saline and radioactive, which precludes use of untreated groundwater for any agricultural or potable use.
- Is at long-term steady-state pressure equilibrium for both the Upper and Basal Members.

The revision of the conceptual hydrogeological model has been incorporated during revisions of the radiation management plan (RMP) / radioactive waste management plan (RWMP) and the groundwater monitoring and management plan (GMMP) (Attachment D) with particular focus on an appropriate risk analysis, and the design of an appropriate groundwater monitoring plan for the Upper Member and the full thickness of the Basal Member as detailed in Section 4.10.

3.10.3 Aquifer Characteristics

Hydraulic Conductivity & Permeability

Permeability tests undertaken on clay and silty clay core samples, obtained from the Eyre Formation clays during the 1999 drilling program, were analysed in a laboratory for vertical hydraulic conductivity. Results indicated that the vertical hydraulic conductivity of the clay layers was very low, in the range 10^{-4} to 10^{-6} m/d (Coffey Geosciences 1999 in Southern Cross Resources 2000). The clays also had permeabilities 4 to 6 orders of magnitude less than the horizontal hydraulic conductivity values calculated from the results of the transmissivity tests in the Basal Member. Therefore application of pumping-induced stress on the aquifer system will see vertical groundwater movements significantly retarded and the dominant direction of groundwater flow is horizontal. Likewise, horizontal movement will also be the dominant means of dissipation of injected fluids. However, in areas where the clay layers lens out or are truncated, the movement of water could occur between the sand units.

The permeability and groundwater bearing capacity of the underlying paleochannel basement rock unit of the Willyama Supergroup was investigated through exploratory drilling, geological logging and drill core analysis. Drill core analyses demonstrate low hydraulic conductivity, averaging 1,071 x 10^{-6} m/d, which is likely to preclude or significantly retard the movement of water to and from potentially fractured rocks in the underlying basement (Southern Cross Resources 2000). These findings were supported during the installation of two deep outer rock monitoring wells in late 2009 that identified a weathered horizon of clay rich metasediments overlying the basement sequence. This intensively weathered zone was found to extend from the top of the formation, 70 m to 160 m deep (at which point wells were terminated). Investigations demonstrate there is little to no capacity for any downward migration of groundwater contained in the Eyre Formation into the Willyama Supergroup. In addition, as the Yarramba Paleochannel in incised into the Willyama Supergroup, the paleochannel boundaries also do not provide an infiltration mechanism.

Transmissivity

The Basal Member is typically highly transmissive across the Honeymoon Mining Lease; with the East Kalkaroo locality (liquid disposal zone) recording significantly higher transmissivities than the ISR Wellfield during recent tests (Table 3.5). The variation in transmissivity between the Honeymoon and East Kalkaroo areas is likely to be due to variations in the permeability and thickness of each unit. Also of note is the decrease in transmissivity values in the western-most observation wells, situated on the eastern edge of ML 6109. Transmissivities obtained from wells tested in the Upper Member were less than 100 m^2/d and are consistent with the sedimentological model of lower energy depositional environments in this unit.

Fracture Pressure

Fracture pressure is the amount of pressure that can be built up in the Eyre Formation before buoyancy and failure of the overlying layers may occur. A conservative fracture pressure has been estimated based on the depth of the top of the Basal Member being a minimum of 75 m, and the density of the sediments above the aquifer being approximately 1.8 tonnes/m^3

The calculated fracture pressure is 135 mH_2O of head above the top of the aquifer or 60 mH_2O of head (588 kPa) pressure (measured at the well head or ground surface). This means that an artesian pressure of 60 m (water levels in observation wells would rise to 60 m above ground surface if casing rose to that high) would be needed before failure of the confining layers could occur.

This applies equally to the thinner clay layers separating the Basal and Upper Member units, since to deform the clay layer, the entire thickness of overlying sediments also needs to be, to some extent, lifted and deformed.

It is important to appreciate that in an open aquifer system such as the Eyre Formation at the Honeymoon mine, build-up of aquifer pressure is most unlikely since pressure will be simply dissipated throughout the regionally extensive aquifer system. The only possible mechanism for drastically increased hydrostatic pressure would be clogging of the aquifer immediately surrounding an injection well

Well & Aquifer	Pumping Rate (L/s)	Maximum Drawdown (m)	Transmissivity (m^2/d)	Storage Coefficient	Leakage Factor (m)	Hydraulic Resistance (d)	Hydraulic Conductivity	Method
1. Aquifer Pump Test Date (Southern Cross, 2000)								
Eastern Monitor Wells (Situated on the Eastern Edge of ML6109)								
Basal Member Well 1	5.00	1.48	608	-	-	-	-	-
Basal Member Well 2	8.10	2.67	800	-	-	-	-	-
Upper Member Well 1	3.50	15.52	39	-	-	-	-	-
Central Monitors (Situated on the Northern Boundary in the Middle of ML6109)								
Basal Member Well 1	5.00	0.50	1809	-	-	-	-	-
Basal Member Well 2	4.00	2.32	-	-	-	-	-	-
Basal Member Well 3	7.95	4.06	898	-	-	-	-	-
Western Monitor (situated within the bounds of the Honeymoon Mine Site)								
Basal Member Well 1	1.50	17.34	-	-	-	-	-	-
Basal Member Well 2	4.00	13.96	66	-	-	-	-	-
Upper Member Well 1	2.00	12.67	102	-	-	-	-	-
Upper Member Well 2	3.25	19.85	80	-	-	-	-	-
East Kalkaroo Test Pump Site								
Basal Member Well 1	0.10	30.00	-	-	-	-	-	-
2. Hydraulic Properties of the Eyre Formation Aquifers (Southern Cross, 2000)								
Honeymoon Monitoring Wells								
Basal Member Well 12	-	-	10-12	1×10^{-5}	-	-	2-3	DeGlee (T, K); Walton
Basal Member Well 2	-	-	44-424	1.4×10^{-4} to 8×10^{-5}	-	-	11-65	DeGlee (T, K); Walton
East Kalkaroo Monitoring Well								
Basal Member Well 1	-	-	230-700	-	-	-	33-100	Theis
Test Site								

[2] The lower transmissivity obtained during pumping tests is likely to have been due to a partial well screen blockage.

Well & Aquifer	Pumping Rate (L/s)	Maximum Drawdown (m)	Transmissivity (m^2/d)	Storage Coefficient	Leakage Factor (m)	Hydraulic Resistance (d)	Hydraulic Conductivity	Method
Test Well Basal Member	-	16.96	230	-	-	-	-	-
Monitor Wells								
North No. 1	-	0.60	652	4.8×10^{-4}	1107	1785	-	-
North No. 2	-	0.57	626	1.7×10^{-4}	1284	3000	-	-
West No. 1	-	0.79	454	4.8×10^{-4}	647	952	-	-
West No. 2	-	0.68	482	2.2×10^{-4}	1245	3389	-	-
3. Hydraulic Properties of the Eyre Formation East Kalkaroo – February to March 2010$_o$								
Liquid Disposal Test Site								
LDWPTH003 Test 1	-	-	550	-	-	9	61.1	CJ* Theis Recovery* Clarke#
LDWPTH003 Test 2	-	-	1054	-	-	9	117.1	
LDWPTH003 Test 3	-	-	500	-	-	9	55.6	
HNWB2 Test 1	-		1647	-	-	9	164	CJ* Recovery
HNWB2 Test 2	-		-	-	-	-	-	
H361 Test 1	-		1617	6.9×10^{-4}	-	-	179.7	CJ* Recovery* Clarke#
H361 Test 2	-		2224	4.7×10^{-5}	-	-	247.1	
H361 Test 3	-		1611	2.7×10^{-5}	-	-	179.0	

Table 3.5 Hydraulic properties of the Yarramba Paleochannel aquifers (Southern Cross Resources, 2000 & Uranium One, February to March 2010)

Notes:

CJ: Cooper Jacob Solution *Kruseman and de Ridder, 2000

#Clarke, 1988 $_o$ Test work undertaken by Uranium One

*Calculated from residual drawdown data.

Groundwater Levels & Flow Contours

Representative water elevation data from the Basal Member and Upper Member aquifer units within ML 6109 are provided in Table 3.6 and diagrammatically in Figure 3.9 and Figure 3.10. The location of these monitoring wells is shown in Figure 3.11.

Monitoring data has been sourced from three consecutive years of care and maintenance groundwater monitoring, January 2004 to 2006. Groundwater levels recorded during the post wellfield trial groundwater monitoring program indicated steady groundwater levels with no significant upward or downward trend, however were not suitable for this assessment as wells had not yet been surveyed to mAHD.

Well ID	Groundwater Level (mAHD)	Dates Recorded
Basal Member - Groundwater Level		
1E12-1	66.35	29/7/2005 – 22/11/2006
1J20-1	66.25	4/8/2004 – 3/11/2006
1I13 1	65.9	21/1/2004 – 3/11/2006
CMONB	65.94	20/1/2004 – 3/11/2006
EMONB	66.3	3/8/2004 – 3/11/2006
Upper Member - Groundwater Level		
SM 1	65.6	21/1/2004 - 3/11/2006
H184	66.07	4/5/2004 – 3/11/2006
H169	66.27	26/1/2004 – 3/11/2006
WMONU	65.59	20/1/2004 - 3/11/2006
EMONU	65.99	20/2/2004 – 3/11/2006

Table 3.6 Groundwater level data

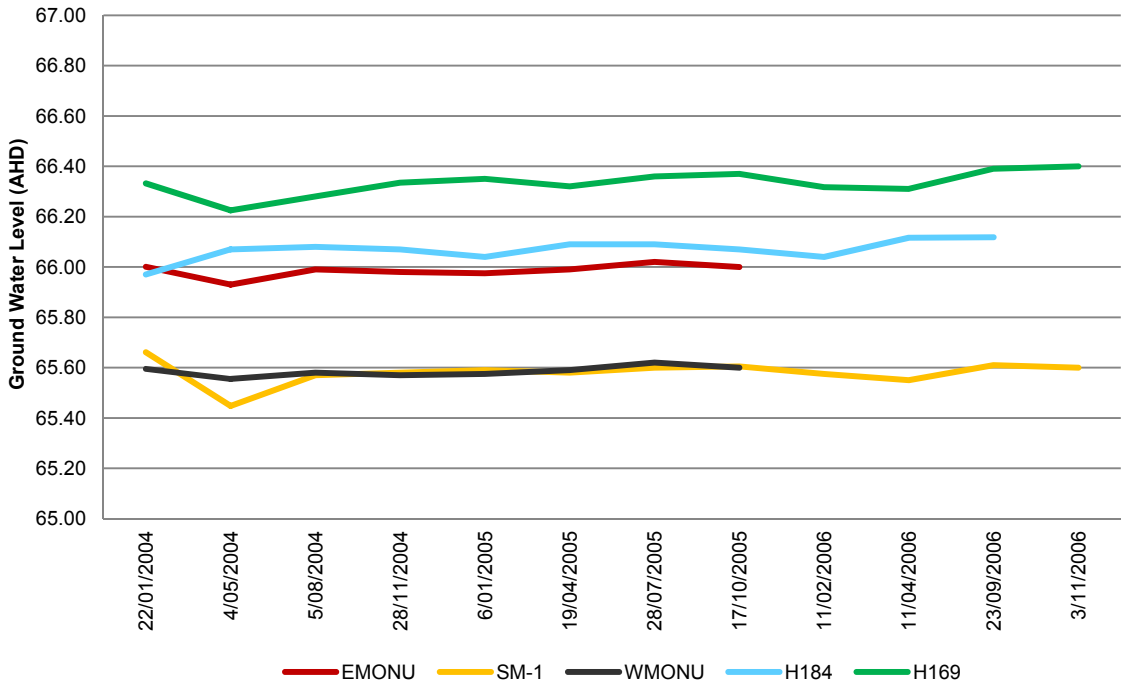

Figure 3.9 Mining Lease 6109 Upper Member 2004 to 2006 monitoring well hydrographs

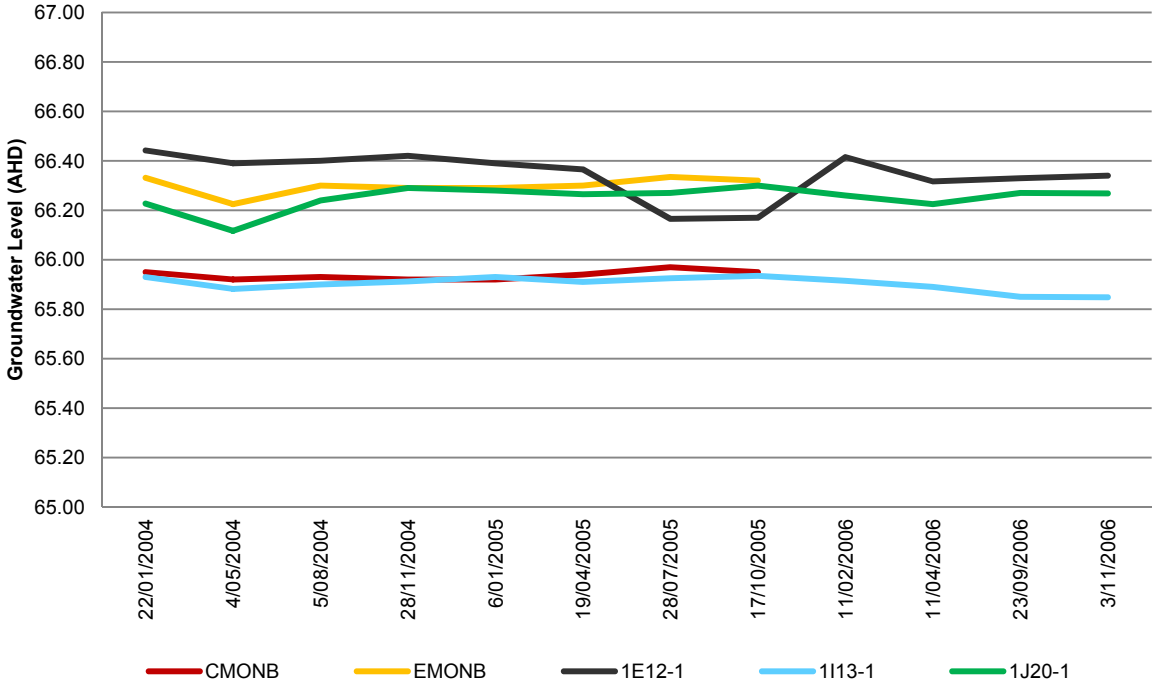

Figure 3.10 Mining Lease 6109 Basal Member 2004 to 2006 monitoring well hydrographs

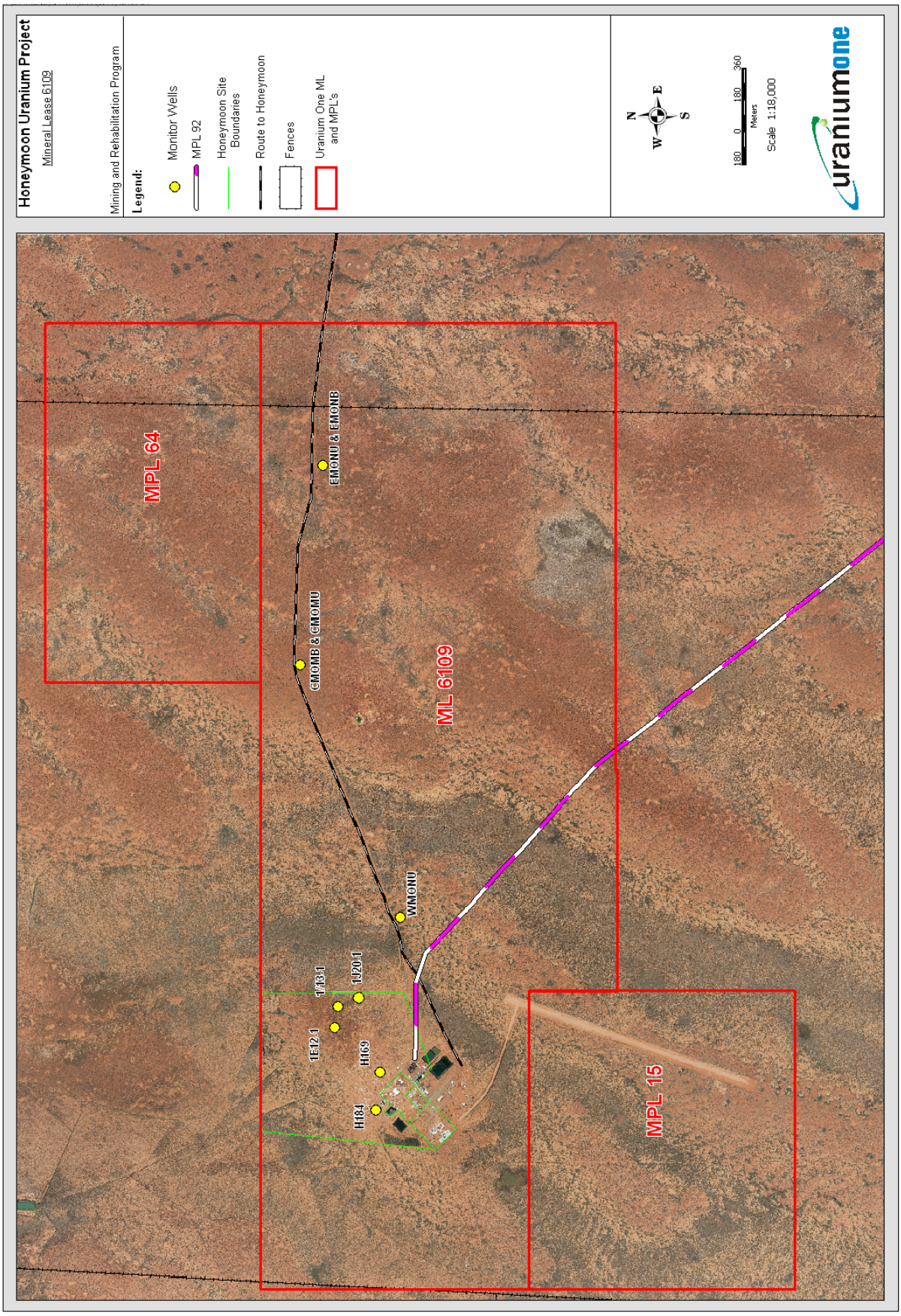

Figure 3.11 Location of Basal Member and Upper Member monitoring wells used in Figure 3.9 and 3.10 hydrographs.

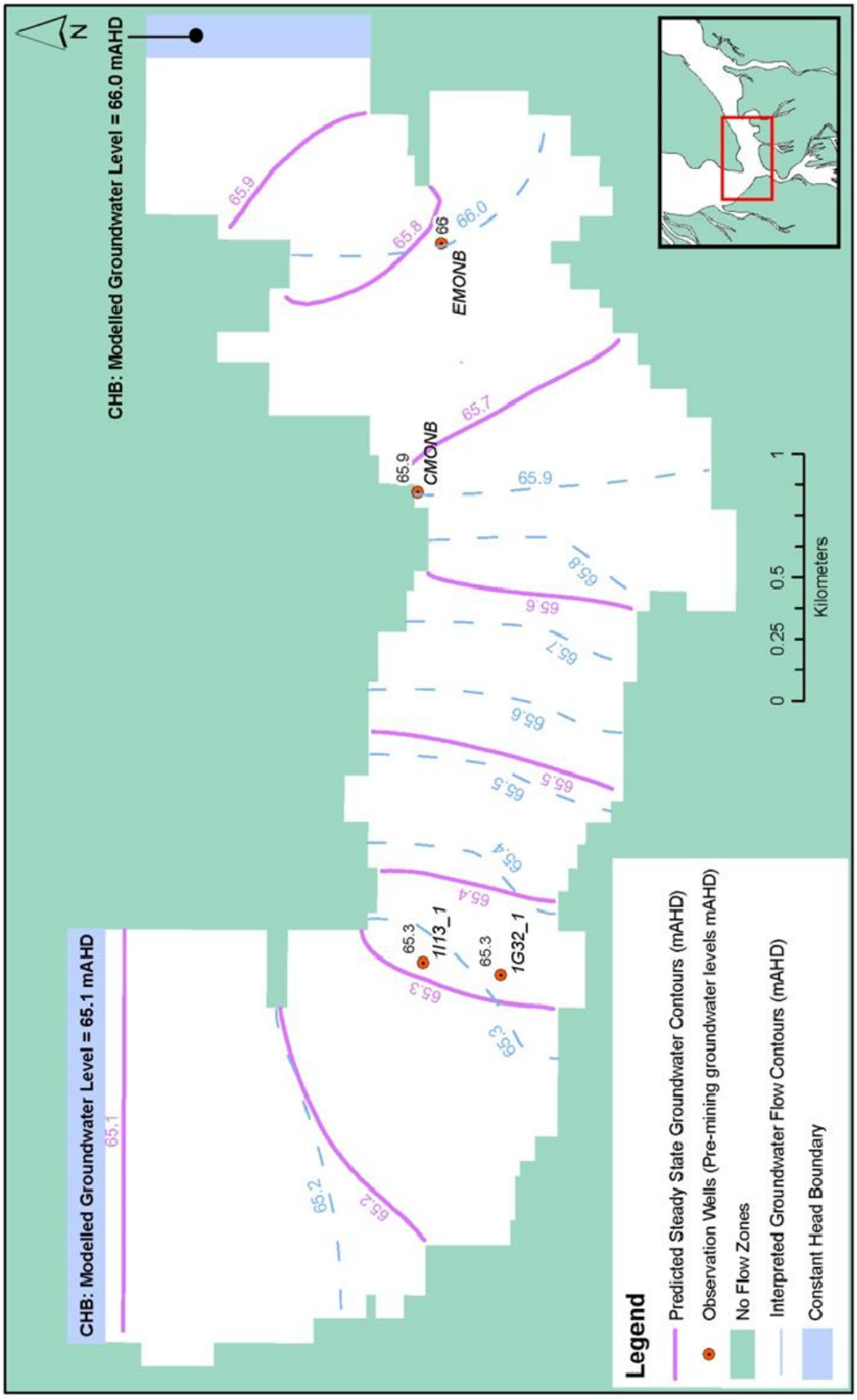

Figure 3.12 Pre-mining steady state (modelled) groundwater levels and flow contours in the Yarramba Paleochannel, Layer 5, Basal Member.

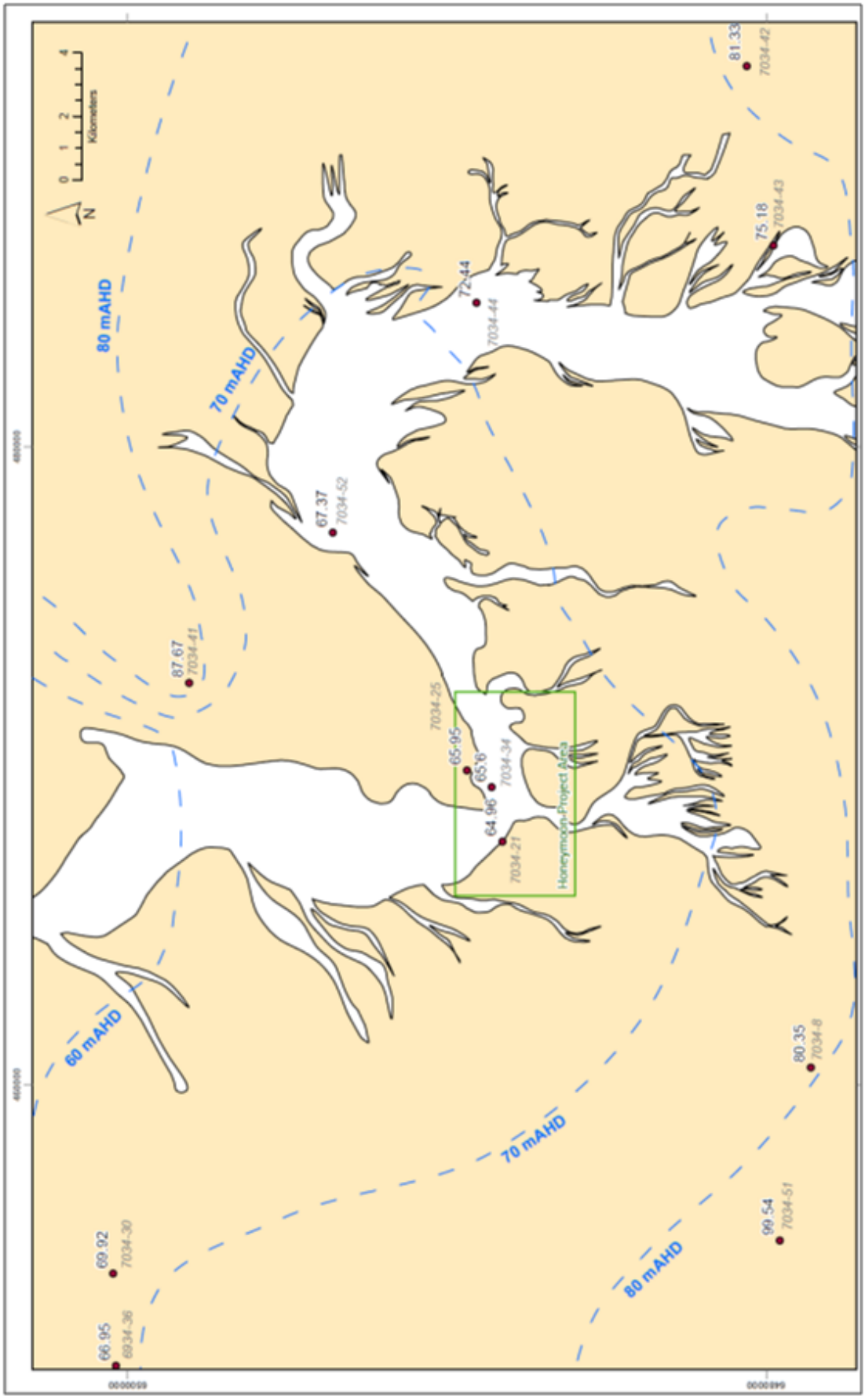

Figure 3.13 Interpreted regional pre-mining groundwater contours for the Yarramba Paleochannel.

Regional Eyre Formation aquifer steady state groundwater levels and flow contours, developed from historical water level data (Table 3.6) are shown in Figure 3.12 and Figure 3.13. The high permeability sediments hosted within the Yarramba Paleochannel appear to act as a drain to the regional groundwater system. This data indicates that groundwater flow is likely governed by channel orientation and constraints on the direction of groundwater movement derived from underlying basement rock and overlying Namba Formation clays. This means that on a regional scale, inferred groundwater flow is from south to north, however, on a local scale, groundwater flow within the Honeymoon mine site is from east to west/northwest as constrained by paleochannel orientation.

3.10.4 Water Quality and Beneficial Use Assessment

Average physical and chemical groundwater quality values are presented in Table 3.7 and have been derived from care and maintenance groundwater monitoring (collected between 2000 and 2009) and baseline groundwater monitoring data (collected between December 2009 and December 2010). Locations for monitoring wells utilised in this assessment are provided in Figure 3.11

Aquifer	Unit	Basal Member		Upper Member	
Analyte		Average	Beneficial Use	Average	Beneficial Use
TDS	mg/L	16,100	None	10,300	3*
Arsenic	mg/L	0.0041	1, 2 & 3	0.0036	1, 2 & 3
Copper	mg/L	0.02	1, 2 & 3	0.008	1, 2 & 3
Lead	mg/L	0.0032	1, 2 & 3	0.009	1, 2 & 3
Nickel	mg/L	0.023	1, 2 & 3	0.004	1, 2 & 3
Sulphate	mg/L	1749	None	1536	None
Uranium	mg/L	0.034	3	0.023	3
Radium-226	Bq/L	87	None	3.1	None
Zinc	mg/L	0.04	1, 2 & 3	0.20	1, 2 & 3
Overall Beneficial Uses		**None**		**None**	

Note:
1. Potable
2. Irrigation
3. Stock watering

Table 3.7 Summary of Groundwater Beneficial Use, adapted from SKM 2010d

Beneficial Use Assessment

The beneficial use of untreated water from the Eyre Formation aquifer, within the limits of ML 6109, has been assessed against Schedule 2 of the Environment Protection (Water Quality) Policy 2003 and the ANZECC 2000 water quality guidelines for potable, irrigation and stock water use (see Table 3.8).

Groundwater quality data used in this assessment has been derived from historic groundwater monitoring data, taken between 2001 and 2009, and baseline groundwater data within the ISR wellfield, collected between 2009 and 2010. The data collated in Table 3.7 demonstrates that untreated groundwater in the Eyre Formation aquifer is of poor quality; sulphate levels typically exceed stock watering guidelines and are not suitable as drinking water (ANZECC/ARMCANZ 2000). Salinity levels range between 9,000 mg/L and 20,000 mg/L in the Basal Member aquifer unit and between 10,000 mg/L and 11,000 mg/L in the Upper Member aquifer unit. On the basis of salinity alone, groundwater in both the Upper and Basal Members within the Honeymoon Mining Lease 6109 are not suitable as stock water.

The concentration of metals, such as copper, lead, magnesium, nickel and zinc within the Eyre Formation aquifer units, are within both the Water Quality Policy (2003) and National Health Guideline levels (2000). However, uranium and radium-226 levels in the Basal and Upper Members exceed the current National Health and Medical Research Council guidelines (ANZECC/ARMCANZ 2000) for safe drinking water. The Upper and Basal Members have uranium concentrations within the stock watering limits; any beneficial use is, however, limited by elevated Ra-226 activity of the waters.

A further beneficial use assessment was undertaken down-gradient of the mining lease to determine the groundwater quality in areas where groundwater from the mining lease can be expected to migrate within 100 years. The wells identified and used in this beneficial use assessment are shown in Figure 3.14. The naturally occurring groundwater was found to exceed stock water guideline limits for sulphate and total dissolved solids (TDS) at all sampled sites.

Stock water guideline concentrations are presented in Table 3.8.

Analyte	Beneficial Use Precluded by SA EPA (2003) Water Quality Criteria and/or ANZECC (2000) National Water Quality Management Strategy - Livestock Use
Total Dissolved Solids	10,000[3]
Arsenic	0.5
Cadmium	0.01
Chromium	1
Copper	0.5
Mercury	0.002
Nickel	1
Lead	0.1
Zinc	20
Uranium	0.2
Radium-226	5 Bq/L
Sulphate	1,000[4]

NB: Units in mg/L unless otherwise indicated

Table 3.8 SA EPA 2003 Water Quality Criteria and/or ANZECC (2000) National Water Quality Management Strategy Values

Water Use

Potable water, required to support the accommodation camp and select processing activities, is extracted from the Eyre Formation Basal Member aquifer unit at East Kalkaroo, upstream from the liquid disposal zone (see wells HMWB3 and HMWB4 in overview map in Figure 3.11). As the groundwater is unsuitable for consumption, a reverse osmosis plant is used to remove the metals, salts and radioactive elements present.

[3] Baseline groundwater quality exceeds sulphate and total dissolved solid limits for livestock use.

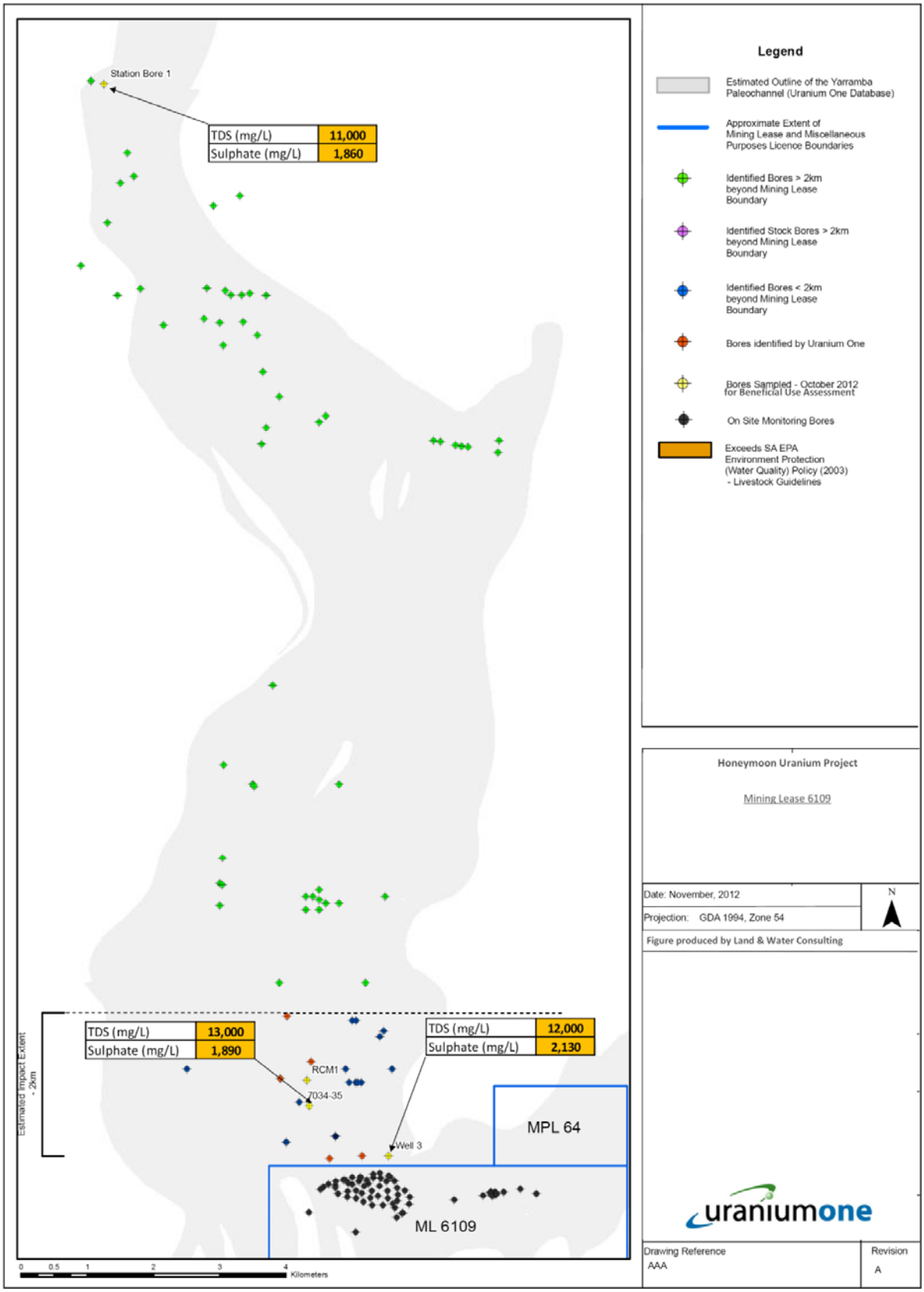

Figure 3.14 Monitoring wells used and identified in Beneficial Use Assessment

3.10.5 The Great Artesian basin

The Great Artesian Basin (GAB) is one of the largest artesian groundwater basins in the world. It comprises sediments of the Eromanga, Surat and Carpentaria Basins. The South Australian portion of the GAB consists of Eromanga Basin sediments only. The GAB is an important source of high quality water for domestic and stock use throughout much of inland Australia with TDS averaging between 500 and 1,500 mg/L in the main aquifer.

The most southerly extent of the GAB is in the Frome Embayment and occurs approximately 70 km to the north of Honeymoon mine, in the vicinity of Lake Frome.

Geological cross-sections and drill hole data from wells drilled near Lake Frome indicate that Tertiary aquifers (including the Eyre Formation) unconformably overlie Mesozoic (i.e., Eromanga Basin and GAB). The Eromanga Basin sediments have been divided into the Cadna-owie Formation (or equivalent) and the Marree Subgroup (MESA, 1986 in Southern Cross Resources 2000). The Cadna-owie Formation is a shoreline sand unit, and at Black Oak Bore near Lake Frome consists of fine sand and a pebble layer (Callen 1990 in Southern Cross Resources, 2000) and, as such, it is likely to be the main water-bearing unit (i.e., aquifer) in the Lake Frome area (Callen, 1990 in Southern Cross Resources 2000).

The Marree Subgroup sediments overlie the Cadna-owie Formation and are likely equivalents to the Bulldog Shale, Coorikiana Sandstone and/or Oodnadatta Formation. The thickness of this group in Black Oak Bore is 37 m (Callen, 1990 in Southern Cross Resources, 2000). The Marree Subgroup sediments typically consist of grey-green shales and minor sandy shale and sand, and form a confining layer to the GAB aquifer. This shale sequence is therefore likely to form an effective barrier to the movement of water between the Cadna-owie Formation (GAB aquifer) and overlying Eyre Formation (Tertiary) sediments.

Other well records examined indicate that wells completed in Tertiary sediments do not flow to the surface in the area underlain by the GAB aquifer. It is concluded that within this area the potentiometric head in the Tertiary aquifer is likely to be lower than in the GAB aquifer. Such a head relationship implies an upward hydraulic gradient from the GAB aquifer to the Tertiary aquifer system, precluding the downward movement of water into the GAB system.

3.11 Hydrology

Regional elevations vary from approximately 150 m (AHD) near the Barrier Highway 50 km south of the Honeymoon mine site, to less than ten metres AHD near Lake Frome and approximately 90 km northwest of the Honeymoon mine site. Local variations in surface relief, to the east and west of the Honeymoon mine, are represented in Figure 3.15 in a 20 km transect.

Honeymoon mine is not within a defined waterway. The nearest surface water features are two ephemeral creek lines, Oonarta Creek and Mingary Creek, situated 7 km west and 11 km east of Honeymoon mine respectively. While the mine is located outside the zone of influence of both these creeks, local heavy rainfall and regional surface waters flow from the Olary Ranges to the north result in flooding of the Oonarta and Mingary Creeks.

Local surface waters are unlikely to recharge any local Eyre Formation aquifer units as the channel sediments are overlain by a substantial thickness of low permeability clays. Any groundwater recharge is likely to occur by infiltration of rainfall in the Olary Ranges to the south, by lateral through-flow from fractured basement rocks and possibly through accessions from tributary channels.

Hill Dam and Brooks Dam are the closest surface water storage features to the mine site, located approximately 1.2 km east and 2 km north west of the Honeymoon mine (refer to Figure 3.1). Hill Dam is maintained by a water bore and utilised for road maintenance

activities, while Brooks Dam is a historic pastoral dam, fed through a series of man-made pastoral drainage channels that collect surface water run-off from the south.

Surface water recharge to the channel aquifers is likely to occur by rainfall infiltration in the southern Olary Ranges by lateral through-flow from fractured basement rocks and possibly through accessions from tributary channels. Recharge by direct infiltration of rain falling at Honeymoon mine is highly unlikely to occur, as the channel sediments are overlain by a substantial thickness of low permeability clays.

Plate 3.2 Aerial view of Mingary Creek in flood (March 2012)

Plate 3.3 Mingary Creek crossing in flood (March 2010)

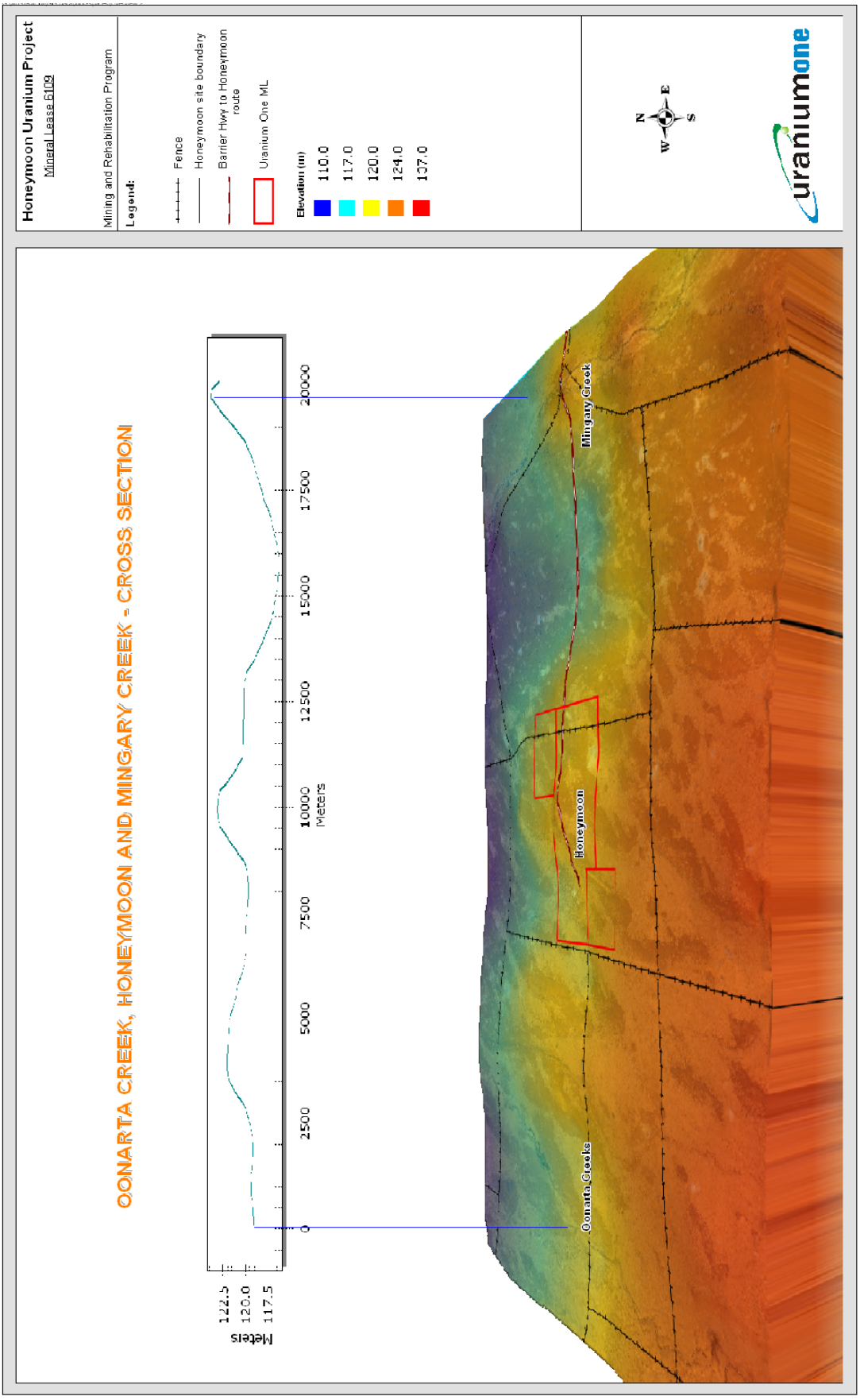

Figure 3.15 Elevation from Honeymoon Mine to Mingary Creek to the East and Oonarta Creek to the West

3.12 Vegetation, Weeds and Plant Pathogens

3.12.1 Vegetation Communities

The following summarises the flora studies that have been undertaken at Honeymoon mine to date:

- Flora, Fauna, Landform and Soils Study (1998) – Resource Monitoring and Planning Pty Ltd (RMP 2007). This report was prepared as part of the 2000 EIS and summarised information from a number of sources. The data were supplemented by extra opportunistic flora and fauna observations in August 1998.
- Baseline Vegetation Survey for the Construction of Plant and Wellfields (RMP 2007). This survey was undertaken to identify the species' richness and extent of vegetation communities in and surrounding Honeymoon mine. It was used to inform and assist the native vegetation management initiatives for ongoing management of native vegetation during construction of the Honeymoon mine.
- Weed and Pest Survey (SKM 2009). This report documents the findings of a weed and vertebrate pest survey conducted in November 2009.
- Annual Weed and Vertebrate Pest Survey (2010). This report summarise the findings of annual weed and vertebrate pest surveys at the Honeymoon mine and associated mining infrastructure corridors (Attachment F).
- Baseline Fauna Surveys (2010). This reports document the findings of baseline fauna surveys (Attachment E).
- In addition to these studies, Uranium One conducted a comprehensive Baseline Ecological Condition Assessment in 2009, including an Ecosystem Function Analysis (EFA) prior to the start of construction (GHD 2009). The results from these surveys are summarised in this section and provided as Attachment G.

The results from the surveys and reports identified above are summarised to provide a description of the vegetation, weeds and pathogens found in the region.

Native vegetation communities dominate the ML and MPLs covering approximately 95% of the area in total with the remaining area containing mining and pastoral infrastructure such as mining plant, roads and dams. The vegetation communities on the ML have been subject to a long history of intense grazing pressure, consequently, the remaining state of the vegetation is reflective of these historical impacts.

In October 2009, Uranium One removed all stock from the pastoral lease. Following the removal of stock, the region experienced sustained summer rainfall resulting in some regeneration of vegetation communities within the ML and MPLs. Five vegetation communities have been identified in the ML and MPLs, which are further described below and overleaf.

The vegetation communities that dominate the Honeymoon ML and MPLs include:

1. *Sclerolaena spp* (species). Limestone copperburr (*Sclerolaena obliquicuspis*) / pale poverty bush (*Sclerolaena cuneata*) – low very open shrubland on the flats with irregularly spaced clay pans or scalds.
2. Bladder saltbush (*Atriplex vesicaria*) / low bluebush (*Maireana astrotricha*) – low open shrubland on the low sandy rises.

   The above mentioned vegetation communities make up over 90% of the vegetation on the ML and MPLs with the following three communities forming only small patches scattered throughout the ML and MPLs (Figure 3.16).
3. Canegrass (*Eragrostis australasica*) – tall grassland in sinks and swamps.
4. Needle bush (*Hakea leucoptera*) – shrubland with an understory of bladder saltbush / low bluebush. This community is limited to only a few scattered trees and therefore has not been represented in Figure 3.16.

5. Purple-wood wattle (*Acacia carneorum*) with a sparse understory of low bluebush.

   The extent and location of these vegetation communities within the ML and MPL 15 are detailed in Figure 3.16.

Sclerolaena spp. – Low Very open Scrubland

The *Sclerolaena spp*. community occurs mostly on the poorer drained soils with higher clay content in the surface layers and in the slightly low-lying areas as shown in Plate 3.4.

This vegetation type can grade into the canegrass grassland in swampy areas where drainage is extremely poor, however, these swamp areas are few and generally only occupy small areas less than 1 ha. Good rains can bring on a flush of intermittent growth of annual saltbushes, daisies, grasses and herbs, which are often the first species to be grazed by livestock when they are present.

The density of bladder saltbush in this community varies considerably from zero to being the dominating species. Areas that have historically sustained prolonged heavy grazing, particularly during drought times, have all but lost the saltbush and are now dominated by the much less palatable pale poverty bush. A full inventory of other flora species that occupy these habitats can be found in Attachment E.

Plate 3.4 Sclerolaena spp. community

Bladder Saltbush and Low Bluebush – Low Open Scrubland

Bladder saltbush and low bluebush (shown in Plate 3.5) is common throughout the region from south of the Barrier Highway to as far north as Lake Frome. It tends to grow in areas where the upper horizons of the soil mantle are slightly thicker and sandier than the soils that support the pale poverty bush community. It is a very important community in wool production areas and has been grazed by sheep in the Honeymoon-Billeroo West area for approximately 150 years. In good seasons, this community can be rich in native grasses and herbs that provide excellent opportunistic grazing for native, feral and domestic herbivores. Destruction of the bladder saltbush through mechanical means or heavy grazing

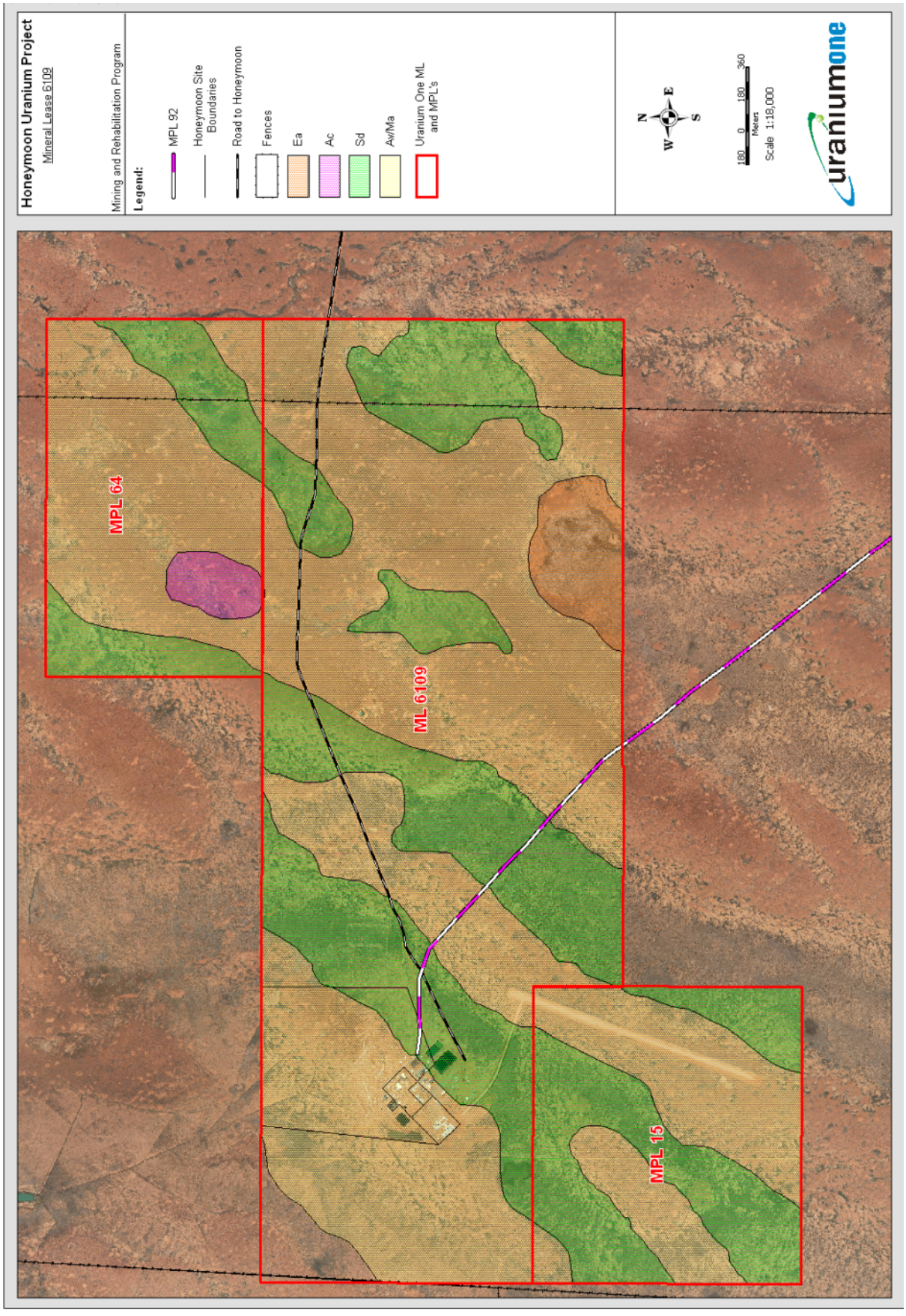

Figure 3.16 Vegetation map of ML6109 and MPL 15

pressure can lead to its death, whereas low bluebush is able to regenerate from the butts if opportunity allows.

Densities of the various plants making up this community vary considerably depending on the localised soil, climatic, moisture and management conditions. A full inventory of other flora species that occupy these habitats can be found in Attachment E.

Plate 3.5 Bladder saltbush and low bluebush - east of Honeymoon mine plant

Canegrass – Tall Grassland in Clay Pans

Canegrass swamp communities are discrete and small (less than 1 ha). They form in depressions within pale poverty bush and bladder saltbush dominated communities where the localised drainage pattern has low-lying patches that collect run-on from the surrounding area. After rain, the water stands for a long while because of the inability of the medium to heavy clay soil to allow it to penetrate, sometimes leading to swampy conditions. Although in most cases, canegrass dominates these communities, annual saltbushes and ephemeral herbs make up the major part of the botanical composition of this community (see Plate 3.6). A full inventory of other flora species that occupy these habitats can be found in Attachment E.

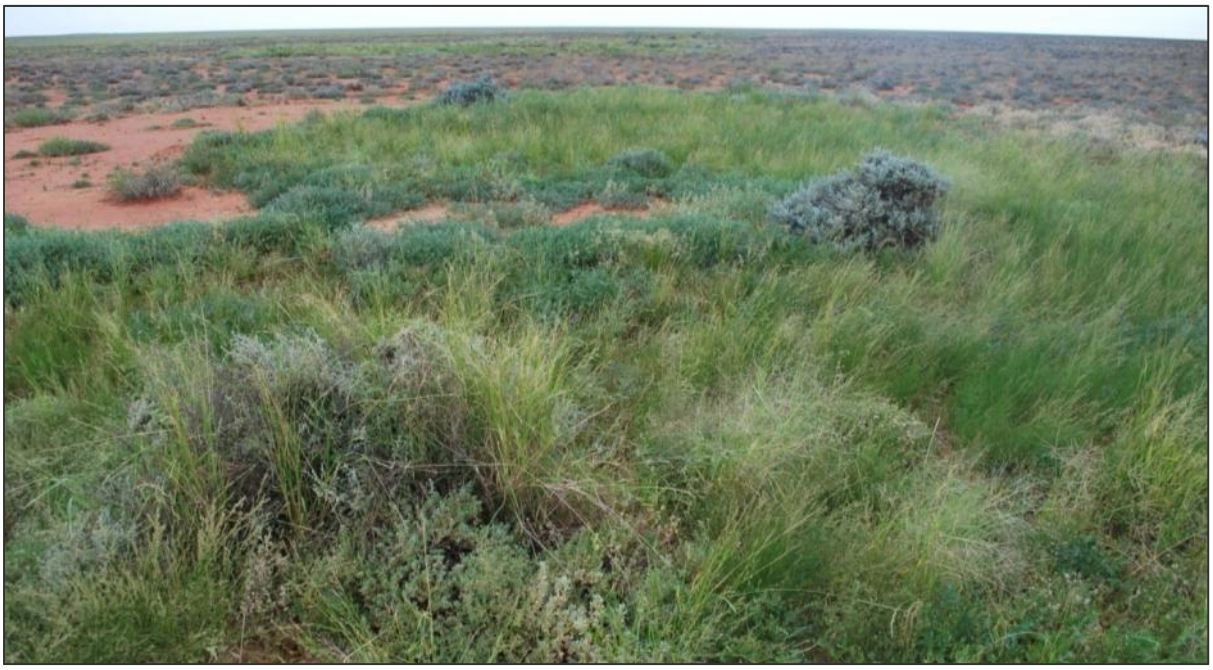

Plate 3.6 Swamp community dominated by canegrass with annual saltbush and ephemerial herbs

Other Minor Communities

Occasional patches of needle bush or narrow-leafed hop bush (*Dodoneae viscosa ssp. angustissima*) with turpentine occur to the northeast and east of the Honeymoon mine. These areas (up to a couple of hectares in size) provide a microclimate that favours the growth of ruby saltbush (*Enchylaena tomentosa*) which can provide secure nesting sites and produce succulent berries favoured by a variety of small birds. The deeper litter from these shrubs also provides a higher level of protection for small reptiles and the mulching function of the litter allows the growth of summer grass in the shelter of the taller shrubs.

Purple-wood wattle occurs in a small patch of about one hectare in an area approximately 3 km east of the Honeymoon mine (north of the northern boundary of the ML) on a low sandy rise over a very sparse understorey of low bluebush and bladder saltbush. The prickly foliage of these shrubs provides good shelter and nesting sites for small birds and the sandy soil, with overhead protection provides good sites for burrowing reptiles. Rabbits also often colonise these groves because of the ease of digging and the excellent protection from aerial predators.

Although listed as ‘vulnerable’ under both Commonwealth and South Australian legislation, purple-wood wattle is quite widespread throughout this region particularly in the valleys southeast of Bimbowrie and adjacent to the Cockburn-Mulyungarie road. Purple-wood wattle also exists as far north as the southern fringe of Lake Frome. Rabbit browsing, and to a lesser extent cattle sheltering, are the most significant threats to these populations, particularly as the processes of regeneration are not fully understood.

The access road to the Honeymoon mine runs south of the purple-wood wattle grove. The farm track that runs northwest from the main access road to Brooks Dam passes close to the purple-wood wattle but is only used by pastoralists and is not used for mine operations or access. Given the sensitivity and importance of these occasional groves of purple-wood wattle, appropriate measures were taken during the mine’s establishment to ensure no disturbance occurred. No mine infrastructure will be sited within or adjacent to any purple-wood wattle habitats.

Vegetation communities dominated by sparse river box (*Eucalyptus largiflorens*) are found along many watercourses in the region. An example exists approximately 11 km east of the Honeymoon mine on the Mingary Creek with shrub and ground layers composed of lignum

(*Muehlenbeckia florulenta*), nitre goosefoot (*Chenopodium nitrariaceum*) and introduced species and annuals.

3.12.2 Native Vegetation Management and SEB

Native vegetation management at Honeymoon mine is managed through the Native Vegetation Management Plan (NVMP). The NVMP has been drafted with consideration to the Native Vegetation Act 1991 and its regulations and following the Guidelines for a Native Vegetation Significant Environmental Benefit Policy: For the clearance of native vegetation associated with the minerals and petroleum industry (DWLBC 2005). The NVMP identifies the total nominated area for vegetation clearance at the mine and the proposed areas for vegetation clearance. All activities that will disturb the grounds surface on site will require a Landscape and Vegetation Permit that will ensure:

- Clearance areas are within approved operational clearance extents.
- Native Vegetation Management Plan and Significant Environmental Benefit (SEB) offset areas are not excessive (in line with proposed task/activity) and are not in areas where threatened or listed species are located.

The NVMP and SEB calculations will be audited by Uranium One annually to ensure that all clearance is within designated areas and no excessive clearance of vegetation has occurred. Section 6 and Attachment H describe further details of vegetation management and SEB for the Honeymoon mine.

3.12.3 Introduced Plant Species

In South Australia introduced plant species are strongly associated with the pattern of rainfall. Areas to the south of the Honeymoon mine contain more introduced plant species than the more arid regions to the north. Many of the invasive weeds have advanced from southern regions where higher rainfall occurs. Due to the arid environment associated with the Honeymoon mine area and its low and unreliable rainfall, weed infestations are generally unable to be supported except in areas that retain greater soil moisture, e.g., along creek lines and run-on areas.

The current distribution of weed infestation at Honeymoon mine reflects patterns of disturbance associated with the establishment and operation of the mine (e.g., transport and enhanced moisture conditions), recent summer rain events and historical grazing impacts.

The species and distribution of weed infestations in and around Honeymoon mine reflect the past and contemporary disturbance and environmental conditions in the landscape associated with the establishment and operation of the mine, together with transport and pastoral impacts. Recent annual surveys concluded that infestations of weeds in and around Honeymoon mine were uncommon and typically confined to small localised populations at sites of high disturbance or favourable moisture conditions.

Introduced weeds at the mine site have established where high levels of soil disturbance, loss of perennial vegetation cover and enhanced nutrient and moisture conditions have provided an ideal location for weed infestations. Evidence of this can be seen particularly in areas adjacent to buildings and associated with the sewage treatment facilities that receive additional run-off from rainfall or retain water for prolonged periods. The main transport route from the mine site to Mulyungarie Road (see Figure 1.1) is a source for localised weed infestations. Trenches beside the road, associated with clearing the landscape, cause water to pool following rainfall events - the weed infestations found in and near Honeymoon mine are localised to these regions of extra water retention and pose a low risk of spread beyond their current distribution.

Weeds and introduced plant species can spread along drainage lines, roads and tracks where propagules are transported in from other areas either on vehicles or in water flows. The minor water catchment created by road formations is particularly susceptible to colonisation by introduced species. Continuous monitoring of vehicles and control measures will need to be taken to prevent weed infestations at Honeymoon mine.

3.12.4 Declared Weed Species at Honeymoon

There are seven declared weed species listed under the SA Natural Resources Management Act (2004) identified within the ML6109 and nearby areas (Table 3.9). Declared species are regarded as particularly invasive and pose significant economic and environmental risks, therefore requiring a level of mandatory control of their infestation.

Outside ML6109, the seven declared weed species were identified along the main transport route, surrounding dams and Mingary Creek. The weeds located along the main transport route are of most concern as they have the potential to be transferred through passing traffic. To reduce the transfer of seeds and propagules, checks are conducted on all new vehicles and plant equipment before they enter the mine site. The other main source of infestation is at Mingary Creek, where there is the potential to transfer seeds downstream. The impact of this on the Honeymoon mine is very low. Each of the seven declared weeds has its own potential impact for Honeymoon mine, so must be reviewed individually to determine the best management options.

The only declared species to be identified on the mine site were onion weed, horehound and Salvation Jane.

Scientific Name	Common Name	Weed Class	Requirements	Location
Xanthium occidentale	Noogoora burr	Class 2b	52(1), 52(2), 56(1),	Mingary Creek and main access road
Xanthium spinosum	Bathurst burr	Class 2d	52(2), 57(2)	Mingary Creek and main access road
Marrubium vulgare	Horehound	Class 3e	52(2), 57(2)	Mingary Creek, main access road and mine site
Echium plantagineum	Salvation Jane	Class 3h	52(2), 57(2)	Main access road and mine site
Asphodelus fistulosus	Onion weed	Class 7a	57 (2)	Mingary Creek, main access road and mine site
Lycium ferocissimum	African boxthorn	Class 2c	52(c), 57(2)	Mingary Creek
Tamarix aphylla	Athel pine	Class 11 weed of national significance	No action	Cummins Dam

Legend:

1. 52(1): requires control of entry and exit of this species by persons into another controlled area.
2. 53(2) requires control of entry and exit of this species along public road within a controlled area (including plants, animals, soil, vehicles or other plant carrying a plant of this class).
3. 56(1) if the landowner becomes aware of this species, they must notify the control board.
4. 57(2) the land owner is to control and keep control of all plants of that class on that land.

Table 3.9 Declared weeds at the Honeymoon mine and nearby areas

Noogoora Burr

The noogoora burr is a weed of national significance (WONS) and is notifiable throughout all of South Australia. This species causes major concern for the wool industry, with major vectors including sheep and waterways. The seed of noogoora burr require good contact with water to germinate, so its presence along the Mingary Creek is likely to be a sufficient pathway for this weed to disperse. While it is currently localised to the creek lines, swift management should be taken to prevent this species from infesting broader areas. With the Honeymoon mine now destocked, a great opportunity to eradicate the infestation of this species presents itself. It will be important to control this species prior to return to pastoral use, as it is poisonous to stock and can become difficult to control when established over large areas.

African Boxthorn

The African boxthorn poses a potential threat to Honeymoon mine and surrounding areas as it provides shelter for rabbits and foxes, and invades native vegetation after disturbance. Increased protection for pest animals increases their threat on native flora and fauna; therefore, it is essential to remove this species from its localised site at Mingary Creek. African boxthorn is extremely drought tolerant and is one invasive species that persists in arid environments. The berries from this species are readily eaten and dispersed by birds, and as a result are often found near water sources. In 2009, several infestations were recorded but these do not appear to have increased; 2010 surveys do not report any higher incidences of African boxthorn.

Bathurst Burr

The Bathurst burr can persist in dryland areas away from waterways; however, it requires adequate water to germinate. It doesn't appear to pose a threat to Honeymoon mine as its seeds are spread on wool. Given that the Kalkaroo Station is now destocked, the transport of seeds is unlikely. Movement along the main transport route via vehicles is a concern as this species was only observed along the main transport route where water from persistent rainfall has pooled. Bathurst burr was also recorded in high abundances at Mingary Creek, and this will remain most likely area of infestation. Control measures around this area will be required to ensure that this weed does not spread further through the waterway.

Athel Pine

Athel pine is particularly invasive in creeks and drainage lines. It can be a problem for water deposits as its deep roots can extract large amounts of water from the water table causing these water bodies to dry up. It also has the potential to increase salinity of the surface soil creating stress for less salt-tolerant plants. Athel pine would be unlikely to pose a major concern to Honeymoon mine as seed dispersal generally requires a flood event, with colonisation requiring a good water source. Before the removal of stock in 2009, Athel pine infestations were recorded adjacent to stock watering points near to the Honeymoon mine; 2010 surveys did not indicate any increase in sightings.

Onion Weed

Onion weed is invasive on roadsides, disturbed areas and overgrazed pastures. Seeds can be spread on vehicles, machinery, animals, wool, clothing and water. This species was observed at the mine site, along the main transport route and at Mingary Creek. Onion weed does not appear to be increasing in abundance, however, continuous monitoring will be important to ensure this weed does not persist in spreading across the mine site.

Salvation Jane

Salvation Jane poses a threat to soil quality if not controlled, as it smothers perennial grasses, then dies off leaving bare patches exposing soil to wind and water erosion in

summer. It is known to be toxic to livestock and if not controlled, will pose a threat to the return of Kalkaroo Pastoral Lease to an operational farm. This species was observed along the main access route with isolated species observed within the mine and around Hill Dam. The species will need to be controlled to prevent further dispersal from vehicles or water.

Horehound

Horehound invades disturbed native vegetation. It is of concern to pastoral leases as it contains burrs that contaminate wool and taints the meat of animals that eat it. At this stage, with the current destocked state of Kalkaroo Pastoral Lease, it does not pose a major concern. Seeds are dispersed mainly by stock and water; therefore, while the site is destocked it presents a good opportunity to eradicate horehound from the mining lease. There is also potential for this species to be transported along the main transport route, so continual vehicle checks are important in reducing the dispersal of this weed.

3.13 Fauna

The following summarises the relevant fauna studies that have been undertaken at Honeymoon mine to date:

- Flora, Fauna, Landform and Soils Study (RMP 1998). This report was prepared as part of the 2000 EIS and summarised information from a number of sources. The data was supplemented by extra opportunistic flora and fauna observations in August 1998.
- Fauna Assessment Honeymoon (EBS 2007). This report provides a fauna survey of the mine site and areas outside of the mine site using standard South Australian fauna survey techniques. It also reports other historic fauna records.
- Weed and Pest Survey (SKM 2009). This report documents the findings of a weed and vertebrate pest survey conducted in November 2009.
- Annual Flora and Fauna Survey (2010). This report documents the findings of an autumn flora and fauna survey following unseasonal summer rains and destocking from the lease. This survey provided an ideal opportunity to conduct additional flora and fauna investigations and to fulfil Uranium One's mining lease conditions to conduct routine, annual flora and fauna surveys in the impact areas and at control sites on a nearby neighbouring pastoral property (Yarramba Station).
- Annual Weed and Vertebrate Pest Survey. This report summarises the findings of an annual weed and vertebrate pest survey of the Honeymoon mine and associated mining infrastructure corridors. This survey was undertaken in May 2010 following unseasonal rainfall events and the removal of stock from the pastoral lease.

In addition to these studies, Uranium One conducted a comprehensive Baseline Ecological Condition Assessment in 2009, including an Ecosystem Function Analysis (EFA) prior to the start of construction (GHD 2009). The results from these surveys are summarised here, and a copy of the report is provided as Attachment G.

Database searches as part of the 2007 survey indicate that over 160 fauna species have been previously recorded within 40 km of the Honeymoon mine, as follows:

- 84 birds.
- 20 mammals.
- 55 reptiles.
- 3 amphibians.

There are three bird species of Commonwealth and South Australian significance whose range is known near Honeymoon mine; however, these species have not been recorded during surveys.

No mammals, reptiles or amphibians of national conservation significance have been recorded in the ML; however two species of Microchiropteran bats have been recorded 10 km east of Honeymoon mine at Mingary Creek. No suitable habitat for these species occurs in the ML. These species, further described in Section 3.12.2, include:

1. Yellow-bellied sheathtail bat (*Saccolaimus flaviventris*) - Rare (SA).
2. Little pied bat (*Chalinolobus picatus*) - Endangered (SA).

Two major fauna habitat types have been identified in the ML area. These include:

a) *Sclerolaena spp.* Limestone copperburr (*Sclerolaena obliquicuspis*) / pale poverty bush (*Sclerolaena cuneata*) – low very open shrubland on the flats with irregularly spaced clay pans or scalds.
b) Bladder saltbush (*Atriplex vesicaria*) / low bluebush (*Maireana astrotricha*) – low open shrubland on the low sandy rises.

Baseline surveys of the ML and neighbouring pastoral property (control sites) (at Yarramba Station) have recorded the following:

- 38 bird species.
- 16 mammal species (13 native and 3 introduced).
- 21 reptile species.
- 2 amphibian species.

Refer to Attachment E for the full species list.

Both habitat types were observed to have similar abundances of mammals and reptile species. The major difference was in species richness and abundance observed, but not between habitat types; rather between the grazed (control sites on the neighbouring property) and non-grazed (Honeymoon mine area), with a greater abundance of animals being recorded in the area surrounding Honeymoon mine.

3.13.1 Birds

Thirty-eight bird species have been observed at Honeymoon mine and along the access road to the Honeymoon mine during field surveys. The most common birds recorded during field surveys include:

- Rufous fieldwren (*Calamanthus campestris*).
- Brown songlark (*Cincloramphus cruralis*).
- White-winged fairy-wren (*Malurus leucopterus*).
- Richard's pipit (*Anthus novaeseelandiae*).
- Zebra finch (*Taeniopygia guttata*).
- Magpie lark (*Grallina cyanoleuca*).
- Budgerigar (*Melopsittacus undulates*).
- Nankeen kestrel (*Falco cenchroides*).
- Welcome swallow (*Hirundo neoxena*).
- Willie wagtail (*Rhipidura leucophrys*).
- Galah (*Eolophus roseicapillus*).
- Cinnamon quail-thrush (*Cinclosoma cinnamomeum*).
- House sparrow (*Passer domesticus*).

Refer to Attachment E for a full list of bird species surveyed at the Honeymoon mine.

No birds of conservation significance have been recorded during any field surveys; however, three birds of Commonwealth and State significance may reside near the Honeymoon mine (but have not been observed). These include:

1. Plains-wanderer (*Pedionomus torquatus*) - Endangered (SA), Vulnerable (Commonwealth).
2. Thick-billed grass-wren (*Amytornis textilis modestus*) - Rare (SA), Vulnerable (Commonwealth).
3. Slender-billed thornbill (*Acanthiza iredalei*) - Vulnerable (SA and Commonwealth).

Plains Wanderer

Endangered SA, Vulnerable Commonwealth

The preferred habitat of plains wanderers is sparse native grassland or old stubble with up to 50% bare ground where larger plants rarely exceed 30 cm in height and the bulk of the vegetation is less than 5 cm in height. These birds rely on camouflage for protection and prefer areas where their view of potential predators is not obstructed by low shrubs. The core distribution of the plains wanderer in South Australia is south of the River Murray, 300 km south of the Honeymoon mine (Baker-Gabb, 1990) in sparse grassland habitat. Their main stronghold is in the Riverina area of New South Wales. There is no evidence of local seasonal movement or migratory behaviour in this species (Baker-Gabb, 1990).

In an unpublished 'Birds Australia' report by Webster (Webster 1996), some areas of 'marginal habitat' were identified on central Kalabity Station (40 km west of Honeymoon mine), and south central Boolcoomata Station (27 km south of Honeymoon mine). Both areas were dominated by grasses. In the vicinity of Honeymoon mine, areas of low vegetation that may provide habitat are generally dominated by pale poverty bush and grasses are only present in significant populations after good rains.

Only scattered records of plains wanderers are known from the region (e.g., Boolcoomatta Station); however, the habitat at the mine site and in the immediate area is probably not suitable for supporting plains wanderers on a permanent basis.

Thick-billed Grasswren

Rare SA, Vulnerable Commonwealth

In South Australia, the eastern subspecies of the thick-billed grasswren is widespread from the Lake Frome basin west to the eastern Lake Torrens basin, northwest to near Leigh Creek and Marree, along the southern and western fringes of the Lake Eyre Basin (including the Davenport Ranges and near William Creek) and west to the Coober Pedy region. The thick-billed grasswren occurs in chenopod shrublands, especially shrublands dominated by saltbush (*Atriplex spp*.) and bluebush (*Maireana spp.*), sometimes among widely scattered trees (DEWHA 2009a).

The thick-billed grasswren usually prefers habitat with more *Maireana spp.* than found at the Honeymoon mine, but has recently been recorded in suitable habitat on the neighbouring property Boolcoomata Station.

Slender-billed Thornbill

Vulnerable SA, Vulnerable Commonwealth

The slender-billed thornbill (western) occurs in arid and semi-arid regions of southern Western Australia and arid regions of South Australia. Its known distribution extends from near Carnarvon in Western Australia, east though central Western Australia and across the Nullarbor Plains to Whyalla, Port Augusta and Port Davis in South Australia. The slender-billed thornbill (western) usually occurs in chenopod shrublands that are dominated by samphires or *Maireana* and *Atriplex* associations (DEWHA, 2009).

The slender-billed thornbill usually prefers habitat with a greater density of *Maireana spp.* than found at the Honeymoon mine, but suitable habitat is available nearby and this species has recently been recorded on neighbouring Boolcoomatta Station.

3.13.2 Mammals

A total of 16 mammal species have been recorded during fauna surveys in the Honeymoon mine site, and on neighbouring properties, including nine ground dwelling mammals and seven bat species. Of these, 13 were native species and three were exotic. No mammal species of national conservation significance have been recorded during field surveys at the mine site and neighbouring properties; however, two bat species with State conservation listings have been recorded at nearby Mingary Creek:

1. Yellow-bellied sheathtail bat (*Saccolaimus flaviventris*).
2. Little pied bat (*Chalinolobus picatus*).

Yellow-bellied sheathtail bat

Rare SA, Not Listed Nationally

The yellow-bellied sheathtail bat is a rare visitor to the arid and semi-arid regions of South Australia and is speculated to migrate during late summer and autumn. In its broader distribution across northern Australia and New South Wales, this species inhabits most environments from wet forests to deserts, but within South Australia, it is associated with chenopod shrublands (less than 1.5 m tall). It is known to roost in groups in tree hollows or buildings, but in treeless areas, utilises mammal burrows (DEC NSW 2010b).

Echolocation calls of this species were recorded at Mingary Creek 11 km from Honeymoon mine where it is likely that the open Eucalypt forest provides suitable roost sites. It is unlikely that this species would habituate the mine site given the lack of suitable roosting sites such as small mammal burrows and tree hollows; however, this species may occur as a transient utilising water bodies to drink from where no other suitable water is available. The yellow-bellied sheathtail bat is rarely detected due to its high flying habits (up to 20 m) and consequently little is known about its ecology and distribution.

Little pied bat

Endangered SA, Not Listed Nationally

The little pied bat occurs in arid and semi-arid regions of South Australia. The preferred habitat in South Australia is arid shrublands, in particular chenopod shrublands (less than 1.5 m in height) dominated by saltbushes (*Atriplex spp.*), bluebushes (*Maireana spp*.) and copperburrs (*Sclerolaena spp.*) (DEC NSW 2010a). These bats rely on tree hollows and rock outcrops / caves for roost sites. They can tolerate high temperatures and dryness but require access to open water in close proximity to roost sites. The distribution of this species extends only slightly into South Australia, with its core distribution located in Queensland and western New South Wales. Its habitat can include dry sclerophyll forest, open woodland, cypress-pine forest and mallee (Van Dyck Strahan 2008).

Echolocation calls for this species have been recorded at Mingary Creek 11 km from the Honeymoon mine where suitable roost sites exist. It is unlikely the mine site would support this species as roost sites are limited. Mingary Creek is the nearest area with habitats likely to support this species, as they prefer foraging along watercourses. Very little information exists about the behaviour and ecology of this species in South Australia.

Ground dwelling mammals that have been sampled or observed at Honeymoon mine are listed in the following sections, all of which are typical for the region:

Native Ground Dwelling Mammals

- Stripe-faced dunnart (*Sminthopsis macroura*), see Plate 3.7
- Fat-tailed dunnart (*Sminthopsis crassicaudata*), see Plate 3.8
- Bolam's mouse (*Pseudomys bolami*), see Plate 3.9
- Red kangaroo (*Macropus rufus*), see Plate 3.10
- Western grey kangaroo (*Macropus fuliginosus*)
- Euro (*Macropus robustus*).
- Short-beaked echidna (*Tachyglossus aculeatus*).

Plate 3.7 Striped-face dunnart (Sminthopsis macroura)

Plate 3.8 Fat-tailed dunnart (Sminthopsis crassicuadata)

Plate 3.9 Bolam's mouse (Pseduomys bolami)

Native Aerial Mammals

- Lesser long-eared bat (*Nyctophilus geoffroyi*).
- Gould's wattled bat (*Chalinolobus gouldii*).
- Inland forest bat (*Vespadelus baverstocki*).
- White-striped mastiff bat (*Tadarida australis*).
- Yellow-bellied sheathtail bat (*Saccolaimus flaviventris*).
- Little pied bat (*Chalinolobus picatus*).
- *Mormopterus sp*.

These Microchiropteran bats have been identified from their echolocation calls in the mine site and surrounding areas during surveys in 2007 and 2010. Gould's wattle bat was the most well recorded species (i.e., most calls recorded of any bat species).

Introduced Mammals

- Red fox (*Vulpes vulpes*).
- European rabbit (*Oryctolagus cuniculus*).
- House mouse (*Mus musculus*).
- Sheep (*Ovis orientalis aries var. merino*).

Refer to Attachment F for further information on pest animals.

Plate 3.10 Red kangaroo (Macropus rufus)

3.13.3 Reptiles and Amphibians

Twenty-one reptile species have been observed within the project area and in the area surrounding Honeymoon Mine. No species of conservation significance are known from the area or have been caught or observed during fauna surveys. The two most common reptile species captured and observed were the central netted dragon (*Ctenophorous nuchalis*) and the sandplain ctenotus (*Ctenotus schomburgkii*).

Plate 3.11 Ctenophorus nuchalis (central netted dragon)

Plate 3.12 Ctenotus schomburgkii (sandplain ctenotus)

No gecko species were recorded within the wellfield area but the following were found outside the wellfield area:

1. Pink-blotched gecko (*Diplodactylis byrnei*).
2. Tessellated gecko (*Diplodactylis tessellates*).
3. Beaked gecko (*Rhynchoedura ornate*).

Two amphibian species have been recorded during fauna surveys and opportunistically:

1. Painted burrowing frog (*Neobatrachus pictus*).
2. Spotted marsh frog (*Limnodynastes tasmaniensis*).

The painted burrowing frog occurs frequently in the Honeymoon mine area following rainfall events.

3.13.4 Pest Animals

Survey and opportunistic observations conducted in September 2009 and May 2010 found that three pest animal species occurred in the area surrounding the mine:

- Red foxes (*Vulpes vulpes*).
- European rabbits (*Oryctolagus cuniculas*).
- House mice (*Mus musculus*).

No feral cats (*Felis catus*) or dingos (*Canis lupus dingo*) were identified during the 2009 and 2010 surveys however anecdotal evidence from neighbouring pastoral stations has suggested that cats and dingos do occur from time to time. Whilst rabbit abundance was found to be generally low across the Honeymoon site and surrounding area, numbers were noticeably higher within the ML compared with those beyond. Evidence of fox activity both inside and outside the ML was similar in 2009 compared with 2010.

An integrated pest animal control program has been implemented for the Honeymoon mine and surrounding areas. This involves rabbit warren destruction via ripping, and baiting with poison oats within the ML, as well as a dog baiting program in co-ordination with the Arid Lands Natural Resources Management Board and surrounding landholders. Feral animal management will be an ongoing part of Uranium One's management initiatives throughout the life of the operation.

3.14 Ecosystem Function Analysis and Rehabilitation

Ecosystem function analysis (EFA) is a monitoring procedure used for the following purposes:

1. To assess the landscape trend when under stress and disturbance.
2. To monitor rehabilitation success.

3.14.1 Initial Monitoring

Initial monitoring provides baseline information about the function of an ecosystem. This information is used to calculate target values for rehabilitation of the sites studied, and to aid in distinguishing 'sustainable' from 'unsustainable' management (Tongway Hindley 2004). Initial monitoring provides the following benefits:

1. Enables better informed decisions about future monitoring.
2. Helps determine the effectiveness of rehabilitation works and any necessary alterations to rehabilitation activities.
3. Identifies problematic areas that may require further rehabilitation and remediation strategies.

3.14.2 EFA Implementation

EFA implementation focuses on three core aspects:

1. Landscape function analysis (LFA).
2. Vegetation and structure composition.
3. Habitat complexity.

Numerous monitoring indicators are used to establish how well the landscape is functioning as a biophysical system. The field indicators monitored reflect stability, water infiltration and nutrient cycling of the landscape and soil, each of which has a distinct significance for landscape function monitoring. These field indicators can be defined as follows (Tongway Hindley 2004):

- Stability – the ability of the soil to withstand erosive forces and to reform after disturbance.
- Infiltration/runoff – how the soil partitions rainfall into 'soil-water' (water available for plants to use), and 'runoff' water which is lost from the local system, or may also transport materials (soil, nutrients and seed) away.
- Nutrient cycling – how efficiently organic matter is cycled back into the soil.

Monitoring for EFA will be undertaken at the Honeymoon mine MLs and MPLs. This will provide an indication of the success of the rehabilitation works as well as allowing rehabilitation activities to be altered if results indicate that the landscape is not being restored appropriately. Monitoring will continue until the function of the impact sites returns to the level present prior to the area being impacted by mining activities (equal to the values exhibited by the control sites), or to a level which is agreed upon by Uranium One and the regulatory authority. It is a requirement that this EFA is undertaken when mine activities cease and rehabilitation works commence. These follow-up assessments will determine the effectiveness of the rehabilitation works and indicate any necessary alterations to rehabilitation activities.

3.14.3 Honeymoon Baseline EFA

Honeymoon mine has undergone a baseline EFA (GHD 2009) (Attachment G) to assess landscape function values for the areas currently being impacted by mining activities. This includes nine EFA sites within the ML and five sites along the transmission line MPL.

Four control sites were selected to represent the local landscape. These range from high to low function and will represent the level to which the impact sites are to be restored. The function of these control sites varies because the landscape across which the mine site and transmission lines reside is variable, with differences in soil types and historic grazing practices influencing the conditions of the landscape prior to mining activities.

The baseline results indicate that the landscape function of the impact sites at Honeymoon fall within the range exhibited by the control sites. These results may reflect a pattern associated with the removal of stock – increased vegetation growth due to the removal of grazing. The impact sites within and adjacent to Honeymoon exhibit only a slight variation in the level of landscape function. Two of these sites were impacted by mining activities when these baseline conditions were analysed. The mine site results indicate that live vegetation, litter patch and cryptogram patches provide the highest value for stability, infiltration/runoff and nutrient cycling and provide better functioning sites.

Along the transmission line (MPL 92) it appears the landscape condition decreases from southeast to northwest. The trend for the landscape condition to decrease to the northwest may be due to differing management activities used by each of the five pastoral stations that the transmission line overlies. Due to this difference in landscape function it is unlikely that the area of the transmission lines within the Honeymoon ML and MPLs will be rehabilitated to a function equivalent to that of the landscape within Mutooroo Pastoral Station, particularly if current management activities persist into the future. Due to this, two to four control transects within each of the pastoral stations were established so that the success of the rehabilitation activities can be determined based on the function of the landscape immediately surrounding the impact site within the powerline corridor.

3.15 Soil

All soils were classified using Northcote et al. 1975, Stace et al.1968 and the Principal Profile Forms (PPF) of (Northcote 1979).

The soil landscape unit is described as plains with some through drainage-ways. Chief soils are brown calcareous earths with some irregular shallow depression-type gilgai. There are Ug5.3 and Ug5.2 soils along the drainage-ways and in clay pans and flats. Three specific soil landscapes have been identified from field inspections (Southern Cross Resources 2000):

1. Plains with irregularly distributed clay pans or scalds; this soil sub-unit supports the pale poverty bush (*Sclerolaena divaricata*) low very open shrubland.
2. Irregular and often discontinuous low sandy rises; this soil sub-unit supports the bladder saltbush (*Atriplex vesicaria*)/low bluebush (*Maireana astrotricha*) low open shrubland. In places where the surface sandy layer is thicker needle bush (*Hakea leucoptera*) shrubland and purple-wood wattle (*Acacia carnei*) are found.
3. Small, randomly distributed canegrass swamps; this soil sub-unit supports the canegrass (*Eragrostis australasica*) tall grassland.

The soils in the area are known to be generally saline. Salinity has important implications for soil corrosively as it affects the process plant and infrastructure; especially where soils remain wet. Placement of mine infrastructure and airstrip on a major sandy rise has minimised the corrosive effects from soils. Generally, the soils are of relatively high strength throughout the mine area; however, they are susceptible to loss of strength when wet. In particular, the claypans and drainage areas can be impassable when wet.

3.16 Heritage

3.16.1 Indigenous Heritage

The Honeymoon mine tenements are situated on the plains of the Lake Frome Basin. Prior to settlement by pastoralists Indigenous groups occupied portions of the Lake Frome Plains on a temporary basis but lack of permanent water supplies prevented permanent occupation. Trails used by the Indigenous groups were mainly along the higher ground to the south of the Honeymoon site where waterholes along creeks, and rock holes in the hills provided more reliable supplies of water. The plains around Honeymoon mine would have been a 'short cut' between the northern Barrier Ranges and the hills of the Olary upland southwest of Honeymoon. After abnormally heavy rains, reliable supplies of water would have been available for several weeks at some locations on this stretch of plain.

National and internationally significant Indigenous sites are known to exist approximately 30 km south of the Honeymoon mine in the Olary Ranges and include:

- Significant rock art and rock engraving sites.
- Distinctive hunting hides made from piles of rocks.
- Surface scatters.
- Stone artefacts.
- Campsites.

Native Title

A Native Title Mining Agreement over the Honeymoon ML is held between Uranium One (formerly held by Southern Cross Resources) and the Adnyamathanha claimant group and has been held since 2002. Consultation with the Adnyamathanha Traditional Owners is a regular part of Uranium One's activities (see Section 3.16.1).

Honeymoon Archaeological Survey

An archaeological survey of the Honeymoon tenements was undertaken in 1998 by Huonbrook Environment and Heritage (Southern Cross Resources 2000). At the time of the survey, representatives of the Adnyamathanha Native Title claimants participated in archaeological investigations of the Honeymoon area. The Native Title claimants subsequently endorsed the findings and recommendations of the archaeological study. The survey of 1998 has been supplemented by a number of clearance surveys carried out across mining tenements prior to ground disturbance activities.

Archaeological and clearance surveys completed between 1988 and 2012 identified fourteen archaeological sites on the Honeymoon ML and MPLs. None of these fourteen sites were formally classified as site, objects or remains under the Aboriginal Heritage Act 1988.

All but one site on the side of the mine airstrip have been left undisturbed. Surface artefacts were removed from this one site, located on the side of the airstrip, following the approval of local Adnyamathanha representatives.

All remaining sites were assessed to be of moderate to low significance in the regional context, and are situated outside the boundaries of the Honeymoon mine site activities, and therefore unlikely to be disturbed by construction or operational activities.

While no formal protection from future disturbance is officially required for these sites, Uranium One will assist in protecting these sites from inadvertent or deliberate disturbance during the Honeymoon operational activities.

3.16.2 National Estate Listings

Pastoral activities dominate the cultural landscape in the Honeymoon mine tenements, and there are no European artefacts recorded that qualify as sites or artefacts under the Register of National Estate.

None of the Honeymoon mining tenements contain places that are listed in the Register of the National Estate, as defined by the Environment Protection and Biodiversity Conservation Act 1999. The nearest registered sites are at Bimba Hill (48 km southwest of Honeymoon), and Lake Namba (70 km northwest of the Honeymoon deposit). For further details refer to the Honeymoon Project Environmental Impact Statement (Southern Cross Resources 2000).

3.17 Proximity to Conservation Areas

State listed conservation areas closest to Honeymoon mine include:

1. Danggali Conservation Park (150 km south).
2. Lake Frome Regional Reserve (110 km north).

Given the large distance between Honeymoon and theses parks there is no likelihood of any impact to these areas.

In addition to the above mentioned State listed conservation areas there are two other conservation areas in the Broken Hill Complex Natural Resource Management area:

1. Boolcoomatta Reserve – privately owned and operated by the Bush Heritage Trust, located 28 km southwest of Honeymoon.
2. Bimbowrie Conservation Park– government owned conservation area located approximately 68 km south of Honeymoon.

While there are no formal ‘conservation reserves’ in the Honeymoon Mining Lease, MPL 92 extends over four Pastoral Leases and includes Boolcoomatta conservation area. Construction and operation of the power line within MPL 92 has been carried out with minimal vegetation clearance, which has resulted in minor visual impact.

Uranium One will work to identified opportunities to support ecological conservation in the local region through supporting the initiatives employed by neighbouring conservation areas. This may involve support environmental initiatives such as ongoing weed and pest control, and sharing of information arising from routine environmental surveys on the ML and MPLs.

3.18 Development Plan Area

The Honeymoon mine is located in ‘Land Not within a Council Area’. Honeymoon mine is within the ‘Remote Areas Zone’ of the ‘Far North’ and is subject to the Development Plan for that area.

The Development Plan states that the Remote Areas Zone is suited to the following uses:

- Pastoral.
- Conservation.
- Mining and remote townships.
- Settlements and Indigenous lands.
- Accommodating defence related activities.

Objectives of development within the zone include:

1. Protection of the conservation value of the region, including arid and wetland environments.

2. Sustained growth in mining, petroleum exploration and related activities, recognising the significance of mineral deposits throughout the region.
3. Development of petroleum/mining-related settlements and infrastructure located in areas that are not environmentally or culturally significant, sensitive, subject to hazards or within close proximity to townships or settlements.
4. Contribution to the desired character of the zone.

The development of the Honeymoon mine is within the desired character of the zone and meets the other key objectives of the plan as outlined. Details of how Uranium One will manage the environmental, social and economic aspects of the mining operation are provided in Section 6 of this document.

3.19 Pre-existing Site Contamination and Disturbance

Prior to construction of the Honeymoon mine, over 50 years of exploration activities and two trial in-situ leaching (ISL) operations were undertaken in the early 1980's and late 1990's to early 2000's. During this long history of exploration and trial mining a number of locations within the ML have been cleared of vegetation and/or vegetation and soils disturbed.

The two trial operations (early 1980's and late 1990's) generated both non-radioactive and low-level radioactive waste materials. A small proportion of the solid non-radioactive wastes, and all solid low-level radioactive wastes are currently stored on-site awaiting permanent disposal within the non-radioactive and radioactive waste facilities (to be established during construction of the mine). These facilities will be managed in accordance with the Environment Protection Act 1993 and the associated Guideline for the Environmental Management of Landfill Facilities (Municipal Solid Waste and Commercial and Industrial General Waste), and in accordance with the Operation Radiation Management Plan and Radioactive Waste Management Plan and the National Code of Practice for the Near Surface Disposal of Radioactive Waste.

In addition to mining and exploration activities, the land has been used for pastoral activities. Long periods of droughts and high stocking densities in the area have resulted in substantial modifications to the vegetation communities.

4 Description of the Operation

4.1 Background

As detailed in Section 1.1, the Honeymoon Uranium Project Environmental Impact Statement (EIS) was submitted by Southern Cross Resources in 2000 and approved in 2001. Mining Lease (ML) 6109 was granted shortly thereafter.

In 2007 a Construction MARP for the Honeymoon Uranium Project was submitted, and approved in 2008 (Uranium One, 2008) by Primary Industries and Resources SA (PIRSA), now the Department of State Development (DSD). Updates to the project design made following approval have resulted in a formal amendment to the Construction MARP being made and approved in 2010 (Uranium One, 2010c).

An Operational Mining and Rehabilitation Program (MARP) was developed and approved in April 2010 under the Mining Act 1971 (PIRSA, 2010). In July 2011 a Program for Environmental Protection and Rehabilitation (PEPR) replaced the requirement for a MARP, in line with the amendments to the Mining Act 1971 and associated regulations.

4.2 Reserves, Products and Market

4.2.1 Geological Environment

Refer to Section 3.9 for a full description of the geology and mineralogy of the Honeymoon site and ore deposit.

4.2.2 Reserves and Resources

Resources have been classified under the Joint Ore Reserves Committee (JORC) Code. The indicated resource in the Honeymoon deposit is 2,900 tonnes of U_3O_8 at an average grade of 0.24% and an average thickness of 1.7 m.

The East Kalkaroo deposit, also within ML 6109, contains an indicated resource of 910 tonnes of U_3O_8 at an average grade of 0.074% and an average thickness of 5.2 m.

4.2.3 Production Rate, Products and Market

The standard commodity to be mined at Honeymoon uranium mine will be uranium oxide concentrate (UOC), the unit price of which in December 2013 is around AUS$34.75/lb. Mine life is projected at seven years. Actual and scheduled annual production rates are shown in Table 4.1.

Production Year	Quantity (Lbs)
2011	68 000
2012	300,000
2013	600,000
2014	880 000
2015	880 000
2016	882 000
2017	778 000

Table 4.1 Actual and scheduled production rates

4.3 Mining Plan

4.3.1 Ongoing Resources and Exploration Drilling

Between 2011 and 2013, the focus of Uranium One's exploration efforts within and immediately surrounding Honeymoon mine included:

1. A ramp up of near-mine exploration of the Yarramba Paleochannel (around the Honeymoon and East Kalkaroo deposits).
2. Continued exploration and development of the potential resources at Gould's Dam and Billeroo in the Billeroo Paleochannel.

Further exploration is required over ML 6109, and MPL 15 to delineate current resources, explore the potential for new resources and test geological models. In order to define additional resources for the Honeymoon mine, additional exploration is required This will consist of mud drilling along the southern margin of the Yarramba paleovalley in the vicinity of Honeymoon mine. The drilling will work eastwards towards East Kalkaroo, then westwards towards Brook's Dam. The target aquifers are the incised Eocene Paleochannels (Eyre Formation) in the Proterozoic basement (Adelaidean and Willyama Supergroup); which are buried under 70 m of Miocene clay (Namba Formation).

The Billeroo Paleochannel will be the subject of further investigation to better define the Paleochannel outline. The proposed timetable for drilling work on the Billeroo Paleochannel has been outlined as a limited program in year one, ramping up in years three and four when new resources are defined.

The following describes the method employed for exploration drilling within the Honeymoon mine tenements.

Exploration drilling will be conducted using conventional rotary mud drilling rigs and carried out by appropriately licensed well drillers. All holes will be completed in accordance with guidelines M21 "Mineral Exploration Drilling – General Specifications for Construction and Abandonment" (PIRSA, 2010).

Exploration drilling is conducted as follows:

Site Setup

- A Landscape and Vegetation Clearance permit is required prior to any surface disturbance within ML6109. A Landscape and Vegetation Clearance permit identifies the location of the area of disturbance and total area (in m^2) to be cleared.
- Vegetation clearance will be minimised through careful site selection (vegetation abundance, maturity and significance). Any clearance will be undertaken using a raised blade above ground level to leave surface rootstock.
- Sump construction will be undertaken in accordance with the Uranium One Australia, Sump Construction Guidelines; which specifies a single drill sump will be excavated at each site which will measure approximately 2 x 4 m with a depth of 1.5 m.
- Where sumps are excavated, topsoil and subsoil will be stockpiled separately for later rehabilitation.
- Approximately 10 degree angled earthen ramps are installed to allow egress of entrapped fauna and visual inspection of sumps are made in the morning and evening. The sump will be constructed with an approximate 10 degree angle on one side, to all the animal egress.
- The sump will be fenced with temporary bunting to deter animals from entering the area.
- Safety signage is required in all drill site work areas.

Drilling Activities

- A hole, 125 to 165 mm in diameter is drilled below the base of the target ore zone, as determined by the supervising geologist. Drilling fluid and drill cuttings from the pilot hole will be retained in the sump.
- The hole is geophysically logged for parameters including gamma, conductivity, resistivity, and uranium grade using Prompt Fission Neutron (PFN) technology. The logs are then interpreted to provide information on the geology and the distribution of uranium in the sequence intersected by the hole.
- The site traffic management plan will be regulated to ensure crews stay on designated tracks and any required off track movement will be captured by a landscape and vegetation clearance permit and associated rehabilitation requirements.

Rehabilitation Requirements

- All drill cuttings and the top 5 cm of soil beneath, will be removed from the ground surface and transferred to the drill sump, 24 hours following completion of any drilling phase.
- The sump area will be backfilled, levelled and compressed to reinstate the original surface condition, then lightly scarified to facilitate natural regeneration of the site. This will occur as soon as practicable - once sumps are sufficiently dry.
- On completion, the drill hole will be cemented to within 2 m of the surface to prevent connectivity between aquifers. Any casing or pre-collar will be removed and the hole capped at 0.5 m below the earth's surface. Stockpiled soil will then be used to fill the remaining 2 meters and a 20 cm mound will be created above the drill hole.
- Where applicable, drill holes will be grouted with concrete.
- Progressive rehabilitation of tracks will be undertaken once new tracks are no longer needed. They will be levelled if necessary and lightly scarified in areas of compaction.
- All casing and drilling materials will be removed and any rubbish left at the site will be removed and disposed of at the mines waste handling facilities.

In most cases the clearing of vegetation from worksites is unnecessary, as the nature of the vegetative cover in the area does not require clearing before work. Rehabilitation works will be undertaken immediately following the completion of the exploration works, and audited by the site Safety, Health, Environment and Radiation (SHER) Department for compliance within three months, thereby not impacting on Significant Environmental Benefits (SEB) arrangements detailed in the Native Vegetation Plan (Attachment H).

4.3.2 Sequence of Mining Operations

Mining commenced in wellfields B and C during the second quarter of 2011 and commenced in wellfield A in 2012 (Figure 4.1). During 2012, Wellfield D was constructed with operations commencing in 2013.

4.3.3 Progressive Rehabilitation Program

The main objectives of the Honeymoon mine progressive rehabilitation plan, in line with conceptual closure objectives (see Section 8.8) are to:

1. Reduce ongoing rehabilitation liabilities by progressively rehabilitating all areas no longer utilised by mine activities; scheduling 50% of these areas annually.
2. Trial the effectiveness of revegetation methods, thus determining the best site specific remedial technique(s) for ongoing and final site rehabilitation.
3. Ensure the beneficial use of the Eyre Formation aquifer beyond the attenuation zone on closure by environmental fate monitoring and annual model validation (see Section 6.5).

The following measures will be employed as part of the Honeymoon mine progressive rehabilitation plan:

1. Planning/Record Keeping:
   - All areas of the mine site no longer required for operational activities (e.g., tracks, completed wellfields, exploration sites and any pre-existing historic disturbance) will be identified from Landscape and Vegetation Clearance permit records, and analysis of annual aerial imagery. These areas will be added to the rehabilitation register, used to schedule rehabilitation works.
   - A GIS system will be employed to physically map out and identify areas on the rehabilitation register. This system will identify areas requiring treatment for residual contamination (radiological or chemical), or rehabilitation. In addition the system will track the progress of revegetation sites.
2. Contamination Treatment:
   - Areas identified with residual contamination will be treated and/or disposed, ensuring effective remedial techniques and limiting the quantity of treatment required on closure.
3. Earthworks:
   - The site will be re-contoured to reinstate any natural gradients, and stockpile topsoil/soil will be respread where available.
   - The area will then be lightly ripped to improve soil structure, stability and rainfall infiltration.
4. Revegetation
   - Revegetation trials will be undertaken to assess the most effective method of re-establishing native, local vegetation species in disturbed areas.
   - Revegetation works will use the methods identified as being most effective e.g. ripping, direct seeding.
5. Assessment:
   - Ecosystem Function Analysis (EFA) will be undertaken annually within revegetation sites and on completion of operational activities.
   - An annual review will be undertaken as part of compliance reporting, to assess the actual rehabilitation undertaken against targets, and to assess the success of the various remedial techniques.

Further detail on progressive rehabilitation activities, and proposed rehabilitation associated with the conceptual closure program are provided in Sections 6 and 8.

4.4 Mining Operations

4.4.1 Modes and Hours of Operations

The mine will operate 24 hours a day, 365 days a year on a fly-in, fly-out basis using commercial charter flights.

4.4.2 Workforce

Operations at the Honeymoon Mine will employ a workforce of approximately 80 people, with two rosters of approximately 40 staff each. The operation will have two 12-hour shifts. The day shift will deploy two thirds of the workforce and the night shift the remaining one third of the workforce. A further 12 contract positions for drillers and caterers will be created and at least two off-site positions (Adelaide based).

The recruitment process began in early 2009, with the majority of the workforce from South Australia. Focused employment campaigns have been undertaken in northern regional

South Australia/New South Wales, with the company maintaining a proactive policy in indigenous employment.

Uranium One Australia established an office in Broken Hill in August 2006 to support mine activities, community engagement and recruitment initiatives.

4.4.3 Types of Mobile Equipment

Table 4.2 lists the mobile equipment used at the Honeymoon Uranium Mine.

Mobile Plant	Qty	Mobile Plant	Qty
Toyota Hilux 4x4 Cab Chassis	6	Hockney 40,000 L Water Tanker	1
Mitsubishi Triton 4x4 Cab Chassis	1	JCB Backhoe Loader	1
Toyota Landcruiser 4x4 Wagon	2	Cat 930 Loader	1
Hino 4x4 Fire Truck	1	Cat 12G Grader	1
Toyota Landcruiser 4x4 cab/chassis	1	Yanmar Mini Excavator	1
Toyota Hiace Bus	1	Steelweld Roller	1
Toyota Landcruiser 4x4 Ambulance	1	Trailers	6
Forklift 2 Ton 4x4 Michigan	1	John Deere 250 KVA Genset	1
Forklift 2.5T Gas Crown	1	Perkins 50 KVA Genset	2
Forklift 3T - Manitou	1	Perkins 165 KVA Genset	1
Telescopic 3T Forklift – Manitou	1	Perkins 400 KVA Genset	2
Franna 20T articulated crane	1	Multipac 20T Roller	1
Kenworth T600 Prime Mover	1	Vermeer vacuum Trailer	1
Mercedes Hiab crane truck	1		

Table 4.2 Honeymoon Uranium Mine Mobile Equipment

4.5 In-Situ Recovery Operations

4.5.1 Process Summary

In-situ recovery (ISR) is a closed loop system that involves the injection of an acidic leach solution containing an oxidant, which is delivered through injection wells into the uranium-bearing strata (see Figure 4.1 and Figure 4.2 for leaching and ISR processes). This solution migrates through the sands, oxidising and mobilising the uranium into a soluble complex. This pregnant leach solution (PLS) is intercepted by production wells located between the injection wells and pumped to the surface. The solution is passed through a processing plant that extracts the uranium by solvent extraction (SX). After processing, the barren leach solution (BLS) is returned to the wellfield to continue the leaching cycle.

In-situ recovery does not involve excavation of open pits or underground mines and all activities requiring operators take place on the surface. On completion of uranium recovery, the wells will be plugged (partially filled with cement), cut off below the surface and the area and back-filled. Process facilities will be removed and the land surface rehabilitated leaving little or no evidence of the uranium mining activities.

Major characteristics of ISR include:

- Minor surface area disturbance.
- Minimal generation of overburden or mine wastes.
- Energy efficient.
- Limited visual impacts.

- Simple processing (no crushing or grinding), and simple building structures and foundations.
- Limited radiological exposure of the ore body to the atmosphere.
- Negligible dust generation.
- Simple surface remediation following closure.

Patterns of vertical bores/wells form wellfields; the wellfield design at Honeymoon is based on a 5-spot pattern. Each wellfield will be controlled from a wellhouse and, a computerised control centre used to manage the 16 extraction and 48 injection wells. Two online wellfields will be required to produce an average PLS flow-rate of 686 m^3/h, and an average PLS grade of 75 mg/L U_3O_8.

A reticulation system will deliver BLS to the wellfields, and PLS to the processing plant for uranium extraction. The reticulated system includes trunklines, control centres and solution feeder lines. PLS is intercepted by production wells located between the injection wells, and pumped to the surface.

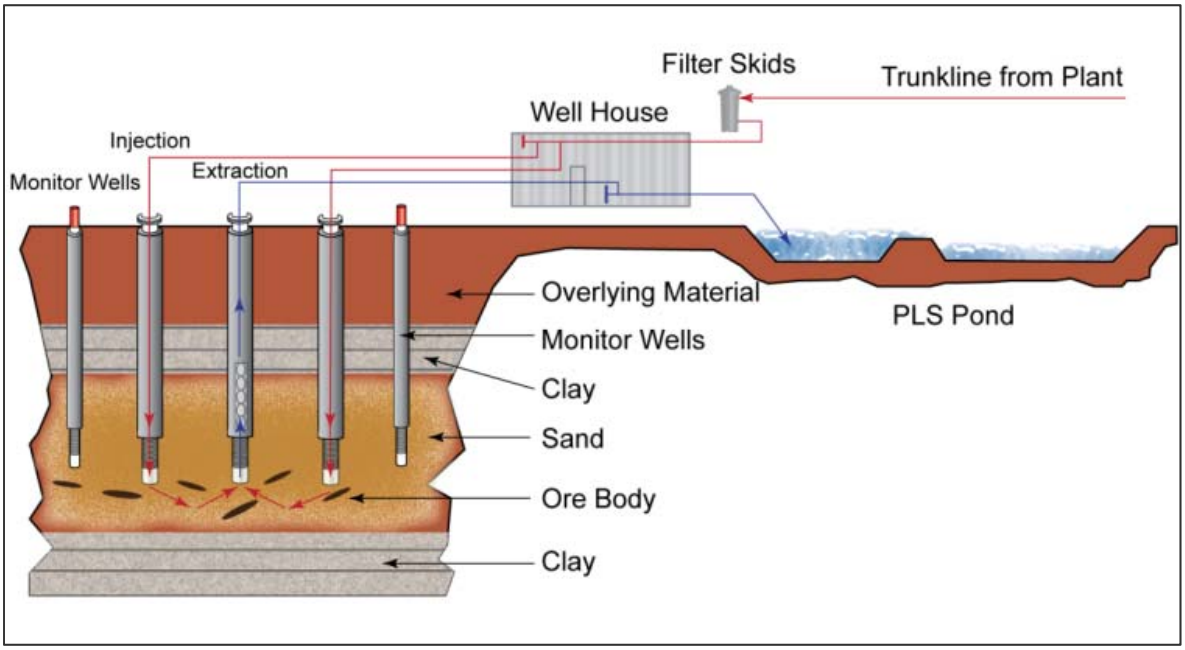

Figure 4.1 Summary of the leaching process

The processing plant is designed to produce 400 t/a U_3O_8, equivalent as uranium peroxide ($UO_4 \cdot 2H_2O$).The processing plant will operate 24 hours, 365 days per year. The processing and extraction process is summarised in the following sections.

Pregnant leach solution is clarified in a settling pond (PLS pond). The PLS pond will be 80 m long by 130 m wide. Settled solids within the PLS are retained and eventually disposed of. Clarified PLS is transferred to two Bateman Litwin pulsed columns, where a kerosene-based organic mixture (Shellsol D70, Amine, D2EHPA, tributyl phosphate (TBP)) extracts the uranium from the PLS. The uranium-bearing organic mixture is then processed through a scrubbing and stripping circuit (strip and scrub mixer settlers), where dissolved iron (waste by-product) is precipitated and removed from the uranium bearing solution by thickening. Iron precipitate is continuously removed from the Loaded Strip Liquor (LSL), with acid digestion of the thickened precipitate. The leachate is recycled to the PLS pond.

The clarified (iron free) uranium solution is pumped into a batch tank where precipitation takes places through the addition of sulphuric acid, hydrogen peroxide and air, producing uranium peroxide (yellowcake) slurry. Yellowcake slurry is produced in three precipitation

tanks, each with approximately 10 hours residence time at average flow-rates, and thickening to 35% w/w solids density.

Yellowcake slurry is pumped into a thickener, where uranium peroxide particles settle out at an underflow density of 35% solids and overflow solution is recycled. The yellowcake slurry is then transferred to a yellowcake storage tank located in the drying and packing plant.

In the drying and packing plant, thickened yellowcake slurry is dewatered in a pressure filter and then dried in a screw-type dryer before being discharged into a hopper for packing in 205 litre steel drums before being placed into sea containers for road transport to Adelaide then exported.

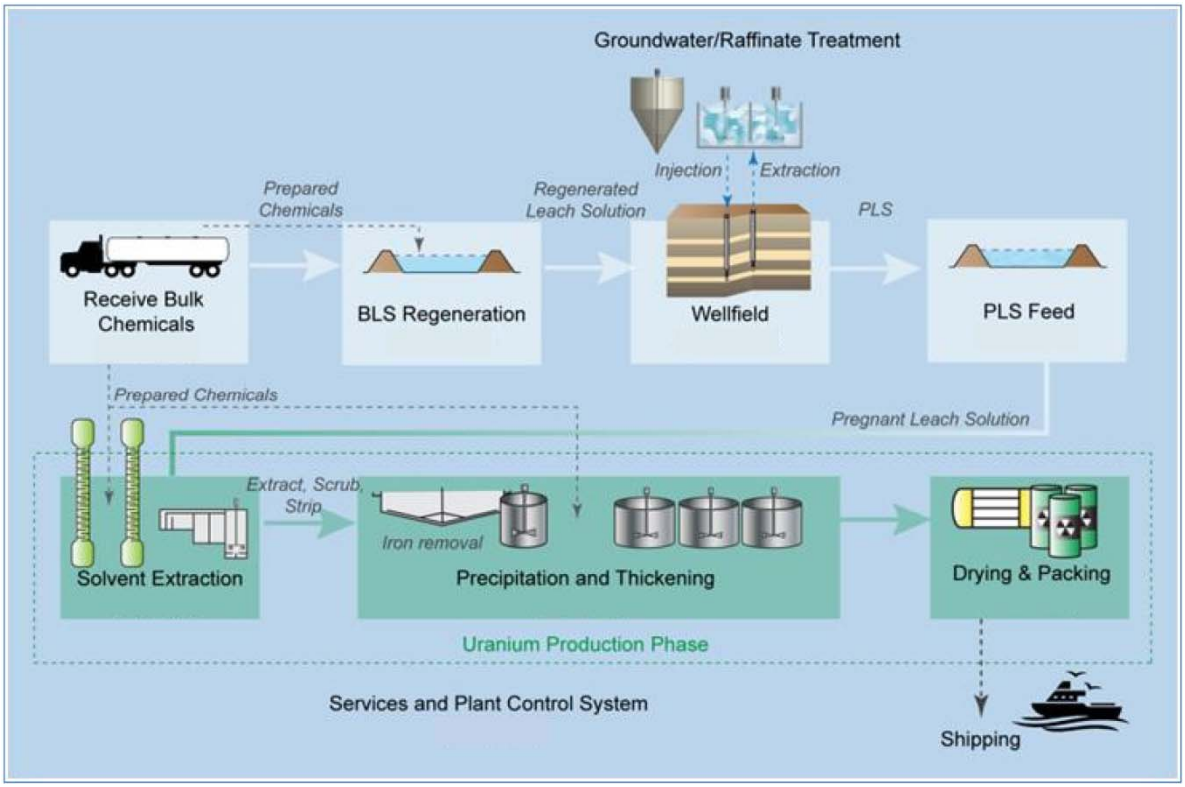

Figure 4.2 Overview of the uranium production process

4.5.2 Operational Components

Main processing and infrastructure components include the:

- ISR Wellfield.
- Solution ponds.
- Groundwater/raffinate treatment plant.
- Processing plant.
- Drying and packing plant.

Supporting facilities/infrastructure include:

- Waste disposal facilities.
- Electricity transmission line.
- Groundwater monitoring network.
- Laboratory.
- Workshops.
- Administration buildings.

- Accommodation, Mess and recreational facilities.
- Sewage treatment plants.
- Raw water supply bores.
- Reverse osmosis (RO) plant(s), raw and potable water tanks.
- Site access roads.

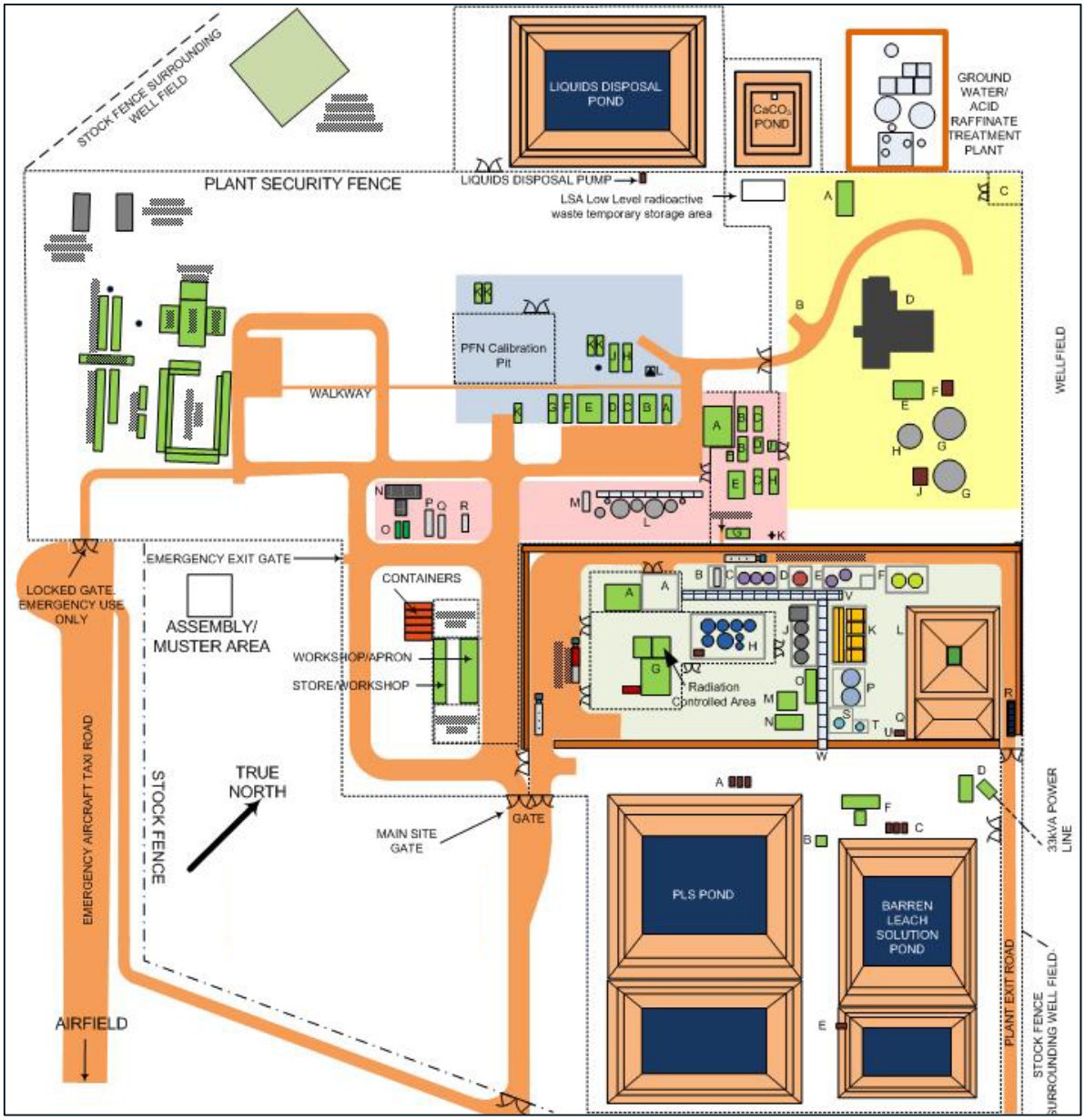

Figure 4.3 Site plan of main mine site (excludes wellfields)

4.6 ISR Wellfields

The wellfield area is comprised of the following components:

- Wells.
- Wellhouses and filter skids.
- Reticulation system.
- Earthen bunding.

Plate 4.1 View of Wellfield C

4.6.1 Well Types

There are four types of well used at Honeymoon, each with a different function):

1. Production (Extraction).
2. Injection.
3. Disposal.
4. Monitor.

Production wells are fitted with an electric submersible pump for extracting groundwater for treatment prior to mining, raffinate treatment and recovering PLS from the ore deposit. The drilled hole is lined with a polyvinyl chloride (PVC) casing and fitted with a screen assembly, designed to reduce the amount of solids entering the extraction plant.

Injection wells are used for injecting BLS into the ore deposit. The drilled hole is lined with a PVC casing and fitted with a screen assembly at the ore zone.

Disposal wells are used for the injection of brine from the RO treatment and process wastes into the Basal Aquifer. Liquid waste generated from processing activities and RO plants will be generated at approximately 900 m^3/day. All liquid waste will be directed into the LDP prior to injection. The liquid disposal wells will be constructed according to national and international standards for well construction and integrity testing (i.e., minimum construction requirements for water bores in Australia (2003) DSD M21 and NUREG-1569 (NRC, 2003). Liquid disposal wells are discussed in detail in Section 4.10.2.

4.6.2 Well Construction

All injection, production, liquid disposal and monitoring wells have been installed using conventional mud rotary drilling rigs and well-completion procedures in accordance with the ‘General Specification for Well Construction Modification and Abandonment in South

Australia' Pursuant to 'Well Construction Permit Issued under the Natural Resources Management Act 2004'.

The typical well construction method employed consists of:

1. A pilot hole, 125–165 mm in diameter is drilled to approximately 3 m below the base of the target ore zone, as determined by interpretation of data from previous exploration drill holes and adjacent wells. Drilling fluid and drill cuttings from the pilot hole and subsequent reaming will be placed in single pits approximately 8 m x 2 m x 2 m deep, located adjacent to the hole. The pits will be subsequently backfilled and rehabilitated.
2. The hole is geophysically logged for parameters including gamma, resistivity, conductivity, and uranium grade using Prompt Fission Neutron (PFN) technology. The logs are then interpreted to provide information on the geology and the distribution of uranium in the sequence intersected by the hole.
3. Production and monitoring wells are then reamed to a diameter of 125–250 mm.
4. The hole will be cased with 100–180 mm inside diameter PVC to above the targeted ore zone.
5. The annular volume between the casing and the reamed hole will be pressure cemented to the surface with sulphate resistant cement slurry, to prevent vertical migration of ground water and leach solution between adjacent aquifers
6. An inflatable packer will be installed at the base of the casing, and then an integrity test (pressure test) will be performed on the well casing at 700 Kpa.
7. Following pressure testing, the 'well screen' assembly will be fitted. This will either be accomplished in a telescoping operation or be installed after under reaming has provided access to the mineralised zone providing solution access to the highly permeable sands at the base of the ore zone.
8. Following screen insertion, and to ensure the well casing has not been damaged by the drilling rods or drill bits, an inflatable packer system will re-test the integrity of the casing length.
9. Each well will be re-integrity tested at 4 yearly intervals during its operational life, and after undergoing any maintenance work involving a drilling rig.
10. The well will be 'developed' by circulating and air lifting to remove fine sand, silt and clay from the 'completed' zone and thereby improve its hydraulic efficiency. The naturally saline and radioactive ground water and silt produced during well development will be transferred to the liquid disposal pond.
11. An electric submersible pump will be installed in each production well.
12. After the highly permeable zone has been mined the pumps will be removed from the production wells and the screens in both the injection and production wells will be plugged using bentonite slurry. The wells will then be reamed at the appropriate levels and screens inserted to provide solution access to overlying mineralized zones.
13. Holes that are not completed as wells will be backfilled with cement to prevent inter-aquifer cross contamination.
14. Where required, routine maintenance on all wells will be undertaken to clean well and screens, and or improve flow rates.

Monitor wells have been constructed with 100 mm inside diameter casing and associated screened interval over the entire section of either Upper or Basal Member. The wells are then fitted with micro purge sampling systems that enable representative samples to be collected from screened interval without purging of the entire monitoring well column. Groundwater samples are extracted at a rate of less than 1 L/s, minimising any potential drawdown.

4.6.3 Wellfield Design

The wellfield design for the Honeymoon mine has historically been based on the '7 spot' pattern, consisting of six injection wells surrounding a centrally located production well in a hexagonal configuration. Based on the May-June 2009 geologic evaluation, a revised '5 spot' pattern configuration was designed, resulting in Uranium One proceeding with a '5 spot' wellfield design as the fundamental pattern configuration (see Figure 4.4). The '5 spot' configuration lends itself to future individual pattern alternatives by increasing injection well numbers to create a hybrid wellfield of 5, 6 and 7 spot arrangements, where local geology/hydrogeology dictates the necessity.

The new '5 spot' pattern is designed to cover approximately the same resource area while reducing the number of wells to cover the deposit. The '5 spot' pattern design is comprised of 165 injection wells and 96 production wells, for a total well count of 261 wells with an approximate 25 m spacing between wells as shown in Figure 4.4 below.

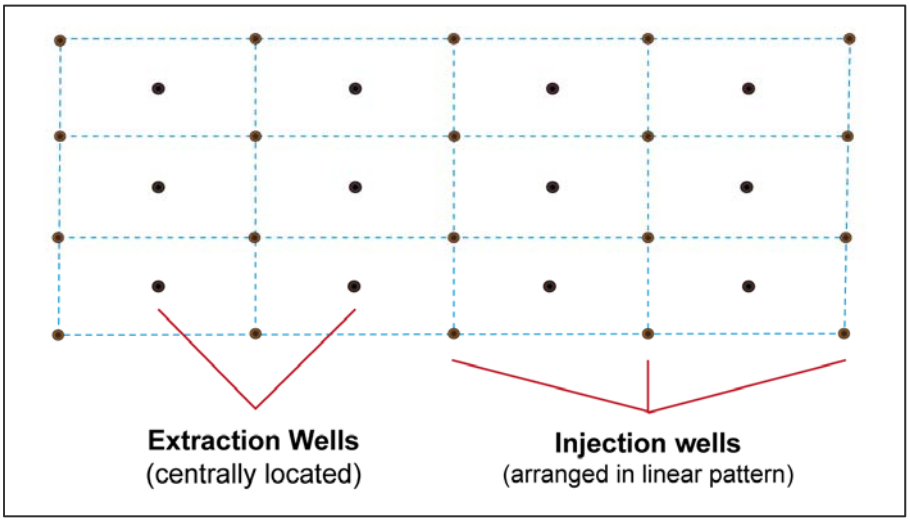

Figure 4.4 Examples of the basic '5-spot' pattern

4.6.4 Wellfield Control and Filtering Systems

Wellhouses

Wellhouses are containerised, skid-mounted control centres, which act as collection and distribution interfaces between groups of wells and the process plant (see Figure 4.5 and Plate 4.2). There are currently four wellhouses within the Honeymoon wellfield, used for controlling flow rates, blending solutions and monitoring solution chemistry. Each wellhouse supports sixteen extraction and 48 injection manifolds, mains manifolds and associated instrumentation to regulate and monitor fluid circulation.

Wellhouses are divided into two compartments, a power and control centre, and a monitoring and sampling (wet) end. The power and control centre consists of a high voltage (11 kV to 415 V) transformer and electrical distribution system for the control of well pumps, data acquisition and provide local controls. The 'wet' end consists of valves, meters and sensors for each of the production/ extraction wells and trunklines.

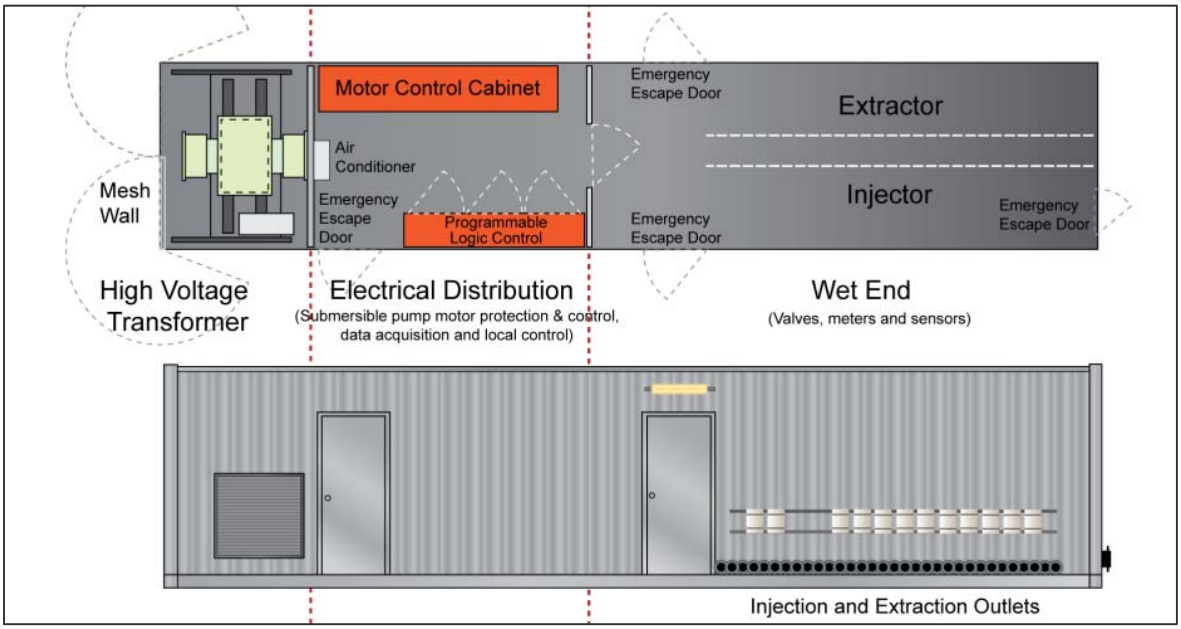

Figure 4.5 Wellhouse layout

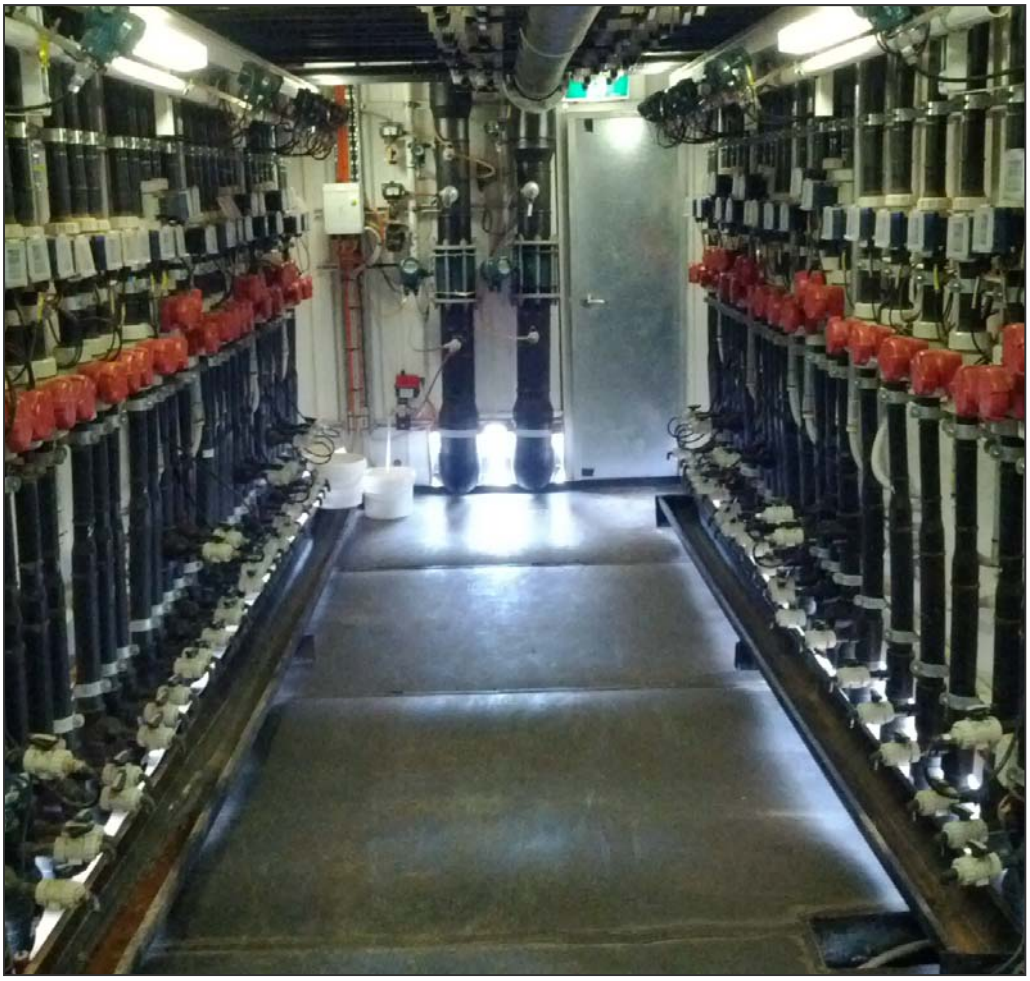

Plate 4.2 Inside a wellhouse at Honeymoon mine

The wellhouses are fitted with a computer control system, which will ensure that any significant leak (reduction in flow/pressure) within the reticulation system is promptly detected and the appropriate sections of the system are automatically shut down. Manual shut down options are also available in case of a computer system failure.

A typical wellhouse contains transformers and electrics, pump control, filters, valves, flow meters, leak detection devices and pressure sensors. Each wellhouse is pressure tested to 6 bar (608 kPa). Injection and production wells are connected individually to injection and production manifolds at the control centres, via butt-fused high density polyethylene (HDPE) pipes. The control centres are connected to the process plant via HDPE injection and production mains.

Each wellhouse has a bunded floor and drip trays under the sampling points, these measures prevent external spills and ensure washdown water can be contained. Both the floor and drip trays drain into a collection sump that is channelled into submersible storage tanks, that is routinely emptied. Each wellhouse is fitted with a safety shower which also drains into the submersible storage tank.

Trunk and feeder lines connecting the wellhouses to wells and/or process plant are laid on the surface, or buried in shallow trenches in areas along transport corridors. Power is fed to the wellhouses from the motor control cabinet (MCC) by an underground 11 kV cable network.

Filter Skids

Each wellhouse is fed with BLS from the BLS pond by a dedicated filter skid.

The filter skid acts as a final filtration point for BLS fluids to remove any suspended particulates prior to distribution and injection (see Plate 4.3). The filter skids use multiple parallel duplex cartridge filters made from glass reinforced polypropylene. The filters contain removable filter bags to capture solid entrained particles, including $CaCO_3$ and $CaSO_4$, to prevent screen blockages and other process plant debris, which are detrimental to ISR operations.

The individual filter cartridges can be bypassed/shut-off and drained to a local sump to allow cleaning or replacement of the internal filters. Local pressure gauges are installed on each cartridge to indicate when cleaning and/or bag replacement is required.

Filter skids are fitted with a basal drip tray to capture any fluids lost during routine bag changes and or cleaning. This drip tray drains into the submersed storage tank.

Filter skids have been static pressure tested to 1000 kPa.

Plate 4.3 Filter skids used at Honeymoon mine

4.6.5 Wellfield Reticulation System

The purpose of the wellfield reticulation system is to deliver BLS to the injection wells and to return PLS from the wellfield production wells to the process plant for uranium extraction.

The reticulation system is managed by a computer controlled system in the wellhouses, which detects any significant leak within the reticulation system and automatically shuts down the appropriate sections. Manual shut down options are also available in the event of a computer system failure.

The wellfield reticulation system consists of:

- Trunk lines.
- Feeder lines.
- Extraction lines.
- Injection lines.

Reticulation lines have been generally located at ground level for minimal surface disruption and easy removal once leaching has been completed. Some pipes are buried due to local conditions or access considerations. All reticulation pipes are designed to be removed on completion of production in each wellfield.

The injection and production trunk and feeder lines connecting the wellfield control centre and the plant are ultra-violet (UV) stabilised HDPE pipe. All lines will be tested with native groundwater prior to being placed in service to confirm the integrity of each welded and flanged joint.

Injection and extraction trunk lines feed process fluids, BLS and PLS between the process plant and the wellhouses, via feeder lines. Trunk lines are comprised of 450 mm (internal diameter) HDPE pipe and are pressure tested to 1,000 kPa (gauge pressure). Trunk lines are mounted above ground on concrete sleepers, which are spaced at approximate 3 m apart.

Feeder lines connect the trunk lines to the wellfield control centres (wellhouses). They are made of 250 mm HDPE pipe and pressure tested to 1,000 kPa.

Injection and extraction lines connect each wellhouse to the individual production and extraction wells. They are made of 90 mm HDPE pipe and also pressure tested to 1,000 kPa.

4.6.6 Wellfield Layout

The wellfield is divided into seven mining zones, or wellfields A to G (see Plate 4.1). The extent of each wellfield may vary and/or additional wellfields may be identified following further geological interpretation and additional near mine exploration drilling.

4.6.7 ISR Wellfield Operations

An ISR wellfield selectively extracts uranium from the deposits by a continuous leaching process. Leach solution is injected into the ore zone via injection wells, and drawn to production wells, dissolving uranium as the solution passes through the host sand between the wells. The uranium-bearing solution is then pumped from the production wells to the process plant where the uranium is recovered; the leach solution is reconditioned and recirculated continuously to the wellfield as leach solution. This is shown schematically in Figure 4.2

Barren leach solution will be introduced into the ore zone via injection wells at an average rate of 2 L/s, depending on the permeability of the Basal Member surrounding the wells. The injection pressure will be approximately 150 kPa for a new well. This will increase with time as the well screen becomes fouled. When the injection pressure reaches 400 kPa the well will be shut down, cleaned out, and returned to service. It should be noted that the major pressure drop is across the well screen, the structure is unlikely to be exposed to a static pressure increase of more than 200 kPa which is well below the fracture pressure of the overlying clays of the Namba Formation.

The leach solution will comprise groundwater from the Basal Member, acidified with sulphuric acid (H_2SO_4) to a pH of approximately 2.0 to 2.5, and sodium chlorate ($NaClO_3$) added as an oxidant. The leach solution will oxidise uranium minerals and dissolve them as sulphates in the form $UO_2(SO_4)_3^{-4}$. Typical analyses of the PLS is shown in Table 4.3.

The proposed injection and production rates for the wellfield patterns will result in a leach-solution retention time in the ore zone of approximately six days. The shortest path time is expected to be approximately one day. The proposed injection rates will result in only a small increase in hydrostatic head because of the highly transmissive nature of the ore zone.

Pregnant leach solution will be pumped from the production wells at a nominal rate of 6 L/s. The production well pumping rate will always maintained at a high level than the injection rate in each pattern. Over extraction of production fluids will maintain of a positive inward hydraulic gradient towards the production wells, and thereby prevent excursion of leach solution from the active mining zone. The overproduction will be removed as a ‘bleed’ stream from the BLS pond following removal of the dissolved uranium in the process plant. The bleed stream will be injected into the Basal Member from the liquid disposal pond via liquid disposal wells.

Analyte	Unit	Pregnant Leach Solution	
		Average	Range
U	mg/L	75	20 - 500
Fe	mg/L	260	110 - 370
SO_4	mg/L	5,300	3,580 - 6,800
Cl	mg/L	8,470	7,650 - 9640
Ca	mg/L	940	400 - 1,050

Analyte	Unit	Pregnant Leach Solution	
		Average	Range
Mg	mg/L	210	90 - 460
Zn	mg/L	110	80 - 130
Na	mg/L	6,170	5,150 - 7,200
HCO_3	mg/L	<5	<5
Ra-226	Bq/L	830	510 - 1,300
TPH	mg/L	2.21	0.25 – 4.1
PAH	mg/L	0.39	0.01 - 44.1
pH	Mg/L	2.1	2 – 2.2
TDS	mg/L	16,430	15,300 - 20,000

Table 4.3 Chemical analysis of pregnant leach solution groundwater

As the uranium mineralisation is present in different horizontal zones, wellfield injection screens may be reset in conjunction with the extraction pumps to mine these different zones into the Basal Member.

As the wellfield mining proceeds, the uranium production from individual patterns will eventually fall below economic levels. Patterns in leached-out areas will be shut down and new patterns in unleached areas brought on-line to maintain the designed process plant feed rate of 192 L/s. This will result in the gradual 'migration' in ISR across the wellfield. Selected wells in each exhausted wellfield pattern will be converted into monitoring wells to allow the early verification of groundwater attenuation and dispersion modelling (see Section 6.5).

Development of the Honeymoon ISR wellfield commenced in Wellfields A, B and C, the area north of the processing plant.

Wellfield Mining Fluid Containment and Contingency Measures

Environmental monitoring wells will be used to maintain a continuous check of groundwater quality outside the mining zone and identify any unintended horizontal and vertical excursion of leach solution. An excursion is defined as the movement of leach solution outside the area of leach activity and can be detected by changes in groundwater chemistry, such as a lowering of the pH and/or increases in uranium or sulphate concentrations (see Section 6.5.6).

4.7 Groundwater and Raffinate Treatment

4.7.1 Introduction

The ISR target aquifer, the Eyre Formation Basal Sands, has been identified with high levels of naturally occurring calcium, with average values of 870 mg/L (see Section 3.10.4). High calcium levels can result in the formation of the mineral gypsum ($CaSO_4$) during the acidification process.

A number of operational risks exist where gypsum precipitation occurs; namely reduced uranium recovery through blockages of well screens and other equipment, and decreased permeability in the host aquifer preventing adequate flow through in the ore zone.

In order to assess the actual operational risks associated with gypsum precipitation, geochemical modelling was undertaken using baseline Basal aquifer groundwater to assess the potential gypsum saturation changes, at varying pH levels (SKM, 2010b). The geochemical modelling produced a set of gypsum saturation indices as a function of Ca concentration and pH. These indices demonstrated that mining operations undertaken

under a pH range of 2.75 to 3, Ca concentrations of up to 800 mg/L would likely prevent the solution becoming oversaturated. With a reduction in Ca levels to 600 mg/L a wider pH operating level of 2 to 3 could be maintained. Any further reduction in Ca levels below 600 mg/L would allow pH levels to be reduced to 1.5 without the oversaturation and precipitation of gypsum.

In order to reduce calcium concentrations in the Basal Sand aquifer, a specific Groundwater and Raffinate Treatment Plant (GRTP) (see Figure 4.6) has been constructed to undertake initial groundwater treatment; reduction of calcium concentrations in the groundwater in the first instance, and raffinate treatment; maintenance of low calcium concentrations in the groundwater over the life of the mine.

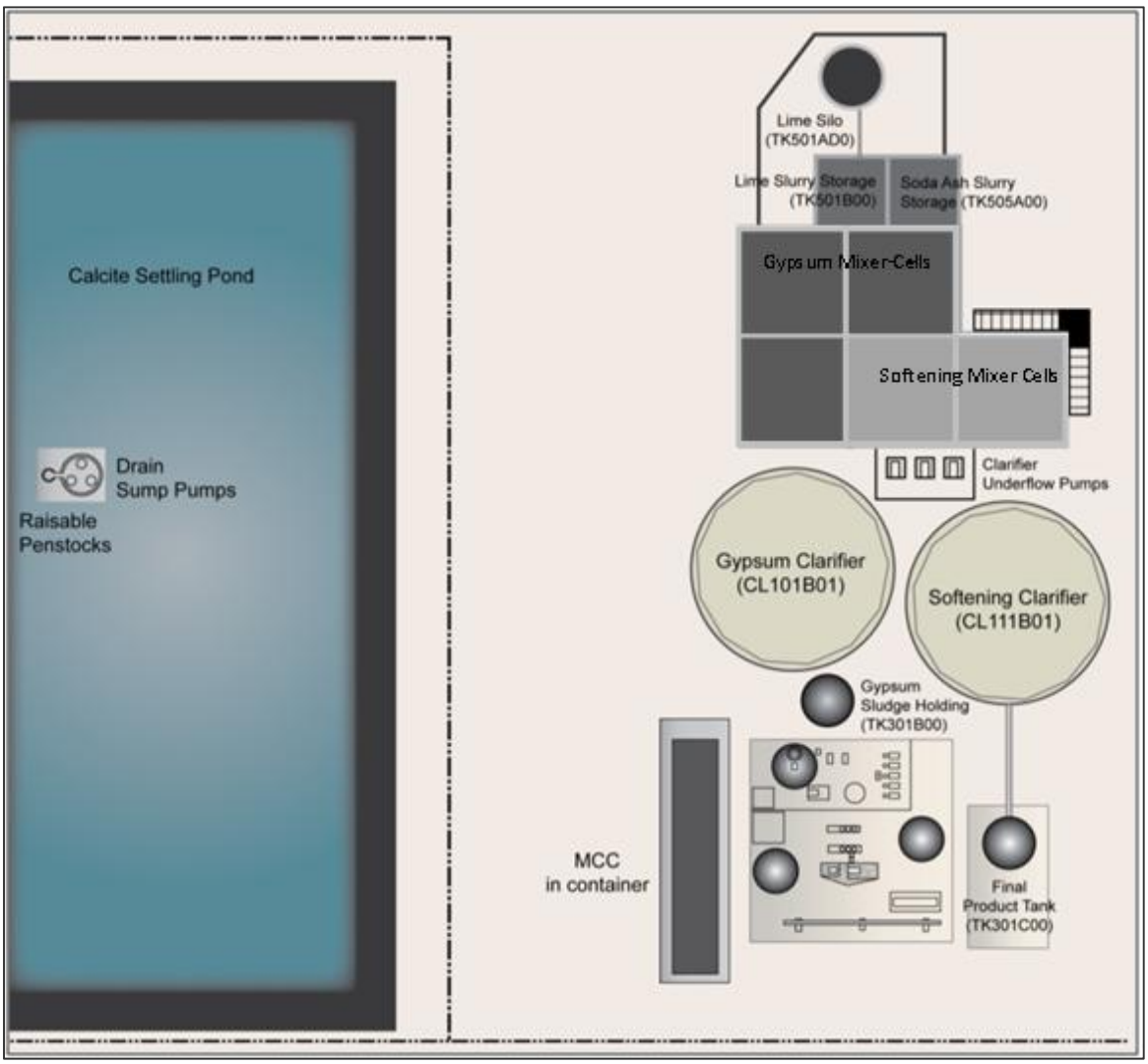

Figure 4.6 Layout of the Groundwater and Raffinate Treatment Plant (GRTP)

4.7.2 Initial Groundwater Treatment

Initial groundwater treatment will be conducted on the target wellfield prior to any other processing or treatment to reduce Ca concentration in the Basal Sands groundwater to below 600mg/L. The groundwater treatment phase will be conducted for each of the six proposed wellfields. Each wellfield will be treated separately and sequentially at a rate of 100 m^3/h, with the volume of water treated for each wellfield ranging from 60,000 to 100,000 m^3.

For each wellfield, groundwater will first be abstracted via the production wells and pumped to the $CaCO_3$ storage pond, where it will be retained for approximately three hours. This will

allow a significant amount of radon (>95%) to be released naturally into the atmosphere and prevent radon build up in the process plant. The groundwater is then sent to the first of the three gypsum mixers and allowed to flow from the third gypsum mixer to the first softening mixer, bypassing the gypsum clarifier.

In the softening mixers, $CaCO_3$ is precipitated by adding soda ash (Na_2CO^3). The Na_2CO_3 is dosed on a timer, which can be adjusted based on the calcium removal results achieved. The mixture of solid $CaCO_3$ and ground water is then sent to the $CaCO_3$ clarifier for separation. The overflow of this clarifier is of final product quality (clean groundwater) and is therefore directed to the product tank, from where it is returned to the wellfield via the injection wells. An underflow pump in the clarifier recycles the sludge to the softening mixer for seeding precipitation of $CaCO_3$ and increasing average particle size. The sludge is periodically dumped to the $CaCO_3$ storage pond, when the solids level in the clarifier is sufficiently high.

The solid material in the $CaCO_3$ storage pond is left to accumulate during the groundwater treatment phase for future consumption in the gypsum precipitation process during the raffinate treatment phase.

Once initial groundwater treatment has been completed, wellfield conditioning is undertaken on the groundwater (to lower the pH of the groundwater in order to facilitate uranium extraction). Subsequently, the leaching process (the injection and removal of leach solution into and from the wellfield) will commence.

4.7.3 Raffinate Treatment

Raffinate treatment will commence just after the commencement of leaching. Raffinate treatment allows calcium concentrations in the wellfield groundwater to be maintained below 600 mg/L.

Gypsum Precipitation and Clarification

Raffinate treatment is undertaken by feeding BLS into the $CaCO_3$ storage pond to facilitate the reuse of stored $CaCO_3$ (produced during the initial groundwater treatment stage). The limestone elevates the pH of the raffinate. The raffinate is then sent to the gypsum precipitating mixer where lime ($Ca(OH)_2$) is added as a secondary neutralising agent. The supply of sufficient limestone and $Ca(OH)_2$ to the gypsum precipitating mixer, as well as the calcium content of the acid raffinate, provides the calcium required to precipitate gypsum ($CaSO_4.2H_2O$).

The addition of limestone and $Ca(OH)_2$ to the raffinate also allows metal salts, in particular, iron and magnesium, to precipitate out of solution. Iron in solution (Fe^{3+}) is preferentially oxidised precipitating iron hydroxide.

The high pH in this tank also allows precipitation of magnesium hydroxide ($Mg(OH)_2$). By removing these salts from the water, calcium ions (Ca^{2+}) are made available for reaction with sulphate (SO_4^{2-}) to form gypsum.

The resulting sludge (precipitate and water) is then fed to the gypsum clarifier which gravitationally separates the sludge into a liquid (clarified water) and a solid (gypsum precipitate with impurities including iron hydroxide and magnesium hydroxide). The clarified water rises and overflows and is directed via collection weirs to both the softening mixer and the ultra filtration (UF) feed mixer. The remaining precipitate sludge is pumped to the gypsum settling pond where the supernatant is returned for reprocessing (i.e., fed back into the gypsum precipitating mixer via the $CaCO_3$ storage pond). The remaining sludge $CaSO_4.2H_2O$ is pumped directly via a pipe to a low level waste cell within the gypsum waste facility, located approximately 200 m west of the plant, for permanent waste disposal. A waste liquid pipe will draw any liquid that rises to the surface out of the waste cell to the

liquid disposal pond (from where it is pumped to the liquid disposal bore for final disposal). Section 4.13.5 provides further details on the gypsum waste facility.

Softening Treatment and Clarification

The purpose of conducting a softening treatment on the water is to further reduce the concentration of calcium in the water.

Softening treatment is undertaken by directing clarified water from the gypsum clarifier to the softening mixer. Soda ash and a small amount of $Ca(OH)_2$ is added to the liquid to increase the pH to approximately 10. At this pH, $CaCO_3$ is at its lowest solubility and has the least amount of residual bicarbonate, which would otherwise increase the amount of acid required for re-acidification. This softening reaction precipitates $CaCO_3$ out of solution.

The water is then directed by gravity to the softening clarifier where the liquids and solids (sludge) are separated gravitationally and an underflow pump recycles the sludge to the softening mixer for seeding precipitation and increasing average particle size.

Once the sludge is of a suitable thickness, it is emptied into the $CaCO_3$ storage pond. Supernatant liquid is pumped back into the wellfield.

Ultra filtration

Reverse Osmosis (RO) will be undertaken as part of groundwater and raffinate water treatment to maximise the recovery of water and reduce sodium levels, However, pre-treatment of water is essential for successful RO due to the requirements for clean water devoid of suspended solids, colloids, organics, metal salts and microbes. Ultra filtration will be used to pre-treat water prior to entering the RO process and will be performed during raffinate treatment.

Ultra filtration is undertaken by directing clarified water overflow from the gypsum clarifier into the UF feed mixer. From the UF feed mixer, the water is pumped across UF membranes (capillaries manufactured from hydrophilic polyvinylidene fluoride), which ensures that only molecules with molecular weights of less than 150,000 Daltons (Da) pass through the membrane. Water contamination is minimised as the hydrophilic properties of the membrane allow preferential wetting by water thereby preventing hydrophobic contaminants from adhering to the membrane surface. Instead, these contaminants adhere to the surface where they can be easily washed off in the cleaning cycles. Once filtered through the UF membrane, the water is pumped into the filtered water tank to await RO.

The UF system requires regular cleaning, which is undertaken through the use of different types of backwash including chemical backwash.

Reverse Osmosis

The addition of Na_2CO_3, which is undertaken during the softening process, increases the concentration of sodium in the water, allowing a build-up to occur over time. A desalination process allows sodium to be removed from the groundwater. RO is the desalination process proposed for the project. By removing sodium from solution, RO provides a higher water recovery rate. Raffinate treatment with RO provides a 95% rate of water recovery compared with raffinate treatment without RO, which only provides 80% water recovery. High water recovery is not only beneficial environmentally (through minimising water loss), but also enables more treated wellfield water to be retained by the mine, hence diluting the wellfield quicker and allowing less time to be used to extract the uranium from this water This process thereby increases the efficiency of the project.

Reverse osmosis is undertaken by pumping water from the UF filtered water tank, under high pressure, across an RO membrane, which results in clean water (permeate) pooling across the membrane and salt water/sodium purge/brine (reject) being left behind. The permeate is mixed with the softened water (i.e., water exiting the softening clarifier), while

the reject is disposed of via the liquid disposal bore into the Basal Sands. Reverse osmosis will be undertaken during raffinate treatment.

Desalination requires protection against inorganic fouling, and an antiscalant suitable for the prevention of $CaSO_4$, is used to prevent precipitation of salt from the concentrated water stream.

4.8 Solution Ponds

4.8.1 Overview

There are six solution ponds located around the processing plant and northwest of the administration buildings (see Plate 4.4); each type has a different function:

- Pregnant Leach Solution Pond (PLS).
- Barren Leach Solution pond (BLS).
- SX Dump pond.
- Stormwater pond.
- Liquid Disposal pond.
- Calcium Carbonate pond.

Plate 4.4 shows the constructed BLS pond.

Pregnant Leach Solution Pond

The PLS pond is 5 m deep and functions as follows:

- Receives PLS from the extraction wells.
- Stores PLS for regulated feed into the processing plant.
- Allows any solids in the PLS to settle, providing a clarified feed for the extraction plant.
- Provides a surge capacity that smooths the flow rate and grade of PLS to the extraction plant.

Barren Leach Solution pond

The BLS pond is 5 m deep and functions as follows:

- Receives and stores BLS from the SX process.
- Clarifies suspended solids prior to re-entry in to the wellfield.
- Provides a regeneration point prior to recirculation, through the addition of sulphuric acid and sodium chlorate.

Plate 4.4 Barren leach solution pond at Honeymoon mine

Solvent Extraction (SX) Dump Pond

The SX dump pond is designed to contain the aqueous liquor and the organics in the SX area either in the case of spillage or should the contents of the SX tanks need to be dumped for any reason. This pond is 4 m deep, constructed from compacted clay and fitted with a 1.0 mm synthetic liner. At the end of the mine life this pond may be used as a disposal pit for the accumulated sediment and other contaminated waste materials.

Stormwater Pond

The stormwater pond has been designed to collect all potentially contaminated surface runoff within the process plant area. Collection of stormwater has been designed in conjunction with perimeter containment bunds and an artificial surface gradient within the processing plant site. The pond has a depth of 4 m and is connected to the liquid disposal pond to enable transfer of stormwater during high rainfall events.

Liquid Disposal Pond

The liquid disposal pond provides for the storage and clarification of all aqueous waste streams. The pond is 5 m deep, constructed from compacted clay and is fitted with a dual synthetic liner with associated leak detection system (LDS). Liquids are filtered at the pond via an independent filtration system prior to transfer to the liquid disposal wells. As with the other ponds, where possible these ponds will be used to dispose any collected sediment at the conclusion of mine life.

Calcium Carbonate Pond

The $CaCO_3$ pond is 4 m deep and provides for the collection and storage of calcite generated during the initial groundwater treatment. Calcite generated during this initial groundwater treatment phase will be consumed during the secondary, raffinate treatment phase to be undertaken on BLS fluids to maintain $CaCO_3$ levels.

The pond also serves as a main radon release point for native groundwater, prior to entry into the groundwater raffinate treatment plant (GRTP).

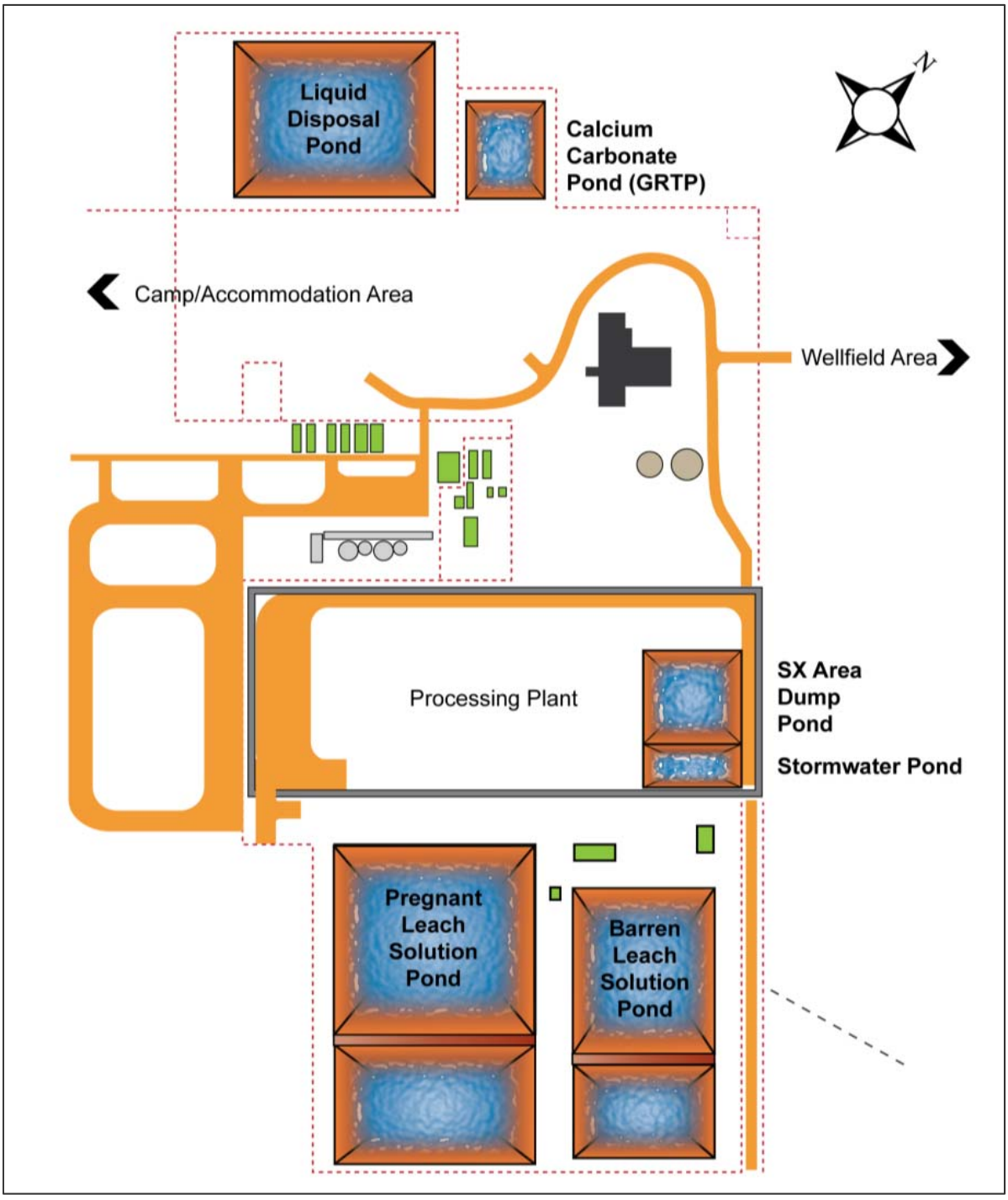

Figure 4.7 Location of process solutions pond at Honeymoon mine

4.8.2 Key Design Features

Each solution and disposal pond is fitted with double HDPE liners, the first is a 1.0 mm synthetic liner which sits on top of a compacted clay layer, and the second a 2.0 mm HDPE liner which provides the primary protection. A 0.5 m layer of water must be retained in all ponds to ballast the liner. Figure 4.8 and Figure 4.9 demonstrate the double liner system used for leak detection and containment in all of Honeymoon mine's solution ponds.

The following details each component of the liner and leak detection system:

1. Standard clay lined earthen pond and batter slopes.
2. 1.0 mm HDPE continuous membrane secondary liner.

3. Flownet mesh covering 20% of the pond base.
4. 2.0 mm HDPE continuous membrane primary liner.

The secondary liner contains any leak in the primary liner. The secondary liner also allows hydrostatic testing of the primary liner without corruption of results by groundwater. Figure 4.9 depicts a typical pond profile.

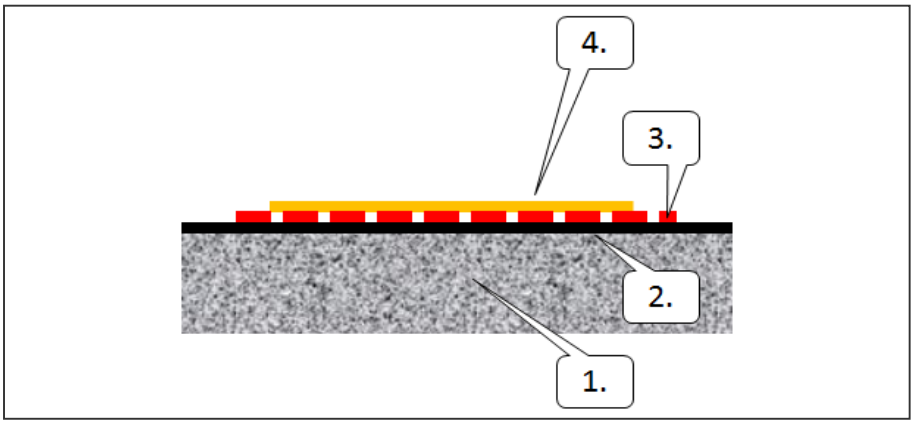

Figure 4.8 Double liner system

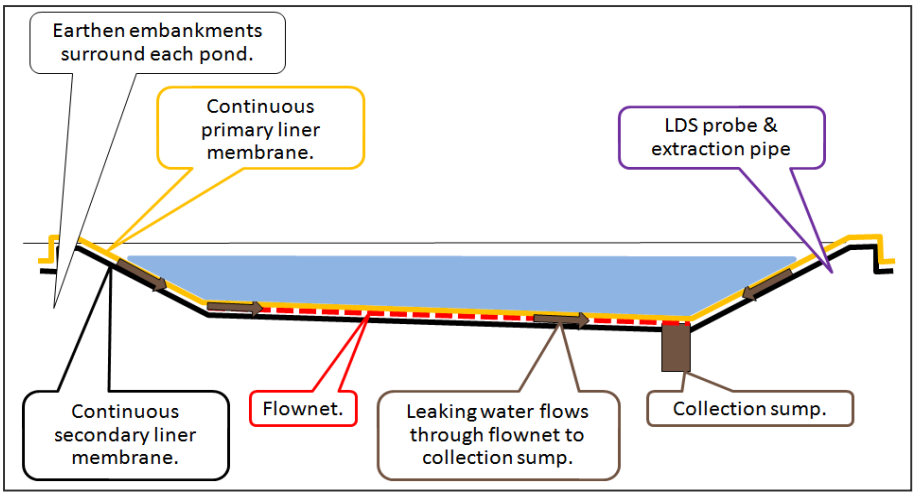

Figure 4.9 Pond profile example

Flownet is installed in a herringbone profile to promote flow of any liquid lost through the primary liner and contained above the secondary liner, to the collection sump (see Figure 4.9 for a cross section of the leakage detection system). Fail-safe 'Multiprobe' probes installed in the collection sump detect presence of liquid and will activate an alarm system in the control room. Failure of these probes will also activate an alarm system.

The primary liner is exposed to the hydraulic head pressure of the liquid stored in the pond, while the secondary liner is only exposed to the natural pressure with only low driving head pressure

A target action leakage rate (TALR) of 22 mL/m^2/d has been applied to pond leakage rates collected in the collection sump. The TALR provides a trigger point above which pond leaks must be found and repaired.

4.9 Processing

4.9.1 Process Overview

Solutions from the wellfield will be processed in the processing plant to produce the final product, Uranium Peroxide ($UO_4 \cdot 2H_2O$). The Honeymoon mine is designed to produce 400 tonnes of Uranium Oxide (U_3O_8) equivalent per annum.

The processing plant comprises:

- Leach liquor handling.
- Solvent extraction.
- Precipitation and thickening.
- Drying and packing

A simplified flow diagram of the process is shown in Figure 4.10

4.9.2 Leach Liquor Handling

Pregnant leach solution is supplied from the extraction wells to the PLS pond via a common manifold pipeline (trunk line). The pond assists PLS blending and offers a volume buffer to regulate the SX plant feed supply. The pre-settler area of the pond also facilitates the settling of suspended solids to ensure a clarified flow to the SX circuit.

4.9.3 Solvent Extraction

The SX process follows ISR in the wellfield and leach liquor handling areas. While the key mineral component of the aqueous feed to the SX plant is uranium in solution, there is also a substantial amount of soluble impurities. The function of the SX area is to selectively extract uranium from the PLS and concentrate it into aqueous strip solution for further processing; this is achieved through an organic medium.

There are four main components in the SX area:

- Extraction.
- Scrub.
- Strip.
- Crud handling.

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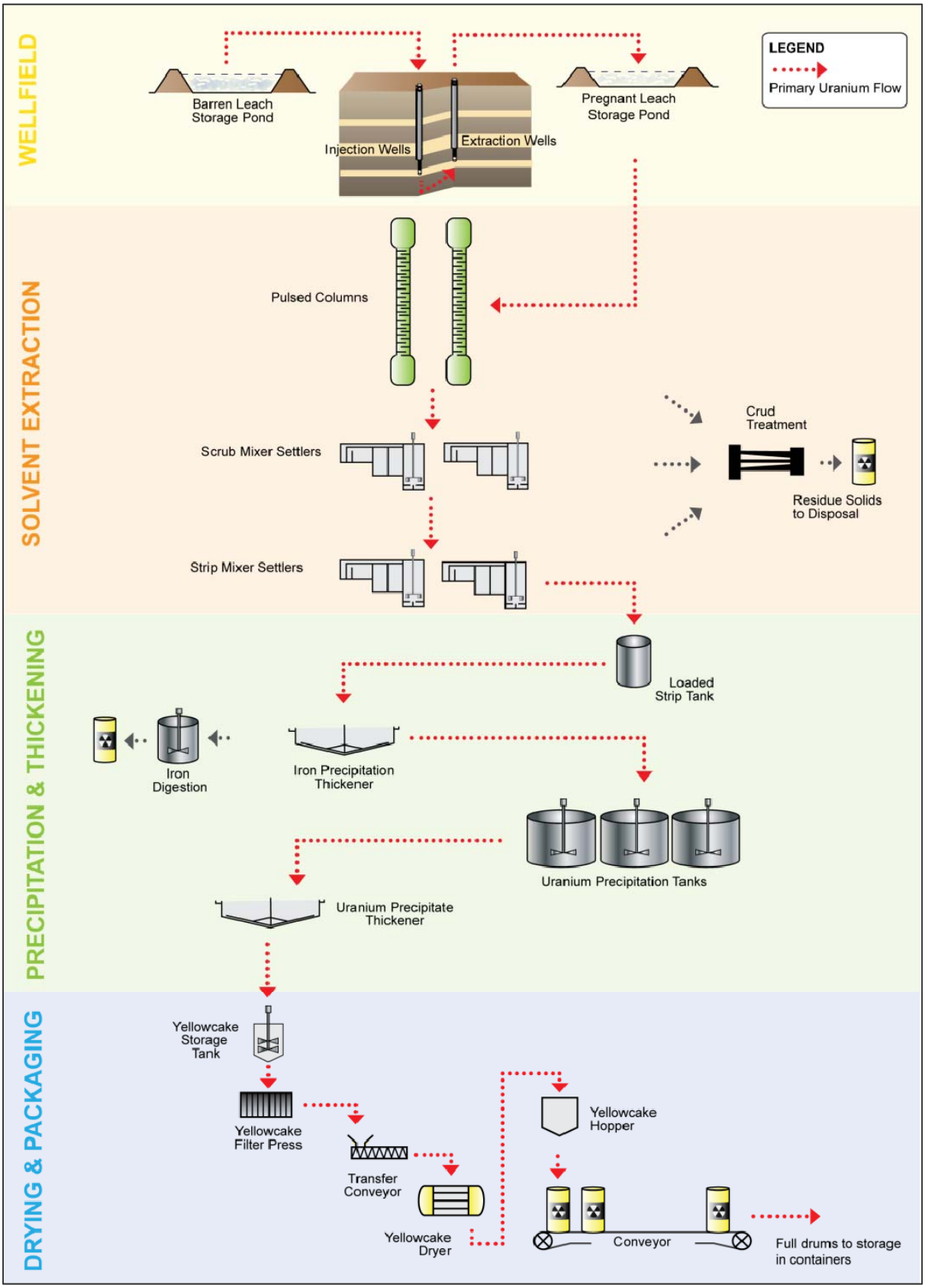


Figure 4.10 Simplified ISR and processing flow diagram

The organic phase comprises:

- Cationic uranium extractant at 2% v/v - Di-ethyl-hexyl phosphoric acid (DEHPA).
- Anionic uranium extractant at 2% v/v - Tri-octyl tertiary amine; (Amine).
- Non polar solvent modifier at 3% v/v - Tri-butyl phosphate (TBP).
- Narrow cut kerosene diluent 93% v/v remainder.

Loaded organic exits at the top of the columns and is advanced to the scrub stage. The BLS exits the columns at the base and is directed to the BLS pond for regeneration prior to being recirculated back into the wellfield. The BLS solution leaving the pulsed columns has a designed organic entrainment of 50 mg/L; however typical entrainment values are less than 25 mg/L.

Organic entrained in the BLS is partly recovered through a semi-automatic organic recovery system. The recovery system is installed on the pre-settler section of the BLS pond and utilises a voraxial separator technique to recover organic and return it to the organic phase to the SX circuit. Discharged BLS contains a residual organic concentration of on average 8 mg/L, which is then recirculated in the ISR wellfield, or discharged to the liquid disposal pond as part of the 0.5 -1% bleed. This BLS 'bleed' stream, used to maintain a constant liquor volume within the PLS and BLS ponds and prevent excursions of mining fluids from the mining zone.

Scrub

Iron and other impurities are co-extracted with uranium in the extraction stage. These contaminants can be partially removed from the organic in the scrub stage. There are two mixer settlers working in series in the scrub stage.

Uranium rich loaded organic is pumped to the scrubbing mixer settler. In the mixer part of the unit, the loaded organic is mixed with a fresh aqueous scrub solution which consists of diluted acid and sodium metabisulphite. As the two phases contact, some of the impurities are removed from the loaded organic on to the scrub solution. The resultant spent scrub solution will contain some uranium and will be recycled back to the PLS pond. The now cleaned or scrubbed loaded solvent advances to the strip stage of the circuit.

Strip

Strip stage performs the final concentration in the SX process, uranium is stripped from the loaded organic phase and concentrated into a small volume of aqueous strip solution. Similar to scrub, strip is carried out by two mixer settlers in two stages. Stripping is undertaken by mixing a sodium carbonate solution (also known as strip solution) with the clean loaded organic. The mass transfer of uranium results in a loaded strip solution with a high concentration of uranium and a barren organic with minimal uranium concentration.

Iron present in the loaded organic precipitates in the strip mixer-settlers. This solid will discharge with the loaded strip liquor towards the precipitation and thickening area, while barren organic is routed to the barren organic tank, ready for recycling through the SX circuit, starting at the Pulse Columns.

Crud Handling

Crud is a mixture of aqueous, solvent and solid phase which usually accumulates in the interface. It is generated from impurities or solids in the solution during the SX process. Crud is removed periodically from the pulsed columns and the settlers, and transferred to the crud holding tank for treatment.

Sulphuric acid, clean water or diluent can be added to the crud tank to aid phase separation. Mixed crud is delivered to the crud centrifuge for further separation, where the aqueous phase is discharged back to the PLS pond. The organic phase is discharged to the

barren organic tank for recycling into the extraction process. Solids gravitate to a drum for permanent disposal.

4.9.4 Precipitation and Thickening

Iron Precipitation Thickening and Dissolution

The iron precipitated during the stripping phase is transferred with the loaded strip liquor to the precipitation thickener where the solid settles out. Flocculent is added to promote the coagulation of iron precipitate as slurry (underflow) in the bottom of the thickener while the uranium-bearing strip solution (overflow) is advanced to the uranium precipitation tanks.

The underflow is decanted from the bottom of the iron precipitation thickener into the iron digestion tank. Here, sulphuric acid is added to dissolve the metal particles. The resulting acidified solution contains a significant amount of dissolved uranium; this solution is returned to the PLS pond, to ensure that the uranium is recovered. A waxy residue that forms and floats in this tank is recovered and placed in drums for disposal.

Uranium Precipitation

The clean overflow from the iron precipitate thickener flows through to the uranium precipitation stage. In this stage the uranium in solution is precipitated into solid form. The reaction occurs in one of three precipitation tanks which are operated in a batch sequence, where one is filling, one is reacting and one is being pumped forward to the uranium thickener.

Once a batch tank is filled, the uranium solution is acidified using measured doses of sulphuric acid. When acidification is complete, hydrogen peroxide is added to start the uranium precipitation process. Sodium hydroxide is later added to maintain the pH of the reaction. On completion of the cycle (approximately eight hours) the contents of the precipitation tank (a slurry of barren strip solution and uranium solid) is pumped to the uranium precipitate thickener.

Uranium Thickening

The purpose of the uranium thickening stage is to thicken the slurry from the precipitation stage to 35% w/w solids. The process is aided by the addition of flocculent. The resulting uranium slurry (underflow) gravitates to the bottom of the thickener while the barren strip liquor (overflow) rises and gravitates to the barren strip liquor tank, from where it is advanced to the reagent area for reagent mixing as required.

The underflow is pumped to the yellowcake storage tank in the drying and packing plant and kept agitated to keep the slurry in suspension.

4.9.5 Drying and Packing

De-watering and Drying

The drying and packaging processes are batch processes. Slurry is pumped from the storage tank to a filter press where the filtrate is returned to the uranium precipitate thickener. The filter press de-waters the slurry to a solid content of 60% w/w solids and discharges into a rotary conveyor for transfer to the yellowcake drier.

The drier is a rotary vacuum paddle type drier where indirect heating from hot oil is used to boil off the moisture. The dried yellowcake with a moisture content of no more than 2% w/w is then transferred to the yellowcake hopper for packing.

Packing

Drum filling occurs once a day, when approximately five drums will be filled in a batch operation. After filling to a target weight and lidding, the drums are washed, dried and labelled prior to being stacked into a shipping container.

Both the drying plant and the drum packing plant use baghouse dust extraction systems to ensure yellowcake dust is contained.

4.9.6 Chemical Inventories and Storage

Chemical Inventories

On-site chemical inventories will vary, though relatively large volumes will be held to ensure that the plant can continue to operate when deliveries are interrupted by weather/road conditions.

The maximum storage volumes of chemical as liquids are:

- Sodium carbonate (5% solution) – 85 m^3.
- Sodium hydroxide (50% solution) – 36 m^3.
- Sodium chlorate (30% solution) – 120 m^3.
- Sodium metabisulphite (50 g/l solution) – 40 m^3.
- Sulphuric acid (98%) – 200 m^3.
- Hydrogen peroxide (70%) – 20 m^3.
- Diluent (kerosene) – 32 m^3.

Other chemicals including hydrochloric acid, DEHPA, Alamine 336 and TBP will be stored on site in 205 L drums or ISO containers up to a maximum volume 5 m^3 of each product.

In addition there will be approximately 500 m^3 of diluent in inventory in the SX mixer settlers.

Maximum inventories of bulk chemicals stored as solids are:

- Sodium Carbonate – 100 tonnes.
- Sodium Chlorate – 40 tonnes.
- Sodium metabisulphite (SMBS) – 20 tonnes.

Storage

The reagent storage and handling areas at the Honeymoon mine are located within the processing plant containment bund, to the north of the main site gate and main processing areas. Each reagent has its own storage and handling area contained within a low concrete bund wall. The area includes road access for tankers and tanker unloading facilities. Figure 4.11 shows the location of each reagent area in relation to the processing plant.

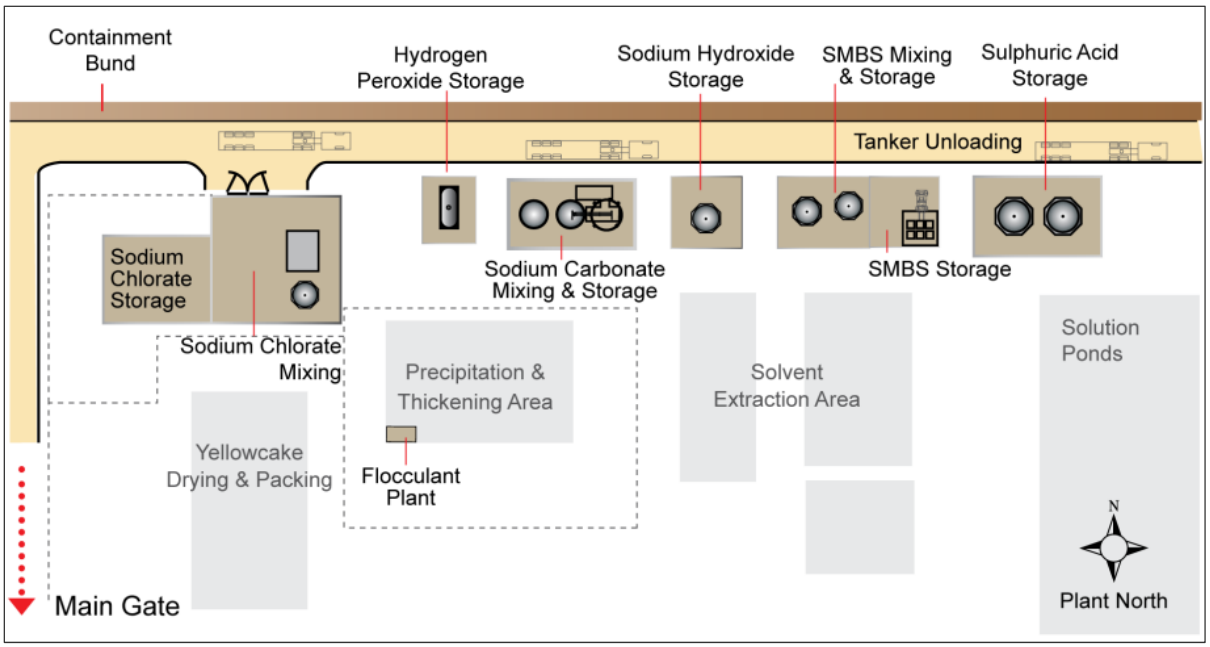


Figure 4.11 Location of the reagents areas at Honeymoon mine

Bunding

All tanks within the plant building, including mixing tanks and tanks storing mixed reagents, are located within individual concrete bunded areas.

The concrete bunds have been constructed in accordance with the SA EPA Guidelines on Bunding and Spill Management (EPA 2007) and are shown in Figure 4.12.

The SX area is sufficient to contain 120% of the total of the tank volume. Leach solution tanks and pipelines outside the plant and within the wellfield are contained within earthen bunds. Earthen bunds have been created around the wellfields perimeter and GRTP perimeter.

Tanks containing raw groundwater are not individually bunded.

Earthen bunds have also been created around the solution ponds to prevent the migration of stormwater off-site, interception drains are also present between the ponds to facilitate the flow of stormwater.

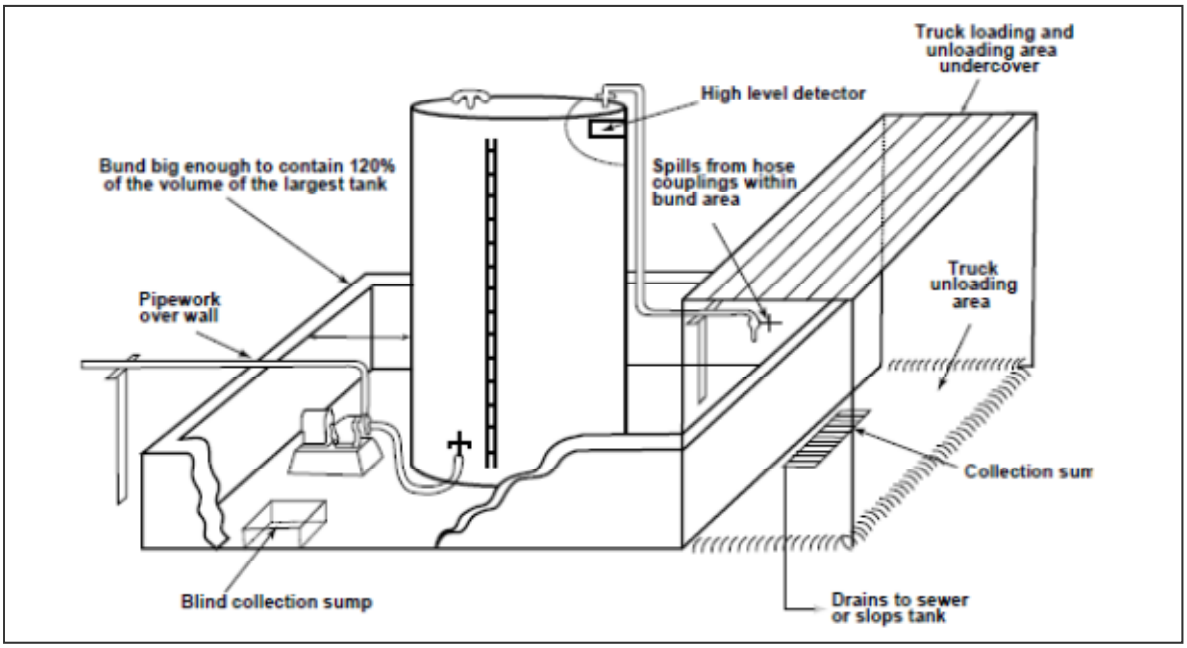


Figure 4.12 Bunding Schematic from SA EPA Guidelines on Bunding and Spill Management (2007)

4.10 Groundwater Monitoring Network

4.10.1 ISR Monitoring Well Network

The 65 monitoring wells contained within the ISR and liquid disposal monitoring network are used to detect:

- Potential cross-contamination of mining fluids in the Upper and Basal Members of the Yarramba Paleochannel.
- Potential mining fluid excursions from horizontal or vertical fluid migration in the ISR wellfield.
- Groundwater attenuation in completed wellfields.
- Groundwater quality surrounding the water source bores.
- Groundwater quality and attenuation rates around the liquid disposal wells.
- Presence of groundwater in the Willyama basement sequence.
- Variations in groundwater levels.

In order to determine appropriate locations and monitoring parameters for wellfield and liquid disposal monitoring wells, a solute transport model was developed for the Eyre Formation aquifers (see Attachment I and J). This model enabled solute movement (using conservative ions and metals) in relation to ISR operations, raw water abstraction points, and liquid waste disposal to be predicted, and based on the potential horizontal extents of the relative solute flow/excursions, suitable locations for the wellfield monitoring, liquid disposal zone and liquid disposal monitoring network were determined.

The ISR monitoring well network (see Table 4.4 and Attachment D).

ISR Monitoring Well Type	Abbreviation	No. of Wells	Monitoring Parameters/Analysis
In-field vertical compliance monitoring wells*	IVCM	16	• Suite 1: Groundwater levels, pH, electrical conductivity (EC),

ISR Monitoring Well Type	Abbreviation	No. of Wells	Monitoring Parameters/Analysis
Outer vertical compliance monitoring wells*	OVCM	6	reduction-oxidation potential (redox), sulphate and dissolved uranium • Suite 2: Groundwater levels, pH, EC, redox, total dissolved solids, total alkalinity, sulphate, major/minor other anions and cations, dissolved metals, total recoverable hydrocarbons (TRH), polycyclic aromatic hydrocarbons (PAH) – naphthalene. Note: See Table 6.15 for more details on the two above suites.
Basal leading indicator monitoring well[L]	BLI	8[¤]	
Outer Basal compliance monitoring wells[L]	OBCM	19	
Total no. of wells		49	

*Installed into Upper Member

[L]Installed into Basal Member

[¤]Eight BLI wells are used as leading indicator wells. There is a ninth BLI well - BLI3, although it is no longer used as a leading indicator well due to its proximity to the ISR wellfield.

Table 4.4 ISR wellfield – groundwater monitoring network

4.10.2 Liquid Disposal and Liquid Disposal Monitoring Well Network

Site selection for a liquid disposal zone considered a number of sensitive/critical receptors, which included:

Mining Lease 6109 Boundary

The liquid disposal well 'zone' required a site with enough distance (based on solute transport movement and attenuation rates) to ensure all waste solutes would not be distributed off the ML boundaries prior to adequate dilution and/or attenuation.

ISR Mining Zone

The movement of the disposal fluids was required to be of a sufficient distance to not impact or interact with the ISR mining operations or movement off the ML boundaries prior to attenuation and/or dilution.

Water Source Bores

Sufficient distances are required between the liquid disposal zone and water source bores to ensure transport of solutions did not reach the water source during the mine life.

Three alternative locations for liquid waste were modelled, the most suitable location was determined to be the former location of the water source well, located in the north eastern side of the mining lease (see Figure 4.14).The raw water source bore was subsequently moved 700 m upstream from this location.

Liquid Waste (Liquid Disposal) Monitoring Network

The liquid waste disposal (LWD) monitoring network consists of 12 dedicated monitoring wells and one temporary monitoring well (LDW8), monitoring the Basal and Upper Member of the Eyre Formation. Basal Member monitoring wells are classified as either inner sentinel wells or outer sentinel wells depending on their distance from the LWD 'zone' and will be used to assess the concentration and movement of disposal solutes within the Basal

Member and calibrate the modelled attenuation and dilution predictions. The Upper Member monitoring wells are only to be utilised for identifying any potential movement of waste fluids from the Basal Member.

The liquid waste disposal monitoring network is summarised in Table 4.5 and displayed diagrammatically in Figure 4.14.

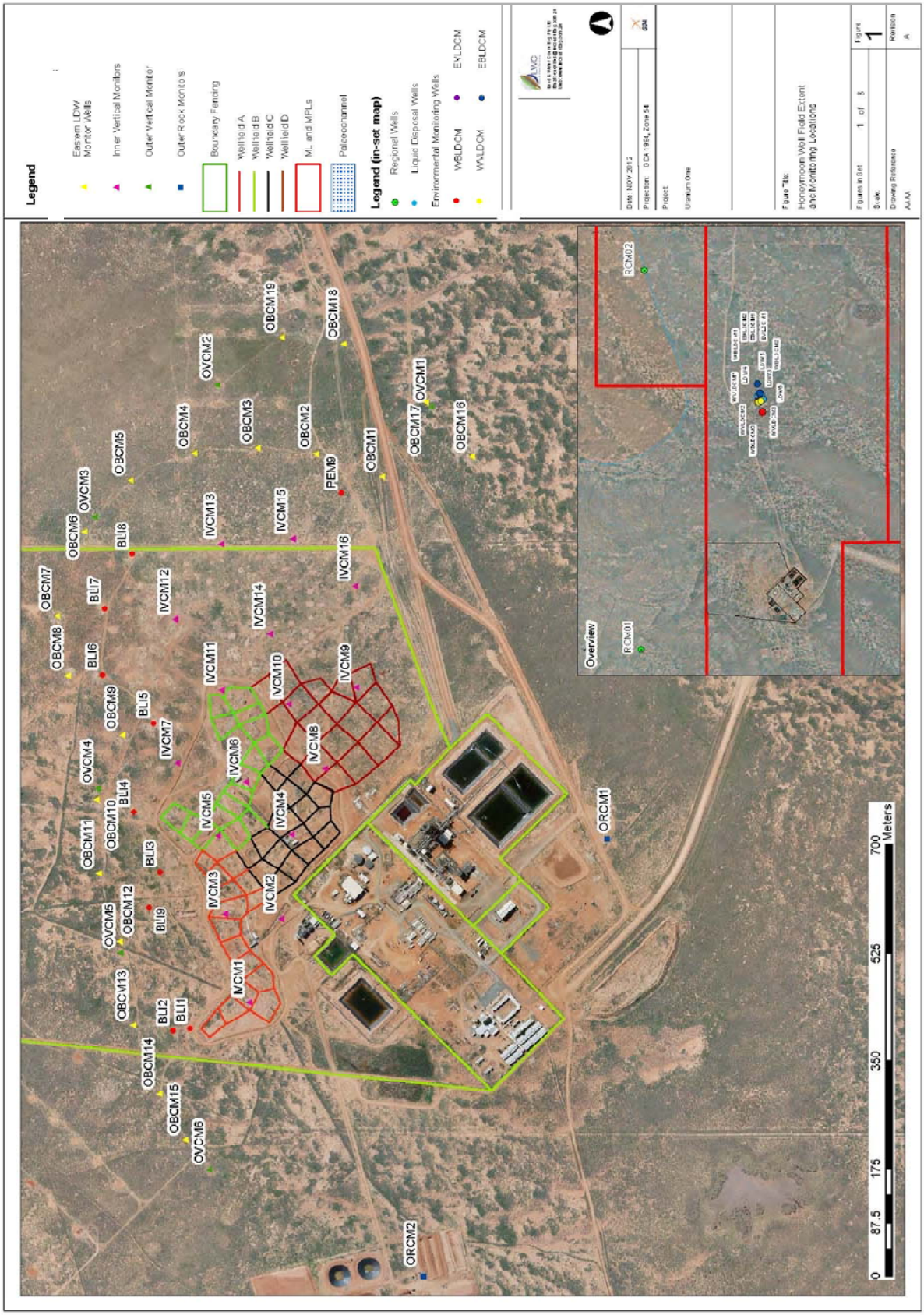
LWD Monitoring Well Type	Abbreviation	No. of Wells	Monitoring Parameters/Analysis
Eastern vertical liquid disposal compliance monitoring well*	EVLDCM	1	• Suite 1: Groundwater levels, pH, EC, redox, sulphate and dissolved uranium • Suite 2: Groundwater levels, pH, EC, redox, total dissolved solids, total alkalinity, sulphate, major/minor other anions and cations, dissolved metals, TRH, PAH – naphthalene. Note: See Table 6.15 for more details on the two above suites.
Western vertical liquid disposal compliance monitoring well*	WVLDCM	3	
Eastern Basal liquid disposal compliance monitoring well[Ł]	EBLDCM	4	
Western Basal liquid disposal compliance monitoring well[Ł]	WBLDCM	4	
Total no. of wells		12	

*Installed into Upper Member

[Ł]Installed into Basal Member

[¤]Eight BLI wells are used as leading indicator wells. There is a ninth BLI well - BLI3, although it is no longer used as a leading indicator well due to its proximity to the ISR wellfield.

Table 4.5 Liquid disposal monitoring network



Note: Wells ORCM1 and ORCM2 do not form part of the ISR nor liquid disposal zone well monitoring network.

Figure 4.13 ISR Monitoring Well Network

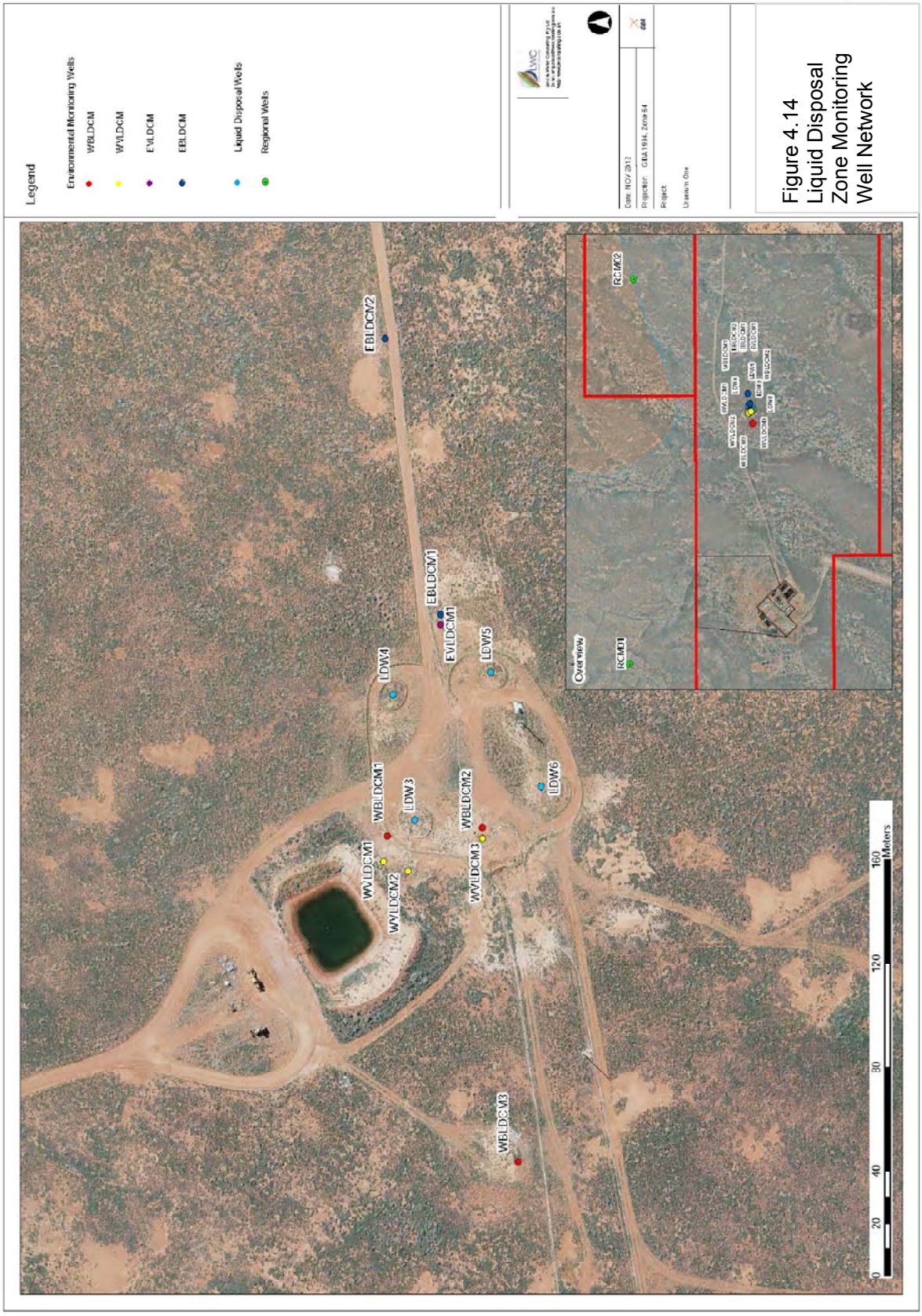


Figure 4.14 Location of the liquid disposal zone, associated monitoring wells and the raw water source bore

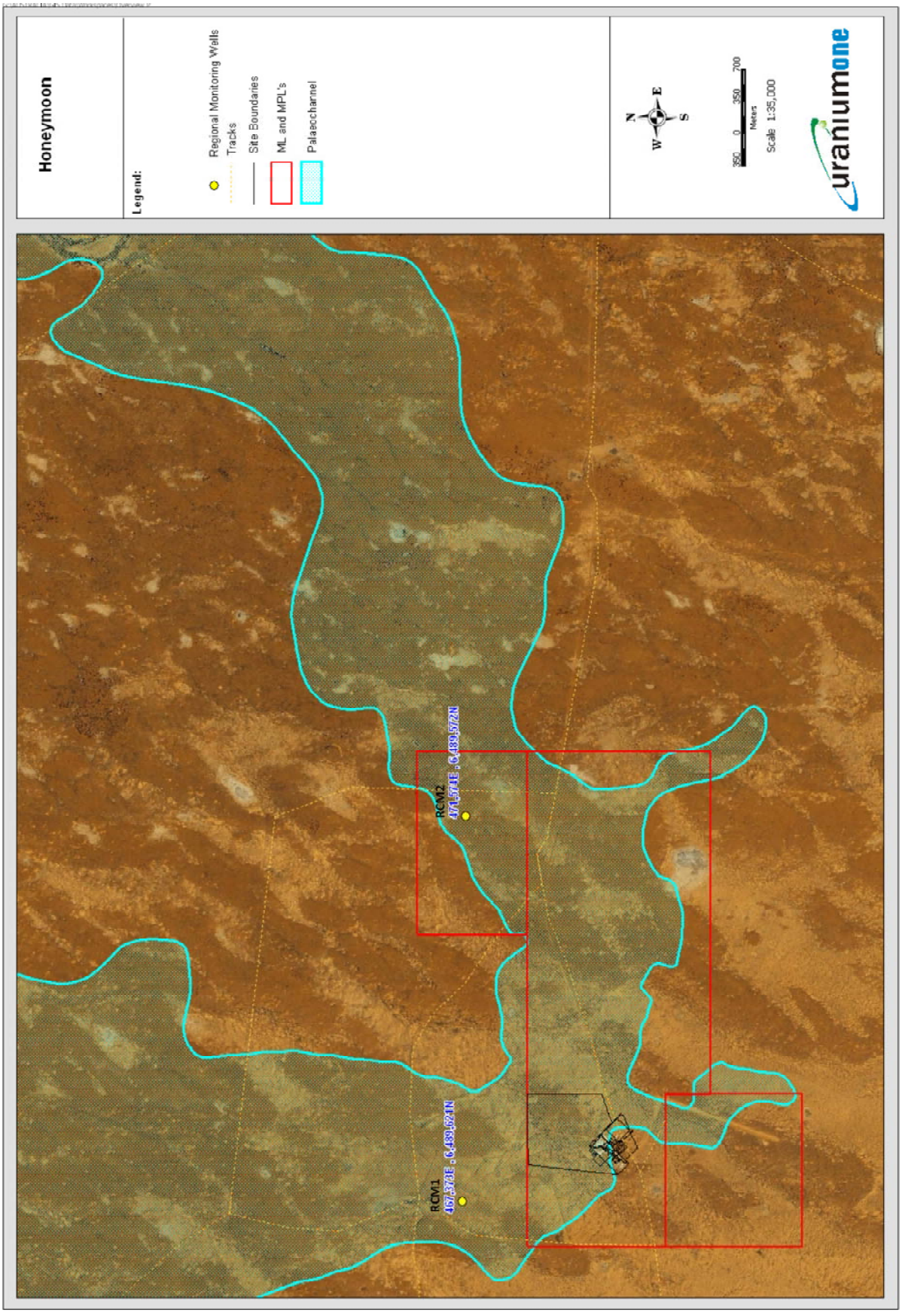


Figure 4.15 Honeymoon mine - regional groundwater monitoring wells

4.10.3 Regional Monitoring Wells

Analysis of local and regional groundwater levels during and following historical trial leach operations, together with recent groundwater modelling, indicate that water use is unlikely to have a measurable impact on water levels in the Eyre Formation aquifer. However, a routine regional monitoring program to assess Static Water Levels (SWL) will be undertaken by Uranium One to confirm the current understanding of local and regional hydrogeological regime. This program will use select regional monitoring wells (see Figure 4.15) in combination with operational monitoring wells, up and down gradient of the Honeymoon mine, to monitor water levels in the Yarramba Paleochannel.

4.11 Transport

Uranium One has prepared a Transport Management Plan (TMP) to ensure that the company meets the requirements under the Commonwealth Nuclear Non-Proliferation (Safeguards) Act 1987, Code of Practice for the Safe Transport of Radioactive Material 2008 and also the South Australian Radiation Protection and Control (Transport of Radioactive Substances) Regulations 2003, under the Radiation Protection and Control Act 1982.

The plan was prepared in conjunction and consultation with various parties that have a direct interest in the transportation process in order to fully identify, address and satisfy each of the regulatory requirements associated with the process.

The following approvals and permits are required for the shipment and export of Uranium Ore Concentrate (UOC):

- Permit to Possess Nuclear Material - obtained from Australian Safeguards and Non-Proliferation Office (ASNO) and issued to Uranium One. A number of other approvals must also be obtained prior to shipment.
- Permit to Transport Nuclear Material - obtained from ASNO and issued to the transport company.
- Minerals Export Permit - obtained from the Australian Government Department of Industry, Tourism and Resources and issued to Uranium One for approval to export UOC.
- License to Transport Radioactive Material and License to Store Radioactive Material – obtained under the Northern Territory Radioactive Ores and Concentrates (Packaging and Transport) Act, 1997.
- Approval by the South Australian Government of the Transport Management Plan for the transport of UOC within South Australia.

The TMP is supported by Uranium One Standard Operating Procedures and by the procedures of the relevant transport companies involved in the transportation of UOC from Honeymoon to Port, and shipping overseas. The TMP covers the following issues:

- Management responsibilities and roles of supervisory personnel.
- Communication procedures and protocols.
- Procedures which minimise the possibility of an accidental release of UOC during transport.
- Procedures for the response to a release of UOC during transport.
- Information regarding emergency response equipment.
- Education and training of drivers, employees, and members of the public.

The TMP will be audited annually by an external agency.

4.12 Fire Protection

The fires at Olympic Dam and other locations in previous years have highlighted the vulnerability of copper SX plants to complete destruction from fires initiated by static electricity, and the need for stringent fire prevention measures to be effective. Fortunately, in uranium SX plants the solvent is highly conductive and hence this virtually eliminates static electricity as a source of ignition. However electrical faults, smoking, hot work and other more conventional sources of ignition exist and require active fire prevention measures.

As a guiding principle, once a fire commences it is absolutely imperative for the fire to be contained immediately and with overwhelming force. This means that the fire protection systems installed should be automatic, suitably-sized and provide coverage within the SX plant of any part that can burn including all pipe work. Limitation of fuel availability to a fire is also an important criterion in fire protection and reduction in intensity.

A hazardous operating procedure (HAZOP) and an environmental risk analysis have been carried out for the Honeymoon SX plant, the latter in consultation with the Radiation Protection Branch of the Environment Protection Authority. Uranium One has also conducted further detailed HAZOP studies after engineering designs were approximately 85% complete.

Fire protection provisions have been designed to meet the Building Code of Australia, Australia Standards and National Fire Protection Association (USA) standards. The fire systems for the Honeymoon site consist of the following:

- Fire Detection and Occupant Warning Systems throughout both the existing areas and the new Solvent Extraction Plant, and Drying and Packing areas.
- Fire Hydrant system serving the entire site
- Fire Hose Reels, where required by the Building Code of Australia, and additionally at each level of the Pulse Column Access platforms.
- Fire Monitors each equipped with 2,000 L of Alcohol Resistant Aqueous Film Forming Foam and self-educing nozzles to the new Solvent Extraction Plant.
- Foam Deluge Systems using foam sprinkler nozzles are provided to the Solvent Extraction Plant Tank Farm transfer pumps, centrifuge and sump, mixer settler area agitators, drainage trench and sump.
- Water Spray Deluge is provided to the Settler Tanks, Solvent Extraction Plant Tank Farm tanks and Pulse Columns.
- Dedicated Fire Pumps are provided for the new Solvent Extraction Plant drawing from a dual tank arrangement providing 1.5 ML of static fire water storage. The pumps are a triple diesel arrangement with two pumps providing the required flow and pressure duty. The duty is based upon providing supply to the two most hydraulically demanding water spray deluge systems running concurrently with foam application and a monitor.
- A second set of fire pumps supply the fire hydrants that are provided to the administrative/control/ laboratory areas.
- Fire Extinguishers are provided in accordance with AS2444 to all new building areas, liquified petroleum gas (LPG) bullet, minor diesel/diluents storage and switch rooms.
- Foam equipped branch pipes are provided, where required by AS1940.
- Tank Suction and Booster points have been provided on the site to enable the Fire Fighting Appliance tanker truck to fill with water and boost fire hydrants where desired.
- All Foam and Water spray deluge systems are automatically operated upon detection of a fire in the applicable area by the fire detection system; each system is also manually operable from either the control valve location or via a manual switch in the control room.

4.13 Wastes

A number of waste streams will be generated through operational activities at the Honeymoon mine site. Wastes have been broadly divided into liquid, solid, non-radioactive wastes and low-level radioactive wastes. Proposed disposal facilities, related construction and operational phases are summarised in the following sections.

4.13.1 Non-Radioactive Liquid Wastes

Two modular Sewage Treatment Plants have been installed adjacent the Honeymoon camp to service all sewage and grey water waste streams derived from the accommodation and mess facilities. Remaining toilets and facilities on site utilise septic tank systems. Sewage and grey water generated from the Honeymoon camp are treated to provide a Class B water quality. Effluent is then disposed of via a surface irrigation system that distributes the effluent over a 2500 m^2 area adjacent to the camp. This disposal method is licensed by the South Australian Department of Health, in conjunction with DSD.

4.13.2 Low-Level Radioactive Liquid Wastes

Stormwater

All stormwater collected within the mine site will be treated as potentially contaminated, and collected and retained by concrete or earthen bunding, sediment ponds or shallow earthen evaporation sumps.

Operational Liquid Waste

Liquid waste generated from processing activities and RO plants will be produced at approximately 900 m3/day. Liquid waste will be temporarily stored in the Liquid Disposal Pond (LDP), prior to being injected into the Basal aquifer via Liquid Disposal Wells. Figure 4.14 shows the location of the liquid disposal zone.

The average chemical composition of the liquid disposal stream generated during operations is provided in Table 4.6 below.

Analyte	Unit	Barren Solution	Process Plant Waste Stream	RO Brine	Disposal Solution
U_3O_8	mg/L	1.7	1.4	0.09	1.5
Fe	mg/L	300	345	<1	133
Mo	µg/L	1.3	4	22	7.4
V	mg/L	5.8	2.7	<0.02	1.1
SO_4	mg/L	7,590	6,375	3,410	4190
Cl	mg/L	8,490	8,765	9,765	8020
Si	mg/L	<8	90	15	47
Ca	mg/L	987	995	1,015	860
Mg	mg/L	250	390	575	373
Al	mg/L	20	65	<1	28
Cu	mg/L	17	3.9	0.01	1.8
Zn	mg/L	70	130	0.09	56
Se	µg/L	39	80	36	49
Na	mg/L	6,160	5,675	6,050	4975
HCO_3	mg/L	<5	<5	200	<5
NO_3	mg/L	<0.5	<7	<0.5	<7
F	mg/L	0.9	1.3	1.6	1.9

Analyte	Unit	Barren Solution	Process Plant Waste Stream	RO Brine	Disposal Solution
Ra-226	Bq/L	413	975	2.1	353
TDS	g/L	22.1	22.4	19.8	19.8
pH		2.3	2.3	6.8	2.8

Table 4.6 Indicative analysis and flows of discharge streams

4.13.3 Solid Waste Materials

Non-Radioactive Waste Materials

The Honeymoon mine will produce a variety of non-radioactive solid wastes from both the mining operation and the supporting infrastructure (for example, accommodation and mess facilities). These wastes include:

- Domestic putrescibles wastes (i.e., food scraps) derived from the accommodation camp, crib and office facilities.
- General industrial wastes (i.e., paper, timber, scrap metals, plastics and other packaging and containers).

Low-Level Radioactive Waste Materials

Operational activities will also generate a range of low level radioactive wastes, these waste types and subsequent management and disposal will be undertaken in accordance with the Honeymoon Operational Radioactive Waste Management Plan (RWMP). The RWMP is required under the South Australian Radiation Protection and Control Act 1982 and National Codes of Practice.

Typical low-level wastes include the following:

- Organic crud, produced in the SX process.
- Contaminated materials (i.e., rags, worn parts, filters, pumps pipe work, soils and PPE).
- Laboratory wastes.
- Calcite and gypsum slurry, produced as part of the GRTP.

4.13.4 Solid Waste Facilities – Site Selection

A comprehensive site selection was undertaken to determine the most appropriate location for the Honeymoon mine waste repositories. This process considered both the environmental and radiological nature of the waste and location, in relation to physical, environmental and social criteria

Key criteria included:

- Limited surface water collection, infiltration and erosion.
- Stable geology and geomorphology
- No identified water table
- Located outside the Yarramba Paleochannel;
- No significant flora, fauna and/or Indigenous heritage sites.
- Adequate isolation.

The repository site identified is situated on the western side of the mine site approximately 10km from the nearest site of permanent human occupancy (see Figure 1.2).

Biological and archaeological surveys have been conducted over this area site to ensure no sites or species of significance exist within this area. This location is outside the bounds of

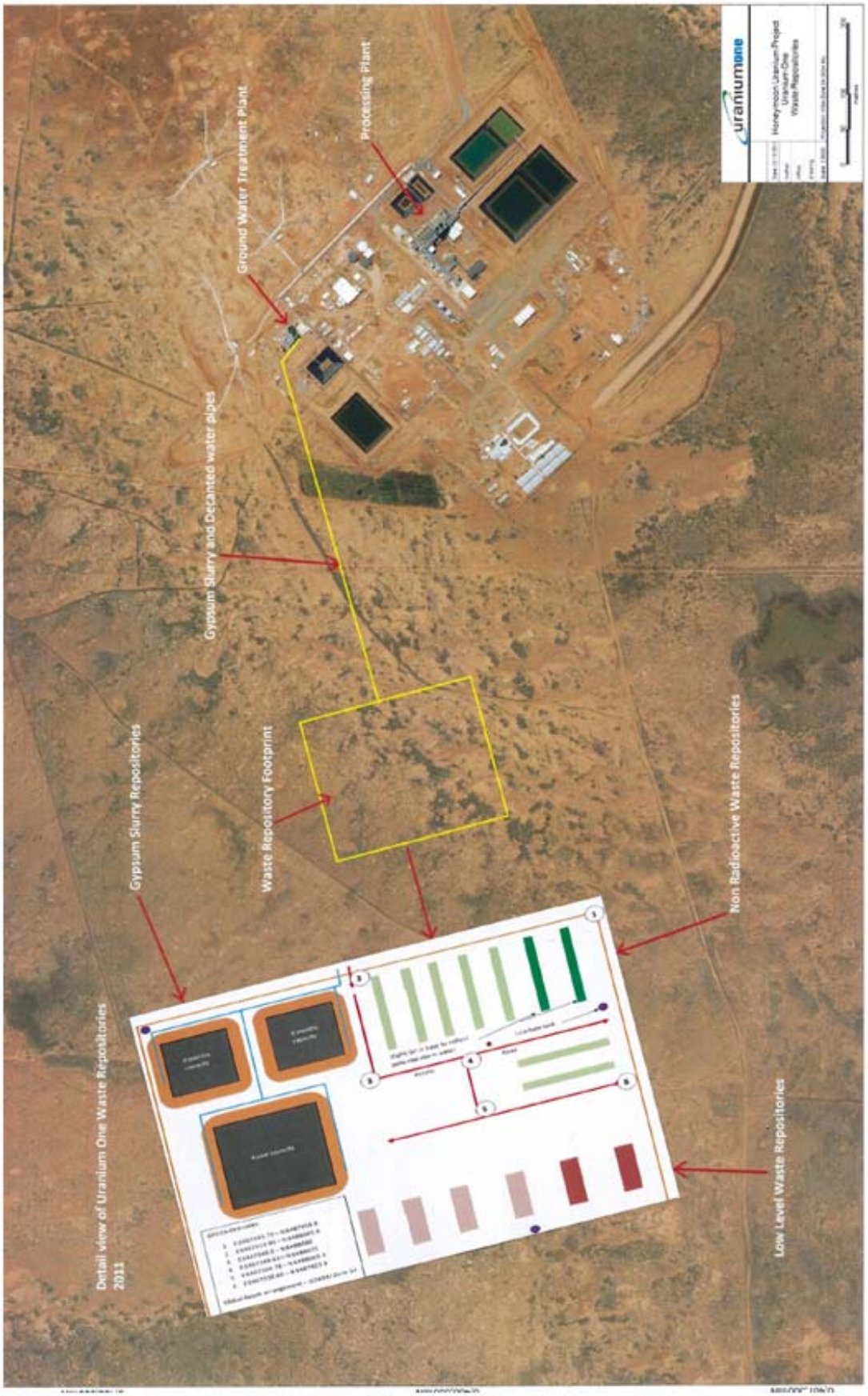


Figure 4.16 ***Honeymoon mine – waste repository layout and location on ML6109***

the Yarramba paleochannel, with no water bearing units identified in over 140 m of stiff consolidated clays and Willyama Precambrian basement.The Honeymoon mine site currently uses the Low Specific Activity (LSA) bay for the temporary storage of low level radioactive waste prior to the transfer over to the low level radioactive waste repository. The LSA provides a covered and concreted bunded area, with sumps collecting any liquids and transferring them over to the liquid disposal pond.

4.13.5 Solid Waste Disposal Facilities

Non-Radioactive Waste Repository

Waste that has no approved further use or ability to be recycled will be disposed of within the Honeymoon mine non-radioactive waste repository. The mine site's non-radioactive waste repository has been designed to accept approximately 280 m^3 of waste per year for the seven years of operation, with an annual contingency of 60 m^3. In addition, a 680 m^3 capacity has been built into the facility to meet closure disposal requirements.

This waste repository has been designed and constructed under the South Australian Environment Protection Act 1993, in accordance with SA EPA guidelines on Environmental Management of Landfill Facilities (Municipal Solid Waste and Commercial and Industrial General Waste) (AEC, 2010a).

The non-radioactive waste landfill repository was designed to ensure[4]:

- The protection of local amenity.
- Unauthorised access to the site and tipping face are prevented.
- Risks posed by landfill gas, subsidence and other potential hazards are minimised.
- Leachate generation and surface water infiltration are minimised.
- Geotechnical stability of the landfill is maintained.

The non-radioactive waste repository landfill will be operated in a series of long trenches that will facilitate the progressive emplacement and compaction of waste, thereby reducing the size of the tipping face (see Figure 4.16 to Figure 4.18 for cell and repository layouts).

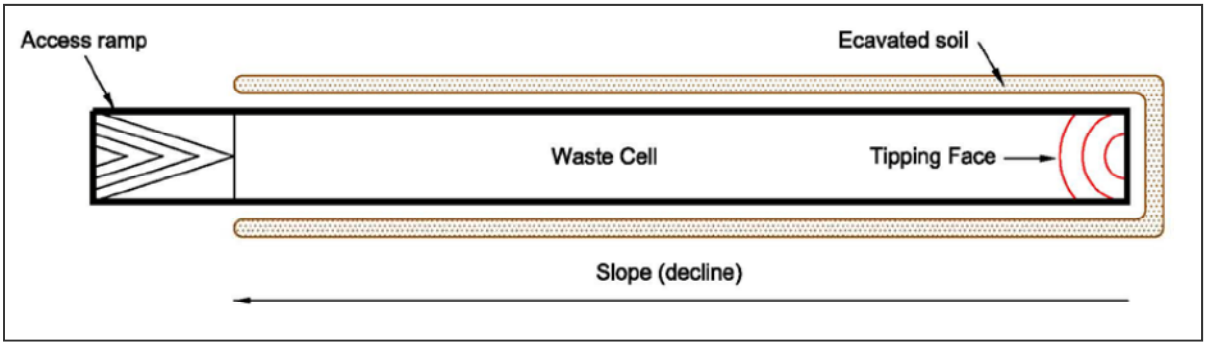


Figure 4.17 Non-radioactive waste cell layout and dimensions

[4] As stipulated by the SA EPA guideline for the Environmental Management of Landfill Facilities.

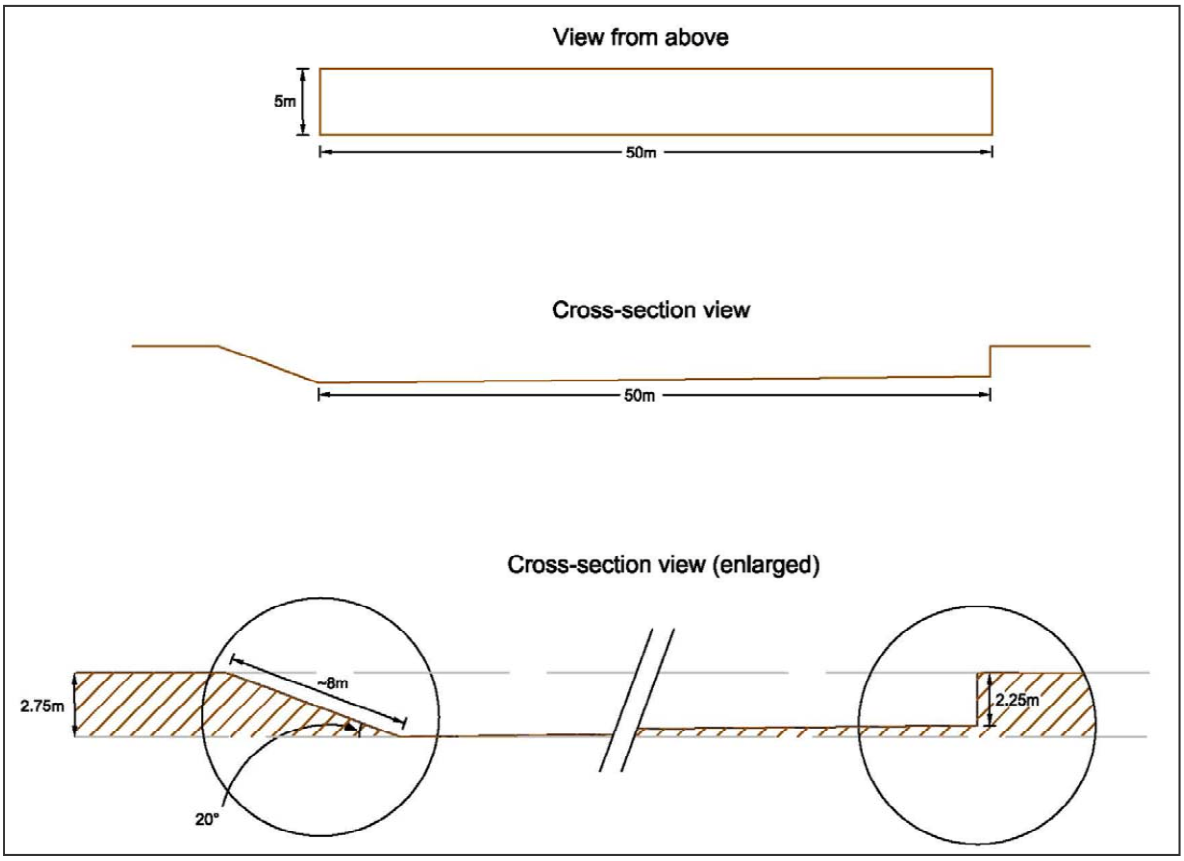


Figure 4.18 Cross-section view of the non-radioactive waste repository

Low-Level Radioactive Solid Waste Repository

In order to permanently dispose of around 150 m^3/y of low-level radioactive waste generated as part of routine mining activities, a series of low level radioactive cells have been designed to cater for the disposal of standard processing wastes and redundant equipment, over the mine life.

The Code of Practice for the near-surface disposal of radioactive waste in Australia (NHMRC, 1992), accepted industry practice and key design parameters were considered during the design of the low level radioactive waste repositories. The key design criteria included:

1. Adequate radiological and safety protection provided to humans, other biota and the environment during both the operational phase and on closure.
2. Structural integrity during operations, and following closure.
3. Two meters of overburden between the waste surface and the ground surface (as required for Category A waste (for Low level Radioactive Solid).

The design of the low level radioactive solid repository during operations and on closure is illustrated in Figure 4.19 and Figure 4.20.

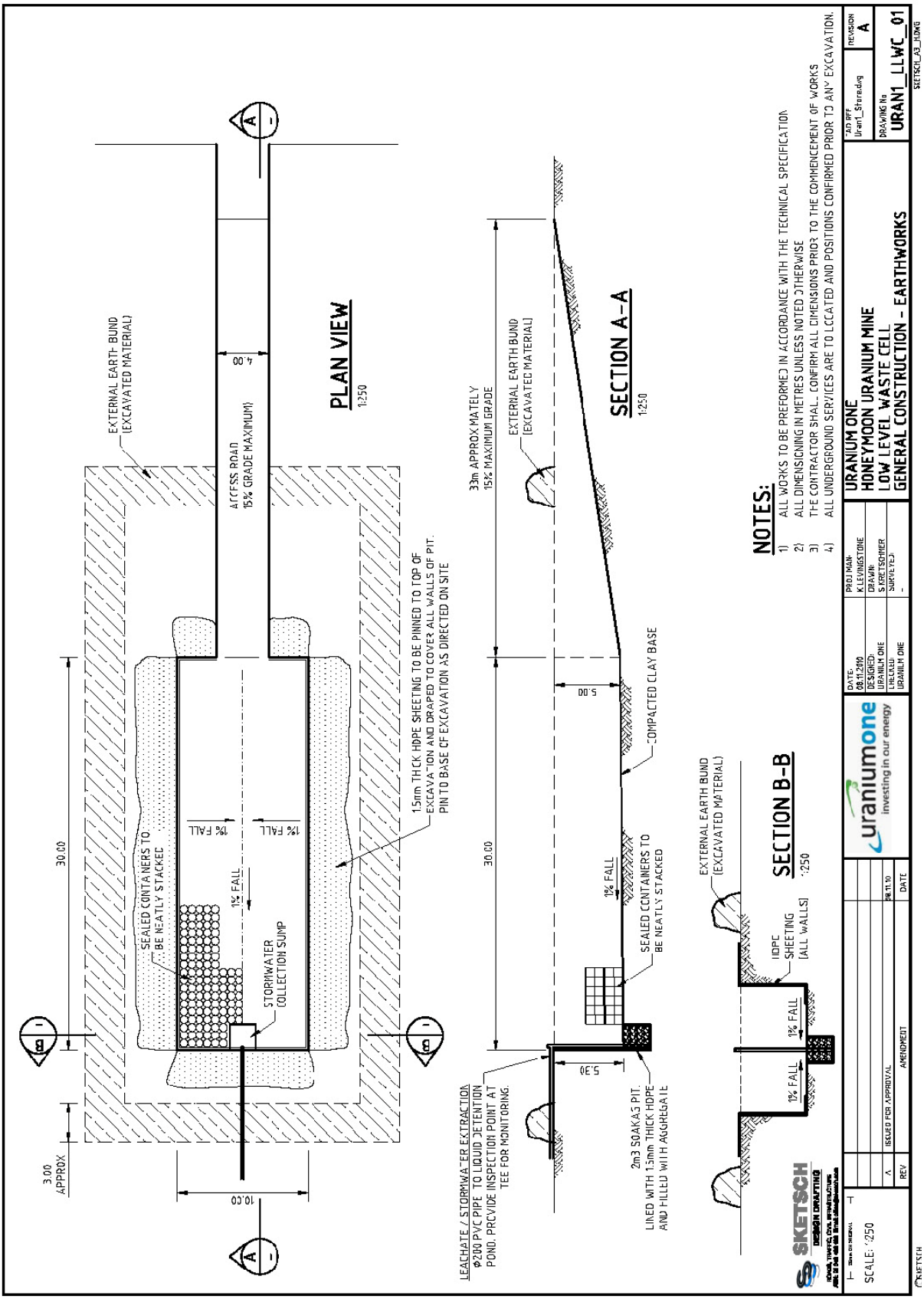


Figure 4.19 Low level radioactive waste repository design

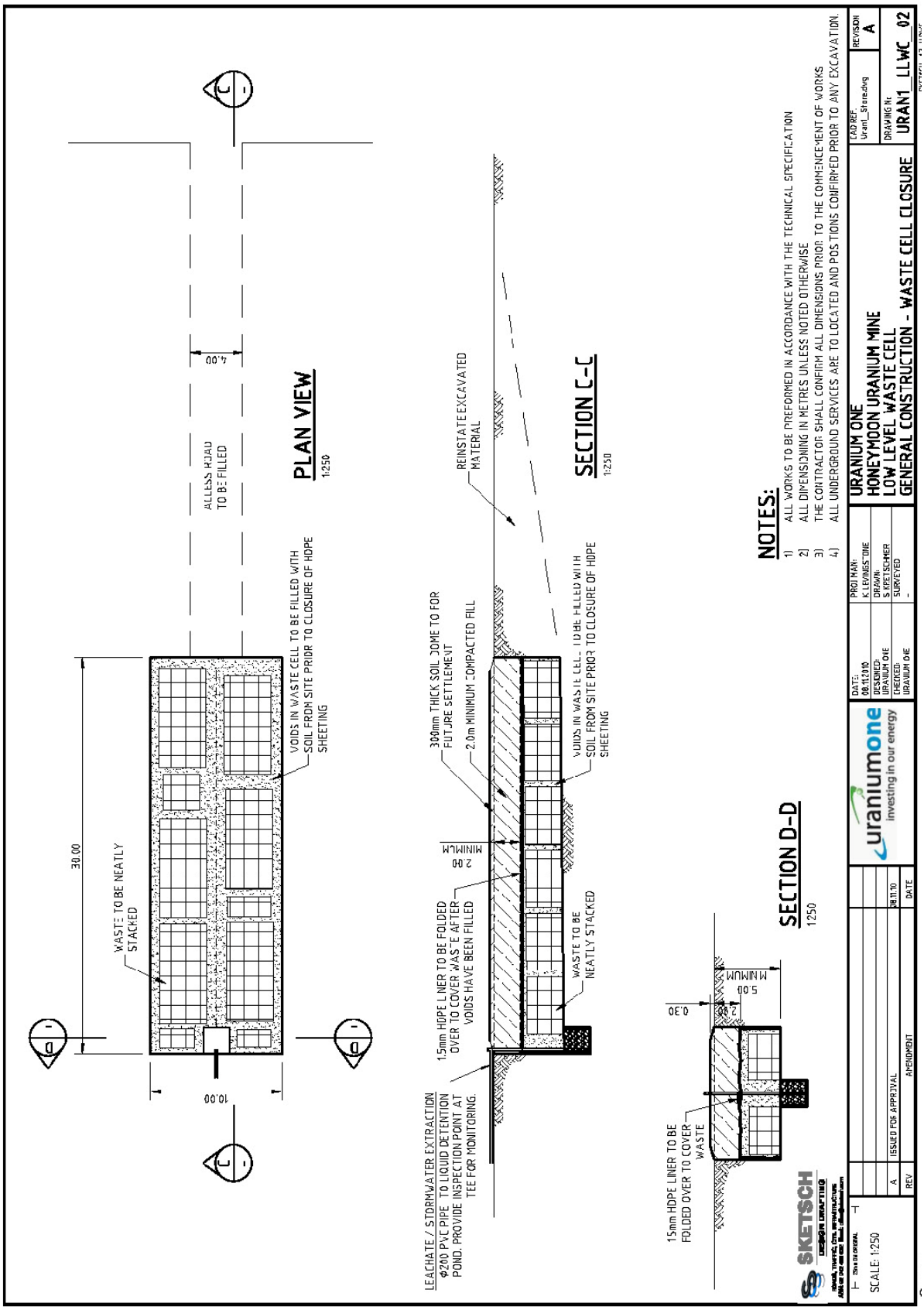


Figure 4.20 Low level radioactive waste repository construction – closure profile

Gypsum Waste Repository

The gypsum waste repository has two main functions; dewatering of gypsum slurry generated in the raffinate phase of groundwater treatment, and as a final disposal site for the gypsum solids.

Key guidelines considered during the design of the low-level solid radioactive waste repository and gypsum repository based on Code of Practice for the near-surface disposal of radioactive waste in Australia (NHMRC, 1992), accepted industry practice and discussions with the Radiation Protection Branch of the South Australian Environment Protection Authority include:

1. Adequate radiological and safety protection provided to humans, other biota and the environment during both the operational phase and on closure.
2. Maximum dewatering capacity
3. Structural integrity during operations, and following closure.
4. Five meters of overburden for Category C waste.

Repository Designs

In order to determine the most effective method of dewatering the gypsum slurry within a gypsum repository and therefore enable timely closure, two different basal drainage designs were initially. These repositories consisted of a two identical 34 x 34 meter repositories with a 10 x 10 meter base. These cells were constructed in 2012 with a basal gravel drainage system and a gabion weir feature (Figure 4.21). The full scale gypsum waste repository consists of a single cell, 54 x 54 meters, with a base of 30 x 30 meters and a maximum depth of 6.3 meters (see Figure 4.22). The base of the cell will be constructed with a 2% gradient, falling in the direction of two 2 meter wide drainage channels, which span the width of the repository floor.

In addition to basal dewatering designs, other key design features of the gypsum repositories include a double lined HDPE system with an inbuilt leakage detection system.

Trial Repository Findings

The trial repositories were designed to take 6 months of gypsum slurry, and were trialled intermittently between February 2013 and July 2013. Results from this period identified that the gravel filtration system was a more reliable dewatering design, and as such a construction and management plan has been developed to cover the construction and operation of a full scale gypsum waste repository (see Figure 4.21 and Figure 4.22).

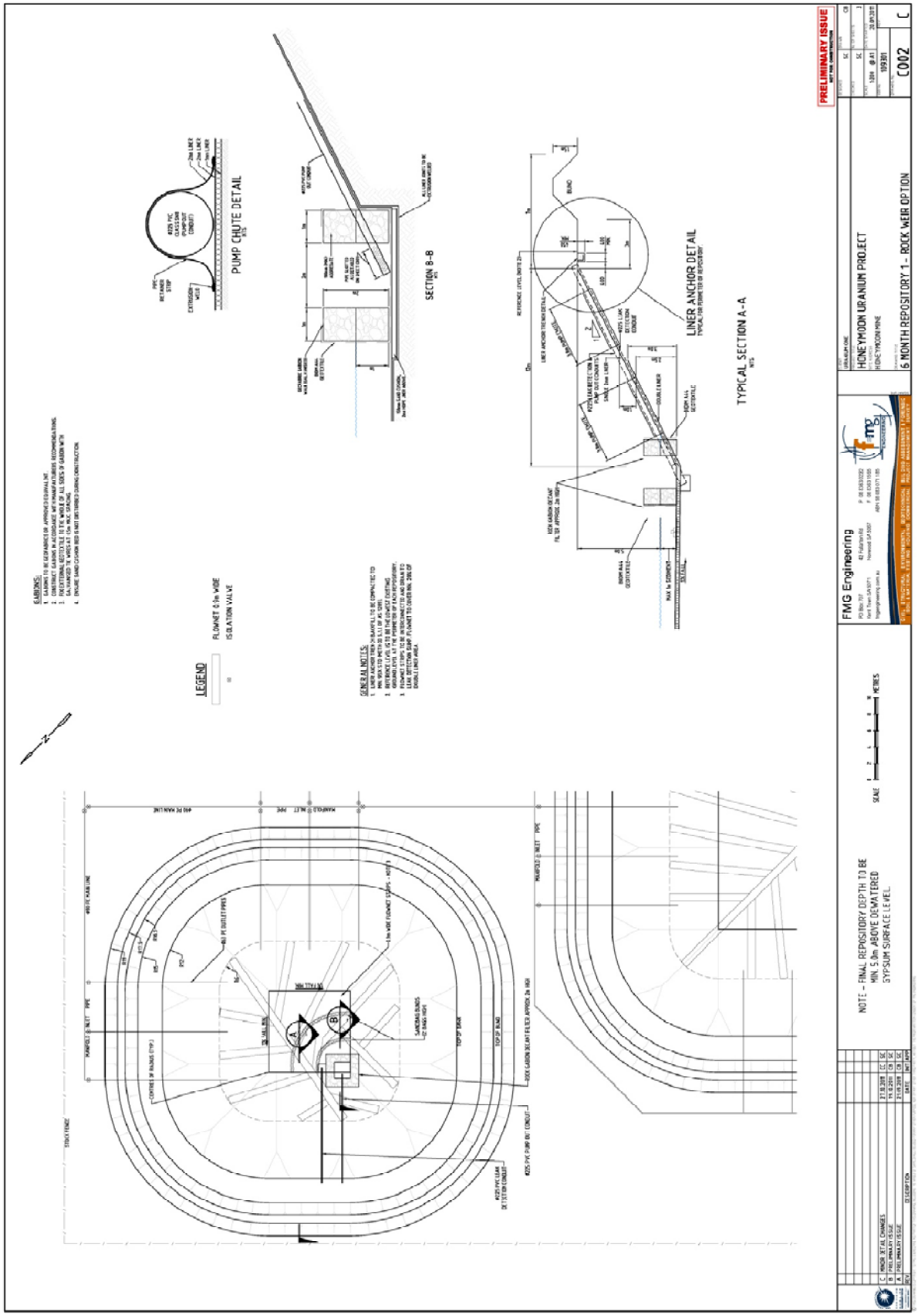


Figure 4.21 Construction specifications for the two trial gypsum waste repositories and full scale repository earthworks

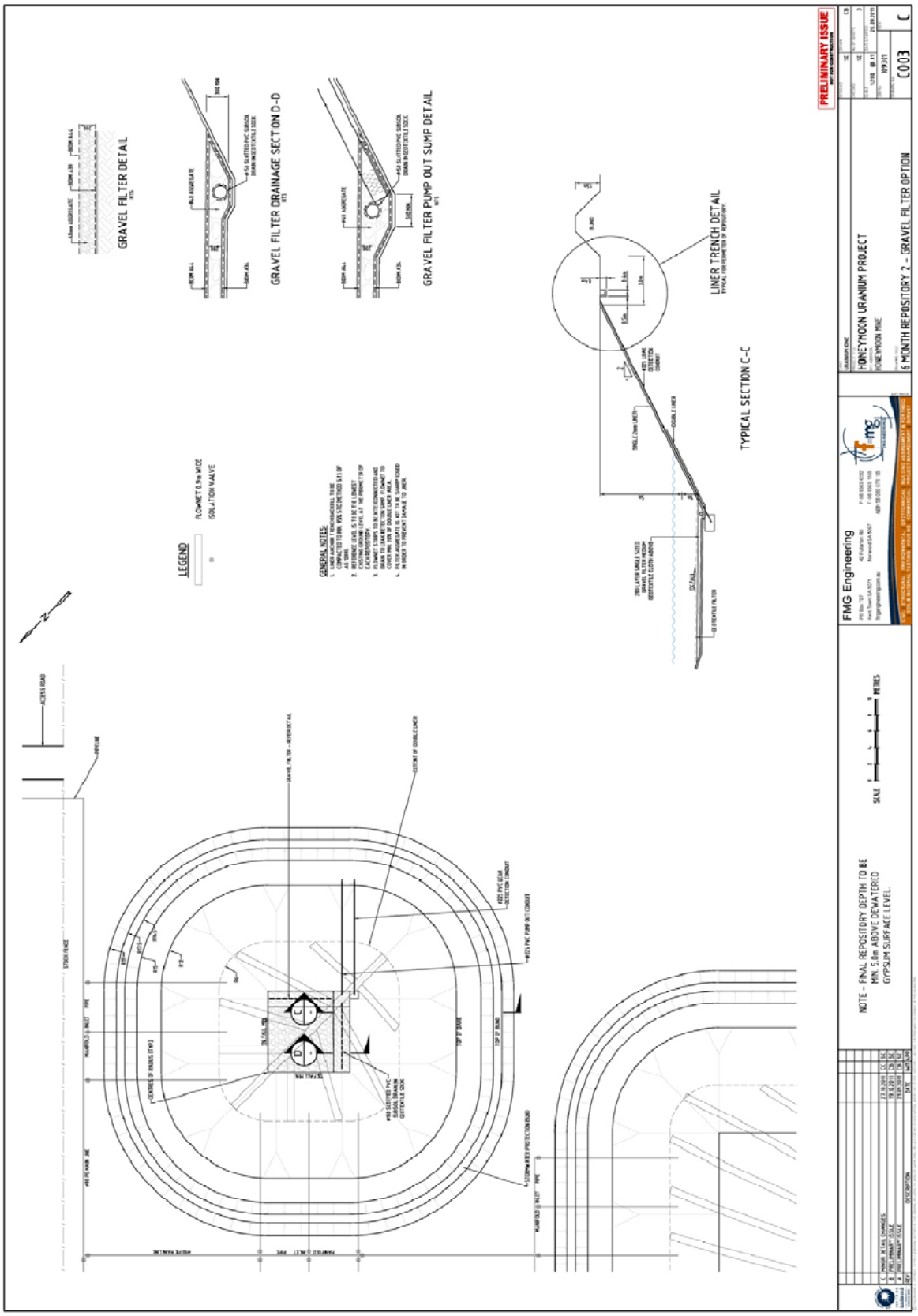


Figure 4.22 Engineering designs for the full scale gypsum repository

4.13.6 Operational Management

Solid Waste Management

The full operational plan for the management of the non-radioactive waste is contained in Attachment N. The operational management plan for low-level radioactive waste materials is contained within the Honeymoon mine operations RWMP. A summary of the key operational management measures for the low-level radioactive waste facilities, gypsum waste and non-radioactive waste facilities are detailed below:

- Identification and classification of waste streams and providing a management framework for each waste stream.
- Segregation measures to prevent inadvertent mixing of non-radioactive waste streams with low-level radioactive waste streams (e.g., discrete locations and signs identifying the two waste repositories).
- Preparation and implementation of management systems to minimise waste generation, such as recycling and reuse programs and other forms of compaction.
- Periodic review of waste management technology with a view to adoption of any new, more cost-effective waste management methods.
- Security measures, security fencing and locks on access points to waste facilities, preventing inappropriate use, wind dispersion and access from native and feral fauna.
- Ensuring appropriate fencing and signage is in place around the landfill facility.
- Ensuring appropriate fire fighting measures are in place.
- Monitor weekly to ensure that:
  - All waste has been covered post-disposal.
  - Scattered rubbish has been collected and disposed of in the landfill.
  - Leachate generation rates are measured and extraction systems are utilised were necessary.
- Treatment of non-radioactive and low-level radioactive solid waste to reduce the total volume and void space, through consolidation and compaction, thereby ensuring void minimisation to prevent subsidence and settlement.
- Regular monitoring of surface waste infiltration and leachate generation will be closely monitored; the gypsum slurry drainage facility will be pumped out regularly, in conjunction with the solid waste facility with any leachate generated will be transferred to the Liquid Disposal Pond (LDP) for disposal down the Liquid Disposal Well (LDW).
- The leachate generated in the non-radioactive waste facility will be diverted into a HDPE 4,500 litre tank which is located adjacent to the repository.
- The individual cells of each waste facility will be successively closed, compacted and rehabilitated to trial closure provisions, and to monitor geotechnical stability and the level of subsidence and surface erosion.
- Fences will be constructed around all facilities. The fencing and locked gates will protect against public entry.

Gypsum Waste Management

Operations

Key operational management and monitoring requirements for the operation of the gypsum repository include:

- Operational inspections on the /decant water transfer and waste deposition system components will be undertaken by process technicians once every shift.

- Installation of 1.2 m chain mesh fencing to prevent unauthorised and fauna accessing the repository.
- Dewatering performance will be monitored daily through the collation of the following data:
  - Volume of gypsum slurry transferred per day (m^3)
  - Volume of flush water transferred to pit per day (m^3)
  - Decant water extracted per day (m^3)
  - Depth of slurry per day of operation (m)
  - Total accumulated gypsum slurry and flush water within pit (m^3)
- Equipment inspections and maintenance activities
- Pond liner leakage monitoring
- Stormwater and erosion monitoring

Closure

Closure preparations will typically commence following each repository reaching its maximum fill depth.

In order to verify the repository has sufficiently dewatered and is ready for permanent closure, the following criteria must be met:

- Leachate decant water pumps, automatically triggered on collection of leachate in the subsurface sump, remain inactivated for a month.
- No surface water is visible on the surface of the repository.

Key closure steps include:

- Removal of all supply and decant lines servicing the repository, while the leak detection decant pipe will be retained along with the leak detection probes.
- A new HDPE liner will be fabricated separate to the repository to form a top liner. This liner will be seam welded to the basal liner. The seam will be integrity tested and the new top liner of lid will then be vacuumed to remove the air and compress the cavity.
- The top liner will be seam welded to the secondary liner at the surface, between the lip of the repository and the anchor trench
- The volume having been vacuum sealed will not require a breather pipe. The vacuum sealed bag will be more sustainable and more able to endure the compressive weight of the backfilling. The vacuumed bag will not have the air pockets or the gasses contained which could add pressure to the internal walls of the void. The gypsum contents of the liner will be able to move and settle without jeopardising the liners integrity.
- The two liners will be sealed to one and other and then vacuumed together. This will form a sealed bag where the gypsum will be isolated.
- Once the new liner is completed, backfill will commence using stockpiled clay.
- This final surface will be smoothed, crowned, lightly ripped and revegetation undertaken in association with the site progressive revegetation program.
- The global positioning system (GPS) coordinates of the repository site will be added to the low level waste register together with the total quantity of gypsum deposited in each facility and the volume of decant water removed.
- Permanent surface markers shall be put in place to define the boundaries and locations of the repositories.
- Security fencing will then be removed.

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4.13.7 Drainage and Sediment Control

The Honeymoon mine site is outside the zone of influence of Mingary and Oonarta Creeks (the nearest watercourses of note to the site) and all structures, including storage ponds on the Honeymoon mine site which have been designed to be above the 1 in 100 year flood level. In addition, all ponds and sediment ponds, with the exception of the stormwater pond, have been designed with a freeboard for a 1:100 average recurrence interval (ARI). Stormwater is managed through a series of containment and collection structures which ensure that stormwater run-off is retained within the perimeter of the mine site.

Within the process plant and around the solution ponds, perimeter earthen bunds have been constructed to contain stormwater and prevent the migration of stormwater offsite. These areas will drain to the stormwater pond for evaporation and or discharge to the LDP. Interception drains and associated sediment ponds are located at the base of the mine site to collect stormwater, allow sediment to settle and provide an evaporation area.

4.13.8 Airborne Wastes

The ISR mining process generates small quantities of airborne radioactive wastes and these are mainly generated in the final phases of the processing plant. A detailed description of the airborne emissions generated and associated monitoring and management techniques are described in detail in the Honeymoon mine Operational Radiation Management Plan and Radioactive Waste Management Plan. The following section provides a brief overview to airborne wastes.

Dust

Other than the drying and packaging area of the plant, the ISR process is generally a ‘wet’ process and the sources of radioactive dust are minimal. There is no dust associated with wellfield operations (other than other air quality emissions), apart from dust from access roads, with dust suppression by water trucks.

However to ensure airborne dust derived from routine operations is avoided and/or minimised where possible, the following engineering control measures have been incorporated in the drying and packing plant.

- The drying equipment and ventilation filtration systems are fully enclosed within a sealed purpose build building.
- The entire building is run at a negative pressure through operation of the bag house, where all internal air extracted in routed to the baghouse for dust separation and collection, therefore ensuring no particulate matter can be discharged to the environment.
- The dryers cannot be operated unless the off-gas plant is running, and the dryer off-gas plant cannot operate unless the drying and packing plant baghouse is running.
- The drum filling is undertaken is separate enclosure, limiting product dust dispersion
- An automatic drum wash system removes any residual product particulate matter from the lid and drum surfaces preventing it from being dispersed around the work area and potentially becoming airborne.
- Adequate washdown water points and sumps provided for ensuring regular and effective cleaning.

Gas - Radon Dispersion

Radon concentrations within native groundwater and process solutions are preferentially released when in contact with the atmospheric due to volatilisation. The groundwater and concentrate solutions accumulate higher concentrations of radon than the atmosphere as a result of ongoing decay of radium present in the mineralisation and process solution.

To minimise radon concentration in operational work areas the following engineering controls have been utilised:

- Process and disposal ponds have been located on the perimeter of the mine site, away from regularly occupied work areas.
- All infrastructure, with the exception of drying and packing, are located outdoors, enabling radon to be dispersed in the atmosphere.
- Process solution tanks within the plant area are enclosed and have fans installed to maintain a negative pressure and ensure positive removal of off-gases.
- Where necessary tanks are connected to the ventilation stack via an inducted ventilation system.
- Vent gases produced during precipitation are inductively drawn off via the gas extraction fans to the plant stack, or vented to a safe location.
- Gases are inductively drawn off during the drying and packing process through a dedicated system comprising of gas extraction fans, baghouse and secondary filter for discharge to atmosphere via a dedicated extraction stack.
- The dryer off-gas plant uses a dedicated extraction fan to extract the hot vapour from the dryer bag house which as it cools, removes the vapour from the condensate and sends any waste liquids from this process to the uranium precipitation thickener via the area sump.

Radon dispersion models have been developed to identify potential radon concentrations, and demonstrate a low potential for radon release from the processing plant and ponds.

4.14 Supporting Surface Infrastructure

4.14.1 Access

Access to the mine site occurs via the Mulyungarie Road, which runs north from the Barrier Highway some 6 km west of the township of Cockburn (refer to Figure 1.2). Approximately 42 km along the Mulyungarie Road there is a turn off onto a 25 km access road running west, which leads to the mine site. The site can also be accessed from Boolcoomatta Road, which runs north from the Barrier Highway 25 km west of Cockburn.

4.14.2 Accommodation and Offices

Current accommodation and office facilities on site consist of:

- 146 person permanent accommodation camp constructed from portable ‘ATCO’ style living units with associated laundry, showering and toilet facilities.
- Industrial sized kitchen and mess.
- Wet mess and games room.
- Gym.

4.14.3 Public Roads, Services and Utilities to be used

As described in Section 2.2, access to the mine site is via the Barrier Highway and the Mulyungarie Road (both gazetted roads). In addition, a private unsealed pastoral road, referred to as the site access road, is utilised to access the mine site from the Mulyungarie turn off.

4.14.4 Site Security

Security provisions for the mine site consist of:

- Primary mine site perimeter fencing; stock fencing (three strands) around the wellfield, non-radioactive and low-level radioactive waste facilities, cyclone mesh around the gypsum repository and cyclone mesh and barbed wire security fence around the camp and processing plant.
- Secondary high security fencing is erected around the precipitation and thickening tanks and drying and packing plant. Fences in these areas are designed to AS1725 with electronic security access points, and high security gates.
- Card activated turnstiles controlling access to the wellfield and process plant. Access is further restricted in the precipitation, thickening and drying and packing plant based on job function and/or responsibilities.
- Monitored and recorded closed circuit television (CCTV).
- Where mechanical locks are used, keys are controlled by an appointed officer and are secured when not in use.

4.15 Resource Inputs

4.15.1 Workforce

Refer to Section 4.4.2.

4.15.2 Energy Sources

Power Supply

A purpose-built transmission line connects the mine site to the national grid to provide the electric power requirements for the processing plant, wellfield and associated infrastructure, and camp (totalling 3 MVA power). The transmission line starts at a Country Energy connection point to the west of Broken Hill in New South Wales and follows the Barrier Highway to Cockburn on the South Australian border (see Figure 1.1 for the transmission line route). The transmission line then proceeds directly to the mine site via a 50 km long, 50 m wide corridor, covered by MPL 92.

Electricity Supply

MPL 92 was granted in August 2007 and construction of the 3 MVA transmission line was completed in 2008. Uranium One has a supply agreement in place with Country Energy and ETSA.

The total power requirement for the mining operation is estimated at 1,500 kW. The electric power requirement for the demonstration plant, wellfield and camp, totalling 450 kW, has been supplied by on-site diesel generators. The operation has two additional 150 kVA generators for the processing plant and five 150 kVA units for the wellfield

Diesel Supply

Diesel is stored for vehicle and emergency power use in a double skinned 68,000 L tank. Diesel is delivered to site in bulk road tankers from Broken Hill on an as required basis.

LPG Supply

LPG is used on site to power hot water and cooking facilities in the accommodation camp. LPG is delivered in bulk road tankers from Broken Hill on an as needs basis, and stored in a bulk 200,000 L tank on site.

4.15.3 Water Sources, Treatment, Storage and Supply Requirements

Raw Water Sources and Treatment

Raw groundwater is sourced from a series of raw water bores located approximately 1550 m east of the process plant, in the far eastern section of ML 6109. The raw water is extracted from a barren section of the Basal Member aquifer, via two dedicated wells (see Figure 4.14).

As the raw water from the Basal Member is too saline for human or stock consumption, it is purified in one of two RO treatment plants. Two units are currently utilised on site; an old unit located in a small building adjacent to the demonstration plant, and a new containerised unit located north of the processing plant. Water is pumped at present from the raw water supply wells to the two raw water storage tanks adjacent the RO plants. Treated water is stored in tanks with sufficient capacity for 10 days' continuous operation. The production capacity of the RO plant is presently 200,000 L/d, with an efficiency level of 50% product to brine waste.

Water treatment facilities on the mine site consist of two RO plants, capable of producing 200,000 L of potable water per day. Waste water (brine) produced from the plant will be re-injected into the Basal Member aquifer via the liquid waste disposal well.

Storage Facility

Water storage facilities on the mine site consist of:

- Two potable water fire tanks – 900,000 L.
- Potable water storage tank – 280,000 L and 46,400 L.
- Reverse osmosis raw feed tank – 20,000 L.
- Under flow RO product tank – 30,000 L.
- Raw water tank – 22,500 L.
- Waste water tank – 25,500 L.
- Water Service Tanks – 2 x 5000 L, 2 x 47,500 L, 2 x 150,000 L.

Water Requirements

In-situ recovery operations are carried out at a near neutral water balance, with the volume of water removed from the aquifer during the mining process near to the volume of water returned to it (see Figure 4.23).

The main water source requirements are derived from the following areas and/or activities:

1. Site amenities: potable water is required to operate the camp, administration and associated processing facilities.
2. Processing: raw water extracted during ISR operations as through the 0.5 to 2% BLS bleed solution, from the ISR loop to insure mining fluids are contained in the designated mining zone.
3. Plant and machinery wash down water: raw and potable water are required for washing down concreted process areas, and vehicle and machinery leaving site.
4. Groundwater Treatment Plant: the gypsum waste production process will require the net extraction of raw groundwater which will form part of the gypsum slurry.
5. Road works and dust suppression: water is carted for use in routine road works.
6. Wellfield and exploration drilling.

The main sources of waste waters are derived from the following activities:

1. Potable water generation: the production of potable water via a reverse osmosis plant generates waste brine in the ratio of 1:1.
2. Process Liquids: bleed solutions and wash down waters in the processing plant.
3. Groundwater Treatment Plant: the gypsum waste slurry generated during the raffinate treatment phase and plant, machinery and vehicle wash down.

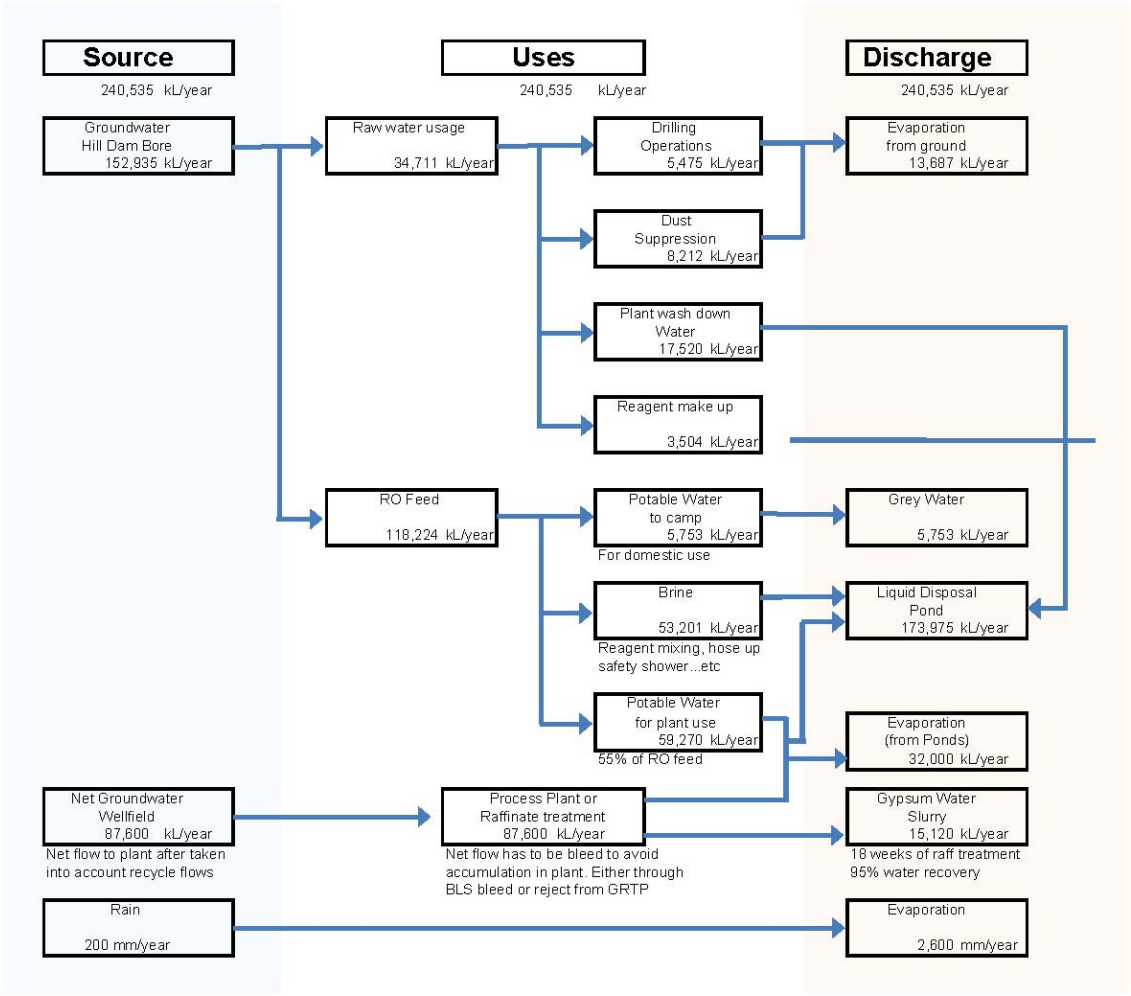

Figure 4.23 Operational water balance

4.16 Mine Completion

Contingency plans for durations of mine care and maintenance are provided in Section 7, and a conceptual full closure plan is detailed in Section 8.

5 Stakeholder Consultation

Uranium One recognises that stakeholder engagement and consultation with the government, local residents, affected and interested communities, and other interested stakeholders is imperative to the success of the Honeymoon mine.

Stakeholder engagement and consultation has been ongoing throughout the development phase of the mine, with activities occurring during development of the Environmental Impact Statement (EIS) (2000), the subsequent development of the Construction MARP (Uranium One, 2007), and the PEPR.

Feedback received through formalised stakeholder engagement and consultation activities has been considered in the drafting of this document.

5.1 Consultation Objectives

The principal objectives of Uranium One's stakeholder engagement and consultation plan are to establish and consolidate Uranium One's reputation as a responsible company in the mining sector, and to ensure the operation of the Honeymoon mine is broadly accepted by its stakeholders. Accordingly, Uranium One's stakeholder engagement and consultation is carried out with the following intent:

- To define and characterise affected communities and other stakeholders for inclusion in engagement activities
- To identify actual and perceived impacts on the affected communities, and ensure that these are captured and addressed throughout the life of the operation and during closure
- To identify appropriate opportunities for involving and communicating with stakeholders
- To provide a means for recording all consultation initiatives and mechanisms through which consultation is undertaken. The mechanisms aim to deliver a system in which matters raised by stakeholders are recorded, actioned and that the outcomes are reported back to those stakeholders
- To provide a process in which future mine planning can take account of issues raised by stakeholders at the earliest possible stage
- To implement a grievance mechanism for the effective resolution of grievances and complaints

5.2 Stakeholder Identification

Stakeholders were identified following a series of internal stakeholder identification meetings and consultation activities (such as those used during development of the original EIS document). Uranium One has identified and compiled a list of 'real' and 'potential' stakeholders to the Honeymoon Uranium mine, as follows:

The 'local' community

- People associated with the immediate area who are directly affected by mining related activities – comprises 13 neighbouring and nearby landowners.
- Indigenous groups including the Adnyamathanha and Kuyani.
- Peripheral communities:
- Communities near to the mine site that may be affected by the mining operations e.g., through employment opportunities, and comprises Cockburn, Broken Hill, Port Augusta and Adelaide.

Local Government

- Broken Hill City Council. – Department of Planning and Local Government SA (DPLG).
- South Australian Department for Environment, Water and Natural Resources (DEWNR).
- Department for State Development (DSD).
- Environment Protection Authority (EPA), including the Radiation Protection Branch.
- SA Health (local government health department).
- Relevant Ministers and Members of Parliament.
- Department of Premier and Cabinet.

Australian Government

- Department of Sustainability, Environment, Water, Population and Communities (DSEWPC).
- Australian Safeguards and Non-Proliferation Office (ASNO).
- Department of Resources Energy and Tourism.
- Interested Ministers and Members of Parliament.

Special interest groups

- Anti-uranium lobbyists.
- Non-Government Organisations (NGOs).
- State Emergency Services (SES).
- Broken Hill Chamber of Commerce and Employers Groups.
- Industry Capability Network (ICN) of South Australia.

Other

- Media (regional, State and national).
- General public (particularly within South Australia).
- Uranium One Contractors/suppliers (including infrastructure providers) to Uranium One.
- Financiers (e.g., brokers, bankers and investors) and their advisors.
- Toronto Stock Exchange (TSX).
- Mining industry (e.g., other mineral explorers or producers in the area).
- Chamber of Mines and Energy (SACOME).
- Minerals Council of Australia (MCA).
- Resource Industry Alliance.

5.3 Consultation Activities

Stakeholder engagement and consultation regarding the Honeymoon mine development has involved a structured and ongoing program of consultation with Government, local land owners and the community, and will continue throughout the life of the mine

The following summarises Uranium One's engagement and consultation activities to date:

- Public Meetings:
  - Three public meetings were held; one each in Cockburn, Adelaide and Port Augusta. The Port Augusta meeting was arranged at the request of a number of the Native Title claimants.
- Consultation regarding the original EIS (Southern Cross Resources, 2000):

  - A total of 1,346 public submissions were received along with 16 submissions from State and Commonwealth agencies. These submissions were addressed in a response supplement to the EIS.
- Broken Hill Police.
- State Emergency and Health service providers.
- State Government and agencies, for example:
- DSD.
- Ongoing consultation with relevant Government departments:
  - EPA
  - ASNO
  - Department of Resources, Energy and Tourism (DRET).
  - DSEWPC.
- Consultation with the local landowners and Native Title claimants.
- Consultation and engagement with the above mentioned stakeholders continues. This will be an ongoing feature during mining operations, starting with information exchange during construction and continuing as an open dialogue during the operations.

A summary of the key issues identified during consultation activities are summarised in Table 5.1.

Stakeholder Group	Individual Stakeholders	Issues Raised	Response
Regional Indigenous Communities	Adnyamathanha Communities (including merged Kuyani Group) Wider Regional Indigenous Community	Indigenous businesses Indigenous employment Environmental performance Cross-cultural matters Consultation for closure planning	• Uranium One proposes to establish a Honeymoon Advisory Committee to discuss relevant issues with the Adnyamathanha representatives. • Uranium One will continue to provide Indigenous employment opportunities. Recruitment links to the Indigenous community have been made via Indigenous recruitment agencies. • Uranium One will annually provide information (Annual Environmental Performance Report) on the company's environmental performance to the relevant Indigenous communities prior to submission to the regulating agency. • Cultural awareness training will be provided to all Uranium One employees (including contractors) through site inductions. Relevant cultural experts will be used in the development of the induction package. • Formal consultation with the Native Title claimants will be undertaken during the preparation of the closure plan.

Stakeholder Group	Individual Stakeholders	Issues Raised	Response
Regional Indigenous Communities	Adnyamathanha Communities Wider Regional Indigenous Community	Indigenous heritage	• Uranium One has conducted a number of Indigenous heritage surveys with Native Title holders as part of the development of the Honeymoon mine. These clearances ensure that activities will not interfere with Indigenous heritage. • If expansion of the Honeymoon site is proposed in the future, further Indigenous surveys and consultation will be undertaken to supplement, where required, the considerable studies carried out to date utilising relevant experts and Traditional Owners. • Uranium One has a qualified community consultation officer to regularly consult and report on Uranium One's Indigenous heritage commitments.
State Emergency Response Agencies	Barrier Highway Committee (NSW/SA Police, Ambulance, Country Fire Service and Hospitals)	Emergency response capability, facilities and support	• Uranium One has emergency response plans in place to respond to mine emergencies (Barrier Highway Emergency Response Plan) and will support SA emergency response agencies as requested. • Uranium One has and will continue to participate in half-yearly meetings and mock exercises as part of the Barrier Highway Emergency Response Committee.
State Emergency Response Agencies	SA Ambulance Service (SAAS) and SA North Eastern Region Health	Emergency response capability, facilities, support and training	• Formal consultation, training and accreditation of Uranium One emergency services facilities and industrial paramedics has been undertaken with the SAS (under the SA Health Act) to enable the mine ambulance to cross State borders, to transport patients to Broken Hill Hospital and care facilities as required. • There will be an ongoing joint training program with SAS in support of the site's emergency response capability.
State Regulators	DSD SA EPA (including the Radiation Protection Branch)	Environmental, health, safety, radiation and transportation	• Uranium One attends regular formal meetings with the State Regulators such as the quarterly In-Situ Recovery (ISR) Radiation Review Committee and the half-

Stakeholder Group	Individual Stakeholders	Issues Raised	Response
	Department for Environment, Water and Natural Resources (DEWNR) SafeWork SA Department of Premier and Cabinet		yearly Honeymoon Environment Consultative Committee. • Environmental, health, safety and radiation safety performance will be documented in the Annual Environmental Performance Report to DSD which can be made available to other agencies by request.
Commonwealth Regulators	Department of the Environment ASNO Department of Resources, Energy and Tourism (DRET)	Environment, safety, physical protection and nuclear safety	• Environmental, safety, physical protection and nuclear safety will be documented in the Annual Environmental Performance Report to the South Australian regulating agency DSD and will be provided to Commonwealth agencies ASNO, DRET. • Regular reporting against permit and licence conditions for a Permit to Possess Nuclear Material, including transportation and physical security of Uranium Oxide Concentrate (UOC).
Regional Pastoralists	Neighbouring pastoralists	Regional farming activity, road conditions, water usage and grazing activity	• Uranium One partakes in regular discussions with local landowners regarding access roads, shared resources and general pastoral issues. • All interactions with landowners will be recorded in a consultation log, which provides a system in which matters raised are actioned and the outcomes are reported back to the landowner • Uranium One's community consultation officer will provide a central contact person, to discuss issues relating to land use or other grievances.
Regional Pastoralists	Pastoral Board	Regional farming and grazing activity	• Kalkaroo Station was formerly heavily stocked and consequently subject to heavy grazing pressure. The station has since been destocked to encourage the regeneration of native species under the advice from the Pastoral Board. The Pastoral Board has specified that the land should remain destocked for an unspecified period of time. • Uranium One continues to manage Kalkaroo Station and will

Stakeholder Group	Individual Stakeholders	Issues Raised	Response
			participate in regular engagement with the Pastoral Board regarding the condition and use of the pastoral lease.
Regional Community Business Forums	Broken Hill Chamber of Commerce and Employers Groups SA North East Economic Forum	Employment opportunities, business grants, local sponsorships and training opportunities	• Uranium One has undertaken a number of focussed recruitment campaigns in northern regional SA/NSW (Broken Hill), Adelaide and Port Augusta that have proven successful. Uranium One established an office in Broken Hill in August 2006 to support the mining activities, and community engagement and recruitment initiatives. Recruitment activities will be ongoing throughout the duration of the mine life. • Uranium One is a member of and regularly attends the Chamber/Employer Group. • Uranium One has presented to the SA North East Economic Forum and will continue to maintain links with this group.
Regional Community Business Forums	Industry Capability Network (ICN) of South Australia	Promotion of South Australian business	• Uranium One actively participates in the ICN of SA.
Non-Government Organisations (NGOs)	All interested parties	Environmental and radiation safety performance	• All NGO communications will either be discussed through the Australian Uranium Association or via Uranium One's website.
General Public	Wider Community	Various	Uranium One has implemented the following measures to ensure requests for operational information, or specific concerns of the wider community are addressed: • Appointment of a specialist community consultation officer. • Regular updating of the Uranium One website. • Maintaining an open doors policy to community enquiries. • Participation in industry forums. • Continued involvement with regional organisations. • Will formalise a community consultation log which will provide a system in which matters raised by the community are considered and the outcomes are reported back to the

Stakeholder Group	Individual Stakeholders	Issues Raised	Response
			individual or group.
Uranium One Workforce	Management Professional Employees Operators and Trade Employees	Terms, conditions and benefits of employment including welfare, training and career development	Uranium One has established a number of committees with representatives from the Uranium One workforce. These committees include the following: • Employee Consultative Committee. • Employee Health and Safety Committee. • Uranium One has also established an Employee Personal Assistance Program which gives all employees access to a counselling service, a database of relevant literature and advice regarding managing difficult situations in the work place.

Table 5.1 Summary of stakeholder consultation

5.3.1 Operational Consultation

An operational stakeholder engagement plan has developed broad individual plans for the engagement of Uranium One Australia with each of the identified stakeholder groups.

5.3.2 Care & Maintenance and Mine Closure – Consultation

Following a decision for the operation to enter a phase of care and maintenance or closure, a revised stakeholder engagement plan will be developed. This plan will review all current stakeholders, and ensure appropriate levels of consultation are undertaken throughout the planning and implementation process.

6 Management of Environmental, Social and Economic Aspects

6.1 Overview

This section summarises the aspects of Uranium One's Honeymoon Uranium Mine (Honeymoon mine) operations that have the potential to influence (both positively and negatively) the natural, social or economic environments.

For each environmental, social and economic aspect an impact assessment has been undertaken to identify the potential, credible impacts resulting from the operation of the Honeymoon mine. Associated avoidance, mitigation or management measures are then described; these measures will be used as the basis for all environmental management and monitoring documentation. Finally, an assessment of the residual risk (with an assumption that management and control measures are implemented) is presented.

Following the impact assessment, the desired management outcomes, measurement criteria and a monitoring program is described for each aspect where a credible environmental, social or economic risk has been identified. Specific measureable criteria are then detailed, which will be used to measure ongoing management and control initiatives implemented by Uranium One at the Honeymoon mine.

6.1.1 Context and Stakeholder Views

The environmental, social and economic aspects of the Honeymoon mine are considered in context of:

- The existing environment (natural, social and economic), analysed through a combination of specialist studies and desktop reviews.
- Stakeholder feedback, assessed through ongoing stakeholder engagement and consultation activities.
- Compliance with appropriate State and Commonwealth legislation.
- Standard industry practices; assessment of environmental, social and economic aspects was assessed in consideration of other similar mining operations (such as Beverley Uranium mine), planning criteria for the region and a collection of relevant Australian and International, codes, policies, standards and guidelines.
- Prior in-situ trial leach operations at the Honeymoon mine during the early 1980s and late 1990s; associated impacts, remedial effectiveness and evidence of groundwater attenuation.
- In-situ recovery (ISR) mining; a method of uranium extraction that minimises the mine footprint, radiological exposure to the ore body, waste product generation, and, consequently, the number of inherent risks to environmental, social and economic aspects, which may be associated with other forms of mining.

6.1.2 Risk Assessment

In order to determine the level of risk associated with various impact events, the likelihood and severity of the consequences were considered separately. Control strategies are considered when assessing and assigning the likelihood and consequences of the various impacts.

Likelihood

The likelihood of each event occurring is determined based on information such as past experience and the effectiveness of proposed control measures. The likelihood is classified using the following system:

- Virtually certain: will occur, or is of a continuous nature, or the likelihood is unknown.
- Likely: likely to occur during mine lifetime.
- Possible: not likely to occur during mine lifetime, but may occur in some mines.
- Unlikely: may occur in some mines.
- Virtually impossible: has almost never occurred in similar mines, but conceivably could.

Severity and/or Consequence

The severity of each event occurring is determined based on information such as the potential scale of the event, the range of stakeholders who may be affected, the duration of the event and the difficulty in remediating the impact. The severity and/or consequence are classified using the following system:

- Negligible: possible impacts but without noticeable consequence.
- Minor: some limited consequence but no significant long-term changes, may be simply rehabilitated, not of significant concern to wider community.
- Moderate: significant changes that may be rehabilitated with difficulty.
- Severe: substantial and significant changes will attract public concern, only able to be partially rehabilitated or uncertain if it can be successfully rehabilitated.
- Disastrous: extreme permanent changes to environment (not able to be practically rehabilitated); major public outrage or the consequences are unknown.

Risk

The risk associated with each event is determined using a matrix as shown in Table 6.1.

Consequence	**Likelihood**				
	Virtually Impossible	Unlikely	Possible	Likely	Virtually Certain
Negligible	Low	Low	Low	Low	Low
Minor	Low	Low	Medium	Medium	Medium
Moderate	Medium	Medium	Medium	Medium	High
Severe	Medium	Medium	Medium	High	High
Disastrous	Medium	Medium	High	High	High

Table 6.1 Risk Matrix

The risk analysis was conducted using a modified Fault Tree Analysis approach. Top level undesired outcomes were identified and organised logically. Events, conditions and factors, which could lead to or contribute to those outcomes, were deductively identified.

The fault tree was not followed down to the level of detail that would be required for plant design analysis; the analysis stopped at a level that would provide input for further design-oriented HAZOP studies (Standards Australia, 2004). The risk assessment was further developed with regard to all other Commonwealth and Mining Lease requirements.

6.1.3 Outcomes and Criteria

A series of environmental, social and economic outcomes have been developed for the operation of the Honeymoon mine. These outcomes seek to address all credible environmental, social and economic impacts identified during the risk assessment, and provide a commitment from Uranium One on the extent to which impacts will be limited.

Attaining compliance for each identified outcome will be assessed through one or more measurable criteria. These 'assessment criteria' outline what will be measured during routine monitoring and what the measurement will be assessed against to demonstrate that specified outcomes have been achieved. Where possible, the assessment has been based on legislative guidelines, codes of practice, industry standards, or baseline monitoring results.

Leading indicator criteria have been developed where possible for outcomes that rely on the successful implementation of control strategies. These warning indictors provide an early indication that the control measures in place are insufficient and require immediate review.

6.1.4 Monitoring Program

A site-specific monitoring program has been developed to detail how the assessment criteria and leading indicator criteria will be monitored. The monitoring program is divided into individual environmental and social outcomes outlining the type, method, location and frequency of assessment methods.

6.2 Soil

6.2.1 Applicable Legislation and Standards

- South Australian Legislation:
  - Environment Protection Act 1993 and Regulations (including the Environment Protection (Miscellaneous Amendment Bill 2005).
  - Native Vegetation Act 1991.
  - Pastoral Land Management and Conservation Act 1989.
  - Natural Resource Management Act 2004.
  - Radiation Protection and Control Act 1982 and associated regulations.
- Commonwealth Legislation:
  - No relevant legislation; compliance with best practice and industry standards.

6.2.2 Potential Impacts

Mining operations have the potential to impact soils through:

- Soil contamination (radiological and non-radiological).
- Degradation of soil quality (removal (erosion) and impacts to soil fertility and stability).

Soil contamination

The primary sources of radiological and non-radiological soil contamination include:

- Accidental release of mining solutions from the above ground wellfield reticulation system.
- Dispersal of drilling mud and machinery oil spills during mine drilling and exploration activities.
- Non-radioactive chemicals and hazardous material spills during transport, handling and storage.

- Product solutions and solid spills from leaks, ruptures and normal operational activities.
- Surface water dispersion of particulate matter.
- Spills, seepage and dispersion of leachate from non-radioactive and low-level radioactive waste facilities.
- Leakage and spills (overflow) from solution ponds.
- Raw groundwater spills during well development and raw water extraction.
- Hydrocarbon storage areas and machinery maintenance areas.

Soil Quality

The prime causes of soil quality degradation include:

- Compaction from traffic and machinery movement off designated roads and tracks.
- Removal of soil surface biota and/or surface crust by traffic and machinery movement.
- Inadequate drainage leading to surface water ponding.
- Removal of vegetation.
- Soil/subsoil stripping and soil stockpiling for extended periods of time.
- Incorrect sequence of stockpiled soil replacement.
- Wind and surface water dispersion of soil stockpiles.
- Uncontrolled stormwater movement.

6.2.3 Control and Management Strategies

In order to ensure that all potential impacts to soil are avoided, mitigated and/or managed during operational activities, the following control measures have been implemented:

Reduction in soil quality through contamination (radiological/non-radiological)

- Integrity/pressure testing of all pipe work.
- Use of earthen bunding containment around the process plant, liquid disposal zone, wellfields and each wellfield trunk line.
- Extraction trunk lines and feeder lines in the wellfield are installed with pressure transducers to identify significant leakage through a loss in pressure.
- Liquid disposal pipes are fitted with pressure transducers and flow meters, monitored via the control room.
- Production wellheads have drip trays with conductivity probes to identify minor leaks.
- Wellhouses and filter skids are fitted with drip trays, catchment areas and sumps.
- 24-hour monitoring of all system controls and leak detection systems.
- Fuel and chemicals will be stored in accordance with Environment Protection Authority Guidelines on Bunding and Spill Management (EPA, 2007b).
- Training in hazardous material handling and spill management.
- Spill response kits available in each work area and where potentially contaminative items are stored/used (e.g., mobile plant with small quantities of fuel storage).
- Regular inspections undertaken on all mine infrastructure to prevent and minimise any identified leaks.
- A site wide traffic management plan to limit vehicle and infrastructure contact.
- Regular revision and auditing of the site traffic management plan.
- A remedial treatment area (i.e., bio-remedial pit) provided on site.

- Non-radioactive and low-level radioactive waste facilities provided on site for disposal of contaminated wastes.
- Internal hazard or incident reporting required for all relevant identified spill events.
- External incident reporting based on the Criteria and Procedures for Recording and Reporting Incidents at SA Uranium Mines (DSD, 2003).
- Weekly environmental inspections undertaken to identify any unreported spill events and initiate remedial actions were required.

Reduction in soil quality through soil compaction

- Weekly environmental inspections and monthly audits.
- Site traffic management plan/induction stipulates all mine site personnel must only utilise designated tracks and roads unless prior authorisation has been made using the Landscape and Native Vegetation Clearance Permit system.
- Closure and rehabilitation of all unauthorised tracks identified.
- Compacted areas ripped and rehabilitated and/or left to regenerate.
- Vegetation clearance minimised through the use of an audited Landscape and Native Vegetation Clearance Permit.
- Surface water/stormwater drainage networks have been designed to slow and direct all surface waters to designated collection points, preventing erosion and allowing suspended sediment to settle out inside the mine site.

Significant reduction in soil quantity through soil erosion

- Stockpiled soils are restricted to a maximum height of 3 meters and have been profiled to prevent wind and rain dispersion.
- Site inductions specify the compulsory requirement to stay on designated tracks and roads.
- Vegetation clearance is minimised through the use of Landscape and Native Vegetation Clearance Permits, submitted and assessed prior to any surface disturbance.
- Revegetation of disturbed/cleared areas undertaken as part of progressive rehabilitation works.
- Progressive rehabilitation works include tracks no longer required for mining activities.
- Surface water/stormwater drainage networks have been designed to slow and route all surface waters to designated collection points allowing suspended sediment to settle out and prevent erosion of the ground surface.

6.2.4 Risk Assessment

Table 6.2 provides a quantitative assessment of the likelihood, consequence and resultant risk associated with the impacts identified in Section 6.2.2, and the residual, likelihood, consequence and risk following implementation of control and management measures presented in Section 6.2.3.

Impact No. 1: Reduction in soil quality through contamination (radiological/non-radiological)	
Risk prior to implementation of controls	Likelihood: Virtually certain Consequence: Minor Level of risk: Medium
Residual risk after implementation of controls	Likelihood: Likely Consequence: Negligible Level of risk: Low

Impact No. 2: Reduction in soil quality through soil compaction	
Risk prior to implementation of controls	Likelihood: Virtually certain Consequence: Minor Level of risk: Medium
Residual risk after implementation of controls	Likelihood: Possible Consequence: Negligible Level of risk: Low
Impact No. 3: Significant reduction in soil quantity through soil erosion	
Risk prior to implementation of controls	Likelihood: Likely Consequence: Moderate Level of risk: Medium
Residual risk after implementation of controls	Likelihood: Unlikely Consequence: Minor Level of risk: Low

Table 6.2 Risk assessment - soil

6.2.5 Justification for Residual Risk

The risk assessment of potential impacts to soil during the operation of the Honeymoon mine, taking into account design and operational management measures, has resulted in the classification of a low residual risk for each of the identified impacts on soil.

In justifying the acceptability of the risk of impacts to soil within the mine site, Uranium One has considered both the practicalities and economics of managing the impacts. The residual risks are considered to be as low as reasonably practicable and for this reason are considered by Uranium One to be acceptable for the mine's ongoing operation.

6.2.6 Outcomes and Measurement Criteria

Predicted outcomes have been identified for each of the credible impacts identified in Section 6.2.2 and are listed in Table 6.3. Outcomes reflect the anticipated level of environmental impact associated from the operation, based on other similar mines and advice provided by independent specialists. Criteria have also been developed to facilitate assessment against the predicted outcomes.

Outcome Measure Criteria	Leading Indicator Criteria	Summary of Control Measure
Impact No. 1, 2 and 3 / Outcome No. 1: Soil is suitable for return to pastoral use post closure.		
• All radiological spills are remediated to the radiological criteria specified in the operational Radioactive Waste Management Plan (RWMP). • Hydrocarbon spills will be	• Annual soil contamination quantities. • Annual assessment of the effectiveness of remedial techniques. • Trend data: number and extent (recorded in m^2 and m^3) of spills recorded.	• Integrity/pressure testing of all pipe work. • Use of earthen bunding containment around the process plant, liquid disposal zone, each wellfield and associated trunk lines. • Liquid disposal pipes are fitted with pressure transducers and flow meters, monitored via the control room. • Extraction trunk lines and laterals are installed with pressure transducers to identify significant leakage through a loss in pressure. • Production wellheads have drip trays with conductivity probes to identify minor leaks. • Wellhouses and filter skids are fitted with drip

Outcome Measure Criteria	Leading Indicator Criteria	Summary of Control Measure
remediated in line with National Environmental Protection Measures (NEPM) Risk Assessment Methodology. • Acid and alkali spill sites will be returned to the local background range. • No significant loss of stockpiled soil from storage areas as determined by annual photo-monitoring. • All unauthorised tracks and clearance/ disturbance areas are investigated, closed and rehabilitated.	• Off-road/track driving not subject to the Landscape and Native Vegetation Clearance Permit will be investigated and rehabilitated.	trays, catchment areas and sumps. • 24-hour monitoring of all system controls and leak detection systems. • Fuel and chemicals will be stored in accordance with EPA Guidelines (Bunding and Spill Management). • Spill response kits available in each work area. • Maintenance staff will undertake regular inspections of mining infrastructure to prevent and minimise any identified leaks. • Spill response kits available in each work area. • Training required for hazardous material handling and spill management. • A remedial treatment area (i.e., bio-remedial pit) has been provided on site. • Internal hazard or incident reports required for all identified spill events • External incident reporting against the Criteria and Procedures for Recording and Reporting Incidents at SA Uranium Mines (DSD, 2003). • Weekly environmental inspections will be undertaken to identify unreported spill events and initiate remedial actions where required. • Site traffic management plan/inductions used to educate site personnel on the sole use of designated roads and tracks unless prior authorisation has been made using the Landscape and Native Vegetation Clearance Permit system. • Progressive rehabilitation of tracks no longer required for mining activities. • Compacted areas ripped and revegetated or left to regenerate, as part of progressive rehabilitation activities. • Stockpiled soils restricted to 3 m in height, profiled and stabilised with water to restricting wind and rain dispersion. • Stabilising cleared areas during high wind events will be undertaken using water spray trucks. • Vegetation clearance, even within designated clearance area will be minimised through the Landscape and Vegetation Disturbance Permit.

Table 6.3 Outcomes and Measurement Criteria – soil

6.2.7 Operational Monitoring Program

A summary of the operational monitoring program for soil is provided in Table 6.4.

Monitoring Method(s)	Monitoring Parameter(s)	Monitoring Frequency	Monitoring Location
Soil Monitoring No. 1: Non-Radiological Spills			
• Hazard reporting. • Incident reporting. • Environmental inspections. • Environmental audits.	• Extent of spill (recorded in m^2 and m^3). • Location (global positioning system (GPS) coordinates). • NEPM Risk Assessment for hydrocarbon spills (see Table 6.3). • Soil pH of acid and alkali spills versus background soil pH. • Remedial actions required (if any). • Close-out details. • Assessment of the effectiveness of remedial method.	• Incident reports as required. • Weekly inspections and monthly audits.	• As required.
Soil Monitoring No. 2: Radiological Spills			
• Hazard reporting. • Incident reporting. • Radiation inspections. • Radiation audits.	• Extent of spill (recorded in m^2 and m^3). • Location (GPS coordinates). • Radionuclide content/activity of soil where required. • Remedial actions required (if any). • Close out details. • Assessment of the effectiveness of remedial method.	• Incident reports as required. • Weekly inspections and monthly audits.	• As required.
Soil Monitoring No. 3: Erosion			
• Subjective visual and photo-point assessment. • Environmental reporting and investigation.	Description of: • Changes to soil profiles. • Depth and formation of erosion gullies. • Operational assessment of effectiveness of surface/stormwater drainage system. • Incident report developed following any impacts on the ML following an extreme rainfall event.	• Annually. • Following rainfall greater than 30 mm within a 24-hour period.	• Stockpiled soils. • Surface/storm water drainage networks. • Earthen bunding. • Mingary and Oonarta creek crossing.
Soil Monitoring No. 4: Soil Quality			
• Incident reporting. • Environmental inspections/ audits.	• Number and extent of significant new (unauthorised) tracks created. • Number and extent of clearance activities undertaken	• As required. • Weekly inspections and monthly audits.	• As required.

Monitoring Method(s)	Monitoring Parameter(s)	Monitoring Frequency	Monitoring Location
	without approval. •		
Soil Monitoring No. 5: Landscape Function Analysis			
• Nutrient cycling and landform stability assessment.	• Percentage of bare soil, dead vegetation, live vegetation, and clay soils along a 50m linear transect.	• Annually.	• Rehabilitated areas.

Table 6.4 Monitoring program - soil

6.3 Flora

6.3.1 Application Legislation and Standards

- South Australian Legislation:
  - Native Vegetation Act 1991.
  - Natural Resources Management Act 2004.
  - National Parks and Wildlife Act 1972.
  - Pastoral Land Management and Conservation Act 1989
- Commonwealth Legislation:
  - Environment Protection and Biodiversity Conservation Act 1999.

6.3.2 Potential Impacts

Mining activities have the potential to impact native flora and vegetation communities through:

- Reduction in native species abundance and/or species richness.
- Introduction and/or increase in abundance of weed species.
- Reduction in soil quality leading to impaired vegetation growth.

Reduction in native species abundance and/or species richness potentially derived from:

- Vegetation removal and soil/sub-soil stripping.
- Fires.
- Fugitive dust.
- Weed introduction and distribution.
- Traffic and machinery movements.
- Overgrazing.

Introduction and/or increase in abundance of weed species potentially derived from:

- Machinery and material importation and movement across site.
- Provision of favourable habitats for weed infestation (e.g., high moisture and nutrient zones).
- Clearance of vegetation creating new areas for newly colonising weed species.
- Overgrazing from pastoral activities or pest species creating new areas for newly colonising weed species.
- Failure to manage existing weed infestations.

Reduction in soil quality leading to impaired vegetation growth potentially derived from:

- Traffic and machinery movements and excavations.
- Soil contamination.
- Overstocking.
- Soil erosion.

6.3.3 Control and Management Strategies

In order to ensure that all potential impacts to flora are avoided, mitigated and/or managed during operational activities, the following control measures have been implemented:

Reduction in native species abundance, species richness and distribution through vegetation clearance

- Significant Environmental Benefit (SEB) – payment is made into the SEB fund to offset planned vegetation clearance on site.
- Limiting vegetation clearance through a Landscape and Native Vegetation Clearance Permit, required for any new operational activity that will disturb the ground surface.
- Traffic management plan implemented and enforced to ensure vehicles and machinery keep to designated tracks and roads.
- Progressive rehabilitation of portions of the mine site no longer required for operational activities.
- Fire protection and intervention measures provided for the mine site and immediate surrounds.
- No pastoral activities within mining tenements.
- Ongoing pastoral lease impact assessment within Kalkaroo Pastoral Lease (if grazing is reintroduced).
- Fugitive dust gauges installed within and outside the mine site to assess operational increases in dust emissions.
- Adherence to the Honeymoon mine Native Vegetation Management Plan.
- Staff training and inductions used to identify areas of ecological significance to staff, contractors and visitors.

Introduction and/or increase in abundance of noxious weeds

- Traffic management plan implemented and enforced to ensure vehicles and machinery keep to designated tracks and roads.
- No exotic species are to be brought in or planted on site.
- Restricting the area of native vegetation cleared through use of the Landscape and Native Vegetation Clearance Permit.
- Herbicide application to noxious weed outbreaks, where recommended by flora specialist.
- Progressive rehabilitation of the mine site to prevent weed species from becoming established.
- Annual weed survey to document any changes to species richness and abundance and assess control measures as required.
- Active management and control of weeds within the mine site.
- Adherence to the Honeymoon mine Native Vegetation Management Plan.

Reduction in soil quality and quantity leading to impaired vegetation growth

- Specific engineering controls have provided for the capture and control of leaks/spills (i.e., drip trays, leakage detection systems and physical barriers such as earthen bunding around the wellfield, process plant and liquid disposal zone to capture and contain spills).
- Automated control systems on mining components, including 24-hour monitoring of all system controls, leak detection systems and regular physical inspections.
- Internal hazard and/or incident reports are required for any identified spill or contamination event.
- External incident reporting will be undertaken based on the Criteria and Procedures for Recording and Reporting Incidents at SA Uranium Mines (DSD, 2003).
- Weekly environmental inspections/monthly audits assist in identifying unreported spill events and initiate remedial actions where required.
- Progressive rehabilitation will rip and where necessary, revegetate, areas no longer required for mining activities.

Soil quality

Measures to protect soil quality are discussed in Section 6.2.3.

Dust generation:

Measures to avoid and minimise dust generation are discussed in Section 6.6 Environmental Air Quality.

Overgrazing

- Formal assessment of pastoral impacts (if grazing is reintroduced) during annual flora, fauna and pest survey.
- Feral animal culling.
- Culling of native animals where recommended by independent specialists / government bodies.

Fire

- Smoking prohibited across all mining tenements with the exception of designated smoking areas.
- Two independent fire control systems installed within the mine site: one within the processing plant and the other servicing the camp, wellfield and administration areas.
- A fire truck, adequate water supplies and a trained emergency response team available in the event of a fire.

Progressive rehabilitation

- Fencing sections of the mine site that are not required for mining activities and progressively revegetating these areas back to a condition suitable for pastoral use.
- Commencing revegetation trials across areas of historical and/or current disturbance.

6.3.4 Risk Assessment

Table 6.5 provides a quantitative assessment of the likelihood, consequence and resultant risk associated with the impacts identified in Section 6.3.2, and the residual, likelihood, consequence and risk following implementation of control and management measures presented in Section 6.3.3.

Impact No. 1: Reduction in native species abundance, species richness and distribution	
Risk prior to implementation of controls	Likelihood: Virtually Certain Consequence: Minor Level of risk: Medium
Residual risk after implementation of controls	Likelihood: Unlikely Consequence: Minor Level of Risk: Low
Impact No. 2: Introduction and or increase in abundance of noxious weeds	
Risk prior to implementation of controls	Likelihood: Likely Consequence: Minor Level of risk: Medium
Residual risk after implementation of controls	Likelihood: Unlikely Consequence: Minor Level of Risk: Low
Impact No. 3: Reduction in soil quality and quantity leading to impaired vegetation growth	
Risk prior to implementation of controls	Likelihood: Likely Consequence: Moderate Level of risk: Medium
Residual risk after implementation of controls	Likelihood: Unlikely Consequence: Minor Level of Risk: Low

Table 6.5 Risk assessment – flora

6.3.5 Justification for Residual Risk

The risk assessment of potential impacts to flora (native vegetation) during the operation of the Honeymoon mine, taking into account design and operational management measures, has resulted in a low residual risk for each of the identified potential impacts to flora.

In justifying the acceptability of these risks, Uranium One has considered both the practicalities and economics of managing the impacts. The residual risks are considered to be as low as reasonably practicable and for this reason are considered by Uranium One to be acceptable for the mine's ongoing operations.

6.3.6 Outcomes and Measurement Criteria

Predicted outcomes have been identified for each of the credible impacts identified in Section 6.3.2 and are listed in Table 6.6. Outcomes reflect the anticipated level of environmental impact associated from the operation, based on other similar mines and advice provided by independent specialists. Criteria have also been developed to facilitate assessment against the predicted outcomes.

Outcome Measurement Criteria	Leading Indicator Criteria	Summary Of Control Measures
Impact/Outcome No. 1: No permanent loss of native species abundance or species richness on or off the mining tenements due to mining operations unless prior approval under the relevant legislation is obtained		
• Compliance with Native Vegetation Management Plan (Attachment H), assessed through annual reconciliation with records from approved Landscape and Native Vegetation Clearance Permits (SEB accounting) and aerial imagery. • Fires generated through direct and indirect mining activities are controlled and contained within the limits of the ML and MPL boundaries.	• Unauthorised clearance activities, off-road machinery/ vehicle movements and fires.	• SEB – payment made into the SEB fund to offset planned vegetation clearance on site. • Limiting vegetation clearance through the site requirement for a Landscape and Native Vegetation Clearance Permit) for any new operational activity that will disturb the ground surface. • Traffic management plan implemented and enforced to ensure vehicles and machinery keeps to designated tracks and roads. • Progressive rehabilitation of portions of the mine site no longer required for operational activities. • Fire protection and intervention measures provided for the mine site and immediate surrounds. • Pastoral activities prohibited from the mining tenements. • Ongoing pastoral lease impact assessment within Kalkaroo Pastoral Lease if grazing to be reintroduced. • Fugitive dust gauges installed within and outside the mine site to assess any increased dust deposition rates.
Impact/Outcome No. 2: No introduction of new noxious weed species, plant pathogens and/or increase in density or distribution of existing weed species and plant pathogens		
• Annual weed survey to demonstrate no statistically significant[5] increase in noxious weed abundance, species richness or distribution compared with control sites on adjacent/adjoining pastoral leases. • The weed monitoring program and the assessment of results will be undertaken by an	• N/A	• No exotic species to be brought in or planted on site. • Limit native vegetation cleared through use of the Landscape and Native Vegetation Clearance Permit. • Herbicide application to noxious weed outbreaks, where recommended by flora specialists. • Progressive rehabilitation of the mine site to prevent weed species from becoming established. • Annual weed survey to document any change in weed abundance, richness and distribution and assess the requirement for control measures. • Active management and control of weeds in the mine site. • Adherence to the Honeymoon mine Native

[5] An appropriately qualified and experienced specialist will assess whether a significant increase in the distribution and species richness of noxious weed species has occurred.

Outcome Measurement Criteria	Leading Indicator Criteria	Summary Of Control Measures
appropriately qualified and experienced specialist.		Vegetation Management Plan (Attachment H).

Table 6.6 Outcomes and Measurement Criteria – flora

6.3.7 Operational Monitoring Program – Flora

The operational monitoring program for flora is listed below in Table 6.7.

Monitoring Procedures/Parameters	Monitoring/Survey Location	Monitoring Frequency
Flora Monitoring No. 1: Aerial/Satellite Imagery Assessment		
• Comparison between approved tracks, roads and vegetation clearance areas against actual ground disturbance as shown on aerial photography.	• Mine Lease and MPL 92 (electricity transmission line corridor).	• Annual
Flora Monitoring No. 2: Weed Survey		
• Ground based surveys (on foot). • Major transport routes by vehicle. • Species, location and extent of all weed infestations recorded and mapped. • Factors contributing to infestations noted.	• Randomly selected sites in the mine impact area, these may include: main access road, Hill Dam, camp site, sewage treatment plant and wellfield. • Randomly selected sites in control areas outside the immediate areas of the mine's influence. • Comparison between species richness, abundance and distribution of weeds compared with identical sites surveyed in the previous year.	• Annual
Flora Monitoring No. 3: Environmental Inspections/Audits		
• Number and extent of significant new (unauthorised) tracks created. • Number and extent of clearance activities undertaken without approval. • Ecological Function Analysis - monitoring of	• Identified locations of species of conservation significance. • All areas closed and rehabilitated.	• Monthly • Annually

Monitoring Procedures/Parameters	Monitoring/Survey Location	Monitoring Frequency
rehabilitation sites		

Table 6.7 Monitoring Program – Flora

6.4 Fauna

6.4.1 Applicable Legislation and Standards

- South Australian Legislation:
  - National Parks and Wildlife Act 1972.
  - Animal Welfare Act 1985.
  - Natural Resources Management Act 2004.
  - Pastoral Land Management and Conservation Act 1989.
- Commonwealth Legislation:
  - Environment Protection and Biodiversity Conservation Act 1999.

6.4.2 Potential Impacts

Mining operations have the potential to impact on native fauna through the reduction in native species abundance and/or species richness, and introduction and/or increase in abundance of pest species.

Reduction in native fauna species richness and/or abundance potentially derived from:

- Vegetation clearance (loss of habitat).
- Drowning in infrastructure features (e.g., mining solution storage ponds).
- Drinking from toxic mining solution storage ponds (mainly aerial fauna).
- Traffic accidents.
- Fauna traps, e.g. fences, pits and wells.

Introduction and/or increase in abundance of pest species potentially derived from:

- Attraction to mine site/domestic waste as a food source.
- Provision of preferred habitats through clearance or creation of habitat.
- Food and human attractants.
- Feeding by site personnel.
- Introduction by site personnel.
- Fencing providing protection from predators.

6.4.3 Control and Management Strategies

In order to ensure that all potential impacts to fauna are avoided, mitigated and/or managed during operational activities, the following control measures have been implemented:

Permanent loss in native fauna abundance and/or species richness in the mining lease area, derived from site operations (including fire)

- Fencing around all mine infrastructures to minimise faunal entry.
- Exit routes provided in excavations over 0.5 m deep (i.e., drilling sumps).

- Regular inspections of excavations and solution ponds and removal of entrapped fauna were possible.
- All disused wells and entrapment hazards rehabilitated and/or capped immediately.
- Compulsory 20 km/h speed limit within the mine site and internally enforced speed limit of 80 km/h along the site access road.
- Compulsory incident reporting for all vehicle animal interactions and recording of animal casualties discovered on site.
- Key personnel trained in animal recovery and handling.
- Use of a Landscape and Native Vegetation Clearance Permit to minimise vegetation clearance and ensure habitat is protected.
- Re-establishing habitat through progressive rehabilitation during operations and full rehabilitation on mine conclusion.
- Annual audit used to track the success of rehabilitation and remedial activities for both mining and exploration.
- Pastoral activities prohibited within all mining tenements and strict controls established from the wider Uranium One owned Kalkaroo Pastoral Lease.
- Firearms and hunting banned from the mine site.
- Fire system and 1.5 ML of static fire water storage, trained emergency response team and fire truck in the event of a fire outbreak.
- Smoking prohibited on site except within designated combustion controlled areas.
- Flora and fauna survey conducted annually to identify trends in species richness and abundance of potentially impacted sites when compared with control sites.
- Ongoing review of aerial faunal interaction with mine solution ponds on site and adaptive management measures applied to prevent aerial fauna interaction where interaction with such water bodies is identified.
- Regular inspection of the transmission line to ensure no entanglement or electrocution of fauna, specifically raptors.
- Significant Environmental Benefit offset payment to assist in the protection of other similar habitat.
- An EFA used to evaluate the effectiveness of rehabilitation works.
- Significant Environment Benefit payment.

Introduction and/or increase in abundance of pest species

The introduction and/or increase may be derived from: food and human attractants, introduction by site personnel, fencing providing protection from predators, the creation of greater access through the generation of new tracks and feeding by site personnel

In order to control the abundance, species richness and distribution of pest species during mining operations, the following control mechanisms have been established:

- Scavenging is controlled by the use of secured bins for all food and food scraps, fencing and progressive closure of non-radioactive (domestic) waste cells.
- Pets prohibited on the mine site.
- Annual pest surveys identify the abundance, species richness and distribution, and identify if population numbers have increased.

Infrastructure interactions

Changes to the landscape through the introduction of mine infrastructure and the movement of machinery will increase the levels of interaction with native fauna. Control measures

established for the Honeymoon mine to minimise impacts to fauna resulting from infrastructure interactions include:

- Stock-proof security fencing around the gypsum, low-level radioactive and non-radioactive disposal pits to prevent faunal entry.
- Stock-proof security fencing around the entire processing plant, solution ponds and broader mine site to restrict ingress from ground based fauna.
- Removal of natural habitats around toxic water bodies to prevent habitation.
- Stock fencing around the wellfield to prevent entry of large fauna.
- All excavations over 0.5 m are required to have a low incline ramp on one side, which acts as an emergency exit for entrapped fauna.
- Regular inspections of excavations and removal of entrapped fauna where possible.
- Rehabilitation of all wells and drill sumps immediately on completion to prevent fauna entrapment.
- Regular inspections of solution ponds for entrapped fauna and fauna recovered where possible.
- Ongoing review of aerial faunal interaction with mine solution ponds on site and adaptive management measures applied to prevent aerial fauna interaction where interaction with such water bodies is identified.
- Mandatory incident reporting for all vehicle animal interactions.
- Mandatory site and access road speed limits.

Competition for resources

- No pastoral activities on mining tenements.
- Strict controls established on pastoral activities in the wider Kalkaroo Pastoral Lease, if grazing is reintroduced.

Fire

Flammable chemicals and process fluids form an integral part of the processing operations. Fire generated from mining activities can destroy key habitat and cause fauna fatalities. Control measures initiated on site include:

- In the event of a fire, the contents of the Pulsed Columns (flammable diluent) can be dumped into the adjacent SX (solvent extraction) recovery pond. The surface fire on the top of the pond can then be smothered.
- A sophisticated fire system has been installed around the processing plant linked to two fire water tanks containing 1.5 ML of fire fighting water.
- A fully trained emergency response team and fire truck is available to immediately respond to any fire outbreak.
- Smoke alarms are fitted in all other enclosed infrastructure across the mine site.
- Smoking on site is prohibited, with the exception of controlled smoking areas.

General management

- Firearms and hunting is banned from all mining tenements.
- Animal welfare protocols have been developed and select personnel trained in animal recovery and handling.

6.4.4 Risk Assessment

Table 6.8 provides a quantitative assessment of the likelihood, consequence and resultant risk associated with the impacts identified in Section 6.4.3, and the residual, likelihood,

consequence and risk following implementation of control and management measures presented in Section 6.4.4 .

Impact No.1: Permanent loss in native fauna abundance and/or species richness in the mining lease area derived from site operations (including fire)	
Risk prior to implementation of controls	Likelihood: Possible Consequence: Moderate Level of Risk: Medium
Residual risk after implementation of controls	Likelihood: Unlikely Consequence: Minor Level of Risk: Low
Impact No.2: Introduction and/or increase in abundance of pest species	
Risk prior to implementation of controls	Likelihood: Likely Consequence: Moderate Level of Risk: Medium
Residual risk after implementation of controls	Likelihood: Unlikely Consequence: Minor Level of Risk: Low

Table 6.8 Risk assessment – fauna.

6.4.5 Justification for Residual Risk

An assessment of the risks of impact to fauna during the operation of the Honeymoon mine and taking into account the design and operational management measures has resulted in the classification of a low residual risk for each of the identified impacts to fauna.

In justifying the acceptability of these levels of risk of impacts to fauna, Uranium One has considered both the practicalities and economics of managing the impacts. The residual risks are considered to be as low as reasonably practicable and for this reason are considered by Uranium One to be acceptable for the mine's ongoing operations.

6.4.6 Outcomes and Measurement Criteria

Predicted outcomes have been identified for each of the credible impacts identified in Section 6.4.2 and are detailed in Table 6.9. The table reflects the anticipated level of environmental impact associated from the operation based on other similar mines and advice provided by independent specialists relating to fauna management. Criteria have also been developed to facilitate assessment against the predicted outcomes.

Outcome Measurement Criteria	**Leading Indicator Criteria**	**Summary Of Control Measures**
Impact/Outcome No. 1: No permanent loss in native fauna abundance and/or species richness in the lease area or adjacent area, derived from site operations (including fire)		
• Annual fauna survey to show no reduction in the abundance and species richness of native fauna in comparison with control sites.	• Fauna entrapment/ death register. • Trends from the monitoring program.	• Regular fence inspections. • Exit ramps provided in all mine and exploration excavations over 0.5 m. • Regular inspections of excavations and solution ponds with entrapped fauna recovered where possible. • Mandatory speed limits within the mine site and along the site access road.

Outcome Measurement Criteria	Leading Indicator Criteria	Summary Of Control Measures
• The fauna monitoring program and the assessment of results will be undertaken by an appropriately qualified and experienced specialist.		• Compulsory incident reporting for all vehicle animal interactions and animal casualties discovered onsite. • Key personnel trained in animal recovery and handling. • Habitat protection through minimising vegetation clearance with a Landscape and Native Vegetation Clearance Permit system and Native Vegetation Management Plan (Attachment H). • Re-establishing habitat through progressive rehabilitation during operations and full rehabilitation on mine conclusion. • Establishment of an audit system to track the success of rehabilitation and remedial activities for both mining and exploration. • Pastoral activities prohibited within all mining tenements and strict controls on pastoral activities established on the wider Uranium One owned Kalkaroo Pastoral Lease. • Firearms and hunting banned from the mine site. • A 1.5 ML fire system, fire fighting water, emergency response team and fire truck in the event of a fire outbreak. • Smoking prohibited on site except within designated smoking areas. • Annual flora and fauna survey. • Fauna survey control sites selected for the comparison of annual fauna survey results. • Ongoing review of aerial faunal interaction with mine solution ponds and adaptive management measures applied to prevent aerial fauna interaction where interaction with such water bodies is identified. • Significant Environmental Benefit offset payment to assist in protecting similar habitat.
Impact/Outcome No. 2: No introduction of new feral animal species or increase in abundance within the mining tenements, in comparison with adjoining pastoral areas.		
• Annual pest survey to demonstrate no increase in feral fauna abundance or species richness when compared with control sites.	• Trends from the monitoring program.	• Scavenging will be controlled by use of secured bins used for food and food scraps, fencing around the perimeter of the non-radioactive waste facility with sections progressively capped and closed. • Pets prohibited on the mine site. • The traffic management will only authorize driving on already marked tracks and prevent the generation of new tracks where possible.

Outcome Measurement Criteria	Leading Indicator Criteria	Summary Of Control Measures
		• Annual pest surveys to identify the abundance and species richness of pests and identify if population numbers have increased based on an assessment of control sites on Kalkaroo and adjacent pastoral leases. • Humane methods of culling of pest species.

Table 6.9 Outcomes and Measurable Criteria – Fauna

6.4.7 Monitoring Program

A summary of the fauna monitoring program is provided in Table 6.10.

Monitoring Procedures/Parameters	Monitoring/Survey Location	Monitoring Frequency
Fauna Monitoring No. 1: Annual fauna survey		

• Permanent Photographic Monitoring Points
• Pitfall Trapping
• Elliott Trapping
• Bat Detector
• Bird Survey
• Active Searching
• Spotlighting
• Opportunistic Observations.
	• Eight survey locations are divided between the mine site, the electricity transmission line and control areas, similar to those of the pre-mine pastoral conditions for established monitoring sites).
	• Other survey locations consist of two trapping lines, each set up with:
	  • 5 x pitfall traps
	  • 15 x Elliot traps
	• Bat detector sites:
	  • 4 x bat detector sites
	• The fauna monitoring program and the assessment of results will be undertaken by an appropriately qualified and experienced specialist.
		• Annual

Fauna Monitoring No. 2: Annual pest survey		

• Sand plot surveys
• Feral animal abundance assessments
• Spotlight transects
• Incidental spotlighting
• Opportunistic observations
	• Survey locations are divided between the mine site and control sites, similar to those of the pre-mine pastoral conditions (see Figure 6.1 for established control monitoring sites).
	• Monitoring included:
	  • 10 x sand plot transects
	  • 4 x spotlight transects
		• Annual

Monitoring Procedures/Parameters	Monitoring/Survey Location	Monitoring Frequency
	• Incidental spotlighting • Opportunistic observations	
Fauna Monitoring No. 3: Site rounds		
• Operational area inspections	• Mine site fences • Solution ponds • Major excavations	• Daily

Table 6.10 Monitoring program – fauna

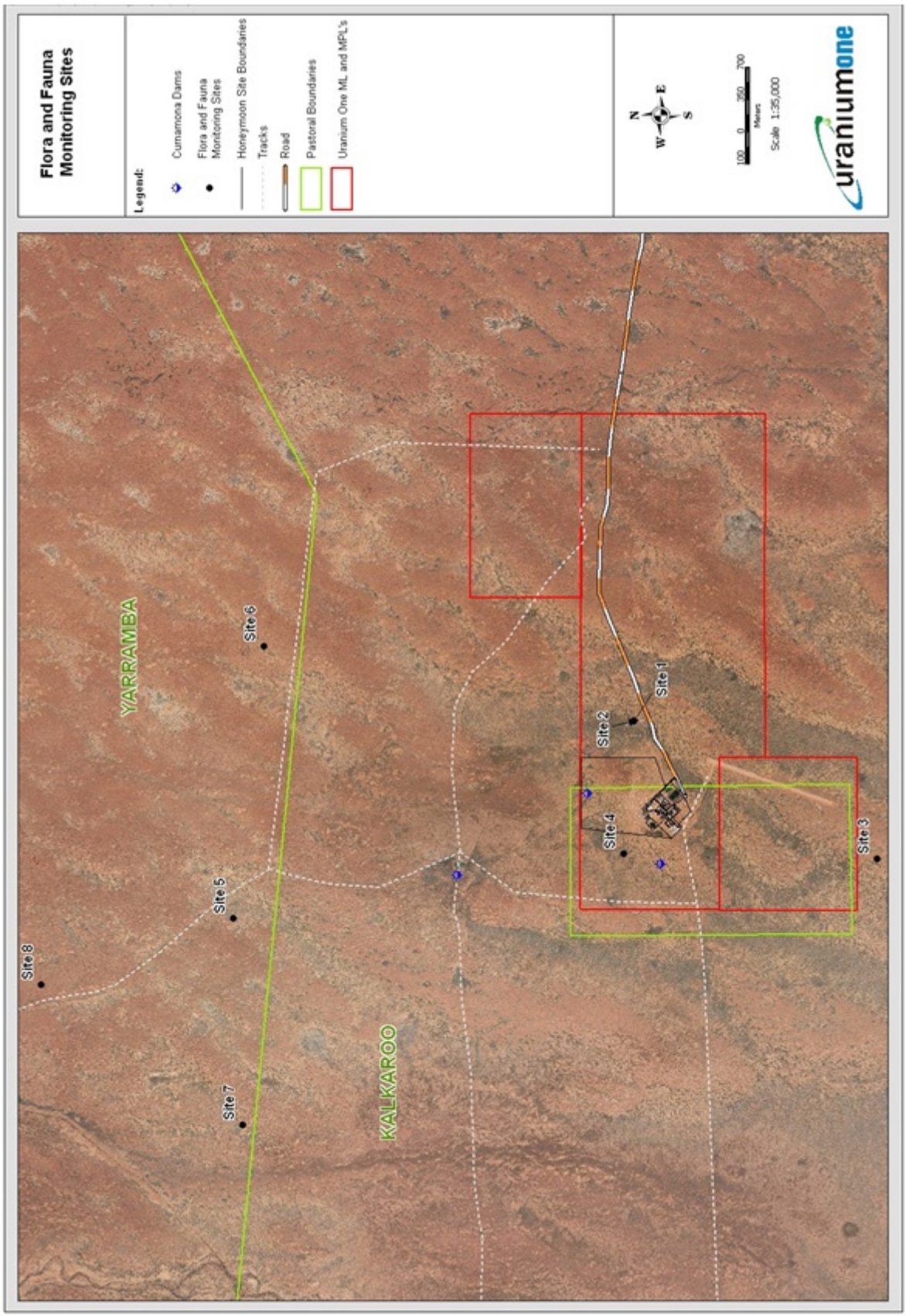

Figure 6.1 Fauna monitoring sites

6.5 Hydrogeology

6.5.1 Applicable Legislation and Standards

- South Australian Legislation.
  - Radiation Protection and Control Act 1982.
  - Natural Resources Management Act 2004 (SA).
  - Environment Protection Act 1993 (SA).
- Commonwealth Legislation:
  - Australian and New Zealand Guidelines for Fresh and Marine Water Quality (ANZECC/ARMCANZ, 2000).

6.5.2 Context

The following hydrogeological studies have been prepared for the Honeymoon mine, and provide information on baseline conditions, hydrogeological modelling, hydrocarbon modelling, and monitoring.

1. Field Leach Trial Wellfield Decommissioning - Water Quality Review. Report prepared for Uranium One Australia Pty Ltd by Sinclair Knight Merz Pty Ltd, February 2010.
2. Numerical Groundwater Flow and Solute Transport Model Reconstruction. Report prepared for Uranium One Australia Pty Ltd by Sinclair Knight Merz Pty Ltd, October 2008 (Attachment K).
3. Honeymoon Uranium Deposit Groundwater Flow Model. Memorandum prepared for Uranium One Australia Pty Ltd by Sinclair Knight Merz Pty Ltd, December 2010 (Attachment L).
4. Recommendations for a Groundwater Monitoring and Management Plan. Report prepared for Uranium One Australia Pty Ltd by Sinclair Knight Merz Pty Ltd, August 2010 (Attachment P).
5. Solute Transport Modelling of Wellfield Operations and Liquid Waste Disposal. Report prepared for Uranium One Australia Pty Ltd by Sinclair Knight Merz Pty Ltd, September 2010 (Attachment I).
6. Addendum to Solute Transport Modelling of Wellfield Operations and Liquid Waste Disposal. Report prepared for Uranium One Australia Pty Ltd by Sinclair Knight Merz Pty Ltd, August 2010 (Attachment J).
7. Natural Attenuation of Mining Fluids at the Honeymoon Uranium Mine. Report prepared for Uranium One Australia Pty Ltd by Sinclair Knight Merz Pty Ltd, November 2010 (Attachment O).
8. Recommendation for the Development of an ISR Wellfield monitoring network in the Honeymoon Region of the Yarramba Paleochannel, Honeymoon ISR. Memorandum prepared for Uranium One Australia Pty Ltd by Sinclair Knight Merz Pty Ltd, August 2010 (Attachment P).
9. Recommendation for the Development of a Liquid Waste Disposal Monitoring Network in the Honeymoon and East Kalkaroo Region of the Yarramba Paleochannel, Honeymoon ISR. Memorandum prepared for Uranium One Australia Pty Ltd by Sinclair Knight Merz Pty Ltd, August 2010b.
10. A Liquid Disposal Well Nested Monitoring Well Network at the Honeymoon Uranium Deposit. Memorandum prepared for Uranium One Australia Pty Ltd by Sinclair Knight Merz Pty Ltd, December 2010c.
11. Groundwater Management and Monitoring Plan, Environmental Management System. A report prepared by Groundwater Science Pty Ltd, April 2014 (Attachment D).

12. Geochemical Study regarding the Entrainment of Organic Diluent in the Leach Solution Stream at Honeymoon mine. Report prepared for Groundwater Science Pty Ltd by UIT (Umweltleistungen) December 2011 (Attachment Q).
13. Validation of Organic Fate and Transport Modelling. Report prepared for Uranium One Australia by Groundwater Science Pty Ltd, February 2012 (Attachment R).
14. Beneficial Use Assessment of the Yarramba Paleochannel. Report prepared for Uranium One Australia by Land and Water Consulting. December 2012 (Attachment 10).

The findings from these reports are summarised below.

6.5.3 Background

Hydrogeological Setting

The hydrogeological system is described in detail in Section 3.10. Figure 6.2 presents a conceptual diagram of the hydrogeological system and mining infrastructure.

The mineralised Eyre Formation aquifer extends from approximately 70 to 120 m depth and is hosted in the Yarramba Palaeochannel. The aquifer is confined above and below by low permeability silt, and clay units of the Namba Formation and weathered basement respectively. Standing water level ranges around 55 m below ground surface (65 m Australian Height Datum (AHD)).

The Eyre Formation aquifer is subdivided into two main lithological units:

- The Upper Member comprises fine grained sands, strongly inter-bedded with low permeability silts and clays. The unit hosts groundwater with salinity above Australian and New Zealand Environment Conservation Council (ANZECC) guidelines for stock use (ANZECC/ARMCANZ, 2000). Estimated groundwater flow velocity ranges around 1 m/year from east to west following paleovalley orientation.
- The Basal Member is coarse grained, highly permeable and hosts the economically significant uranium at the Honeymoon mine. Salinity and radionuclides are naturally elevated above ANZECC/ARMCANZ guidelines for stock use. Groundwater flow velocity estimates range from 10 to 75 m/year from east to west along paleochannel orientation.

Analysis of hydrostatic pressure response to mining indicates that the Upper and Basal Members are in hydraulic equilibrium and that hydrostatic pressure changes are transferred from one unit to the other. Essentially, the two stratigraphic members form one interconnected aquifer – the Eyre Formation Aquifer (Groundwater Science, 2012).

Mine & Groundwater Interactions

Mining comprises 3 areas which interact with the groundwater system (Figure 6.2).

1. ISR Wellfield
   This comprises injection and extraction wells, and associated monitoring wells. Groundwater, treated with reagents to reduce pH and increase oxidation potential, is circulated from injection to extraction wells, with a slight over extraction to maintain a net movement of fluids towards the mining zone. Mining lixiviant is acidic, and exhibits elevated total dissolved solids, dissolved metals, radionuclides and trace amount of hydrocarbons.
2. Liquid Disposal
   The liquid waste disposal zone comprises a series of injection wells that are used to inject liquid wastes into the aquifer. Liquid waste is acidic, and exhibits elevated total dissolved solids, dissolved metals, radionuclides and trace amount of hydrocarbons.

3. Raw Water Supply
   Two water production wells are available to pump groundwater to the surface for use in the mining process. Only one production well is used at a time. Solution ponds and solid waste repositories also have the potential to interact with the groundwater system if leakage occurs.

6.5.4 Groundwater Modelling

In order to understand and predict the potential impacts of mining on the groundwater system as discussed in the sections that follow, and to allow an informed risk assessment in Section 6.5.7, a suite of models have been developed to predict the fate of mining fluids in the subsurface. The models are summarised as follows:

- Three dimensional groundwater flow model (Groundwater Science 2012 – Attachment S). This model provides the framework for groundwater flow velocity and flow direction for the subsequent solute transport and reactive transport models.
- Three dimensional solute transport modelling which considered dilution and dispersion of mining and liquid waste solutions (Attachment I, Attachment J and Attachment K).
- One dimensional reactive transport modelling which considered the natural attenuation of mining and disposal solutions through sorption mechanisms.
- One dimensional reactive transport modelling which considered the natural attenuation of trace hydrocarbons through sorption and biodegradation mechanisms (Attachment Q).

Each of these models is briefly discussed in the sections that follow.

Three dimensional groundwater flow modelling

The hydrogeological groundwater flow model, which forms the basis for the geochemical modelling, was refined in 2012 (Attachment L) to reflect the current understanding of the hydrogeological system comprising two main aquifer units: the Upper Member and Basal Member (see Section 3.10). The groundwater flow model predicts a flow velocity in the Basal Member of approximately 12 m/year in an east to west direction constrained by palaeochannel orientation.

Three dimensional solute transport modelling

The solute transport models were developed to facilitate planning of wellfield, monitoring well, disposal well and raw water supply well locations to ensure that each domain does not impact on other mine domains and to ensure that monitoring wells are appropriately located.

Long term transport and dilution of mining fluids following mine closure was also predicted.

The modelling showed that:

- Liquid waste disposal would not impact on the raw water supply for the duration of the proposed mine life.
- Operational mining solution flare away from the ISR wellfield would extend outwards some 25 to 50 m.

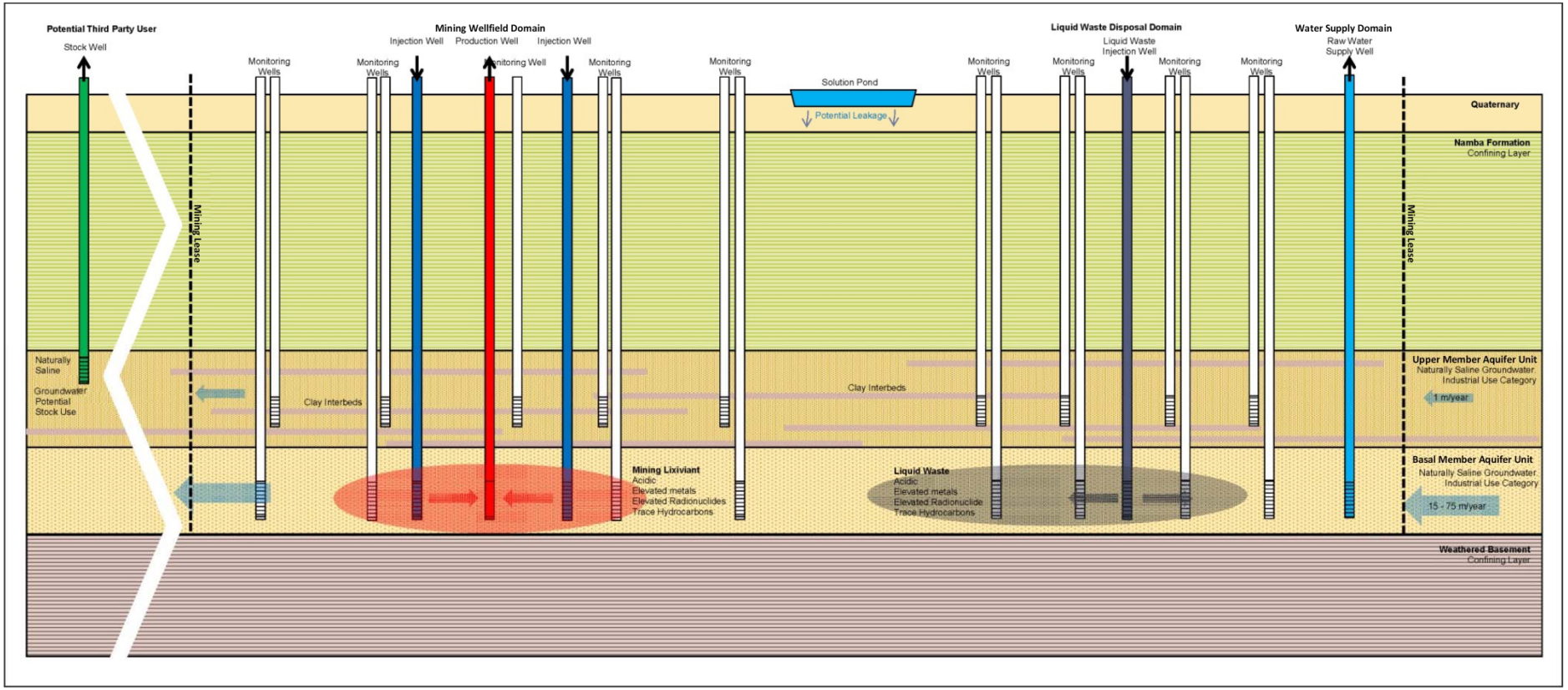

Figure 6.2 Conceptual sketch of the hydrogeological system and mining infrastructure

- Following mine closure, residual mining and liquid waste fluids would move slowly down gradient, with dilution occurring along the flow path.

One dimensional metals and uranium reactive transport modelling

One dimensional reactive transport modelling was undertaken to predict the rate of natural attenuation of mining and disposal fluids that could be expected due to sorption of dissolved metals and uranium. The modelling predicted that in 7 years following mine closure:

- Dissolved metals might travel between 1 and 637 m, whilst
- Uranium might travel between 8 and 438 m.

The upper ranges of these estimates are extremely conservative, since the methodology does not consider acid neutralisation and oxidant consumption through reaction of residual fluids with the host rock during fluid movement. Acid neutralisation and oxidant consumption would be expected to significantly reduce the mobility of metals including uranium.

One dimensional hydrocarbon reactive transport modelling

To provide an initial prediction of the fate of trace hydrocarbons within the Basal Member, one dimensional reactive transport modelling was undertaken using preliminary field data for hydrocarbon concentrations in process and disposal fluids (Umweltleistungen, 2011).

This transport model uses the Advection Dispersion Reaction (ADR) equation to describe the dynamics of organics present in an aqueous phase in which dispersion occurs and hydrocarbons are removed through sorption and biodegradation.

To set up and validate this model, an intensive sampling program has been undertaken on injected and extracted mining solution and liquid disposal fluids. The monitoring results are summarised in Table 6.11 below.

Hydrocarbon	Fraction	Barren Leach Solution (mg/L)	Pregnant Leach Solution (mg/L)	Liquid Disposal Solution (mg/L)
		Average	Average	Average
Total Petroleum Hydrocarbons	Sum $C_{10} – C_{36}$	7.93	2.78	4.10
Polyaromatic Hydrocarbons	Naphthalene	0.006	0.085	0.33

Table 6.11 Average hydrocarbon concentrations in processing and liquid disposal fluids generated during operations at Honeymoon mine

The modelling method and parameters of dispersion, sorption and biodegradation were validated through comparison of modelled versus measured rates of hydrocarbon removal observed during wellfield operation. The model was found to be conservative; under-predicting rates of hydrocarbon removal by 25 to 50% (Groundwater Science, 2012b - Attachment R). The conservative model predicted that, following mine closure, trace hydrocarbons would be removed through sorption and biodegradation within a 100 m zone of the source (Figure 6.3).

Third party peer-review by Petrotek Engineering LLC, found that the hydrocarbon model was appropriate for the application, conservative in the set-up and parameter selection and consistent with the results of hydrocarbon migration in field studies.

Ongoing model validation and refinement

The groundwater flow and chemical fate modelling described above provides critical information to allow an informed risk assessment of the potential impact of mining and also underpins mine closure strategies described in 8.10.2..

Ongoing model validation and refinement during mine operation will be used to improve the understanding of the fate of mining fluids, and to improve the predictive capability of the models.

This iterative approach comprises:

1. A comprehensive monitoring plan to determine groundwater flow and solute transport down-gradient of the mining zone and the liquid waste disposal zone.
2. Use of monitoring data to verify and recalibrate the groundwater flow and transport models on an annual basis, thus providing an improved prediction of the fate of mining fluids and liquid waste.

In this way, the understanding of the fate of fluids in the aquifer will undergo a process of continuous improvement (summarised in Table 6.12) and the confidence of post mining predictions will be maximised.

Natural Attenuation Mechanism	Modelling Approach	Validation monitoring data set	Future validation and refinements
Groundwater flow	3 dimensional groundwater flow model	• Aquifer pressure response to mining. • Chemical data at Basal leading indicator (BLI) wells and liquid disposal monitoring wells.	• Revision to incorporate updated geological data. • Recalibration to pressure changes induced by mining.
Dilution and dispersion	3 dimensional groundwater solute transport model	• Chemical data at BLI wells and liquid disposal monitoring wells	• Dispersion parameters will be revised based on monitoring data.
Reactive transport of dissolved metals and uranium	1 dimensional reactive transport modelling	• Chemical data at BLI wells and liquid disposal monitoring wells. • ISR wellfield process chemical data.	• Sorption parameters will be revised based on monitoring data. • Reagent consumption due to fluid rock interaction will be incorporated based on wellfield process data. • Reactive transport can be incorporated into a refined 3 dimensional reactive transport model.
Reactive transport of trace hydrocarbons	1 dimensional reactive transport modelling	• Chemical data at BLI wells and liquid disposal monitoring wells. • ISR wellfield process chemical data.	• Sorption and biodegradation parameters will be revised based on monitoring data. • Sorption and biodegradation can be incorporated into a refined 3 dimensional reactive transport model.

Table 6.12 Overview of natural attenuation modelling validation and refinement

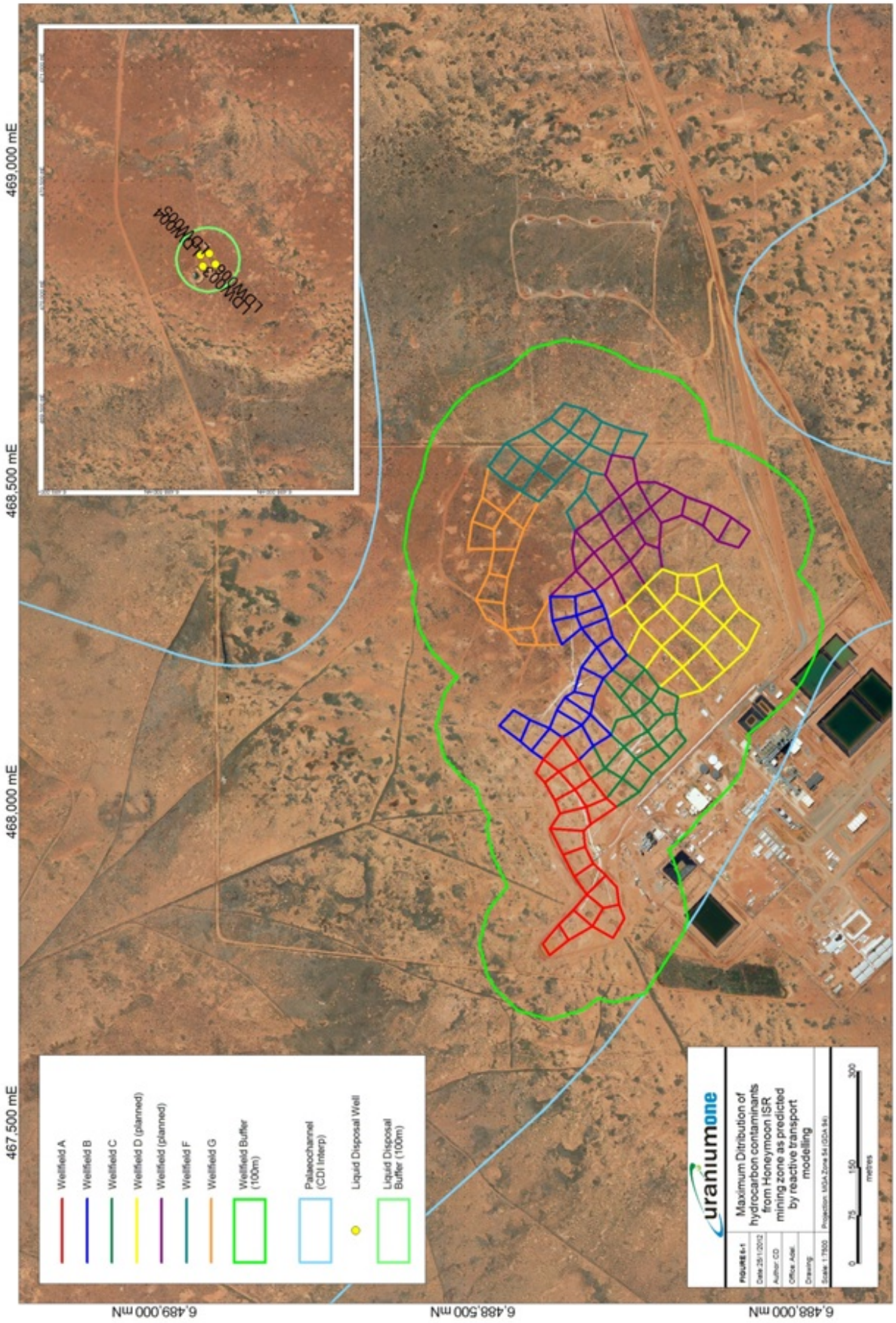

Figure 6.3 Buffer around the Honeymoon ISR mining zone and liquid disposal zone (see inset) identifying the maximum distribution of hydrocarbon contaminants zone as predicted by reactive transport modelling

6.5.5 Potential Impacts

Potential impacts on the groundwater system during operations include:

1. Vertical movement of mining and disposal fluids into the Upper Member.
2. Horizontal excursions of mining fluid outside the mining zone.
3. Horizontal movement of disposal fluid to the raw water abstraction zone.
4. Reduction in groundwater quality in the Upper Member through vertical seepage from solution ponds.
5. Reduction in groundwater quality in the Upper Member through vertical seepage from waste storage facilities.
6. A change in aquifer pressure (measured as water levels in wells) due to net extraction or injection of groundwater.

6.5.6 Control and Management Strategies

Control and management strategies for each of the potential impacts described above are detailed below.

Vertical movement of mining and disposal fluids into the Upper Member of the Eyre Formation aquifer

Preventative Measures

Engineering methods:

- Constructing and decommissioning wells in accordance with:
  - Department for Environment, Water and Natural Resources (DEWNR) well permit requirements.
  - Minimum Construction Requirements for Water Bores in Australia (2003) and Primary Industries and Resources South Australia (2003) (DSD) Guideline M21.
- Integrity testing all wells following well construction at intervals of four years and/or following any maintenance work involving a drilling rig. A ‘Well Integrity Record’ will also be completed for each tested well.

Administrative controls:

- Maintenance of a negative water balance at the wellfield through operational bleed between 0.5 and 2 %.
- Monthly groundwater monitoring at 16 in-field vertical compliance monitoring wells (Upper Member) and quarterly monitoring in the 6 outer perimeter vertical compliance monitoring wells, within and surrounding the ISR wellfield.
- Monthly groundwater monitoring at 4 vertical wells surrounding the liquid disposal zone.

The detection of mining or liquid disposal fluids is indicated by the exceedence of the excursion control limits as discussed in Section 4.10.2 and 6.5.6.

Contingency Measures

Specific actions to be undertaken in the event of a vertical excursion is detected in the outer perimeter vertical compliance monitoring wells, includes:

- Groundwater re-sampling interval to confirm validity of results.
- Following confirmation of a vertical excursion, mining in the pattern will be shut down.
- Formal notification made to the Director of DSD and the Senior Scientist at the EPA Radiation Protection Branch and contingency measures discussed.
- All injection wells in the pattern under investigation will be re-integrity tested.

- Over-extraction from the underlying Basal Member

Horizontal Excursions of Mining Fluid during Operations

Preventative Measures

Administrative controls:

- ISR Wellfield fluid controls:
  - Maintenance of a negative water balance at the ISR wellfield through operational bleed between 0.5% and 2%.
  - Manual check systems for each well (i.e., flow rates) and automatic shut off and or alarms if abnormal conditions occur.
- Monitoring:
  - Routine groundwater monitoring to detect the presence of mining fluids at the margins of the mining zone using 8 outer perimeter Basal Member compliance monitoring wells.

Engineering measures

- Constructing and decommissioning wells in accordance with:
  - DEWNR well permit requirements.
  - Minimum Construction Requirements for Water Bores in Australia (2003) and the DSD M21.
- Integrity testing all wells, following well construction and at intervals of four years and/or following any maintenance work involving a drilling rig. A 'Well Integrity Record' will also be completed for each tested well.

Contingency Measures

Specific actions undertaken in the event of an excursion include:

- Groundwater monitoring:
  - Re-sampling to confirm the validity of initial results.
  - Increased sampling frequency in and surrounding the area of excursion to closely monitor the effectiveness of any remedial actions.
- Reporting:
  - Formal reporting to the Director of Mines of DSD and the Senior Scientist at the EPA Radiation Protection Branch.
- Operational:
  - Immediate cessation of injection operations adjacent to the detection wells.
  - Commencing extraction in nearby hydraulically connected mining areas to ensure a net inward movement of the groundwater into the mining zone. Monitoring wells will be continuously assessed to determine the effectiveness of this measure.

If operational measures are unsuccessful in controlling and reversing the excursion, additional monitoring wells will be installed 10 to 100 meters away from the monitoring well(s) that have identified the excursion. Wells will be monitored weekly.

Solute flow from the liquid waste disposal penetrates the mining zone, raw water extraction area and/or moves off the ML boundary

Preventative Measures

- Groundwater flow modelling has been undertaken to predict the expected extent of the liquid waste plume and ensure that it is contained within the target zone.

- Eight Basal Member monitoring wells have been installed around the liquid disposal zone, to map and assess the disposal solute plume and calibrate the hydrogeological and geochemical model.
- Four Upper Member vertical monitoring wells have been installed adjacent to the liquid disposal zone to ensure any vertical movement from the Basal Member to the Upper Member can be detected.
- Additional monitoring wells will be installed if during operations the disposal fluid plume extent cannot be identified and future flows modelled.
- Annual review and ongoing calibration of the hydrogeological model against actual monitoring data and plume movement (review of chemical composition and natural attenuation).
- Provision of a series of control measures, i.e., three additional contingency well locations, if hydrological modelling cannot be calibrated by the field monitoring data or the creation of a hydrogeological mound to show the solute flow path.

Reduction in groundwater quality through vertical seepage from solution ponds

Preventative Measures

- Specialised features incorporated in the design of the solution ponds to prevent seepage include; compacted clay construction, continuous double high density polyethylene (HDPE) ultraviolet (UV) stabilised liner (primary and secondary), herringbone profile geotextile between primary and secondary liner with leakage detection probe and extraction pipe to extract leakage and transfer to a collection sump.
- Natural features of the site are also an effective control measure, i.e., there is over 50 m of low permeability clays between the base of the solution ponds and the Upper Member aquifer.
- Management features include established Target Action Leakage Rate (TALR), with rates above TALR triggering pond repair (Peggs, 2006).

Reduction in groundwater quality through vertical seepage from waste storage facilities

Preventative Measures

- The low-level radioactive waste repository and gypsum waste repository have been designed in accordance with the Near Surface Disposal of Radioactive Waste Australia Code of Practice (NHRMC, 1992) and the requirements of the Radiation Protection and Control Act 1982.
- The gypsum waste repository, liquid disposal and solution fluid ponds have been engineered and constructed using earthen compacted clay, double HDPE lined and an internal leak detection/drainage system.
- The non-radioactive waste facility (domestic landfill) have been designed and licensed in accordance with the South Australian EPA Guidelines for Environmental Management of Landfill Facilities (2007).
- A leachate extraction and disposal system has been incorporated into the design and construction of the gypsum, non-radioactive and low-level radioactive waste facilities.
- Management of waste facilities will be in accordance with EPA licence conditions and the RWMP.
- All waste facilities have been located outside the Yarramba Paleochannel, ensuring there is no potential for migration to the underlying aquifer system.

A change in aquifer pressure (measured as water levels in monitoring wells) due to net extraction or injection of groundwater.

Honeymoon mine is operated to maintain the Basal Member at a near neutral water balance. Significant imbalance in the water budget is impossible since all water is sourced from and ultimately disposed to the Basal Member. A slight addition of water to this system occurs through addition of reagents, whilst a slight removal of water occurs through evaporation from ponds and potable consumption. This highly transmissive aquifer will quickly diffuse the effects of small imbalances over a very short distance.

Preventative Measures

- A near-neutral overall water balance is maintained for the mine.
- Groundwater levels in the Upper and Basal Members will be monitored via a series of line production/injection wells and the series of Basal and Upper Member monitoring wells.
- Any water level reduction beyond agreed limits (see 6.5.10) will be recorded and intervention actions taken (see the operational water balance in Section 4, Figure 4.23).
- Monitoring of up-gradient and down-gradient regional monitoring wells as a baseline for local water levels.

6.5.7 Risk Assessment

Table 6.13 provides a quantitative assessment of the likelihood, consequence and resultant risk associated with the impacts identified in Section 6.5.7 and the residual likelihood, consequence and risk following implementation of control and management measures as presented in Section 6.5.8.

Impact No. 1: Vertical movement of mining or disposal fluids into the Upper Member aquifer.	
Risk prior to implementation of controls	Likelihood: Possible Consequence Negligible Level of risk: Low
Residual risk after implementation of controls	Likelihood: Virtually Impossible Consequence: Negligible Level of risk: Low
Impact No. 2: Horizontal excursions of groundwater and/or mining fluid outside the perimeter monitoring network.	
Risk prior to implementation of controls	Likelihood: Possible Consequence: Negligible Level of risk: Low
Residual risk after implementation of controls	Likelihood: Virtually Impossible Consequence: Negligible Level of risk: Low
Impact No. 3: Solute flow from liquid waste disposal penetrates the mining zone, raw water extraction area and/or moves off the ML boundary	
Risk prior to implementation of controls	Likelihood: Possible Consequence: Moderate Level of risk: Medium
Residual risk after implementation of controls	Likelihood: Unlikely Consequence: Moderate

	Level of Risk: Medium
Impact No. 4: Reduction in groundwater quality through vertical seepage from solution ponds	
Risk prior to implementation of controls	Likelihood: Virtually Impossible Consequence: Moderate Level of risk: Medium
Residual risk after implementation of controls	Likelihood: Virtually Impossible Consequence: Minor Level of Risk: Low
Impact No 5: Reduction in groundwater quality through vertical seepage from waste storage facilities	
Risk prior to implementation of controls	Likelihood: Virtually Impossible Consequence: Moderate Level of risk: Medium
Residual risk after implementation of controls	Likelihood: Virtually Impossible Consequence: Minor Level of Risk: Low
Impact No. 6: Depletion of local groundwater resources as a result of mining activities	
Risk prior to implementation of controls	Likelihood: Virtually Impossible Consequence: Negligible Level of risk: Low
Residual risk after implementation of controls	Likelihood: Virtually Impossible Consequence: Negligible Level of risk: Low

Table 6.13 Risk Assessment – Hydrogeology

6.5.8 Justification for Residual Risk

An assessment of the risks and associated control and management methods for the extraction of groundwater, mining of uranium via an ISR technique and disposal of mining waste fluids within the Upper and Basal Members, has resulted in the classification of a low residual risk for each of the identified hydrogeological impacts.

In justifying the acceptability of these levels of risk, Uranium One has considered both the practicalities and economics of prevention, minimisation and management of relevant impacts on the environment, and the associated existing beneficial use of the resource. The residual risks are considered to be as low as reasonably achievable, and for this reason are considered by Uranium One to be acceptable for the ongoing mining operations.

6.5.9 Outcomes and Measurement Criteria

Outcomes for each of the credible impacts identified in Section 6.5.7 are listed in Table 6.14. Compliance against each of the identified outcomes will be assessed through the listed measurable criteria and, where available, leading indicator criteria.

Outcome Measurement Criteria	Leading Indicator Criteria	Summary Of Control Measures
Impacts No. 1, 2, 3, 4, 5 / Outcome No. 1: No compromise to the environmental values of the Eyre Formation aquifer outside the mining lease.		
• Excursion control monitoring demonstrates that mining and liquid disposal solutions are contained within target areas. i.e., no excursions are recorded at compliance monitoring wells. • Groundwater monitoring will be undertaken in accordance with the program set out in Table 6.15 and Attachment D.	• Stable chemical trends at leading indicator wells and compliance monitoring wells. • Stable water level trends in all monitoring wells. • Maintenance of an accurate water balance.	• Well construction and integrity testing in accordance with Australian and International Standards. • Plugging/decommissioning of all historic exploration and trial leach wells. • Strict control of wellfield water balance. • Predictive models have been used to determined sustainable operational liquid disposal volumes and set solute concentration limits for monitoring wells installed downstream of the liquid disposal wells. • Monthly monitoring of leading indicator monitoring wells (BLIs and IVCMs) (non-reportable) and quarterly monitoring of compliance monitoring wells (OBCMs and OVCMs).

Table 6.14 Outcomes and Measurement Criteria – hydrogeology

6.5.10 Operational Monitoring Program

Table 6.15 summarises the hydrogeological monitoring program for the mine.

Monitoring Method(s)	Monitoring Parameters	Monitoring Details	Monitoring Frequency	Monitoring Location(s)
Groundwater Monitoring No. 1: Groundwater Levels				
• Water level meter	• Static water levels (SWL)	• Water levels will be measured at all wells on the monitoring schedule. • Investigation levels for drawdown limits for all monitoring wells are set at 1.5 m, based on the mean results from trial leach operations and baseline fluctuations.	Monthly	• 8 x Basal Member Leading Indicator (BLI) compliance monitoring wells.
			Quarterly	• 19 x Outer Basal Compliance Monitoring (OBCM) wells.
			Monthly	• 16 x Inner Vertical Compliance Monitoring (IVCM) wells.
			Quarterly	• 6 x Outer Vertical Compliance Monitoring (OVCM) wells.
			Quarterly	• 4 x Vertical (Upper Member) Liquid Disposal Compliance Monitoring wells.
				• 2 x Regional Compliance Monitoring (RCM) wells.
				• 2 x Outer Rock Monitoring (ORM) wells.
			Monthly	• 4 x Eastern Basal Member Liquid Disposal Compliance Monitoring (EBLDCM) wells.
				• 4 x Western Basal Member Liquid Disposal Compliance Monitoring (WBLDCM) wells.
Groundwater Monitoring No. 2: Excursion Control Monitoring				
• Micropurge	• Suite 1:	• Excursion control parameters and	Monthly	• 8 x Basal Member Leading

Monitoring Method(s)	Monitoring Parameters	Monitoring Details	Monitoring Frequency	Monitoring Location(s)
ground-water monitoring system. • Field parameters measured using a calibrated water quality meter. • Chemical analysis	- SWL - pH - Electrical conductivity (EC) - Redox (Eh) - Sulphate (SO_4) - Uranium (U)	associated excursion control limits (ECL): - pH – 5.6. - Sulphate – 2578 mg/L. - Dissolved uranium - 1.6 mg/L. • An excursion event is classified to have occurred if any two ECLs are exceeded at one or more compliance wells. • Chemical analysis will either be performed in-house (with QA/QC samples sent to a NATA-accredited laboratory) and/or at a NATA-accredited laboratory.		Indicator (BLI) compliance monitoring wells.
			Quarterly	• 19 x Outer Basal Compliance Monitoring (OBCM) wells.
			Monthly	• 16 x Inner Vertical Compliance Monitoring (IVCM) wells.
			Quarterly[6]	• 6 x Outer Vertical Compliance Monitoring (OVCM) wells.
			Quarterly	• 4 x Vertical (Upper Member) Liquid Disposal Compliance Monitoring wells.
Monitoring Method(s)	**Monitoring Parameters**	**Monitoring Details**	**Monitoring Frequency**	**Monitoring Location**
Groundwater Monitoring No. 3. Environmental Fate Monitoring				
• Micropurge water sampling system. • Field parameters measured using a calibrated	- Suite 1, and Total Recoverable Hydrocarbons - Poly Aromatic Hydrocarbons - Naphthalene	• Monitoring will be undertaken at wellfield and liquid waste zones to provide data to validate natural attenuation models. • Chemical analysis will either be performed in-house (with QA/QC	Quarterly	Process Solutions: • BLS pond pump • PLS trunkline

[6] On detection of mining fluids in IVCM wells.

Monitoring Method(s)	Monitoring Parameters	Monitoring Details	Monitoring Frequency	Monitoring Location(s)
water quality meter.	• Suite 1, or Suite 2 if two or more ECL's are exceeded. • Suite 2: - SWL, pH, EC, Eh TDS - Ca, Mg, Si, K, SO_4, Cl, Total Alkalinity. - Dissolved metals: Ag, Al, As, B, Ba, Be, Bi, Cd, Cr, Co, Cu, Fe, Hg, Li, Mn, Ni, Pb, Sn, Th, U, Va, Zn. - Total recoverable hydrocarbons (TRH) - Polyaromatic hydrocarbons (PAH) – naphthalene	samples sent to a NATA-accredited laboratory) and/or at a NATA-accredited laboratory. • Suite 2 parameters have been selected based on the South Australian EPA Water Quality criteria (2003) and/or ANZECC (2000) National Water Quality Management Strategy - Livestock Use, and the geochemical parameters required to validate and/or update the natural attenuation models.		Wellfield: • 8 x BLI wells Corresponding OBCM wells will be monitored quarterly on detection of mining fluids at BLI wells. Liquid Disposal Zone: • 4 x Eastern Basal Member Liquid Disposal Compliance Monitoring (EBLDCM) wells. • 4 x Western Basal Member Liquid Disposal Compliance Monitoring (WBLDCM) wells. • Monitoring will only commence once disposal fluid found in the previous well (i.e. EBLDCM1 > EBLDCM2, etc)
Groundwater Monitoring No. 4. Liquid Disposal Fluid Monitoring				
• Flow meter reading	• Injection volume (L/day). • Flow rates (L/s), recorded as a daily average.	• All liquid waste injected into the LDW(s) will be monitored using a flow meter which feeds back to the main control room.	Daily	• Flow meter readings collated in the control system Citect.
• Direct sampling from the LDP pump	• Suite 1 & Ca • Suite 2 and Ra-226.	• Sampling of representative liquid disposal fluid will be undertaken at the liquid disposal pump.	Monthly Quarterly	• LDP pump.

Table 6.15 Monitoring Program – Hydrogeology

Excursion Control Parameters

An excursion will be deemed to have occurred if any two excursion control parameters (ECPs) in groundwater sampled from any compliance monitoring well exceeds their respective excursion control limit (ECL).

ECLs have been developed for pH, sulphate and uranium using the US EPA statistical tool 'Pro-UCL' based on historical background data. The ECL for each of these ECPs is equal to the maximum reported concentration of that parameter over the last 7 years plus the standard deviation of the parameter dataset.

6.6 Environmental Air Quality

6.6.1 Applicable Legislation and Standards

- South Australian Legislation:
  - Radiation Protection and Control Act 1982 and associated regulations.
  - Environment Protection (Air Quality) Regulations 1994.
- Commonwealth Legislation:
  - National Environmental Protection Measure (Implementation) Act 1998.

6.6.2 Potential Impacts

All actual and/or credible potential impacts on air quality, derived from the operation of the Honeymoon mine, as described in Section 3.5, are included in the impact assessment.

1. Reduction in air quality due to the dispersion of fugitive dust emissions (total insoluble and combustible matter) potentially derived from:
   a) Vegetation clearance.
   b) Soil disturbance and removal of biota and soil crust.
   c) Historical pastoral activities on Kalkaroo Pastoral Lease.
   d) Pastoral activities on adjacent pastoral leases.
   e) Traffic movement along the site access road and internal site tracks.
2. Elevated radon concentrations in the atmosphere, potentially derived from the following mine areas/activities:
   a) Groundwater extraction and circulation in the calcite pond prior to entering the groundwater treatment circuit.
   b) Barren leach solution storage in the BLS pond.
   c) Pregnant leach solution storage in the PLS pond.
   d) Open processing, storage tanks, chambers and pulsed columns.
   e) Malfunction of ventilation and gas extraction systems.
   f) Drilling and well maintenance activities.
3. Generation and dispersion of radionuclide rich dust, potentially derived from:
   a) Dried solution and/or product spills in the processing plant and wellfield.
   b) Routine maintenance on wellfield and processing plant equipment.
   c) Inappropriate storage and disposal of waste materials.
   d) Dried particulate in solution and disposal ponds.

6.6.3 Control and Management Strategies

In order to ensure that all potential impacts to air quality are avoided, mitigated and/or managed during operational activities, the following measures have been implemented:

Reduction in air quality due to the dispersion of non-radioactive particulate matter (total insoluble and combustible matter)

- Maintenance of dirt roads using compaction and water spraying where required.
- Maximum mine site speed limit of 20 km/h.
- Maximum site access road and Mulyungarie road speed limit of 80 km/h.
- Minimising land disturbance (i.e., unnecessary clearance of vegetation) and undertaking progressive rehabilitation of areas no longer required for mining, reducing the airborne distribution of soils.
- Use of mains electricity over diesel generators whenever possible.
- Equipment purchased and maintained in accordance with national air quality standards.

Environmental dispersion of radionuclide rich dusts

- The areas around the pulsed columns, scrubbers, storage tanks, thickeners, precipitation and liquor tanks are fully bunded, with wash down facilities and dedicated sumps to ensure any aqueous spills and solids are diluted and extracted prior to becoming airborne.
- The depth and design of all process and disposal ponds ensures that particulate matter deposited during operations is retained in the base of the structure, even when water levels are lowered.
- Tanks and process components are largely enclosed to ensure solutions and/or products are not dispersed.
- The drying and packing equipment and ventilation systems are fully enclosed with a number of water source points and internal sumps for routine internal wash downs.
- The emission of product dust from the drying and packaging plant are managed by a baghouse which separates and collects airborne dust via eight filter bags connected to the plants vent stack via a secondary filter and air extractor fan.
- Regular airborne radionuclide area monitoring is undertaken using low, medium and high volume air samplers.

Increased radon / radon decay product concentrations in the atmosphere

- The calcite and PLS pond are situated outside routinely occupied work areas.
- The pulsed columns are connected to a ventilation system via a plant stack to extract radon from the system.
- All enclosed scrubbing and stripping extraction tanks and vessels are connected to a ventilation system via a plant stack to extract radon from the system.
- Vent gases/off-gases produced during the precipitation and thickening process are inductively drawn off through gas extraction fans which discharge vent gases to the atmosphere through the off-gas vent stack.
- Audible sirens and beacons are activated to alert personnel when both off-gas extraction fans fail to operate.
- The dryer off-gas plant uses a vacuum pump to extract the hot vapour from the dryer baghouse, cools and separates the vapour and condensate and sends any

waste liquids from this process to the uranium precipitation thickener via the area sump and off-gas to the plant baghouse.

- An airlock is used in the batching area of the drying and packing plant.
- Other controls include the dependence on the correct operation of the baghouse to operate the off-gas system, the entire drum packing plant area and the dryer.

6.6.4 Risk Assessment

Table 6.16 presents a quantitative assessment of risk of the potential impacts to air quality and consequences before and after the implementation of control measures presented in Section 6.6.3 Residual risk presents the final assessment, post management measures. In order for the management measures to be effective, the residual risk should always be the same as or lower than the initial assessment.

Impact No. 1: Reduction in air quality due to the dispersion of non-radioactive particulate matter (total insoluble and combustible matter)	
Risk Prior to Implementation of Control	Likelihood: Likely Consequence: Minor Level of Risk: Medium
Residual Risk after Implementation of Controls	Likelihood: Unlikely Consequence: Negligible Level of Risk: Low
Impact No. 2: Environmental dispersion of radionuclide rich dusts (derived from operational activities)	
Risk Prior to Implementation of Control	Likelihood: Likely Consequence: Moderate Level of Risk: Medium
Residual Risk after Implementation of Controls	Likelihood: Possible Consequence: Negligible Level of Risk: Low
Impact No. 3: Increased radon gas and radon decay product concentrations in the atmosphere	
Risk Prior to Implementation of Control	Likelihood: Likely Consequence: Moderate Level of Risk: Medium
Residual Risk after Implementation of Controls	Likelihood: Likely Consequence: Negligible Level of Risk: Low

Table 6.16 Risk Assessment - Environmental Air Quality

6.6.5 Justification for Residual Risk

An assessment of the risks associated with the generation and dispersal of non-radioactive, radioactive airborne particulate matter, radon and associated engineering and administrative management measures, has resulted in the classification of a low residual risk for each of the identified air quality impacts.

In justifying the acceptability of these levels of risk to the protection of the environment Uranium One has considered both the practicalities and economics of prevention, minimisation and management of relevant impacts. The residual risks are considered

to be as low as reasonably achievable and for this reason are considered by Uranium One to be acceptable for ongoing operations.

6.6.6 Outcomes and Measurement Criteria

Outcomes for each of the credible impacts identified in Section 6.6.2 are listed in Table 6.17 below. Compliance against each of the identified outcomes will be assessed through the listed measurable criteria and, where available, leading indicator criteria.

Outcome Measurement Criteria	Leading Indicator Criteria	Summary Of Control Measures
Impact No. 1: Outcome No. 1 – No adverse impact to the public and the environment from radon release or the dispersal of radionuclide rich particulates		
• Calculated radiation dose rates to the public are within dose limits specified by the Radiation Protection and Control Act 1982[7].	• Monitored airborne concentrations of long lived alpha and radon decay product concentrations in environmental monitoring locations to be below investigation/ action levels as defined in the Radiation Management Plan (RMP) under the RPC Act 1982.	• The calcium carbonate pond and PLS pond are sited outside regularly occupied work areas. • Enclosed sections of the pulsed columns, tanks and chambers are connected to a ventilation system to extract radon from the system. • Vent gases/off-gas produced during the precipitation, thickening, drying and packing processes are inductively drawn off through gas extraction fans and released to the atmosphere through the off-gas vent stack. • The dryer off-gas plant cannot operate unless the drying and packing plants baghouse is running. • An airlock is used in the batching area of the drying and packing plant. • Process components are fully bunded, with wash down facilities to ensure any aqueous spills and solids are wet down and directed into sumps prior to becoming airborne. • Regular personal and area monitoring will be undertaken to determine the levels of airborne long lived alpha concentrations, and assessment of exposure levels.

Table 6.17 Outcomes & Measurement Criteria - Environmental Air Quality

6.6.7 Operational Monitoring Program

Table 6.18 outlines the monitoring program for environmental air quality.

Monitoring Procedures/Parameters	Monitoring/Survey Location	Monitoring Frequency
Air Quality Monitoring No. 1		
• Environmental monitoring of airborne radionuclide concentrations will be in accordance with the South Australian Radiation Protection and Control Act 1982 and the site Radioactive Waste Management Plan.		

[7] Dose limits under the RPC Act outline the maximum dose to the public from the operation is 1 mSv/y.

Table 6.18 Monitoring Program - Environmental Air Quality

6.7 Indigenous Heritage

6.7.1 Applicable Legislation and Standards

- South Australian Legislation:
  - Aboriginal Heritage Act 1988.
- Commonwealth Legislation:
  - Native Title Act 1993.

6.7.2 Potential Impacts

The following section describes the impacts, controls, management and monitoring of Indigenous heritage at Honeymoon mine; non-indigenous heritage has not been included in this impact assessment as there are no credible risks to non-indigenous heritage.

The two main credible potential impacts to Indigenous heritage within the Honeymoon mining tenements, derived from the mining operation (as described in Section 3.16.1) are:

1. Disturbance to identified and unidentified Indigenous archaeological sites, objects and remains
2. Disturbance to potential Indigenous archaeological sites objects and remains.

These potential impacts may be derived from:

- Vehicle/machinery movements outside of designated tracks or roads.
- Landscape and vegetation clearance activities.
- Increasing access to the local area.
- Construction of secondary infrastructure; wells, extension to the airstrip, construction of waste disposal facilities and resource drilling programs.

6.7.3 Control and Management Strategies

In order to ensure that all potential impacts to cultural heritage are avoided, mitigated and/or managed during operational activities, the following measures have been implemented:

Disturbance to Indigenous archaeological sites, objects or remains without approval

- All site clearances must be authorised through a Landscape and Native Vegetation Clearance Permit prior to any surface disturbance activities. The permit requires that the disturbance area is identified through a grid referenced diagram and GPS coordinates. These areas are then cross checked against locations of all known archaeological sites within the associated mining tenements.
- All clearance activities will be undertaken in compliance with the approved site clearance limits, which have been subject to an Indigenous archaeological assessment and clearance.
- All site inductions will include information on the local Native Title Claimants, importance of protecting sites of cultural significance, details on the locations of the archaeological sites within the mining tenements and personal requirements under the Aboriginal Heritage Act 1988.

- Incident reporting, if a known Indigenous or non-Indigenous archaeological site is disturbed.
- Annual monitoring of Indigenous archaeological sites to ensure no unauthorised disturbance has occurred.
- Any proposed vegetation clearance or surface disturbance activities outside designated survey areas will require a complete Indigenous archaeological survey to ensure compliance with the Aboriginal Heritage Act 1988 and the Heritage Act 1993.
- The community engagement plan includes regular consultation with regional Indigenous communities, Native Title Claimants the Adnyamathanha, who will be regularly consulted and kept informed on the mine's progress including environmental compliance at regular forums.

Disturbance to unidentified Indigenous sites, objects or remains of significance

- Any supplementary clearance areas within the mining tenements will require Aboriginal community and amenity clearances with Native Title Claimants.
- All additional clearance areas will also require an Indigenous archaeological survey to ensure compliance with the Aboriginal Heritage Act 1988.
- The site wide traffic management plan will ensure vehicles and machinery keep to designated roads and tracks.
- All site clearances must be authorised through a Landscape and Native Vegetation Clearance Permit prior to any surface disturbance activities. The permit requires that the disturbance area is identified through a grid referenced diagram and GPS coordinates. These areas are then cross checked against locations of all known archaeological sites within the mine site and associated mining tenements.
- Incident reporting is required in the event that a potential Indigenous archaeological site is discovered.
- Site inductions provided to all Uranium One personnel and contractors to ensure appropriate actions to be taken in the event of a chance find of archaeological sites.
- The community engagement plan includes regular consultation with regional Indigenous communities, Native Title Claimants the Adnyamathanha, who will be regularly consulted and kept informed of the development of the mine and associated environmental performance.

6.7.4 Risk Assessment

Table 6.19 provides a quantitative assessment of the likelihood, consequence and resultant risk associated with the impacts identified in Section 6.7.2 and the residual likelihood, consequence and risk following implementation of control and management measures presented in Section 6.7.4.

Impact No. 1: Disturbance to Indigenous archaeological sites, objects or remains without approval	
Risk Prior to Implementation of Controls	Likelihood: Unlikely Consequence: Minor Level of Risk: Low
Residual Risk after Implementation of Controls	Likelihood: Virtually Impossible Consequence: Minor Level of Risk: Low

Impact No. 2: Disturbance to unidentified Indigenous sites, objects or remains of significance	
Risk Prior to Implementation of Controls	Likelihood: Unlikely Consequence: Moderate Level of Risk: Medium
Residual Risk after Implementation of Controls	Likelihood: Virtually Impossible Consequence: Moderate Level of Risk: Low

Table 6.19 Risk Assessment - Indigenous Heritage

6.7.5 Justification for Residual Risk

An assessment of the risks of impact to sites of Indigenous heritage during the construction of the Honeymoon mine, and taking into account operational management measures, has resulted in the classification of a low residual risk for each of the identified impacts to any sites of Indigenous heritage.

In justifying the acceptability of these levels of risk of impacts to sites of Indigenous heritage, Uranium One has considered both the practicalities and economics of managing the impacts. The residual risks are considered to be as low as reasonably practicable and for this reason are considered by Uranium One to be acceptable for the mines ongoing operations.

6.7.6 Outcomes and Measurement Criteria

Outcomes for each of the credible impacts identified in Section 6.7.2 are listed in Table 6.20 below. Compliance against each of the identified outcomes will be assessed through the listed measurable criteria, and where available, leading indicator criteria.

Outcome Measure Criteria	Leading Indicator Criteria	Summary of Control Measure
Impact/Outcome No. 1: No disturbance to Indigenous sites, objects or remains of significance without prior approval under the Aboriginal Heritage Act 1988		
• No ground disturbance will occur without an Indigenous heritage clearance. • Annual monitoring of known Indigenous archaeological sites demonstrates no unauthorised disturbance.	N/ A	• All site clearances must be authorised through a Landscape and Native Vegetation Clearance Permit prior to any surface disturbance activities. • All clearance activities will be undertaken in compliance with the approved site clearance limits, all which have been subject to an Indigenous archaeological assessment and clearance. • Traffic management plan implemented to ensure vehicles and machinery keep to designated tracks and roads. • Any supplementary clearance areas within the mining tenements will require Aboriginal community and amenity clearances with Native Title Holders. • All additional clearance areas will also require an Indigenous survey to ensure compliance with the Aboriginal Heritage Act 1988.

Outcome Measure Criteria	Leading Indicator Criteria	Summary of Control Measure
		• Incident reporting is required in the event that a known Indigenous or non-Indigenous archaeological site is disturbed. • Annual monitoring of Indigenous archaeological sites to ensure no unauthorised disturbance has occurred. • All mine site inductions will include information on the local Native Title Claimants, importance of protecting sites of cultural significance, details on the locations of the archaeological sites within the mining tenements, protocols for chance find of archaeological sites and personal requirements under the Aboriginal Heritage Act 1988. • Incident reporting is required in the event that a potential Indigenous archaeological site is discovered

Table 6.20 Outcomes & Measurement - Indigenous Heritage

6.7.7 Operational Monitoring Program

The Indigenous heritage operational monitoring program is outlined in Table 6.21.

Monitoring Method(s)	Monitoring Parameter(s)	Monitoring Frequency
Indigenous Heritage Monitoring No. 1: Visual Assessment of Indigenous Archaeological Sites		
• Photo points established at each known Indigenous heritage site.	• 14 x sites within ML 6109	• Annually
• Annual visual inspection to assess: - Vegetation clearance or surface disturbance. - Vehicle or machinery tracks. - Infrastructure development.		• As required
• Records of all inductions.		

Table 6.21 Operational Monitoring Program - Indigenous Heritage

6.8 Safety, Security and Protection of Third Party Property

6.8.1 Applicable Legislation and Standards

- South Australian Legislation:
  - Occupational Health Safety and Welfare Act 1986 and associated regulations.
- Commonwealth Legislation:
  - Compliance with best practice and industry standards.

6.8.2 Potential Impacts

The three credible potential impacts to safety and security of the Honeymoon mine site during the operational phase include:

1. Deaths or injuries caused by unauthorised third party access to the mine site.
2. Deaths or injuries caused by unauthorised third party access to the secure areas of the mine site.
3. Damage to third party property.

Unauthorised Access to the General Mine Site

1. Deaths or injuries caused by unauthorised access to the general mine site, potentially derived from:
   a) Substandard fencing.
   b) Lack of a security plan and trained responders.
   c) Anti-nuclear public sentiments.
   d) Unauthorised Access to secured areas.
2. Deaths or injuries caused by unauthorised access to secured areas potentially derived from:
   a) Lack of adequate security measures.
   b) No ability to restrict entry to secure location by selective entry provisions.
   c) Inadequate recording of personnel entering and exiting secure areas.
   d) Lack of recording media over the site.
   e) Lack of procedures or not applying and enforcing them.
3. Damage to third party property potentially derived from:
   a) Use of gazetted and private roads by mine traffic.
   b) Interactions with livestock on site and public roadways.
   c) Fire generation through mining and ancillary activities.

6.8.3 Control and Management Strategies

In order to ensure that all potential impacts associated with site safety and security are avoided, mitigated and/or managed during operational activities, the following measures have been implemented:

Deaths or injuries caused by unauthorised third party access to the general mine site

- Site security plan developed and implemented.
- Approved fencing around all mine infrastructure; this includes stock fencing around the wellfield perimeter and high security fencing around the restricted mine infrastructure.
- All entrance points/gates will be kept closed if unattended and will be kept locked at all times.
- Access to internal work locations via locked gates or swipe card system.
- Security cameras and CCTV at entrance points and in strategic locations.
- Security personnel or operational staff trained in security measures.
- Keys and swipe cards issued to personnel, contractors and visitors will be recovered prior to departing site.
- All security measures will be regularly inspected, maintained in good repair and kept free of equipment, structure or placement of items within 2 m from the perimeter of the fence or gate.

Death or injury caused by unauthorised entry to the secure areas

- Site security plan developed and implemented.
- Security fences installed to 2.4 m in height from ground level, including anti-climb measures.
- Gates into high security areas are 2.4 m high and have anti-climb measures.
- All entrance points/gates will be kept closed if unattended and will be kept locked at all times.
- Internal double security fencing around the precipitation and yellowcake drying and packing plant has been installed.
- Restricted swipe card entry to the drying and packing plant.
- Security cameras and CCTV at entrance points and in strategic locations.
- Security personnel or operational staff trained in site security measures.
- All security measures will be regularly inspected, maintained in good repair and kept free of equipment, structure or placement of items within 2 m from the perimeter of the fence or gate.
- Main entry gates to be attended or continuously monitored by CCTV or locked.
- All site visitors will be supervised at all times.
- Contact reporting scheme for all personnel and contractors if they are approached by person(s) inappropriately seeking information of a sensitive nature.

Impacts to Third Party Property

Roads:

- The Uranium One Traffic Management Plan has enforced speed limits for travel on dirt roads.
- Mine traffic is restricted on the site access road and/or Mulyungarie Road following a significant rainfall event.
- Regular maintenance undertaken on both the site access road and Mulyungarie Road to check the status of the grids, adjacent fences and maintenance support provided in consultation with the local pastoralists/landowners, where relevant.

Fire:

- Fire breaks installed and maintained around the perimeter of high risk areas to prevent the spread of fire.
- Two fire systems are present on site, complete with 1.5 ML of fire fighting water.
- Trained Emergency Response Team (ERT) and a fully equipped fire truck are available to control a fire outbreak.
- A comprehensive fire management system has been installed for the operation and management of fire risks associated with the SX plant.

Livestock:

- Self-imposed speed limit is applied to all Uranium One personnel and contractors using the site access road and Mulyungarie Road.
- Site inductions also cover the requirement to slow down when approaching stock and giving them right of way when crossing roads.
- A notification protocol and reimbursement have been set up if stock are accidently hit and killed during routine travel.

- The Honeymoon mine consultation register will be used to record any third party property damage occurrence and/or complaint.

Community:

- Implementation of the community consultation plan to ensure appropriate consultation of shared public infrastructure and direct liaison with adjacent pastoralists/landowners.

6.8.4 Risk Assessment

Table 6.22 presents a quantitative assessment of the risk of the potential impacts to site safety and security and consequences before and after the implementation of the control measures presented in Section 6.8.3. Residual risk presents the final assessment, post management measures. In order for the management measures to be effective, the residual risk should always be the same as or lower than the initial assessment.

Impact No. 1: Deaths or injuries caused by unauthorised third party access to the general mine site.	
Risk prior to implementation of controls	Likelihood: Possible Consequence: Severe Level of Risk: Medium
Residual risk after implementation of controls	Likelihood: Unlikely Consequence: Severe Level of Risk: Medium
Impact No. 2: Death or injury caused by unauthorised entry to secure areas.	
Risk prior to implementation of controls	Likelihood: Possible Consequence: Severe Level of Risk: Medium
Residual risk after implementation of controls	Likelihood: Virtually Impossible Consequence: Severe Level of Risk: Medium
Impact No. 3: Impacts to third party property.	
Risk prior to implementation of controls	Likelihood: Likely Consequence: Minor Level of Risk: Medium
Residual risk after implementation of controls	Likelihood: Likely Consequence: Negligible Level of Risk: Low

Table 6.22 Risk Assessment - Safety & Security

6.8.5 Justification for Residual Risk

An assessment of the risks associated with safety and security in the mine site and associated mining tenements during operation, has identified a medium residual risk associated with unauthorised entry and a low residual risk for impacts to third party property.

In justifying the acceptability of the levels of risk associated with providing the appropriate level of safety and security for a uranium mine, Uranium One has

considered both the practicalities and economics of managing these impacts. The residual risks are considered to be as low as reasonably practicable.

6.8.6 Outcomes and Measured Criteria

Outcomes for each of the credible impacts identified in Section 6.8.2 are listed in Table 6.23 below. Compliance against each of the identified outcomes will be assessed through the listed measurable criteria, and where available, leading indicator criteria.

Outcome Measure Criteria	Leading Indicator Criteria	Summary of Control Measure
Impact/Outcome No. 1: No deaths or injuries from the unauthorised entry of the public into the mine site that could have been reasonably prevented.		
• Investigation of any death or injury to the public will demonstrate that it could not have been reasonably prevented.	• No. of unauthorised (attempted or successful) unauthorised entries into the site.	• Site security plan developed and implemented. • Approved fencing around all mine infrastructure; this includes stock fencing around the wellfield perimeter and high security fencing around the remainder of the secure mine site. • All entrance points/gates kept closed if unattended and kept locked at all times. • Access to internal work locations via locked gates or swipe card system. • Security cameras and CCTV at entrance points and in strategic locations. • Security personnel or operational staff trained in security measures. • Keys and swipe cards issued to ex- personnel, visitors and contractors will be recovered prior to departing site. • Regular fence and site inspections. • All security measures are regularly inspected, maintained in good repair and kept free of equipment, structure or placement of items within 2 m from the perimeter of the fence or gate.
Impact/Outcome No. 2: No damage to third party property.		
• Annual review/audit of the Honeymoon mine consultation register to assess the timing and successful close out of any third party complaints related to property damage.	• N/A	Roads: • Enforced speed limits for all mine personnel travelling on dirt roads. • Mine traffic is restricted on the site access road or Mulyungarie Road following a significant rainfall event. • Regular maintenance checks are undertaken on both the site access road and Mulyungarie Road to check the status of the grids, adjacent fences and maintenance support provided in consultation with the local pastoralists/ landowners, where relevant. Fire: • Appropriate employee, contractor and visitor education, land management and fire fighting systems to prevent the spread of a bushfire

Outcome Measure Criteria	Leading Indicator Criteria	Summary of Control Measure
		generated from mining activities. • Comprehensive operational systems and fire control measures developed for operation and management of fire risks associated with the Solvent Exchange plant. Livestock: • Self-imposed speed limit is applied to all Uranium One personnel and contractors using the site access road and Mulyungarie Road. • Site inductions also cover the requirement to slow down when approaching stock and give them right of way when crossing roads. • A notification protocol and reimbursement have been set up if stock are accidently hit and killed during routine travel. • The Honeymoon mine consultation register will be used to record any third party property damage occurrence and/or complaint.

Table 6.23 Outcomes & Measurement Criteria - Safety & Security

6.8.7 Operational Monitoring Program

The safety and security operational monitoring program is outlined in Table 6.24.

Monitoring Method(s)	Monitoring / Survey Location	Monitoring Frequency
Safety and Security Monitoring No. 1: Area inspections.		
• Fence inspections. • Gate/lock inspections. • Security cameras.	• Mine site perimeter. • All internal fences and gates. • All CCTV cameras.	• Daily during morning and evening rounds.
Safety and Security Monitoring No. 2: Injuries and deaths to the public.		
• Investigation of all injuries and deaths to the public resulting from unauthorised access to the site.	• All injuries and deaths	• As required.
Safety and Security Monitoring No. 3: Testing of security system.		
• Correct operation of security system.	• High security areas.	• As required by the site security plan.
Safety and Security Monitoring No. 4: Access records.		
• CCTV. • Access records. • Alarm events.	• High security areas.	• As required by the site security plan.
Safety and Security Monitoring No. 5: Third party property.		
• Correct operation of fire system. • Consultation record for mine and landowner interactions regarding shared resources such as roads and	• All mine site plant. • All shared resources areas.	• Quarterly. • Updated following consultation

Monitoring Method(s)	Monitoring / Survey Location	Monitoring Frequency
fences.		activities.

Table 6.24 Monitoring Program - Safety & Security

6.9 Surface Water

An assessment of the local hydrological system has determined that potential impacts of mining operations on surface water quality are not considered credible and are therefore not considered in this section.

6.10 Radiation

Radiological impacts on soil, groundwater and air quality are considered in Sections 6.2, 6.5 and 6.6.

Full consideration of occupational and environmental radiation, methods to avoid, minimise and manage potential exposures and detailed monitoring requirements are outlined within the Honeymoon mine Operational Radiation Management Plan and Radioactive Waste Management Plan (RMP/RWMP). The approved operational RMP and RWMP are a requirement under the Radiation Protection and Control Act 1982.

6.11 Noise

Due to the remote geographical location, the 10 km distance between the mine site and the nearest resident, and distance of over 60 km from the nearest main road, impacts derived from noise outside the mine are not considered credible and are not discussed in this section.

Although noise to nearby receptors is not considered a credible impact, Uranium One will comply with the South Australian Environment Protection (Noise) Policy 2007 to ensure that occupational noise is within the limits specified in the Occupational Health, Safety and Welfare Regulations 1995, Division 2.10.

6.12 Visual Amenity

Due to the remote geographical location, the significant distances between the mine site and the nearest sensitive receptors and the level of visual screening affording the mine, impacts to visual amenity are not considered credible impacts and are not discussed in this section.

7 Care and Maintenance

7.1 Background

Care and maintenance is defined in this document as; the temporary shutdown and preservation of all operational components associated with the Honeymoon mine, whilst ensuring environmental, social and economic impacts are appropriately managed.

7.1.1 Ramp Down and Steady State Phases

In order to transition the Honeymoon mine from operations to care and maintenance, a number of specific ramp-down steps are required across the mine site. These activities were designed to ensure identified environmental, economic and social risks associated with care and maintenance would be kept as low as reasonably practicable. Key ramp down steps and steady state care and maintenance requirements are summarised in Table 7.1 below.

Area/ Component	Ramp Down to Care & Maintenance	Routine Care &Maintenance Activities
Groundwater & Raffinate Treatment Plant (GRTP)	• Key ramp down steps include: - Transfer of all calcite, gypsum and groundwater in the mixer cells and clarifiers to the calcite pond. - Flushing and cleaning concrete mixer tanks and clarifiers. - Flushing and isolating GRTP pipe work and pumps. - Identification and excavation of any spills to soil around the mixer tanks and clarifiers. - Disposal of contaminated soil and waste to the low-level radioactive waste repository. - Residual lime removed from the lime silo. - Earthen bunds reformed around the perimeter of the GRTP.	• Routine C&M activities/inspections include: - Retaining the water fill in the mixer cells. - Removal of any water collected in the clarifiers and/or sumps. - Inspecting the integrity of pipe lines, tanks and vessels and making repairs where required. - Ensuring the continued operation/effectiveness of sumps and bunds.
Calcite Pond	• Key ramp down steps include: - Transfer and permanent disposal of calcite deposits within the pond to the full-scale gypsum repository. - Cleaning of pond walls to remove residual calcite sediments. - Covering residual calcite in the base of the pond by a permanent water layer. - Pressure washing water jets and walkways to remove loose calcite.	• Routine C&M activities/inspections include: - Maintenance of the water cover to ensure residual calcite cannot dry and dust. - Routine pond liner leak detection monitoring. - Ensuring perimeter fencing remains intact and secure.

	- Spills to soil around the pond; identified, excavated and transferred to the low-level radioactive waste repository for disposal.	
ISR Wellfield	• Key ramp down steps include: - Slow ramp down of process fluid circulation, injection and extraction volumes. - Over extraction to ensure C&M commenced with mining fluids retained in the mining zone. - Cleaning, isolation of wellhouse and filter skid components. - Removal of well infrastructure (pumps/electrical cables) from all extraction wells. - Cleaning and storage of well electrical cables and pumps in a secure undercover location. - Wellheads capped with bolting plates to preserve them for future use and prevent faunal entry. - Draining and flushing trunk and feeder lines with raw water. - Trunk lines blanked off or isolated. - Waste pipe work chipped and disposal of in the low-level radioactive waste repository. - Residual low level radioactive waste disposed of in the low-level radioactive waste repository.	• Routine C&M activities/inspections include: - Monitoring the natural attenuation of mining fluids as they move from the ISR wellfield down hydraulic gradient at a rate of approximately 10-15m/year. - Routine assessment of key wellfield components; trunk lines, feeder lines and wellhouse infrastructure. - Security inspections; daily perimeter fence and area checks • No remediation activities (soil or vegetation) is proposed within the wellfield during the C&M phase, as mining within wellfields A-D is proposed to recommence during future operations.
Process Ponds	• Key ramp down steps include: - Residual pregnant leach solutions (PLS) in the PLS pond processed through the SX plant. - Barren leach solution (BLS) transferred to the liquid disposal pond for injection into the Eyre Formation Basal Member as waste fluids. - Raw water used to dilute and/or fill the PLS and BLS ponds to a height in which covers pond sediments. - Pond walls, pumps and sumps cleaned and decontaminated.	• Routine C&M activities/inspections include: - Pond embankments will be monitored to ensure stability is maintained. - Set pond water heights will be monitored to ensure any basal sediment is kept under water, and ponds cannot overfill. - Pond liner monitoring utilising the automated leak detection systems.
SX Dump Pond	• Key ramp down steps include: - Residual organic and dissolved uranium processed through the SX plant.	• Routine C&M activities/inspections include: - Pond liner monitoring utilising the automated leak detection

	- Pond walls washed down.	systems.
Stormwater Pond	• Key ramp down steps include: - Pond walls washed down. - Excess fluids removed from the pond.	• Routine C&M activities/inspections include: - Monitoring stormwater pond height, ensuring at no time liquids exceed 20% of capacity. - Pond liner monitoring utilising the automated leak detection systems.
Process Plant – SX	• Key ramp down steps include: - Progressive reduction in process fluid flows through the plant, and extraction of residual uranium from PLS and SX dump pond fluids. - All tanks, vessels, pipe work and pumps (with the exception of the pulse columns) emptied, flushed with process water. - Potable water used to fill, or part fill fibreglass tanks and vessels. - Concrete bunds washed and sumps cleaned out. - Earthen bunding around the process plant re-established. • Diluent within the pulse columns retained for future operational phases.	• Routine C&M activities/inspections include: - Maintaining a water fill in specific tanks and vessels. - Routine inspection/operation of pumps and sumps. - Routine inspections of the pulse columns, pipe work and tanks to ensure the integrity of the area is maintained. - The pulse column deluge and fire systems will be routinely monitored and serviced. - Monitoring the integrity of the process plant perimeter bund. • Hazardous area requirements will remain in the SX due to the presence of diluents in the pulse columns.
Precipitation & Thickening	• Key ramp down steps include: - Transfer of all uranium product from the precipitation tanks to the thickening tanks, then into the drying and packing plant. - Flushing of precipitation and thickening tanks to remove excess sediments. - Part filling the precipitation tanks with water. - Pressure washing concrete bunding and sumps to remove any unfixed uranium product.	• Routine C&M activities/inspections include: - Inspection of water in precipitation vessels. - Integrity checks for all vessels, tanks, pipe work and sumps. - Pumps intermittently activated where required.
Drying & Packing	• Key ramp down steps include: - All residual product in the yellowcake storage tank dried and packed, with all product dispatched from site. - Empting, and flushing all tanks, vessels, pipe work and pumps. - Filter press cleaned and isolated. - Filter bags on the dryers and bag	• Routine C&M activities/inspections include: - Dryers routinely rotated. - Sumps checked and operated as required. - Integrity of pipe work, tanks and security features of the building inspected.

	house removed and disposed of in the low-level radioactive waste repository. - Pressure washing concrete bunding and sumps to remove unfixed uranium product. - The storage shed was then thoroughly cleaned and secured.	
Reagent Alley	• Key ramp down steps include: - Removal of all reagents from storage tanks and vessels. - Isolation of tanks/vessels. - Cleaning concrete bunds and sumps.	• Routine C&M activities/inspections include: - Integrity checks of vessels, bunds and sumps.
Demonstration Plant	• Key ramp down steps include: - All internal components of the old demonstration plant were stripped out, crushed and disposed of in the low level radioactive waste repository. - The concrete bund was stripped cleaned and used for storage of wellfield infrastructure	• Routine inspections to be carried out in this area to assess services and security.
Gypsum Repository	• Key ramp down steps include: - Leachate from the gravel filter trial gypsum repository transferred to the liquid disposal pond. - Excess gypsum within the trial gravel filter gypsum repository, slurried and decanted into the full scale repository. - Calcite from the calcite pond and groundwater and raffinate treatment plant transferred into the full scale gypsum repository. - Closure of the dried gabion weir trial repository. - Perimeter earthen bund re-established.	• Routine C&M activities/inspections include: - Monitoring for surface subsidence over the closed trial gabion weir gypsum waste repository. - Closing the trial gravel filter gypsum waste repository, following sufficient leachate removal and surface evaporation. - Monitoring leachate volumes from the trial gravel filter gypsum repository. - Integrity checks of pipes and tanks. - Leak detection monitoring of the pond lining via Citect. - Ensuring a water cover is maintained over the gypsum surface of the full scale gypsum repository so the surface does not dry and dust causing a radiological hazard. - Monitoring the integrity of soil stockpiles and earthen bunding.

Low Level Radioactive Waste Facility	• Key ramp down steps include: - Identification and disposal of all low level radioactive waste and contaminated materials (e.g. soil) from around the entire mine site in the low level radioactive waste repositories. - Closure of all open low-level radioactive waste repositories.	• Routine C&M activities/inspections include: - Monitoring of surface subsidence over closed low level waste repositories. - Monitoring natural regeneration of native flora. • No low level waste facilities will be open or utilised during the C&M phase. Any low level waste generated will be appropriately contained and stored for onsite disposal at a later date.
Liquid Disposal	• Key ramp down activities include: - Disposal of waste fluids from ramp down activities into the liquid disposal pond. - Intermittent injection into the liquid disposal wells.	• During C&M the liquid disposal pond will continue to receive brine from reverse osmosis activities, wash down water and from rainfall. • Periodic disposal will be required from the liquid disposal pond to the liquid disposal wells. • Routine C&M activities/inspections include: - Monitoring the height of the liquid disposal pond, to ensure liquid disposal activities can be triggered when high levels are reached. - Routine calcium and sulphate analysis of the disposal fluid, to ensure fluids are kept below gypsum saturation levels - Monitoring pipework, well heads to ensure the integrity of the system is maintained.
Camp & Administration Buildings	• No changes to the camp and administration buildings required.	• The camp and administration buildings will continue to be used and maintained during the C&M phase. • Routine area and infrastructure inspections will be undertaken.

Table 7.1 Ramp-down activities undertaken at the Honeymoon mine in preparation for care and maintenance

7.1.2 Regulatory Notifications

To progress the formal transition of the Honeymoon mine from an operational status to that of care and maintenance, formal notification must be made to all relevant South Australian and Federal regulators.

Approval to restart the facility will require the submission and approval of an operational plan from the Department for State Development (DSD) and the Environment Protection Authority (EPA). The operational plan will incorporate; a review of the operational groundwater monitoring and management plan (Attachment D), any proposed changes to mining operations, and details of engineering modifications to the GRTP to ensure complete containment of fluids during operation.

7.2 Management of Environmental, Social and Economic Aspects during Care and Maintenance

7.2.1 Impact Assessment

As outlined in Section 7.1, planning for care and maintenance has been undertaken by assessing the potential impacts on the natural, social and economic environment, derived from the change to operational state. Key risks identified during this assessment together with suitable control measures to reduce residual risk are detailed in Table 7.2. The risk associated with each event is determined using a matrix as shown in Table 6.1.

Impact No. 1: Reduction in soil quality through radiological or non-radiological contamination	
Initial Risk Ranking:	Likelihood: Possible
	Consequence: Moderate
	Risk: Medium
Controls:	The following activities will be undertaken to prevent the permanent reduction in soil quality: • Pipework, tanks and equipment containing reagents, process fluids and/or waste fluids will be flushed, cleaned and sealed off prior to the operation entering care and maintenance. • Pipework will be isolated. • Adequate freeboard will be retained and actively monitored in each pond to prevent a possible overflow. • Pond embankment walls will be routinely monitored to ensure competence. • Pond leakage detection systems will be monitored regularly, and repairs performed where target action leakage rates are exceeded. • Earthen bunding around the process plant, liquid disposal zone and wellfields will be routinely inspected and regularly maintained. • Operational chemical management procedures will be retained for use during care and maintenance. • Fuel and chemicals will be stored in accordance with Environment Protection Authority Guidelines on Bunding and Spill Management (2007b). • Spill response kits will be retained in fuel dispensing areas and where potentially contaminative items are stored and/or used (e.g., reverse osmosis chlorine stores). • Routine site and environmental inspections will be undertaken to identify and rectify any leaks. • Incident reporting procedures will be utilised where required to record and track spill events to soil. • Existing bioremediation pit will be utilised to treat hydrocarbon spills, while spills of acid/alkaline to soil will be remediated.
Residual Risk:	Likelihood: Unlikely
	Consequence: Minor
	Risk: Low

Impact No. 2: Inadequate topsoil and subsoil management leads to a reduction in available resources for rehabilitation.	
Initial Risk Ranking:	Likelihood: Possible
	Consequence: Moderate
	Risk: Medium
Controls:	The following activities will be undertaken in order to manage soil stockpiles: • Topsoil and subsoil stockpiles will be routinely monitored to assess signs of erosion using established photo points. • Soil stockpiles will be re-contoured where significant erosion is identified. • Stockpiles will be identified by type, i.e., topsoil or subsoil to prevent inappropriate use.
Residual Risk:	Likelihood: Unlikely
	Consequence: Moderate
	Risk: Medium

Impact No. 3: Unauthorised clearances and off track movements results in damage to vegetation and soils, limiting rehabilitation success.	
Initial Risk Ranking:	Likelihood: Possible
	Consequence: Minor
	Risk: Medium
Controls:	Unauthorised clearances and off-track movements will be prevented by: • Inductions provided to all site visitors, employees and contractors to inform them on the requirement to remain on designated roads and tracks at all times, and the requirement for a Land and Native Vegetation Clearance Permit prior to any proposed clearance/disturbance activity. Unauthorised clearances and tracks will be identified by: • Routine environmental assessments carried out across the mine site. • Assessment of new tracks and/or clearances against aerial photographs taken prior to the commencement of care and maintenance. Identified unauthorised clearances and significant tracks will be either: • Recorded as an incident, and added to SEB clearance tracking sheets and baseline aerial photograph. • Fenced off and rehabilitated.
Residual Risk:	Likelihood: Unlikely
	Consequence: Minor
	Risk: Low

Impact No. 4: Impaired vegetation growth due to poor soil quality.	
Initial Risk Ranking:	Likelihood: Possible
	Consequence: Moderate
	Risk: Medium

Controls:	**Management and monitoring techniques to be employed during care and maintenance to protect soil quality include:** • Incident reporting procedures will be utilised where required to record and track spill events to soil. • Routine site and environmental inspections will assist in identifying any potential unidentified/unreported spill events, and initiate remedial actions where required. • Operational chemical management procedures will be retained for use during care and maintenance. • Fuel and chemicals will be stored in accordance with Environment Protection Authority Guidelines on Bunding and Spill Management (2007b). • Spill response kits will be retained in fuel dispensing areas and where potentially contaminative items are stored and/or used (e.g., reverse osmosis chlorine stores). • Existing bioremediation pit will be utilised to treat hydrocarbon spills, while spills of acid/alkaline to soil will be remediated according to background. • Impacts to soil derived from vehicle and machinery movements will be limited by mandatory use of existing, designated tracks, and no off track driving. • Progressive rehabilitation of portions of the mine site no longer required for operational activities.
Residual Risk:	Likelihood: Unlikely
	Consequence: Moderate
	Risk: Medium

Impact No. 5: Movement of residual radioactive contamination into undisturbed areas from surface water flows.	
Initial Risk Ranking:	Likelihood: Possible
	Consequence: Moderate
	Risk: Medium
Controls:	The following controls will be utilised to prevent the potential flow of contaminated surface water from flowing outside the mine site: • Earthen containment bunding surrounding the process plant, ponds and the wellfield will be routinely monitored and maintained to ensure it remains intact. • Surface water drainage ponds will be monitored and maintained to contain surface waters within the designated mine site. • Regular surveillance will be undertaken on pond embankments to monitor the development of erosional features, and ensure adequate maintenance is undertaken where necessary. • Pond levels will be kept at a height sufficient to cover any accumulated basal sediments and ensure sufficient freeboard for extreme rainfall events. • The stormwater pond will be kept as low as possible to ensure it can accept all surface water drainage from within the process plant. • Routine care and maintenance and environmental inspections will be undertaken across the mine site to assess these requirements.
Residual Risk:	Likelihood: Unlikely
	Consequence: Moderate
	Risk: Medium

Impact No. 6 Reduced abundance/or species richness of flora compared to baseline.	
Initial Risk	Likelihood: Possible

Impact No. 6 Reduced abundance/or species richness of flora compared to baseline.	
Ranking:	Consequence: Moderate
	Risk: Medium
Controls:	Native flora species and abundance will be maintained during care and maintenance by: • Restricting and tightly managing vegetation clearance, through the use of a landscape and vegetation clearance form. • Restricting pastoral activities within mining tenements. • Installing fire breaks around the mine. • Restricting vehicles and machinery to designated tracks, preventing unnecessary ground disturbance. • Earthmoving equipment brought to the mine site must undergo weed and seed verification. • Staff training and inductions include specific site environmental controls. • Significant Environmental Benefit (SEB) payment made into the SEB fund to offset existing vegetation clearance.
Residual Risk:	Likelihood: Virtually Impossible
	Consequence: Moderate
	Risk: Medium

Impact No. 7: Increased abundance of introduced noxious weeds.	
Initial Risk Ranking:	Likelihood: Possible
	Consequence: Minor
	Risk: Medium
Controls:	Noxious weeds will be identified and managed during care and maintenance using the following controls: • Biennial weed survey to document any changes to species richness and abundance, and assess the effectiveness of control measures. • Active management and control of noxious weeds within the mine site. • No pastoral activities will be undertaken within mining lease. • Vehicles and machinery will be restricted to designated tracks, to prevent unnecessary ground disturbance. • Earthmoving equipment brought to the mine site must undergo weed and seed verification. • Any vegetation clearance required during care and maintenance will be undertaken through a Landscape and Native Vegetation Clearance Permit, which keeps account of all native vegetation cleared against available SEB clearance allowances. • Staff training and inductions will be used to specify site environmental controls.
Residual Risk:	Likelihood: Unlikely
	Consequence: Minor
	Risk: Low

Impact No.8: Permanent loss in native fauna abundance and/or species richness in the mining lease area derived from care and maintenance activities (including fire).	
Initial Risk Ranking:	Likelihood: Possible
	Consequence: Moderate
	Level of Risk: Medium

Controls:	Native fauna loss through entrapment will be minimised by: • Closing all wellfield sumps during the ramp down to care and maintenance. • Capping all wells. • Closing all full waste repositories. • Retaining fencing around all mine infrastructure to minimise faunal entry. • Undertaking regular inspections of ponds and fenced areas to check for entrapped fauna. Other key controls include: • A compulsory 20 km/h speed limit within the mine site and internal speed limit of 80 km/h along the site access road. • Compulsory incident reporting for all vehicle animal interactions and recording of animal casualties discovered on site. • Minimising any vegetation clearance to ensure habitat is protected. • Re-establishing native habitat through progressive revegetation. • Biennial fauna survey conducted to identify trends in species richness and abundance within the mine site compared with control sites. • Ongoing feral animal control.
Residual Risk:	Likelihood: Unlikely
	Consequence: Moderate
	Level of Risk: Medium

Impact No.9: Introduction and/or increase in abundance of pest species.	
Initial Risk Ranking:	Likelihood: Likely
	Consequence: Minor
	Level of Risk: Medium
Controls:	Pest species will be controlled by: • Prohibiting domestic pets being brought on or kept on the mine site. • Ongoing feral animal trapping and baiting. • Actively managing scavenging by securing food bins and managing scrap foods in animal proof bins. • Maintaining perimeter fencing. Monitoring of the effectiveness of these controls will be carried out by using: • Biennial pest surveys, to identify the abundance, species richness and distribution, and identify if population numbers have increased.
Residual Risk:	Likelihood: Possible
	Consequence: Minor
	Level of Risk: Medium

Impact No. 10: Cross contamination of mining and disposal fluids between the Upper and Basal Members of the Eyre Formation aquifer.	
Initial Risk Ranking:	Likelihood: Possible
	Consequence Minor
	Level of risk: Medium
Controls:	The potential for cross contamination between the Upper and Basal Eyre Formation aquifers will be minimised by: • Ensuring all in-use disposal wells are integrity tested at four year operational intervals and/or following any maintenance work involving a drilling rig. • Ensuring the construction of any additional disposal wells and

	decommissioning activities are undertaken in accordance with: the Department for Environment, Water and Natural Resources (DEWNR) well permit requirements, the Minimum Construction Requirements for Water Bores in Australia (2003) and Primary Industries and Resources South Australia (2006) Guideline M21 (now DSD). Verification monitoring to demonstrate no cross contamination has occurred will be undertaken by: • Routine monitoring of two Upper Member monitoring wells around the liquid disposal zone and two in the ISR wellfield (see Table 7.4).
Residual Risk:	Likelihood: Unlikely
	Consequence: Negligible
	Level of risk: Low

Impact No. 11: Failure of monitored natural attenuation so that the beneficial use of the Eyre Formation aquifer, beyond the attenuation zone[8] is constrained by contaminants elevated through mining.	
Initial Risk Ranking:	Likelihood: Virtually Impossible
	Consequence: Moderate
	Risk: Medium
Controls:	During the anticipated three year C&M phase, mining and disposal fluids within the ISR wellfield and liquid disposal zone will not be actively remediated, rather undergo natural attenuation as the mining and/or disposal fluids flow down-gradient within a 2 km attenuation zone north of the mining lease boundary. This attenuation zone has undergone a detailed beneficial use assessment (BUA) (LWC, 2012) to confirm that this water is naturally unsuitable for stock use. The ability of mining fluids present within the groundwater of the mining zone to naturally attenuate post mining, without any active remediation has been demonstrated from field data collected during and following the Honeymoon field leach trials (SKM, 2010). Natural attenuation of mining fluids during the C&M phase will be demonstrated by: • Routine groundwater monitoring data providing actual solute dispersion rates and concentrations to be compared with the original modelled predictions. • Actual monitoring data will enable the validation of geochemical and hydrogeological models or trigger the need to re-run the model. • Verification of the natural attenuation, 1D hydrocarbon model and solute transport model will be undertaken annually. • Funding will be made available to ensure groundwater monitoring will continue until a fully calibrated natural attenuation model can be produced, which demonstrates the attenuation of mining fluids in line with stock watering guidelines[9] within the designated 2km attenuation zone from the mining lease boundary.
Residual Risk:	Likelihood: Virtually Impossible
	Consequence: Moderate

[8] Defined as 2km from the edge of the mining lease.

[9] With the exception of Sulphate and Total Dissolved Solids, which already exceed Stock Watering Guideline Values (See Table 8.5).

Impact No. 11: Failure of monitored natural attenuation so that the beneficial use of the Eyre Formation aquifer, beyond the attenuation zone[8] is constrained by contaminants elevated through mining.	
	Risk: Medium

Impact No. 12: Reduction in air quality due to the dispersion of non-radioactive particulate matter (total insoluble and combustible matter).	
Initial Risk Ranking:	Likelihood: Possible
	Consequence: Moderate
	Level of Risk: Medium
Controls:	Dust/particulate generation will be limited by: • Applying a maximum mine site speed limit of 20 km/h and an access road and Mulyungarie road speed limit of 80 km/h. • Minimising land disturbance (i.e., unnecessary clearance of vegetation) reducing the airborne distribution of soils. • Use of mains electricity over diesel generators where possible. • Equipment purchased and maintained in accordance with manufacturers standards. Personnel exposure non-radioactive airborne particulates will be limited by: • Use of respiratory devices (.e.g., dust masks) during specific dust generating activities or high winds, and/or • Restriction of outside work duties during high winds.
Residual Risk:	Likelihood: Possible
	Consequence: Minor
	Level of Risk: Medium

Impact No 13: Increased occupational and environmental radiation exposure derived from dispersal of radionuclide rich gases and dusts during the ramp-down and care and maintenance phases.	
Initial Risk Ranking:	Likelihood: Possible
	Consequence: Moderate
	Risk: Medium
Controls:	Occupational and environmental radiation exposures will be minimised by: • Removal and permanent disposal of historic and operational low-level radioactive waste, including the internal components of the demonstration plant. • Closure of open low level repositories by the end of the ramp-down phase. • Transfer of excess calcite in the calcite pond to the gypsum repository for permanent disposal. • Closure of the two trial gypsum waste repositories. • Use of raw water to provide a stabilising layer over the full size gypsum waste repository. • Removal and disposal of aqueous and solid materials from the solvent extraction, precipitation plant and drying and packing plant. • Use of raw water used to cover any radionuclide rich basal sediments in process ponds and cover calcite in the calcite pond. • Thorough cleaning of all process areas, buildings (e.g. drying and packing plant), significantly contaminated areas (e.g., the GRTP surrounds) to reduce airborne radionuclide concentrations. • Emptying and cleaning of the groundwater and raffinate treatment plant.

Impact No 13: Increased occupational and environmental radiation exposure derived from dispersal of radionuclide rich gases and dusts during the ramp-down and care and maintenance phases.	
	• Airborne radiation monitoring will be routinely conducted to enable the effectiveness of controls to be verified. • Use of appropriate respiratory protection during any invasive work activity.
Residual Risk:	Likelihood: Unlikely
	Consequence: Minor
	Risk: Low

Impact No. 14: Increased occupational radiation exposures and potential for environmental contamination from low-level radioactive waste management during care and maintenance.	
Initial Risk Ranking:	Likelihood: Possible
	Consequence: Moderate
	Risk: Medium
Controls:	A reduction to the risk associated with low-level radioactive waste management and disposal during the care and maintenance phase will be achieved by: • Removing and disposing of waste materials during the ramp-down activities. • Closing all open low level radioactive waste repositories prior to commencement of C&M. • Ensuring low level radioactive waste generated during C&M is managed according the C&M Radiation Management Plan and Radioactive Waste Management Plan.
Residual Risk:	Likelihood: Virtually Impossible
	Consequence: Minor
	Risk: Low

Impact No. 15: Damage to identified Indigenous heritage sites during ramp-down and care and maintenance activities.	
Initial Risk Ranking:	Likelihood: Unlikely
	Consequence: Moderate
	Level of Risk: Medium
Controls:	In order to prevent damage to identified sites of indigenous heritage[10] the following actions will be undertaken: • All site inductions will include information on the local Native Title Claimants, importance of protecting sites of cultural significance, and personal requirements under the Aboriginal Heritage Act 1988. • All ramp down and care and maintenance personnel will be briefed on locations where indigenous heritage sites exist and associated requirements. • Annual monitoring of Indigenous archaeological sites will demonstrate no unauthorised disturbance has occurred. • Internal incident reporting will be undertaken if a known Indigenous or non-Indigenous archaeological site is disturbed.
Residual Risk:	Likelihood: Virtually Impossible
	Consequence: Moderate

[10] None of these sites have been formally registered or assigned a level of significance.

Impact No. 15: Damage to identified Indigenous heritage sites during ramp-down and care and maintenance activities.	
	Level of Risk: Medium

Impact No. 16 Deaths or injuries caused by unauthorised third party access to the general mine site.	
Initial Risk Ranking:	Likelihood: Likely
	Consequence: Severe
	Risk: Medium
Controls:	In order to prevent injuries and/or death from unauthorised third party access to the site the following controls have been set: • All fencing around mine infrastructure; stock fencing around the wellfield perimeter and high security fencing around the restricted mine infrastructure will be retained and secured. • Daily care and maintenance site security checks will be undertaken. • All entrance points/gates will be kept closed if unattended and locked at all times. • Closed-circuit television (CCTV) will be retained for use at entrance points and in strategic locations. • Regular site inspections will be undertaken within and along the perimeter of the mine site. • All permanent care and maintenance personnel will be trained to an Occupational First Aider level, with medical support provided by a specialist external provider and the Royal Flying Doctors. • Ongoing consultation with key regional stakeholders (e.g., Cockburn police and emergency services) and adjacent pastoral properties.
Residual Risk:	Likelihood: Virtually Impossible
	Consequence: Severe
	Risk: Medium

Impact No. 17: Lack of security and associated safety of site personnel and third parties during care and maintenance.	
Initial Risk Ranking:	Likelihood: Possible
	Consequence: Severe
	Risk: Medium
Controls:	Site safety and security will be maintained by the implementation of the following actions during the ramp-down process: • All permanent care and maintenance personnel will be trained to an Occupational First Aider level, with medical support provided by a specialist external provider and the Royal Flying Doctors. • Ongoing consultation with key regional stakeholders (e.g., Cockburn police and emergency services) and adjacent pastoral properties • Maintenance of fire detection and control systems. • Use of site CCTV systems for routine monitoring and review. • Regular fence and gate inspections, ensuring perimeter gates are kept locked and repairs are made where necessary. • Permanent manning of the site during care and maintenance. • Maintain communications with local emergency services and pastoralists.
Residual Risk:	Likelihood: Unlikely
	Consequence: Severe

Impact No. 17: Lack of security and associated safety of site personnel and third parties during care and maintenance.	
	Risk: Medium

Impact No. 18: Damage to key operational components and infrastructure during the care and maintenance phase.	
Initial Risk Ranking:	Likelihood: Possible
	Consequence: Severe
	Risk: Medium
Controls:	Preservation methods will include: • All electrical systems and component not required during care and maintenance will be isolated. • Fire systems will be retained in a fully operational mode, with supplier inspections and routine maintenance routinely undertaken. • Operational equipment will be maintained during care and maintenance in line with the requirements of their operational manuals. • Equipment not required during care and maintenance will be removed from service and stored where practicable, (e.g., well pumps and electrical cabling). • Removal of solutions, reagents and other fluids and solids from all tanks, pipes and pumps and flushed with potable water to preserve them for future use. • Routine inspections will be carried out by care and maintenance personnel to identify any major repairs or works required. Protection of the equipment from third party interference and/or theft will include: • Maintenance of site CCTV security systems • Routine security inspections by care and maintenance personnel • All perimeter fences will be secured and kept locked at all times. • Increased signage placed around the mine perimeter to notify third parties that all materials and equipment may contain residual radioactive materials and cannot be removed from the site.
Residual Risk:	Likelihood: Unlikely
	Consequence: Severe
	Risk: Medium

Impact No. 19: Removal or theft of radioactive contaminated materials from site.	
Initial Risk Ranking:	Likelihood: Possible
	Consequence: Moderate
	Risk: Medium
Controls:	In order to prevent the unauthorised removal and/or theft of materials/equipment during care and maintenance the following controls have been set: • Administrative procedures in the care and maintenance RMP/RWMP set out the requirements that must be followed when removing material from the Supervised Area in the mine site, and or off site. The prime procedural control is the requirement for a clearance permit to be issued and signed off by the RSO or delegate, prior to any item being removed from site where it has been in the Supervised area. Theft will be minimised by: • Removal of all product from site prior to the commencement of C&M.

	• Disposal of contaminated waste and redundant equipment/material in low-level radioactive waste repositories. • Maintaining site security and carrying out routine inspections • The Honeymoon mine site being permanently manned. • Information signage at the front gates and perimeter gates. • Training and supervision of care and maintenance staff and contractors on the hazards involved in unauthorised removal and or theft of potentially contaminated items.
Residual Risk:	Likelihood: Unlikely
	Consequence: Moderate
	Risk: Medium

Impact No. 20: Safety and stability of waste facilities.	
Initial Risk Ranking:	Likelihood: Unlikely
	Consequence: Severe
	Risk: Medium
Controls:	The following controls will be utilised to ensure site waste facilities are kept safe and stable during care and maintenance: • Closure of all low level radioactive waste facilities during the ramp down process. • Closure of the two trial gypsum waste facilities. • Significant soil covers of the low level waste repository and gypsum waste repository, 2 and 5 meters respectively, will ensure waste is not exposed from erosional forces. • Soil mounds will be established across all waste facilities to account for predicted soil settlement. • Monitoring of any subsidence will be undertaken following closure, with remedial measures undertaken where required. • Closed waste facilities will be allowed to revegetate, preventing surface erosion. • Signage will be placed around all four boundary fences of the gypsum repository enclosure to warn of the deep low-level radioactive repository.
Residual Risk:	Likelihood: Virtually Impossible
	Consequence: Moderate
	Risk: Medium

Impact No. 21: Impacts to third party property.	
Initial Risk Ranking:	Likelihood: Possible
	Consequence: Minor
	Level of Risk: Medium
Controls:	Potential impacts to third party property will be avoided and/or managed by use of the following controls: • Use of the site access road and/or Mulyungarie Road is restricted following significant rainfall (>5 mm in 24 hours). • Self-imposed speed limit of 80 km/h is applied to all Uranium One personnel and/or contractors using the site access road and Mulyungarie Road. • Site inductions specify speed limit requirements and requirements to slow and give way to stock along external roads. • A notification protocol and reimbursement have been set up if stock are accidently hit and killed during routine travel. • The Honeymoon mine consultation register will be used to record any third

Impact No. 21: Impacts to third party property.	
	party property damage occurrence and/or complaint. • Implementation of the community consultation plan to ensure appropriate consultation of shared public infrastructure and direct liaison with adjacent pastoralists/landowners.
Residual Risk:	Likelihood: Unlikely
	Consequence: Minor
	Level of Risk: Low

Table 7.2 Risk Assessment of the Potential Impacts Associated with Care and Maintenance

7.2.2 Care & Maintenance Outcomes and Measurement Criteria

In order to ensure the potential environmental, social and economic impacts (Table 7.2) are appropriately managed during the care and maintenance phase, a series of environmental, social and economic outcomes have been developed, and are provided in Table 7.3.

Attaining compliance for each identified outcome will be assessed through the use specific measurement criteria (Table 7.4). Measurement criteria can be used to demonstrate that specified outcomes have been achieved and where possible are based on legislative guidelines, codes of practice, industry standards, or baseline monitoring results.

No.	Outcome	Outcome Measurement Criteria
1	Soil is suitable for return to pastoral use post closure (Impact No. 1-5)	• All identified spills and/or releases to soil are recorded and assessed through the internal incident reporting system within 24 hours of occurring. • Remediation is undertaken in line with; the NEPM risk assessment methodology, baseline soil pH, Bachman recording and reporting requirements, and/or radiological clean-up criteria as agreed with the EPA.
		• All soil and topsoil stockpiles are monitored at set photo points annually, or following significant rainfall, to assess the stability of the stockpile. • Each monitoring round will be assessed against baseline and historical photo point assessments to demonstrate soil stockpiles will be retained for remedial activities.
2	All impacted areas are returned to a stable and resilient state, with evidence that the ecosystem function will ultimately be achieved (Impact No. 4)	• Annual EFA surveys carried out on rehabilitated areas >2 ha demonstrate compliance with baseline EFA values or show trends that can be confidently predicted to reach and pass reference EFA values.
3	No permanent loss of native flora species abundance or species richness on or off the mining tenements due to mining operations unless prior approval under the relevant legislation is obtained (Impact No. 6 & 7).	• A biennial review of additional disturbances/clearances can be verified against approved Landscape and Vegetation Clearance forms, and within Sustainable Environmental Benefit (SEB) clearance allocations.
		• A biennial review of internal incident records demonstrates no fires have occurred outside the SEB clearance area as a result of Honeymoon C&M activities.
4	No introduction of new noxious weed species, plant pathogens and/or increase in density or distribution of existing weed species and plant pathogens (Impact 7)	• No statistically significant[11] increases in noxious weed abundance, species richness or distribution within the mining area, in comparison with control sites on adjacent/adjoining pastoral leases. • This is a biennial assessment.
5	No permanent loss in native fauna abundance and/or species richness in the lease area or adjacent area, derived from site operations (Impact No. 8 & 9)	• No identifiable reduction in the abundance and species richness of native fauna is identified during the biennial native fauna survey undertaken at locations in both the mine site and representative control sites (Figure 6.1).
6	No introduction of new feral animal species or increase in abundance within the mining tenements, in comparison with adjoining pastoral areas (Impact No. 9)	• Results from the biennial feral animal survey demonstrate no increased numbers and/or species of feral animals within the mine site in comparison to control sites (Figure 6.1).

[11] As determined by a suitably qualified ecologist.

No.	Outcome	Outcome Measurement Criteria
7	No compromise to the environmental values of the Upper and Basal Members of the Eyre Formation aquifer outside the Mining Lease (Impact No. 10 & 11).	• Quarterly liquid disposal monitoring in the Basal Member identifies the extent and concentration of the liquid disposal plume enabling geochemical and hydrogeological models to be annually assessed and calibrated (See Section 6.5.4) .
		• Baseline physical and chemical values are maintained in the Upper Member of the Eyre Formation during C&M, demonstrated by quarterly monitoring results from select Upper Member monitoring wells in the ISR wellfield and liquid disposal zone.
		• Eighteen Environmental Basal Member monitoring wells, surrounding the ISR wellfield, will be monitored quarterly to track the movement of mining fluids. • Environmental monitoring wells will be screened for the presence of mining fluids using the analytical testing Suite 1. • Once identified, mining fluids will be characterised and concentrations monitored using a comprehensive analytical suite, Suite 2. • Results will be used on an annual basis to calibrate and validate the natural attenuation models to demonstrate that stock water guideline values[12] will be preserved outside the 2 km mine attenuation zone (Figure 8.5)
		• Eight former production Basal Member monitoring wells within the ISR wellfield will be monitored quarterly using Suite 2 to assess changes in the mining fluid concentrations over time following ingress of fresh water from upstream, and migration of mining fluids downstream.
		• Results from the Basal Member groundwater monitoring program will be used on an annual basis to calibrate and validate the natural attenuation models to demonstrate that stock water guideline values[15] will be preserved outside the 2 km mine attenuation zone (Figure 8.5).
8	No adverse impact to the public and the environment from radon release or the dispersal of radionuclide rich particulates (Impact No. 13-15)	• Environmental monitoring and reporting of airborne radionuclide concentrations will be in accordance with the South Australian Radiation Protection and Control Act 1982 and the site Care and Maintenance Radiation Management Plan and Radioactive Waste Management Plan (Uranium One, 2014).
9	No disturbance to	• Annual visual assessments undertaken at

[12] This excludes parameters that already naturally exceed stock water guidelines i.e. salinity and sulphate concentrations

No.	Outcome	Outcome Measurement Criteria
	Indigenous sites, objects or remains of significance without prior approval under the Aboriginal Heritage Act 1988 (Impact No. 15)	Indigenous sites within the Honeymoon mining tenements, demonstrate no unauthorised disturbance has occurred.
10	Risks to the health and safety of the public are as low as reasonably achievable (Impact No. 16 & 17).	• All C&M site security and safety inspections within the Honeymoon mine site are completed during each 12 months period.
		• Compliance with public radiation dose limits, specified by the Radiation Protection and Control Act 1982[1]
11	No unauthorised access, theft, malicious damage, or unapproved removal of contaminated equipment (Impact No. 18 & 19).	• Incident investigations into any cases of unauthorised site access, theft, malicious damage or unapproved removal of contaminated equipment at the Honeymoon mine site will be assessed annually to demonstrate compliance with security or radiation procedures.
12	Demonstrated safety and stability of closed waste facilities (Impact No. 20)	• All closed waste repositories will be monitored quarterly to ensure; fence lines and gates remain secure, and any surface subsidence is identified and remediated. • Inspections will continue until the stability of each repository's surface can be demonstrated for a minimum of a 12 month period. • When repositories have been deemed stable, perimeter fencing will be removed from that area and revegetation works will commence.
13	All reported impacts to third party property are appropriately recorded and closed out (Impact No. 21)	• All impacts to third party property, resulting from Uranium One activities at the Honeymoon mine will be logged in the stakeholder consultation register, and any required compensation paid within 90 days. • Compliance will be assessed on an annual basis.

Table 7.3 Care and Maintenance – Key Environmental Outcomes and Measurement Criteria

7.2.3 Monitoring

A site-specific monitoring program has been developed for the duration of care and maintenance. Monitoring requirements are summarised in Table 7.4, along with key outcomes and measurement criteria.

Outcome Measurement Criteria	Monitoring Program	Locations	Target Value(s)	Frequency	Control or Baseline data
Outcome No.1: Soil is suitable for return to pastoral use post closure (Impact No. 1-5)					
All identified spills and/or releases to soil are recorded and assessed through the internal incident reporting system within 24 hours of occurring. Remediation is undertaken in line with the NEPM risk assessment methodology, baseline soil pH, Bachman recording and reporting requirements and radiological clean-up as agreed with the SA EPA.	• The following information will be collected and recorded in the internal incident register and site spill register[13]: - Extent of spill = measured in m^2). - Location = GPS coordinates taken at the spill site. - Details on the nature of substance/liquid spilt. - Penetration depth into soil/substrate (mm). - Any remedial actions required.	• N/A	• Non-radiological spills will be remediated in line with the NEPM soil contamination risk assessment (NEPM, 1999), or baseline soil pH levels if an acid or alkaline spill. • Radiological spills will be remediated following consultation and agreement with the EPA Radiation Protection Division (RPD)[14].	• Incident reports and spill records will be logged and recorded within 24 hours of a spill being identified. • Remediation of spills will be undertaken within 7 days of the spill event, or following agreement with the EPA RPD.	• Non-radioactive spills assessed using the 'Soil contamination-NEPM Risk Assessment methodology' (NEPM, 1999) or returned to baseline acid/alkaline ranges. • Radioactive spills will be remediated following consultation and agreement with the EPA RPD.

[13] Spills exceeding Bachman recordable or reportable criteria will also be logged in the Recordable and Reportable Incident Register.

[14] A case by case clean up for radiological spill will be determined through consultation with the EPA, as a set radiological clean up criteria has yet to be developed by the EPA

Outcome Measurement Criteria	Monitoring Program	Locations	Target Value(s)	Frequency	Control or Baseline data
All soil and topsoil stockpiles are monitored annually, or following significant rain to assess the stability of the stockpile at set photo-points. Each monitoring round will be assessed against baseline and historical photo point assessments to demonstrate soil stockpiles are physically stable and will remain intact for future remedial activities.	• Subjective visual and photo-point observations will be undertaken at signed posted monitoring points, along two soil stockpiles and one topsoil stockpile. • The following features will be assessed in these observations: - Presence, depth and formation of erosional features. - Slumping, and/or other features of instability. - Presence of any stabilising vegetation. - Unauthorised removal. • Assessment of effectiveness of surface/stormwater drainage system.	• Six permanent monitoring points at the main soil stockpile • Four permanent monitoring points at the waste repository overburden stockpile • Two permanent monitoring points at the waste repository topsoil stockpile.	• Soil stockpile assessments do not identify a significant loss and/or instability of stockpiled soil.	• Annually, and following rainfall greater than 30 mm within a 24-hour period.	• Baseline stockpile photo-point photographs and assessments.
Outcome No. 2: All impacted areas are returned to a stable and resilient state, with evidence that the ecosystem function will ultimately be achieved (Impact No. 4)					
Annual EFA surveys carried out on rehabilitated areas >2 ha demonstrate compliance with baseline EFA values or show trends that can be confidently predicted to reach and pass reference EFA values.	• An Ecological Function Analysis (EFA) assesses the stability and resilience of rehabilitated areas by measuring the following parameters along a 50 m linear transect: - Percentage of bare soil. - Dead vegetation. - Live vegetation, and • Clay soils.	• Any rehabilitated area >2 ha within the Mining Lease or Miscellaneous Purpose Licence.	Rehabilitated areas reach representative baseline EFA values, or demonstrate trends that provide confidence of reference baseline EFA values being reached.	• Annually, until representative EFA levels are reached, or a level agreed with the regulatory authority.	• Baseline data, providing the target EFA values is provided in Attachment G, Baseline Ecological Condition Assessment and Ecosystem Function

Outcome Measurement Criteria	Monitoring Program	Locations	Target Value(s)	Frequency	Control or Baseline data
					Analysis (GHD 2009) utilising four control sites representative of the four main soil and landscape types.
Outcome No. 3: No permanent loss of native flora species abundance or species richness on or off the mining tenements due to mining operations unless prior approval under the relevant legislation is obtained (Impact No. 6 & 7).					
A biennial review of additional disturbances/clearances can be verified against approved Landscape and Vegetation Clearance forms, and within Sustainable Environmental Benefit (SEB) clearance allocations.	• Baseline clearance extents, recorded as an overlay to a site 2013 aerial image, will be used to perform a visual site assessment to identify any new disturbances/clearances. • Results will be recorded on a new overlay to the 2013 aerial photograph. • Approved Landscape and Vegetation Clearance Permit records and completed SEB clearance tracking will be used to verify if the identified disturbances have been approved.	• Mining Lease and Associated Miscellaneous Purpose Licences.	• All native vegetation clearances have an approved Landscape and Vegetation Clearance Permit, and have been tracked within the SEB tracking sheet to ensure sufficient SEB clearance is available (130 ha) .	• Biennial assessment	• Landscape and Vegetation Clearance Permit records. • SEB clearance tracking sheet. • October 2013 aerial photograph.
A biennial review of internal incident records demonstrates no fires have occurred outside the SEB clearance area as a result of Honeymoon C&M activities.	• The internal incident register will provide a record of all fires generated during care and maintenance, both inside and outside of the mining lease. • Key recording criteria include: - Number	• Mining Lease and Associated Miscellaneous Purpose Licences	No unplanned and uncontrolled fires outside the SEB clearance area.	• Biennial	• N/A

Outcome Measurement Criteria	Monitoring Program	Locations	Target Value(s)	Frequency	Control or Baseline data
	- Location (in context to the Mining Lease and SEB clearance extent). - Extent of impact • Controls used.				
Outcome No. 4: No introduction of new noxious weed species, plant pathogens and/or increase in density or distribution of existing weed species and plant pathogens (Impact 7)					
No statistically significant[15] increases in noxious weed abundance, species richness or distribution within the mining area, in comparison with control sites on adjacent/adjoining pastoral leases. This is a biennial assessment.	• A specialist floristic survey will be undertaken using ground based foot and vehicle surveys to compare the current: - Species richness. - Species abundance. - Distribution of weeds. • These results will be recorded and mapped, and factors contributing to infestations noted. • These results will then be compared with the baseline and most recent survey results.	• The survey is undertaken across randomly selected sites, in the: - Mining area, and • Control sites outside the mining area and mining lease (Section 6.4.3 and Attachment F).	• Distribution and density of weeds is comparable to representative control sites.	• Biennial survey.	• Three control sites set up to provide comparative ongoing survey locations (Section 3.12 Baseline weed and pest survey ((GHD, 2010)) Attachment F).
Outcome No. 5: No permanent loss in native fauna abundance and/or species richness in the lease area or adjacent area, derived from site operations (Impact No. 8 & 9)					
No identifiable reduction in the abundance and species richness of native fauna is identified during the biennial native fauna survey undertaken at	• A specialist fauna survey will be undertaken to assess the current species richness, abundance, and distribution of birds, mammals, reptiles and amphibians using the following	• The survey is undertaken at eight sites within the mine site, electricity transmission line,	• Survey results for the mine site record an equal or greater variety and concentration of native fauna species, in comparison to control	• Biennial survey.	• Eight control sites are set up outside areas directly impacted by mining operations (see

[15] As determined by a suitably qualified ecologist.

Outcome Measurement Criteria	Monitoring Program	Locations	Target Value(s)	Frequency	Control or Baseline data
locations (Figure 6.1), in both the mine site and representative control sites (Figure 6.1).	survey methods: - Permanent photographic monitoring points - Trapping (Pitfall traps and Elliot traps) - Bat Detectors - Bird Survey - Active Searching - Spotlighting • Opportunistic Observations	and representative control sites (outside the mining impact area and Mining Lease) (Section 6.4 and Figure 6.1).	sites.		Figure 6.1). • Baseline fauna survey results (Uranium One, 2010) undertaken prior to the commencement of construction in 2010, detailed in Section 3.13
Outcome No. 6: No introduction of new feral animal species or increase in abundance within the mining tenements, in comparison with adjoining pastoral areas (Impact No. 9)					
Results from the biennial feral animal survey demonstrate no increased numbers and/or species of feral animals within the mine site in comparison to control sites (Figure 6.1).	• Feral animal surveys record the variety of species, population numbers within the mine site vs. the control sites outside the mining area and Mining Lease. • The survey is undertaken using: - 10 x sand plot transects - 4 x spotlight transects - Incidental spotlighting - Opportunistic observations • A formal report will be prepared to collate all field data and provide an interpretation of trends in population numbers and distribution.	• The survey is undertaken within the mine site, and three control sites outside the extent of mining impacts and outside the Mining Lease (Section 6.4 and Figure 6.1).	• No new feral animal species identified within the mine area, and no significant increase in population numbers within the mine area in comparison to representative control sites.	• Biennial survey.	• Three control sites were set up to provide comparative ongoing survey locations (Section 6.4 and Attachment F).
Outcome No. 7: No compromise to the environmental values of the Eyre Formation aquifer outside the Mining Lease (Impact No. 10 & 11)					
Quarterly liquid disposal	• Liquid disposal volumes (m^3/day) and average daily flow	• Liquid disposal pipeline	N/A	• Disposal volumes and	N/A

Outcome Measurement Criteria	Monitoring Program	Locations	Target Value(s)	Frequency	Control or Baseline data
monitoring in the Basal Member of the Eyre Formation aquifer (Figure 7.3) identifies the extent and concentration of the liquid disposal plume enabling geochemical and hydrogeological models to be annually assessed and calibrated (see Section 6.5.4).	rates (m^3/s) will be recorded from a flow meter.			average flow rates (m^3/s) recorded daily.	
	• Liquid waste fluid from the liquid waste pond will be sampled monthly using Suite 1 and calcium. • Suite 1 - pH, EC, Eh, SWL, SO_4, U - Ca	• Liquid disposal pond pump.		• Monthly Suite 1 & Ca	
	• Liquid waste fluid from the liquid waste pond will be sampled quarterly using Suite 2 and Ra-226. <u>Suite 2</u> - SWL, pH, EC, Eh, TDS - Ca, Mg, Si, K, SO_4, Cl, Total Alkalinity. - Dissolved metals: Ag, Al, As, B, Ba, Be, Bi, Cd, Cr, Co, Cu, Fe, Hg, Li, Mn, Ni, Pb, Sn, Th, U, Va, Zn. - Total recoverable hydrocarbons (TRH) - Polyaromatic hydrocarbons (PAH) – naphthalene • This analytical suite will enable the comparison of physical, chemical and radiological concentrations in the injection fluid to be compared with that sampled in monitoring wells.			• Quarterly Suite 2 & Ra-226	

Outcome Measurement Criteria	Monitoring Program	Locations	Target Value(s)	Frequency	Control or Baseline data
	• The dispersion, dilution and attenuation of liquid disposal fluids injected into the Basal Member will be tracked by monitoring a linear series of liquid disposal monitoring wells	Liquid Disposal Basal Member Monitoring Wells (Figure 7.3)[16]: • Down-gradient (West) - WBLDCM1 - WBLDCM2 - WBLDCM3 - LDW8[17] • Up-gradient (East) - EBLDCM1 - EBLDCM2 - EBLDCM3 (see Figure 4.14):	• The presence of mining fluids will be confirmed if 2 or more Excursion Control Limits (ECLs) are exceeded. • The analytical results from Suite 2 sampling will enable the distribution and attenuation of the liquid disposal plume to be defined and tracked.	• Quarterly: Suite 1. • On detection of disposal solutions: Suite 2.	• ECL's: pH: < 5.4 SO4: >2.6g/L U: >1.6 mg/L
	• The liquid disposal groundwater monitoring results will be used with the ISR wellfield data to calibrate and verify the: - 1D flow model - Solute transport model - Numerical flow model - Hydrocarbon model.		• Verification of/or calibration of, concentration and distances predictions provided in the following models: - 1D flow model - Solute transport model - Numerical flow model, - Hydrocarbon model.	• Annually	• Concentrations and dispersion distances predicted by the: 1D flow model, solute transport model, numerical flow model and hydrocarbon model.
Baseline physical and chemical values are	• Upper Member Vertical Monitoring Wells will be	Upper Member - Vertical Monitoring	• The presence of mining fluids will be confirmed	• Quarterly: Suite 1, and	ECL's: • pH: < 5.4

[16] The next monitoring well in series will be monitored for the presence of disposal fluid, only once disposal fluid found in the previous well (i.e. EBLDCM1 > EBLDCM2, etc)

[17] To be used as a monitoring well only.

Outcome Measurement Criteria	Monitoring Program	Locations	Target Value(s)	Frequency	Control or Baseline data
maintained in the Upper Member of the Eyre Formation during C&M, demonstrated by quarterly monitoring results from select Upper Member monitoring wells in the wellfield and liquid disposal zone (see Figure 7.4).	sampled and screened for the presence of mining and or disposal fluids using Suite 1. • The presence of mining fluids will be confirmed if 2 or more Excursion Control Limits (ECLs) are exceeded.	Wells: • ISR Wellfield (Figure 7.4) - IVCM4 - IVCM5 • Liquid Disposal Zone (Figure 7.4) - WVLDCM1 - EVLDCM1	if 2 or more Excursion Control Limits (ECLs) are exceeded. • The analytical results from Suite 2 sampling will enable the distribution and attenuation of the liquid disposal plume to be defined and tracked.	Suite 2 on detection of mining or disposal fluids.	• SO4: >2.6g/L • U: >1.6 mg/L
Eighteen[23] Environmental Basal Member monitoring wells, surrounding the ISR wellfield (Figure 7.2 & 7.3), will be monitored quarterly to track the movement of mining fluids. Environmental monitoring wells will be screened for the presence of mining fluids using the analytical testing Suite 1. Once identified, mining fluids will be characterised and concentrations monitored using a comprehensive analytical suite, Suite 2.	• Basal Member ISR Wellfield Environmental Monitoring Wells will be sampled and screened for the presence of mining fluids using: Suite 1 • The presence of mining fluids will be confirmed using sampling with Suite 2 if 2 or more ECLs are exceeded. • The analytical results from Suite 2 sampling will enable the distribution and attenuation of the liquid disposal plume to be defined and tracked. • Suite 2 parameters have been selected based on the South Australian EPA Water Quality criteria (2003) and/or ANZECC (2000) National Water Quality	Basal Member - Environmental Fate Monitoring Wells (Figure 7.2): • Wellfield – Basal Leading Indicator: - BLI1-BLI5 - BLI6-8[19] - BLI9 • Wellfield - Outer Basal: - OBCM9-15 - OBCM7-8[23]	• Stock water guideline values retained[17] outside of the 2km attenuation zone from the northern boundary of the mining lease boundary, and verification of geochemical models from monitoring data: • Stock water guidelines values: - As = 0.5 mg/L - Ca = 0.01 mg/L - Ch = 1 mg/L - Cu = 0.5 mg/L - Hg = 0.002 mg/L - Ni = 1 mg/L - Zn = 20 mg/L	Quarterly: • Suite 1, and Suite 2 on detection of mining fluids.	ECL's: • pH: < 5.4 • SO4: >2.6g/L • U: >1.6 mg/L

[19] The requirement to monitor these wells will be based on the results of the potentiometric review

Outcome Measurement Criteria	Monitoring Program	Locations	Target Value(s)	Frequency	Control or Baseline data
Results will be used on an annual basis to calibrate and validate the natural attenuation models to demonstrate that stock water guideline values[18] will be preserved outside the 2km mine attenuation zone (Figure 8.5).	Management Strategy - Livestock Use, and the geochemical parameters required to validate and/or update the natural attenuation models. • Results will be recorded in an internal groundwater database.		- U = 0.2 mg/L - Ra-226 = 5 Bq/L		
Eight Former Production Basal Member monitoring wells within the ISR wellfield (Figure 7.2) , will be monitored quarterly using Suite 2 to assess changes in the mining fluid concentrations over time following ingress of fresh water from upstream, and migration of mining fluids downstream.	• Basal Member - Former Down-gradient and Up-gradient Production Wells will be sampled and analysed for concentrations of mining fluids using Suite 2.	<u>Basal Member - Former Production Monitoring Wells:</u> • Wellfield – Down-gradient (Figure 7.2): - HMI005r - HMI011r - HMI012r - HMP018 - HMI151	• Natural attenuation and dilution rates as mining fluids move down gradient from the mining zone as a function of local groundwater movement.	• Quarterly	• Arrival and dilution of mining fluids from baseline mining zone concentration as a function of geochemical modelled predictions (see Attachment 0).
		<u>Basal Member - Former Production Monitoring Wells (Figure 7.2):</u> • Wellfield – Up-gradient - HM0201 - HM0208 - HM0231	• The effect of clean water ingress on mining fluids within the ISR wellfield.	• Annually	

[18] This excludes parameters which already naturally exceed stock water guidelines i.e. salinity and sulphate concentrations

Outcome Measurement Criteria	Monitoring Program	Locations	Target Value(s)	Frequency	Control or Baseline data
Results from the Basal Member groundwater monitoring program will be used on an annual basis to calibrate and validate the natural attenuation models to demonstrate that stock water guideline values[20] will be preserved outside the 2km mine attenuation zone (Figure 8.5).	• The ISR wellfield and liquid disposal groundwater monitoring results will be used to assess rates of physical dilution, dispersion, and natural attenuation, enabling groundwater and geochemical models to calibrated and validated.	N/A	• Verification of/or calibration of, concentration and distance predictions provided in the following models: - 1D flow model - Solute transport model - Numerical flow model, and - Hydrocarbon model.	• Annually	• Concentrations and dispersion distances provided by the 1D flow model, solute transport model, numerical flow model and hydrocarbon model.
To detect water bearing units in the underlying Willyama Formation metamorphic basement sequence	• Two outer rock monitoring wells will be dipped to determine the presence/depth of groundwater.	• ORMW1 & ORMW2	N/A	• Quarterly	• Baseline data collected prior to operations.
Outcome No. 8: No adverse impact to the public and the environment from radon release or the dispersal of radionuclide rich particulates (Impact No. 12-14)					
Environmental monitoring and reporting of airborne radionuclide concentrations will be in accordance with the South Australian Radiation Protection and Control Act 1982 and the site Care and Maintenance Radiation Management Plan and Radioactive Waste Management Plan (Uranium One, 2014).					
Outcome No. 9: No disturbance to Indigenous sites, objects or remains of significance without prior approval under the Aboriginal Heritage Act 1988 (Impact No. 15)					
Annual visual assessments and photographic comparison	• A visual inspection will be carried out at the identified sites to assess for:	• Fourteen sites within the mining tenements.	• No visual evidence of disturbance.	• Annual assessment	• Photographs and assessments

[20] This excludes parameters which already naturally exceed stock water guidelines i.e. salinity and sulphate concentrations

Outcome Measurement Criteria	Monitoring Program	Locations	Target Value(s)	Frequency	Control or Baseline data
undertaken at fourteen indigenous sites within the Honeymoon mining tenements demonstrates no unauthorised disturbance has occurred.	- New tracks - Ground based movements - Vegetation clearance.				from prior operational inspections.
Outcome No. 10: Risks to the health and safety of the public are as low as reasonably achievable (Impact No. 16 & 17).					
All C&M site security and safety inspections within the Honeymoon mine site are completed during each 12 months period.	• Compliance with routine site safety and security inspections, the routine assessment of: - Integrity of fence lines around project infrastructure - Secured gates - Adequate warning/safety signage • Security inspections will be recorded on task sheets.	• Honeymoon mine site	• Site inspection records demonstrate all safety and security measures are maintained throughout C&M.	• Annual assessment	• N/A
Compliance with public radiation dose limits, specified by the Radiation Protection and Control Act 1982[1]	• Environmental monitoring and reporting of airborne radionuclide concentrations will be in accordance with the South Australian Radiation Protection and Control Act 1982 and the site Care and Maintenance Radiation Management Plan and Radioactive Waste Management Plan (Uranium One, 2014).				

Outcome Measurement Criteria	Monitoring Program	Locations	Target Value(s)	Frequency	Control or Baseline data
Outcome No. 11: Demonstrated safety and stability of closed waste facilities (Impact No. 20)					
All closed waste repositories will be monitored quarterly to ensure; fence lines and gates remain secure, and any surface subsidence is identified and remediated. Inspections will continue until the stability of each repository's surface can be demonstrated for a minimum of a 12 month period. When repositories have been deemed stable, perimeter fencing will be removed from that area and revegetation works will commence.	• The footprint of all closed waste cells will be monitored and the following information recorded on inspection sheets: - Repository type and number. - Date of inspection. - Relevant climatic information (e.g., recent significant rainfall event) - Subsidence from elevated mound level +0.2m from ground surface. - Any surface cracks or features that indicate instability. • Routine security inspections will be carried out around the waste facilities to ensure fence lines remain intact, and perimeter gates are kept locked. These records will be kept as part of completed task sheets.	• All closed low level radioactive waste, non-radioactive waste and gypsum waste repositories.	• Consistent surface stability; no depressions below the natural ground surface developing over a 12 month assessment period.	• Quarterly assessment	• N/A

Outcome Measurement Criteria	Monitoring Program	Locations	Target Value(s)	Frequency	Control or Baseline data
Outcome No. 13: All reported impacts to third party property are appropriately recorded and closed out (Impact No. 21)					
All impacts to third party property, resulting from Uranium One activities at the Honeymoon mine will be logged in the stakeholder consultation register, and any required compensation paid within 90 days. Compliance will be assessed on an annual basis.	• All informal and formal communications with third parties, related to the Honeymoon mine site, will be logged on the stakeholder consultation register, with details of the: - Person/organisation - Date - Type of communication (formal/informal, verbal, letter etc). - Nature of communication - Close out/remedial actions required. • Date all actions closed out.	• Any location where activities are being carried out by Uranium One in connection with the Honeymoon mine.	• Consultation records demonstrate that all agreed actions, and or compensation payments are made within 90 days.	• Annual compliance assessment	N/A

Table 7.4 Care and Maintenance Outcomes, Measurement Criteria and Monitoring Program

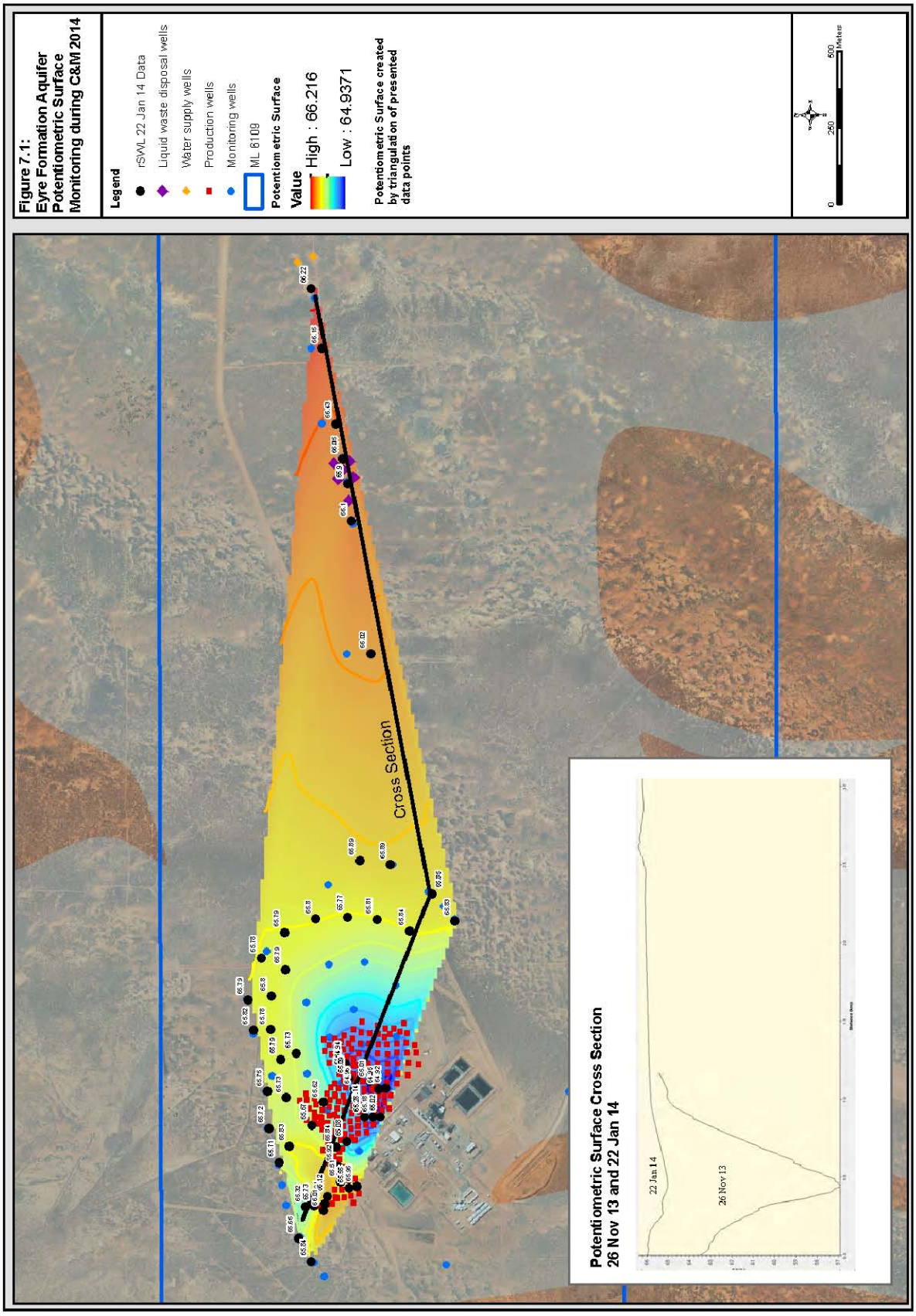

Figure 7.1 Eyre Formation aquifer potentiometric surface monitoring during care & maintenance

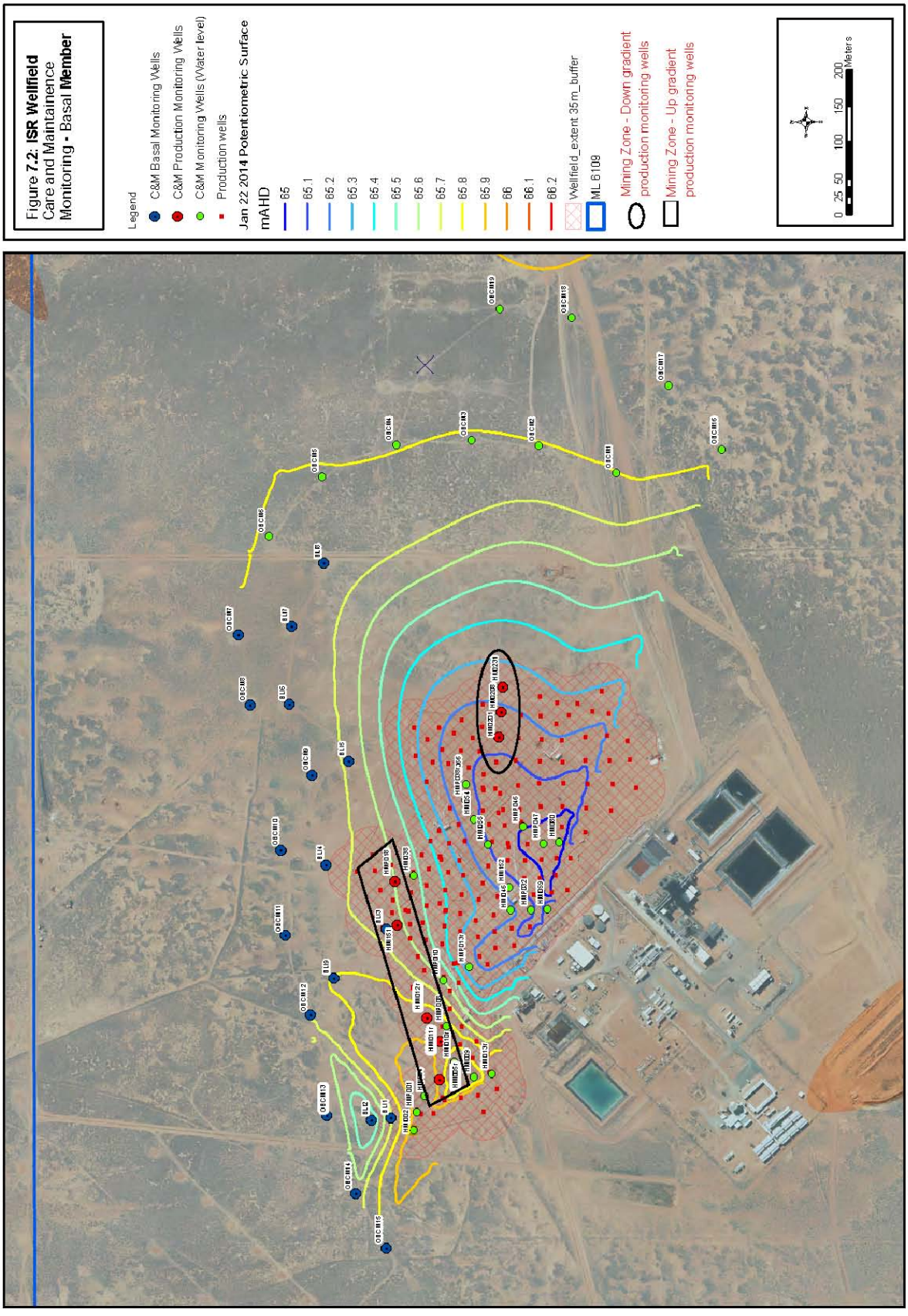

Figure 7.2 ISR Wellfield – Care & maintenance monitoring in the Basal Member of the Eyre Formation

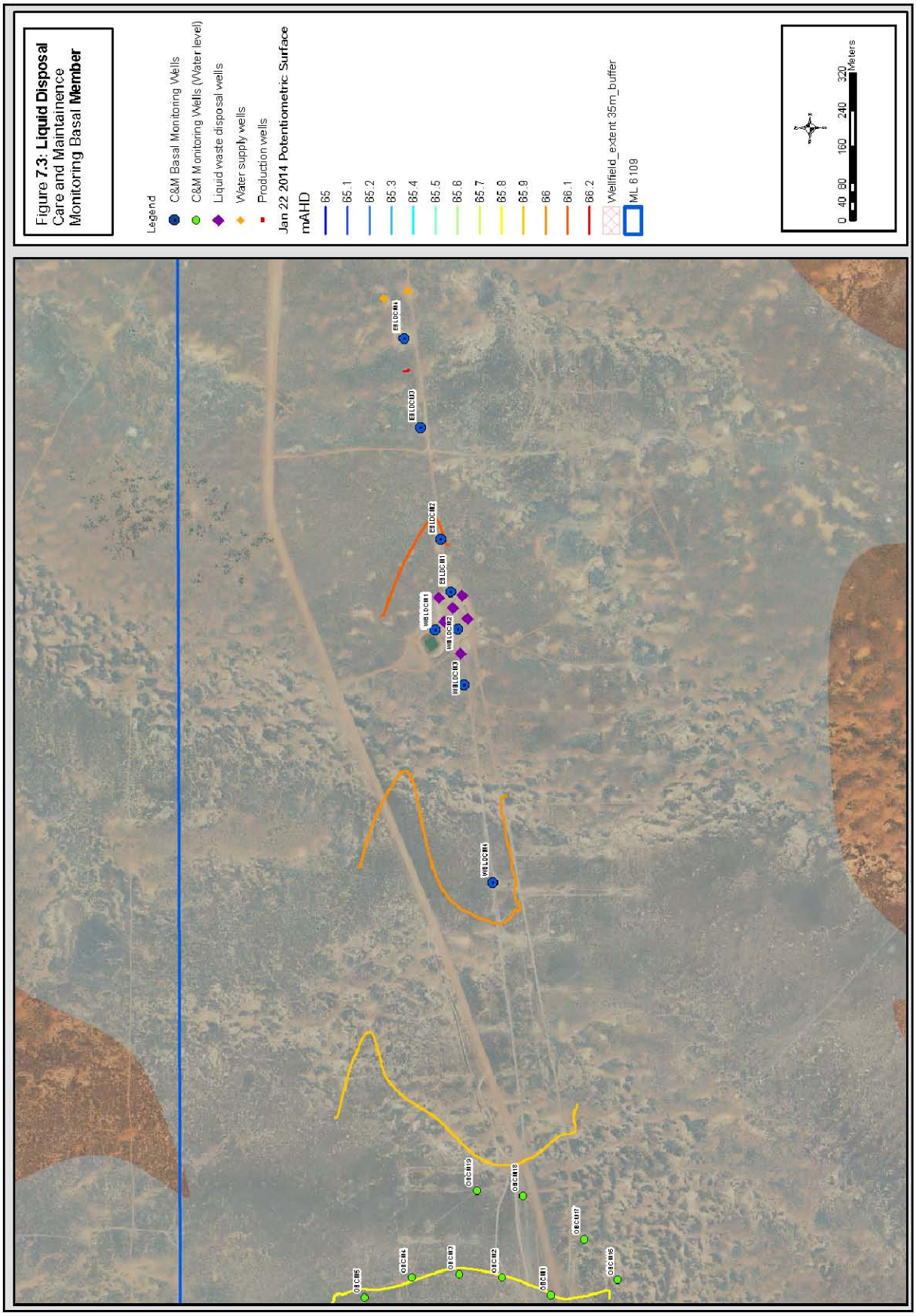

Figure 7.3 Liquid disposal – Care and maintenance monitoring in the Basal Member of the Eyre Formation

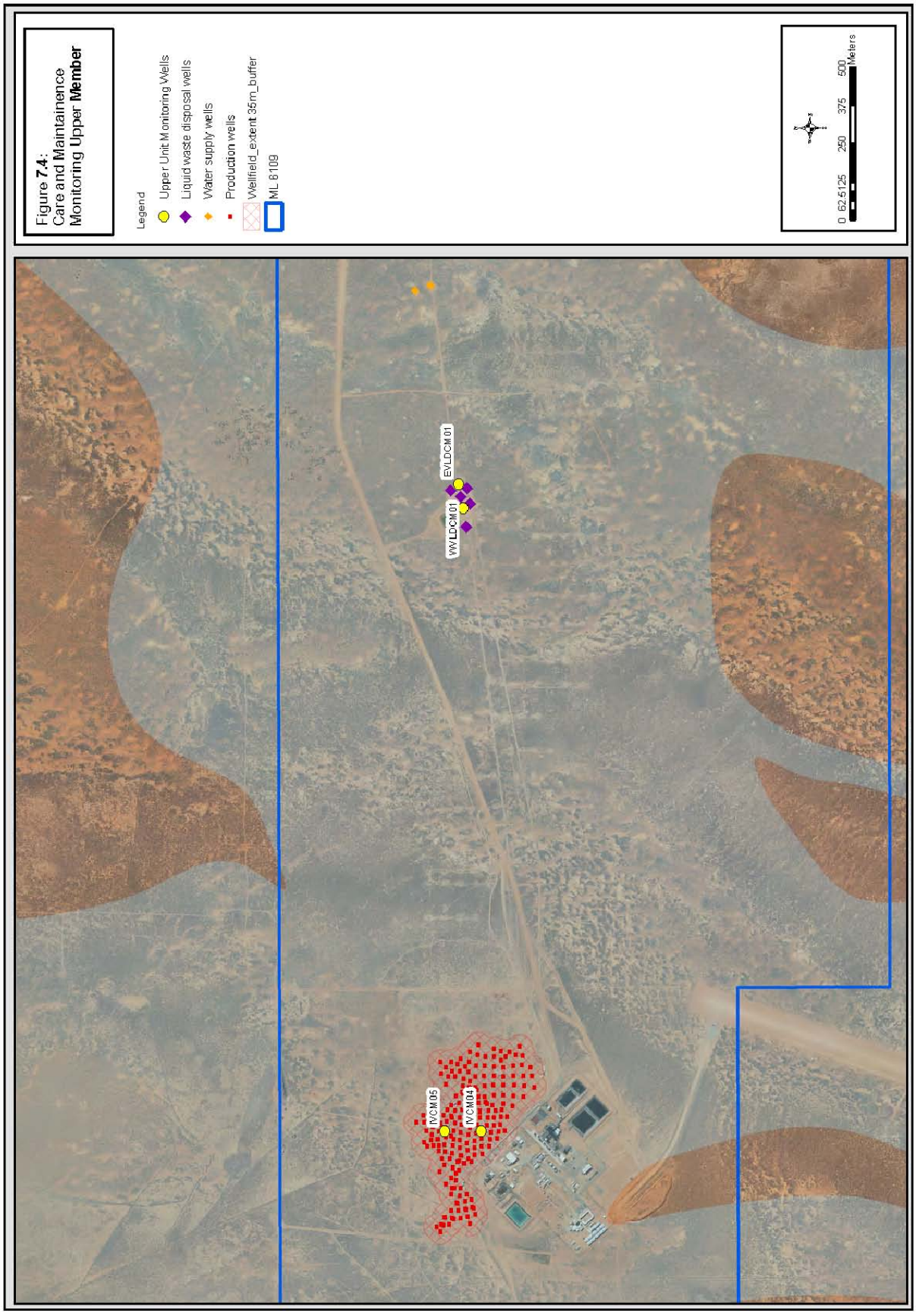

Figure 7.4 Care & maintenance monitoring in the Upper Member Eyre Formation aquifer.

7.2.4 Monitoring and Management Personnel

During periods of care and maintenance environmental monitoring requirements, as detailed in Table 7.4, will be carried out by a suitably trained environmental technician or environmental scientist. All monitoring activities will be overseen and reviewed by a qualified environmental scientist.

7.2.5 Reporting

A routine review of the compliance of the operation against the commitments and monitoring criteria detailed in Table 7.4 will be made annually in conjunction with the Honeymoon annual compliance report. Quarterly reporting will also be undertaken for select environmental and groundwater monitoring results as part of the Honeymoon In-Situ Recovery Environmental Radiation Report.

Additional groundwater monitoring and modelling reporting requirements are detailed in the Groundwater Monitoring and Management Plan Care & Maintenance Addendum (Attachment 0).

8 Mine Closure

8.1.1 Background

The development of the Honeymoon mine conceptual closure plan has been undertaken though consideration of objectives and principals contained within the Strategic Framework for Mine Closure (ANZECC/MCA, 2000), the Mine Closure and Completion Handbook (DITR, 2006) and the requirements outlined in the Primary Industries and Resources South Australia Guidelines for Preparation of a Mining Lease Program (PIRSA, 2011).

Closure requirements reflect the obligations under the South Australian Mining Act 1971, the conditions of Mining Lease (ML) 6109, Miscellaneous Purposes Licences (MPLs) 15 and 92. Although considered in some detail within the conceptual closure plan, specific radiation management procedures for closure are detailed within the Operational Radiation Management Plan (RMP) and Radioactive Waste Management Plan (RWMP), under the South Australian Radiation Protection and Control Act 1982. The closure planning process will require further consultation and agreement with the South Australian Environment Protection Authority (EPA) Radiation Protection Branch.

8.1.2 Regulatory Notifications

To progress the formal transition of the Honeymoon mine from an operational or care and maintenance status to closure, formal notifications must be made to all relevant South Australian and Federal regulators.

8.2 Objectives

The conceptual closure plan is a specific planning framework. The objectives of this closure plan include the following:

- Provide an annual review to update the closure plan, based on actual mine development and rehabilitation target progress.
- Assess residual risks and identify appropriate controls prior to mine closure.
- Ensure the beneficial use of the Eyre Formation aquifer beyond the attenuation zone.
- Actively engage and consult with stakeholders in the closure process.
- Progressively rehabilitate during operations, limiting liability and refining remedial techniques.
- Ensure the stability of landscapes and soil surfaces and re-establish vegetation and habitat.
- Restore the baseline visual amenity of the region.
- Ensure waste materials and radioactive materials are isolated and safely contained.
- Ensure human and ecological health is not impacted from radiological or non-radiological contamination.
- Ensure rehabilitation and remedial works are site specific and appropriate.
- Ensure the successful return of the ML and associated tenements to pastoral use (as stipulated in the ML conditions), and use by Native Title Claimants.

8.3 Background and Context

A full background to the physical and biological environment within and surrounding the Honeymoon mine is covered in Section 1.

8.4 Stakeholders Involvement and Issues

Uranium One will consult with stakeholders of the Honeymoon mine during each phase of closure planning via the activities set out in a stakeholder engagement and consultation strategy.

The main objective of this strategy is to:

- Appropriately define and characterise affected communities and other stakeholders for inclusion in engagement activities.
- Identify actual and perceived impacts on the affected communities and ensure that these are captured and addressed throughout the life of the operation and during closure.
- Identify appropriate opportunities for involving and communicating with stakeholders.
- Provide a means for recording all consultation initiatives and mechanisms through which consultation is undertaken. These mechanisms aim to deliver a system in which matters raised by stakeholders are recorded, actioned and that the outcomes are reported back to those stakeholders.
- Provide a process in which future mine planning and design can take into account issues raised by stakeholders at the earliest possible stage.
- Implement a grievance mechanism for the effective resolution of credible grievances and complaints.

The key stakeholders along with issues and concerns raised during the consultative processes are detailed in Section 5.2 and summarised in Table 8.1 below.

Stakeholder Group	Individual Stakeholders	Issues Raised
Regional Indigenous Communities.	• Adnyamathanha communities (including merged Kuyani Group). • Wider regional Indigenous community.	• Indigenous businesses. • Indigenous employment. • Environmental performance. • Cross-cultural matters. • Consultation for closure planning. • Indigenous heritage.
State Emergency Response Agencies.	• SA Ambulance Service (SAAS) and SA North Eastern Region Health. • Royal Flying Doctors Service.	• Emergency response capability, facilities, support and training.
State Regulators.	• DSD • EPA including the Radiation Protection Branch). • Department of Environment, Water and Natural Resources (DEWNR) • Department of the Premier and Cabinet.	• Environmental, radiation and transportation.
Commonwealth Regulators.	• Department of Sustainability, Environment, Water, Population and Communities (DSEWPC). • Australian Safeguards and Non-Proliferation Office (ASNO). • Department for Resources, Environment and Tourism (DRET). • Geosciences Australia.	• Environmental, safety, physical protection and nuclear safety.

Stakeholder Group	Individual Stakeholders	Issues Raised
Local Pastoralists.	• Neighbouring pastoralists.	• Regional farming activity, road conditions, water usage, drainage, pest including weed control, grazing activity and Honeymoon mine's electricity transmission line and associated track.
Regional Pastoralists.	• Pastoral Board.	• Regional farming and grazing activity.
Local Fauna Harvesters	• Local fauna harvesters	• Kangaroo harvesting.
Regional Community Business Forums.	• Broken Hill Chamber of Commerce and Employers Groups. • SA North East Economic Forum.	• Employment opportunities, business grants, local sponsorships and training opportunities.
Regional Community Business Forums.	• Industry Capability Network (ICN) of South Australia.	• Promotion of South Australian business.
Non-Government Organisations (NGOs).	• All interested parties.	• Safety, environmental and radiation safety performance.

Table 8.1 Summary of stakeholder consultation

Engagement and consultation activities will occur throughout the life of the mine and include ongoing engagement and consultation with Native Title Claimants, the local community, local pastoralists and fauna harvesters, government stakeholders, non-government organisations, the wider community and other interested parties. This will be achieved through information exchanges and media releases on the Uranium One website and through the establishment of a grievance mechanism for the effective resolution of credible grievances and complaints.

Final land use will involve regular consultation with the South Australian Pastoral Board, Native Title Claimants and other interested parties.

8.5 Scope and Description of Closure Domains

Mine components have been divided into three closure domains, a series of discrete zones based on both the anticipated type and degree of remediation required on closure and associated relinquishment timing.

Within the ML, two separate domains have been identified and divided on the basis of whether contamination (non-radiological or radiological) is likely to be present during and following operations.

The MPLs comprise the third domain, characterised by limited ancillary infrastructure, lack of any contamination and minimal landscape modifications.

The domain areas are summarised below:

Closure Domain 1: ML 6109 – Contaminated Areas: Process Infrastructure i.e., Process Plant and Wellfield.

Closure Domain 2:	ML 6109 – Un-contaminated Areas: Support Infrastructure i.e., Camp and Administration.
Closure Domain 3:	Miscellaneous Purposes Licences 15, and 92: Support Infrastructure i.e., Airstrip and Electricity Transmission Line.

The three domains are shown in Figure 8.1, Figure 8.2 and Figure 8.3

8.5.1 Components of Closure Domain 1: ML6109 – Process Infrastructure

Wellfield

- Wells and wellheads.
- Monitoring wells and attenuation monitoring.
- Reticulation system.
- Wellhouses and filter skids.
- Workshops.
- Groundwater raffinate treatment plant.

Process Plant

- Pulsed columns.
- Reagent storage areas.
- Scrub and strip mixer settlers.
- Crud centrifuge, crud tanks and barren organic tanks.
- Precipitation tanks, iron thickener and uranium thickener.
- Drying and packing plant.
- Workshops.
- Processing ponds.
- Pregnant leach solution (PLS) pond.
- Barren leach solution (BLS) pond.
- Liquid disposal pond.
- Calcite storage pond.
- Solution Extraction (SX) dump pond.
- Stormwater pond.

Waste Facilities

- Non-radioactive waste repository.
- Gypsum waste repository.
- Low-level radioactive waste repository.

Miscellaneous Infrastructure

- Liquid disposal wells and associated monitoring wells.
- Liquid disposal well attenuation monitoring.

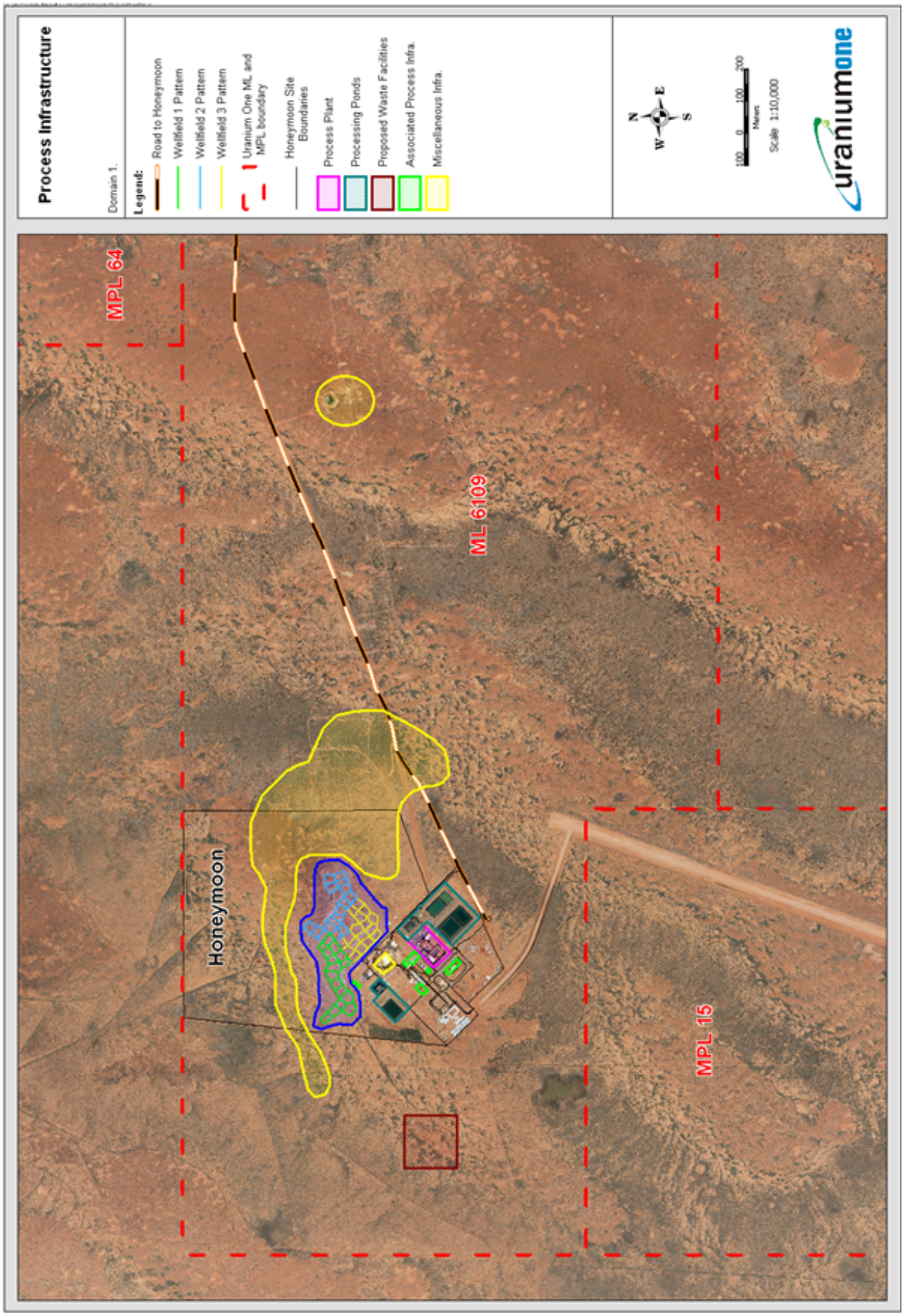

Figure 8.1 Closure Domain 1: Process infrastructure

8.5.2 Components of Closure Domain 2: ML6109 – Support Infrastructure

Camp

- Accommodation units.
- Kitchen, wet and dry mess.
- Laundry and ablution blocks.
- Septic system and sewage treatment plant.

Administrative Buildings

- Office buildings.
- Change rooms and ablution blocks.
- Crib rooms.
- First aid room.
- Laboratory.
- Paths and car parking facilities.

Reverse Osmosis (RO) Units

- RO building and containerised RO.
- Potable water and raw water tanks.
- Fire system components and associated tanks.

Roads and Fencing

- Main access tracks and internal track network.
- Internal/external security fencing.
- Pastoral fencing around wellfield.

8.5.3 Components of Closure Domain 3: Miscellaneous Purpose Licence 15 and 92

- MPL 15.
  - Airstrip.
- MPL 92.
  - Electricity transmission line.

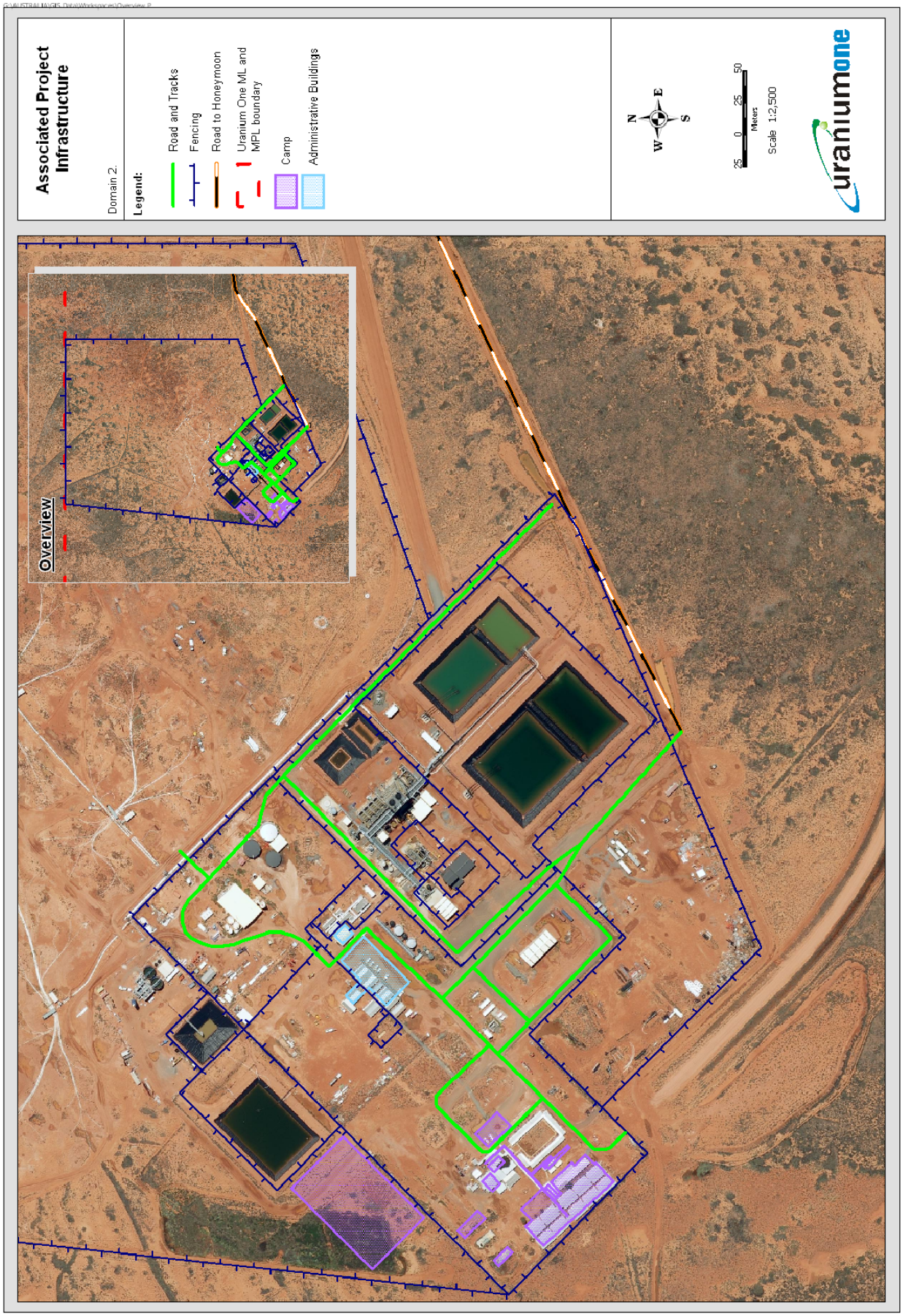

Figure 8.2 Closure Domain 2: Support Infrastructure

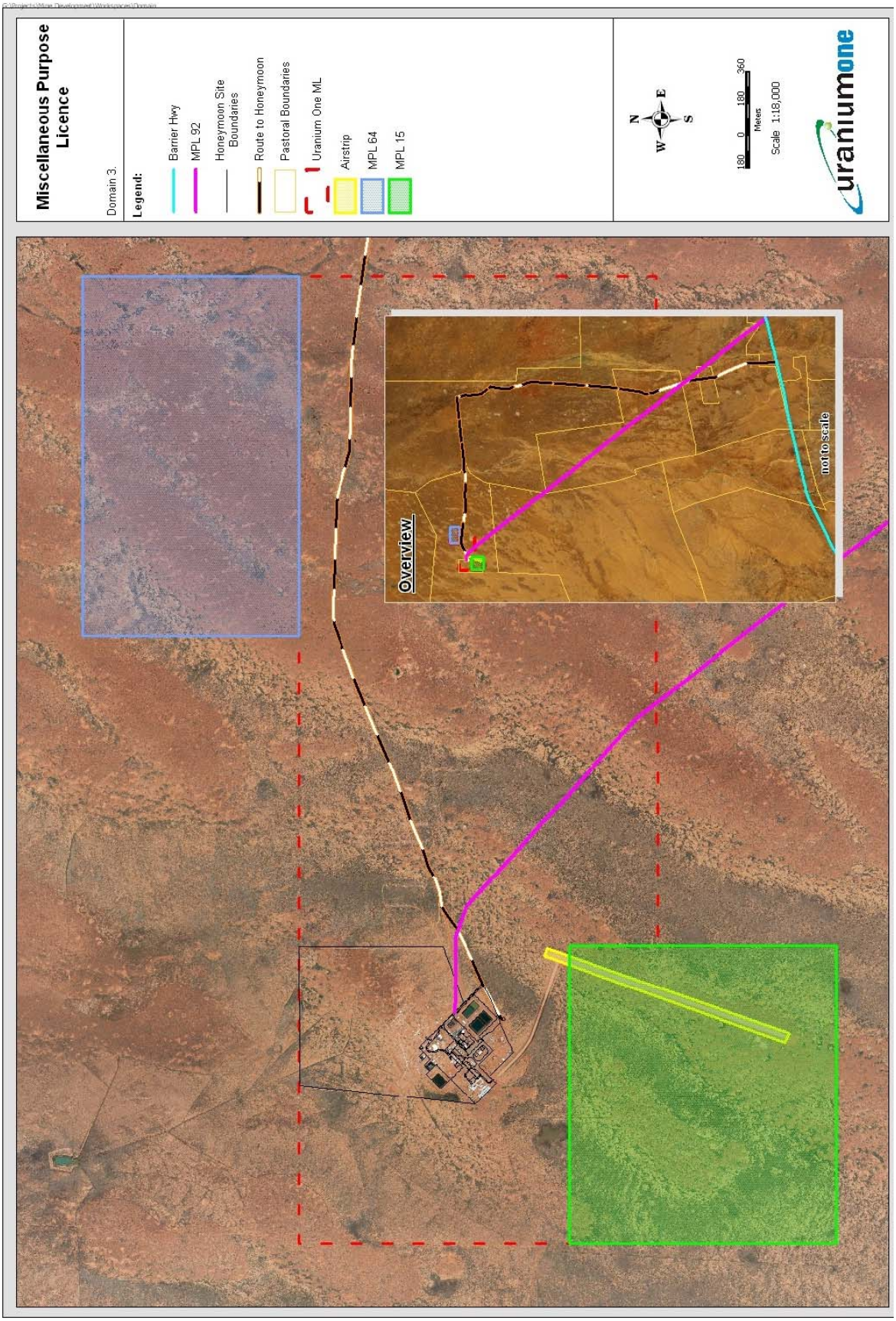

Figure 8.3 - Closure Domain 3: MPL's 15 & 92

8.6 Potential Environment, Economic and Social Impacts of Mine Closure

Planning for closure has been undertaken through a risk assessment of credible and potential impacts of an environmental, economic and social nature, that may remain during or following mine closure. These impacts, associated control measures and associated residual risk are detailed below in Table 8.2.

Impact No. 1: Soil contamination (radioactive/non-radioactive) remaining following operational phase	
Risk prior to implementation of controls	Likelihood: Virtually Certain Consequence: Minor Level of Risk: Medium
Residual risk after implementation	Likelihood: Unlikely Consequence: Minor Level of Risk: Low
Primary Control Measures: • Progressive remediation of all significant areas of soil contamination during operations will assist in establishing effective remedial methods, and limit quantity of remedial works required on closure. • Provision of a low-level radiological waste repository, a gypsum waste disposal repository and a non-radioactive waste repository will enable the onsite disposal of surface materials exceeding EPA radiological, and National Environment Protection Measures (NEPM) guidelines where in-situ remediation cannot be undertaken.	

Impact No. 2: Failure of remedial radiological and non-radiological contamination measures to meet agreed EPA Limits	
Risk prior to implementation of controls	Likelihood: Possible Consequence: Moderate Level of Risk: Medium
Residual risk after implementation	Likelihood: Unlikely Consequence: Moderate Level of Risk: Medium
Primary Control Measures: • Progressive contamination treatment and clean-up during operations will establish effective remedial methods for treatment and/or disposal thereby limiting the quantity and duration of remedial works required on closure. • Provision of low-level radiological storage facility and non-radioactive waste disposal facility for the disposal of surface materials that cannot meet EPA guidelines. • Ongoing review and consultation with the SA EPA and industry specialists to review current management and treatment measures.	

Impact No.3: Introduction of new weed species and increased weed density and distribution interferes with effective rehabilitation	
Risk prior to implementation of controls	Likelihood: Possible Consequence: Minor Level of Risk: Medium
Residual risk after implementation	Likelihood: Unlikely Consequence: Minor Level of Risk: Low

Impact No.3: Introduction of new weed species and increased weed density and distribution interferes with effective rehabilitation
Primary Control Measures: • All vehicles/machinery will require weed and seed documentation and hygiene checks prior to commencing closure works within the mine site. • Long-term monitoring, commencing after rehabilitation will evaluate the progress of rehabilitation towards fulfilling long-term land use objectives. It will also determine whether the rehabilitated ecosystem is likely to be sustainable over the long-term.

Impact No. 4: Reduced species abundance and/or species richness compared to baseline	
Risk prior to implementation of controls	Likelihood: Possible Consequence: Minor Level of Risk: Medium
Residual risk after implementation	Likelihood: Unlikely Consequence: Minor Level of Risk: Low
Primary Control Measures: • Progressive rehabilitation will assist in identifying effective re-vegetation techniques. • Contingency funding made available for rehabilitation and closure. • Long-term monitoring commencing after rehabilitation, will evaluate the progress of rehabilitation towards fulfilling long-term land use objectives, and determine whether the rehabilitated ecosystem is likely to be sustainable over the long-term.	

Impact No. 5: Re-vegetation levels failing to meet specified baseline/agreed criteria for return to pastoral use within closure timeframes	
Risk prior to implementation of controls	Likelihood: Possible Consequence: Minor Level of Risk: Medium
Residual risk after implementation	Likelihood: Unlikely Consequence: Minor Level of Risk: Low
Primary Control Measures: • Progressive rehabilitation will be used to determine effective re-vegetation techniques. • Contingency funding made available for rehabilitation and closure, if initial rehabilitation techniques are determined not suitable. • Long-term monitoring will be undertaken to evaluate the progress of rehabilitation towards fulfilling long-term land use objectives and determine whether the rehabilitated ecosystem is likely to be sustainable over the long-term.	

Impact No. 6: Poor re-vegetation techniques or poor management of the re-vegetation operations leads to unsatisfactory outcomes.	
Risk prior to implementation of controls	Likelihood: Possible Consequence: Minor Level of Risk: Medium
Residual risk after implementation	Likelihood: Unlikely Consequence: Minor Level of Risk: Low

Impact No. 6: Poor re-vegetation techniques or poor management of the re-vegetation operations leads to unsatisfactory outcomes.
Primary Control Measures: • Ecosystem Function Analysis (EFA) will assess the effectiveness of rehabilitation activities. • Long-term monitoring will evaluate the progress of rehabilitation towards fulfilling long-term land use objectives and determine whether the rehabilitated ecosystem is likely to be sustainable over the long-term.

Impact No. 7: Increased abundance of introduced species	
Risk prior to implementation of controls	Likelihood: Possible Consequence: Minor Level of Risk: Medium
Residual risk after implementation	Likelihood: Unlikely Consequence: Minor Level of Risk: Low
Primary Control Measures: • Long-term monitoring will be undertaken to evaluate the abundance and distribution of pest species and provide for any required control mechanisms.	

Impact No. 8: Fauna levels show reduced species abundance and/or diversity compared to control sites following closure	
Risk prior to implementation of controls	Likelihood: Possible Consequence: Minor Level of Risk: Medium
Residual risk after implementation	Likelihood: Unlikely Consequence: Minor Level of Risk: Low
Primary Control Measures: • Removal of mine fencing after 3 years of closure. • Regular long-term monitoring will commence following the removal of fencing, a process that will start after the formal sign off of re-vegetation levels.	

Impact No. 9: Impacts on identified Indigenous heritage sites from rehabilitation activities	
Risk prior to implementation of controls	Likelihood: Possible Consequence: Minor Level of Risk: Medium
Residual risk after implementation	Likelihood: Unlikely Consequence: Minor Level of Risk: Low
Primary Control Measures: • All closure operators and contractors will be briefed on the Indigenous sites within the area and of the requirements to stay within the bounds of historical disturbance. • Audits will be undertaken during and following mine closure to ensure no disturbance has occurred.	

Impact No. 10: Stability of waste facilities compromised by use of highly erodible, unstable materials	
Risk prior to implementation of controls	Likelihood: Possible Consequence: Severe Level of Risk: Medium
Residual risk after implementation	Likelihood: Virtually Impossible Consequence: Severe Level of Risk: Medium
Primary Control Measures: • Geotechnical assessment of capping materials will be undertaken as part of the final closure plan. • Construction and closure of all waste facilities will be undertaken with reference to EPA guidelines and the Near Surface Disposal of Radioactive Materials Code of Practice and the relevant operational management plans. • The facilities will not be at ground level and therefore not an erodible surface feature. • Revegetation will be encouraged over waste facilities to prevent surface erosion. • Monitoring of completed waste cells throughout operations will give an early indication of issues with materials and/or design allowing corrective measures to be undertaken prior to closure.	

Impact No. 11: Risks remain to public and fauna due to dose rates and unstable structures	
Risk prior to implementation of controls	Likelihood: Possible Consequence: Severe Level of Risk: Medium
Residual risk after implementation	Likelihood: Virtually Impossible Consequence: Severe Level of Risk: Medium
Primary Control Measures: • Construction and closure of facilities to be undertaken in accordance with EPA guidelines and the Near Surface Disposal of Radioactive Materials Code of Practice. • Geotechnical assessment of capping materials to be undertaken as part of final closure plan. • Waste facilities will be closed at ground level and therefore do not have the potential to fail in-situ. • The RWMP and Near Surface Disposal of Radioactive Materials Code of Practice will be employed to ensure that dose levels on closure are within specified limits. • Operational and post closure confirmatory radiation monitoring.	

Impact No. 12: Waste materials are not disposed in a chemically and physically stable state	
Risk prior to implementation of controls	Likelihood: Possible Consequence: Moderate Level of Risk: Medium
Residual risk after implementation	Likelihood: Unlikely Consequence: Moderate Level of Risk: Medium
Primary Control Measures: • Construction, disposal and closure of facilities to be undertaken in reference to the EPA	

Impact No. 12: Waste materials are not disposed in a chemically and physically stable state
guidelines and the Near Surface Disposal of Radioactive Materials Code of Practice. • Approved waste management plans will ensure that both low-level radioactive waste and general waste streams are segregated and disposed of in an appropriate manner. • The RWMP and RMP will be revised to consider the closure processes. • Any closure contractors will be fully supervised to ensure appropriate waste management practices are observed.

Impact No. 13: Increased radiological exposure during the dismantling and closure activities associated with Domain 1	
Risk prior to implementation of controls	Likelihood: Virtually Certain Consequence: Moderate Level of Risk: High
Residual risk after implementation	Likelihood: Virtually Certain Consequence: Minor Level of Risk: Medium
Primary Control Measures: • The RWMP and RMP will be revised to consider closure processes, exposure pathways, monitoring and management requirements. • Occupational radiation monitoring will be undertaken throughout the closure process to ensure the ALARA (as low as reasonably achievable) principal is observed with regard to dose rates.	

Impact No. 14: Removal of radioactive contaminated materials off site	
Risk prior to implementation of controls	Likelihood: Likely Consequence: Severe Level of Risk: High
Residual risk after implementation	Likelihood: Unlikely Consequence: Minor Level of Risk: Low
Primary Control Measures: • The RWMP and RMP to be revised to provide the necessary controls during closure. • Closure contractors will be fully supervised to ensure appropriate waste management practices are observed.	

Impact No. 15: Cross contamination of mining and disposal fluids in Upper and Basal Members of the Eyre Formation aquifer post closure	
Risk prior to implementation of controls	Likelihood: Possible Consequence: Negligible Level of Risk: Low
Residual risk after implementation	Likelihood: Unlikely Consequence: Negligible Level of Risk: Low
Primary Control Measures: • All well decommissioning activities will be undertaken in line with industry standards. • Groundwater monitoring will be undertaken to assess efficiency of well decommissioning and to ensure cross contamination of mining solution and or disposal fluids from the mined	

Impact No. 15: Cross contamination of mining and disposal fluids in Upper and Basal Members of the Eyre Formation aquifer post closure
Basal Member aquifer into the Upper (un-mined) aquifers has not occurred. • Contingency funding will be made available for additional monitoring and or modelling costs, and increased closure timeframe.

Impact No. 16: Failure of monitored natural attenuation such that the beneficial use of the Eyre Formation aquifer beyond the attenuation zone is constrained by contaminants elevated through mining.	
Risk prior to implementation of controls	Likelihood: Unlikely Consequence: Minor Level of Risk: Low
Residual risk after implementation	Likelihood: Unlikely Consequence: Minor Level of Risk: Low
Primary Control Measures: • Revision of natural attenuation models. • Investigation and risk assessment of the greater than expected mobility of contaminants including BUA over an extended area. • Investigation and implementation of active remediation methods if required to ameliorate impacts.	

Impact No. 17: Surface water bodies are compromised from the run-off of contaminated soils within the mine site.	
Risk prior to implementation of controls	Likelihood: Possible Consequence: Minor Level of Risk: Medium
Residual risk after implementation	Likelihood: Unlikely Consequence: Minor Level of Risk: Low
Primary Control Measures: • Perimeter bunding around infrastructure areas. • Clean-up of contaminated areas on closure.	

Impact No. 18: Technical difficulties caused by adverse geological conditions, mechanical or processing failures	
Risk prior to implementation of controls	Likelihood: Unlikely Consequence: Moderate Level of Risk: Low
Residual risk after implementation	Likelihood: Virtually Impossible Consequence: Moderate Level of Risk: Low
Primary Control Measures: • Contingency funding will be made available if technical difficulties caused the mine to be put on care and maintenance or closed.	

Impact No. 18: Rehabilitation failure due to poor implementation or management	
Risk prior to implementation of controls	Likelihood: Possible Consequence: Moderate Level of Risk: Medium
Residual risk after implementation	Likelihood: Unlikely Consequence: Minor Level of Risk: Low
Primary Control Measures: • Contingency funding will be made available if rehabilitation is un-successful or if additional management resources are required to oversee the process. • Progressive rehabilitation that will commence with the start of the mines operational phase will ensure that rehabilitation methods are effective.	

Impact No. 19: The external visual amenity of the site is acceptable to relevant stakeholders	
Risk prior to implementation of controls	Likelihood: Possible Consequence: Minor Level of Risk: Medium
Residual risk after implementation	Likelihood: Unlikely Consequence: Minor Level of Risk: Low
Primary Control Measures: • Consultation with stakeholders during final closure planning. • Removal of all surface infrastructure during closure works. • Reforming landscapes to resemble the surrounding environment.	

Impact No. 20: Pastoral use cannot be re-established in the mine site due to failure of rehabilitation/closure measures.	
Risk prior to implementation of controls	Likelihood: Possible Consequence: Severe Level of Risk: Medium
Residual risk after implementation	Likelihood: Unlikely Consequence: Severe Level of Risk: Medium
Primary Control Measures: • Fencing around the mine to be retained for an initial vegetation establishment period. • Progressive rehabilitation will assist in determining time frames for sustainable revegetation works. • Contingency funding will be made available if rehabilitation is unsuccessful and additional time and resources are required to re-establish pastoral activities within the mine site.	

Impact No. 21: Political/policy changes or social/community pressures	
Risk prior to implementation of controls	Likelihood: Possible Consequence: Severe Level of Risk: Medium
Residual risk after implementation	Likelihood: Possible Consequence: Moderate

Impact No. 21: Political/policy changes or social/community pressures	
	Level of Risk: Medium
Primary Control Measures: • Reduction of risks and liabilities through compliance with: • The Honeymoon mine Program for Environmental Protection and Remediation under the Mining Act 1971 • The Honeymoon mine Operational Radiation Management Plan and Radioactive Waste Management Plan and Licence conditions under the Environment Protection Act 1993 and the Radiation Protection and Control Act 1982. • All other relevant State and Federal Legislation. • Closure planning and implementation initiatives, success and adaptive management measures will be conveyed to the community via the Uranium One website or a similar communications forum.	

Impact No. 22: Reduced population levels, employment opportunities and spending in the local communities	
Risk prior to implementation of controls	Likelihood: Likely Consequence: Moderate Level of Risk: Medium
Residual risk after implementation	Likelihood: Likely Consequence: Minor Level of Risk: Medium
Primary Control Measures: • Closure works carried out where possible by local operators. • Ongoing monitoring and assessment to use local and regional specialists.	

Impact No. 23: Increased human health (i.e., safety) risks	
Risk prior to implementation of controls	Likelihood: Possible Consequence: Moderate Level of Risk: Medium
Residual risk after implementation	Likelihood: Unlikely Consequence: Moderate Level of Risk: Low
Primary Control Measures: • Avoidance of risks and liabilities through full compliance with the PEPR, RWMP and RMP. • Occupational and environmental radiation monitoring during closure. • Assessment and compliance reporting to regulatory agencies to ensure human health risks are considered and compliant with legislative requirements. • Regular community consultation to inform the public on closure methods.	

Impact No. 24: Premature mine closure through economic pressures (commodity prices, higher extraction costs, receivership/voluntary administration)	
Risk prior to implementation of controls	Likelihood: Possible Consequence: Severe Level of Risk: Medium
Residual risk after implementation	Likelihood: Possible Consequence: Minor

Impact No. 24: Premature mine closure through economic pressures (commodity prices, higher extraction costs, receivership/voluntary administration)	
	Level of Risk: Medium
Primary Control Measures: • Continual reduction in liabilities by optimising operational works with progressive rehabilitation activities during the active mine life (in alignment with closure plan). • The mine owner and operator, Uranium One, is a large and financially secure international company. • A closure security bond has been provided to the State Government (DSD) to ensure that in the unlikely event of premature mine closure, all remedial responsibilities will be met by Uranium One. • The security bond is reviewed and revised every two years to account for increased closure costs and or a reduction in closure liabilities.	

Impact No. 25: Potential burden on the South Australian Government should Uranium One not be able to provide post-closure monitoring and maintenance costs	
Risk prior to implementation of controls	Likelihood: Possible Consequence: Disastrous Level of Risk: High
Residual risk after implementation	Likelihood: Virtually Impossible Consequence: Disastrous Level of Risk: Medium
Primary Control Measures: • Regular review of bond in line with mine development and changes and the consumer price index (CPI). • Continual reduction in liabilities by optimising operational works with progressive rehabilitation activities during the active mine life (in alignment with closure plan). • The mine owner and operator, Uranium One, is a large and financially secure international company. • A closure security bond has been provided to the State Government (DSD) to ensure that in the unlikely event of premature mine closure, all remedial responsibilities will be met by Uranium One. • The security bond is reviewed and revised every two years to account for increased closure costs and or a reduction in closure liabilities.	

Table 8.2 Impacts and controls

8.7 Closure Outcomes, Measurement Criteria and Closure Strategies

The specific outcomes, measurement criteria and closure strategies represent ML and MPL Conditions, and Uranium One Australia's commitment to closure of the Honeymoon mine.

The outcomes, measurement criteria and closure strategies identified in Table 8.3, and include integral measures such as progressive rehabilitation. Progressive rehabilitation measures will limit rehabilitation bond increases, the scope and cost of final closure requirements. Importantly, the closure strategies will result in successful impact reduction outcomes well before formal sign off.

8.7.1 Social and Economic

- Active community consultation regarding the mine closure concept, progression and timing will be carried out.
- Infrastructure will be retained for pastoral use if desired by the landowner and/or adjacent pastoral properties. Infrastructure may include the airstrip, water treatment plants, sheds

or other non-contaminated static or portable buildings. Approval from DSD will be sought for the retention of any mine infrastructure.

- Utilisation of local business and skills wherever possible and economical to assist with closure works.

8.7.2 Environmental

- Progressive rehabilitation carried out on all non-utilised areas prior to closure.
- Radiological exposures controlled during closure.
- No human or ecological health or safety risks following closure preventing the return to pastoral use.
- Waste disposal facilities returned to safe, stable and regular landforms, considering physical, geotechnical and geochemical perspectives.
- No change in beneficial use of the Eyre Formation Upper and Basal Member aquifer units.
- Re-establishing the ecological condition and landscape function to that of adjoining pastoral property (as a minimum). Refer to ecosystem function analysis (EFA) in Section 3.14 for a description of the assessment procedure that will be utilised to demonstrate successful revegetation of the Honeymoon mine site.
- Visual amenity comparable to surrounding pastoral properties.

Outcome Measure Criteria	Summary of Closure Strategies (Control Measures)
Outcome No. 1: Useful infrastructure retained for pastoral use	
• Stakeholder engagement records show consultation and engagement prior to the final closure plan will include the potential ongoing use of selected mine infrastructure for pastoral use and the formal agreement from DSD.	• Community consultation will be rolled out three years prior to the intended closure of the Honeymoon mine to identify potential infrastructure that could be retained for pastoral use. • Formal consultation and signoff by DSD in the event that select infrastructure has been requested for retention by local pastoral pursuits.
Outcome No. 2: Progressive rehabilitation undertaken on all non-utilised mine areas prior to closure	
• Annual Mining and Rehabilitation Compliance Reporting to evaluate the target of 50% rehabilitation of all areas no longer utilised per annum. • Ecosystem Function Analysis (EFA) will be used to demonstrate landscape function is trending towards sustainable levels.	• Aerial photography and geographic information systems (GIS) will be employed to map out and identify all areas no longer required for mining activities, and track progress of progressive rehabilitation targets. • Re-vegetation trials to determine the most effective method of re-establishing native vegetation species in disturbed areas. • Progressive rehabilitation undertaken and closure of tracks no longer required. • Compacted areas will be ripped as part of progressive rehabilitation activities. • EFA will be used to quantify the progress and success of completed rehabilitation and re-vegetation trials.

Outcome No. 3: Risks to the health and safety of the public and fauna are as low as reasonably achievable	
• Independent safety audit will be undertaken in each domain. • All waste facilities and ponds closed according to EPA standards, and undergo a geotechnical assessment. • All chemical and hydrocarbon remnants will be remediated to EPA contaminated site standards or local norms. • All radiation clean-up standards achieved and agreed by the EPA. • All potential fauna traps are backfilled, well heads grouted, capped and backfilled. • Rehabilitation of waste facilities will be undertaken in accordance with the Environment Protection Act 1993 and the Environment Protection and Radiation Control Act 1982 and associated Regulations. • Geotechnical assessment of backfilled ponds, and waste disposal facilities at closure demonstrates stability is acceptable.	• Contaminated materials/soils will be removed and disposed of within the on-site waste disposal facilities or through a licensed agent. • All chemically treated soils will be neutralized where possible or disposed of according to EPA guidelines. • Radiological contamination will be remediated and/or removed and disposed of within on-site waste disposal facilities. • All chemicals, processing reagents and hydrocarbons removed by an EPA licensed agent or returned to the supplier will be documented and recorded through an authorized waste manifest. • Audits will show all access tracks are rehabilitated and drill holes are capped in accordance with national guidelines. • All ponds will be drained, outer HDPE liners folded inwards and sealed, then outer embankments used to cap and reinstate the natural surface. • The RMP/RWMP will be updated and amended for closure. • The industrial and domestic (non-radioactive) landfill facility will be rehabilitated according to EPA guidelines. • All low-level radioactive waste facilities will be capped with between 2 to 5 m of clay and marked with concrete tombstones to identify the areas as radioactive waste disposal facilities. • The non-radioactive waste disposal facility will be closed in accordance with the South Australian EPA Guidelines for Environmental Management of Landfill Facilities. • The low-level radioactive waste disposal facility will be closed and capped with clay in accordance with the RWMP and with reference to the Near Surface Disposal of Radioactive Waste Australia Code of Practice (ARPANSA, 1992). • An integrity assessment of the low-level radioactive waste disposal areas will be conducted in accordance with the RWMP. • All wells are to be decommissioned in accordance with appropriate industry standards.

Outcome No. 4: No compromise to the environmental values of the Eyre Formation aquifer outside the mining lease boundary.	
• Outside the attenuation zone, 2 km outside the mining lease boundary, contaminants will not exceed stock water guideline values (Table 8.5) as a result of mining, with the exception of parameters which already naturally exceed stock water guidelines i.e. salinity and sulphate	• Monitored Natural Attenuation (MNA) will be employed to ensure that contaminants associated with mining are removed, or reduced in concentration to below stock water limits within 2 km down gradient (north) of the ML boundary (the attenuation zone as shown in Figure 8.5) • Within this zone, Beneficial Use Assessment (BUA) has confirmed that the natural groundwater does not meet stock water guidelines, and the movement of mining fluids can cause no further constraint on beneficial use. • Validated natural attenuation models, described in Section 6 and detailed in Attachment O, will be used to provide the data to assess against this outcome measurement criteria.

concentrations. • The attenuation zone is defined as an area 2 km down-gradient (north) of the ML where the detailed Beneficial Use Assessment (LWC, 2012) has confirmed that the water is naturally unsuitable for stock use.	• Environmental fate monitoring described in Section 6 and detailed in Attachment R will provide timely data for annual validation of natural attenuation modelling. • Annual model validation and calibration will be undertaken and assessed in accordance with published standards (ASTM D5981 – 96 (2008) Standard Guide for Calibrating a Groundwater Flow Model Application).
Outcome No. 5: All impacted areas are returned to a stable and resilient state, with evidence that the ecosystem function will ultimately be achieved	
• Representative test sites on rehabilitated areas have achieved or by trends may be confidently predicted to reach and pass sustainability thresholds as defined by EFA.	• Stockpiled soils re-spread and ripped (where required). • Local flora species established across the mine site during progressive and final rehabilitation. • Annual flora surveys following closure to assess rehabilitation measures and provide recommendations for remedial works. • The mine site area will remain fenced post closure to allow seeding and re-vegetation to be established. • Re-vegetation failure will be re-seeded and fertilised where applicable. • Ecosystem function analysis and flora survey will assess rehabilitation progress, as measured by comparison with EFA values (soil stability, infiltration and nutrient cycling) and perennial species composition and abundance of control sites. • Feral animal control to continue throughout the closure process to ensure increased pressures are not placed on rehabilitated areas. • Herbicide application to noxious weed outbreaks, where recommended by flora specialists.
Outcome No. 6: Visual amenity is comparable to surrounding pastoral properties	
• Audit of domain against final closure plan to confirm no infrastructure remains on site.	• All infrastructure and elevated earthen mounds will be removed and areas cleared. • Cleared surfaces are to be re-vegetated with local flora species.

Table 8.3 Outcome, Criteria and Strategy measures

8.8 Pre-Closure Works

8.8.1 Revision of Conceptual Closure Plan

The Honeymoon mine Conceptual Closure Plan will be reviewed every two years. A frequent review will ensure any relevant changes to the operational scope and duration are considered and addressed.

8.8.2 Development of Formal Closure Plan

A formal draft closure plan will be developed three years prior to closure, and will initiate active discussion and consultation with key stakeholders. During the development process, the specific outcomes and measurement criteria outlined in Section 8.7 will be reviewed and

revised to take into consideration the results of trials and investigations, changes in mine planning and feedback from stakeholders on final land uses.

8.8.3 Exploration Remedial Works

Closure of exploration sites on the ML or associated MPLs will be undertaken immediately following the completion of each exploration program. Wells that are to be retained for further use will be completed following the methods described in Section 4.3.1 and further rehabilitated upon mine closure. The following details the proposed closure activities associated with exploration activities:

- On completion, the exploration drilling drill holes will be cemented to within 2 m of the surface to prevent connectivity between aquifers. Any casing or pre-collar will be removed and the hole capped at 0.5 m below the earth's surface prior to final backfilling.
- On final rehabilitation all drill cuttings will be placed in the sump prior to backfilling and the sump will be backfilled and levelled to reinstate the original surface condition, minimise the visual impact of activities and facilitate natural regeneration of the site. This will occur as soon as practicable (once sumps are sufficiently dry) following completion of the program.
- All casing and drilling materials will be removed and any rubbish left at the site will be removed and disposed of at the mines waste handling facilities.
- New tracks to drill sites will be minimal and strict controls are enforced to ensure crews stay on designated tracks via use of the Landscape and Native Vegetation Permit system. Progressive rehabilitation of tracks will be undertaken; once new tracks are no longer needed they will be lightly scarified and reseeded where required.

In most cases the clearing of vegetation from work sites is unnecessary, as the nature of the vegetative cover in the area does not require clearing before work. Rehabilitation works will be undertaken immediately following the completion of the exploration works, and audited by the mine site Safety, Health, Environment and Radiation (SHER) Department for compliance within three months, thereby not impacting on Significant Environmental Benefits (SEB) arrangements detailed in the Native Vegetation Plan (Attachment H).

8.9 Post Closure Works

8.9.1 Domain 1: Closure Activities

- Domain wide radiological and non-radiological survey will be undertaken to assess and identify remnant surface and potential sub-surface contamination.
- Formal radiological assessment and cataloguing of all infrastructures to be removed, and the resale and recycling capabilities of material assessed.
- Non-contaminated and recyclable material reused, sold or removed.
- Decommissioning of remaining wellfields and groundwater monitoring wells.
- Dismantling and disposal of all contaminated materials into mine site waste repositories.
- Capping and re-contouring of process and disposal ponds.
- Removal of internal fences and retention of exterior fences to restrict grazing during rehabilitation.
- Re-contouring earthen bunds and re-spreading stockpiled soils.
- Light ripping (where required) and direct seeding of cleared areas with local flora species.
- Post closure groundwater monitoring to monitor and analyse attenuation and migration trends of remnant ISR mining fluids (i.e., BLS) and liquid disposal fluid plumes, using prescribed monitoring wells.

- Groundwater monitoring and associated modelling undertaken for designated monitoring wells every quarter.
- Pest animal management following closure of the mine to ensure no pest infestations (e.g., rabbits) which could potentially destroy rehabilitated areas.

8.9.2 Domain 2: Closure Activities

- Domain wide radiological and non-radiological contamination surveys will be carried out to ensure no surface contamination.
- Transportable buildings and recyclable materials will be removed from site.
- Concrete paths and gravel tracks will be removed and disposed of within site waste disposal facility.
- Removal of internal fences, and retention of exterior fences to restrict grazing during rehabilitation.
- Where required, light ripping and direct seeding of cleared areas with local flora species.

8.9.3 Domain 3: Closure Activities

- On closure, MPL 15 will be surrendered following necessary surveys to ensure impacts on flora and fauna meet or exceed baseline levels, and ensuring no additional clearance has occurred.
- Partial bond refund on relinquishment of MPL 15.
- Following consultation and agreement with stakeholders, the Electricity Transmission Line on MPL 92 will be dismantled and materials sold or recycled were possible. Any remaining waste materials generated will be disposed of within the onsite waste disposal facility.
- All ground and vegetation disturbance caused during removal of the transmission line will, where required, be lightly ripped and directly seeded with local flora species.

8.10 Post Closure Monitoring and Maintenance

During the closure monitoring period all physical remedial works carried out across the domains will be regularly monitored by a suitably qualified environmental scientist and assessed against ML conditions, outcomes and associated measurement criteria. The closure monitoring program will involve assessing a series of parameters that will provide a measure of the success and/or failure of rehabilitation and remedial works.

The following aspects will be monitored following closure:

- Flora and fauna, abundance, species richness, distribution and pest species.
- Landscape and soil stability.
- Public safety safeguards, including radiological levels.
- Groundwater quality:
  - Dilution and attenuation of mining and disposal solutes concentrations.
  - The extent of hydrocarbons, and associated concentrations in the Basal Member.
  - Accuracy of groundwater modelling predictions.

In the first three years post closures, key monitoring activities will include the following:

- Re-vegetation failure will be addressed with re-seeding where appropriate.
- Areas of surface erosion will be re-contoured, stabilised and re-seeded where appropriate.

- Formal EFA works will be undertaken annually and assessed against baseline and control sites.
- MPL 92 will be relinquished following successful re-vegetation works, and on meeting EFA assessment criteria values.
- Quarterly groundwater monitoring will be carried out in designated monitoring wells to assess attenuation levels within the wellfield and liquid disposal zone against modelled solute levels and predicted time frames.
- An updated attenuation and hydrocarbon model will be developed during closure to assess actual attenuation, and hydrocarbon dispersion within and surrounding the wellfield and liquid disposal zone against initial predictions.
- Formal rehabilitation bond review and partial bond refund.

In the monitoring period, three to seven years post closure, key activities will include:

- Ecological trends will be assessed through EFA to determine if baseline or controls have been met or will be met at the conclusion of the closure period.
- Fauna monitoring will be undertaken every two years to contribute to the EFA information.
- Groundwater monitoring to calibrate and/or revise hydrocarbon, geochemical and solute transport models. Groundwater monitoring will also provide a direct measure of attenuation and hydrocarbon sorption/degeneration.
- All areas within a domain will be signed off on reaching successful completion outcomes and associated measurement criteria.
- Formal government assessment and full or partial bond refund and lease relinquished.
- Returning the mining leases into a productive component of Kalkaroo Pastoral Lease, an acceptable and designated land use for the region.
- As required by the Lease Conditions, Uranium One will provide DSD with a Mine Completion Report prior to lease relinquishment, in accordance with the guidelines approved by the Director of Mines.

8.10.1 Maintenance

The regular monitoring of parameters discussed in Section 8.10.2 will enable maintenance or rectification works to be undertaken without delay, keeping the closure process on the agreed time trajectory.

Maintenance activities are likely to involve repair and management of eroded surface areas or the reseeding of areas due to poor vegetation establishment. More specifically, where monitoring has identified erosion, weed invasion, failure of revegetation or excessive browser damage to regenerating vegetation, maintenance activities will be implemented to ensure regeneration progresses successfully and rapidly.

8.10.2 Groundwater Monitoring, Natural Attenuation Modelling, and Model Validation

Background

Natural attenuation modelling, undertaken to predict the degree of dispersion and attenuation of solutes post closure (associated with the ISR wellfield and liquid waste disposal operations), is detailed in the following reports:

- Numerical Groundwater Flow and Solute Transport Model Reconstruction. Report prepared for Uranium One Australia Pty Ltd by Sinclair Knight Merz Pty Ltd, October 2008 (Attachment K).
- Solute Transport Modelling of Wellfield Operations and Liquid Waste Disposal. Report prepared for Uranium One Australia Pty Ltd by Sinclair Knight Merz Pty Ltd, September 2010 (Attachment I).

- Addendum to Solute Transport Modelling of Wellfield Operations and Liquid Waste Disposal. Report prepared for Uranium One Australia Pty Ltd by Sinclair Knight Merz Pty Ltd, August 2010. (Attachment J).
- Natural Attenuation of Mining Fluids at the Honeymoon Uranium Mine. Report prepared for Uranium One Australia Pty Ltd by Sinclair Knight Merz Pty Ltd, November 2010. (Attachment O).
- Geochemical Study regarding the Entrainment of Organic Diluent in the Leach Solution Stream at Honeymoon mine. Report prepared for Groundwater Science Pty Ltd by UIT (Umweltleistungen) December 2011 (Attachment Q).
- Validation of Organic Fate and Transport Modelling. A report prepared by Groundwater Science and UIT (Umweltleistungen) 2012 (Attachment R).

The Honeymoon mine groundwater monitoring network (as detailed in Section 6.5) has been developed to detect and measure solute concentrations and migration distances during and post mine operations.

Monitoring Regime

The environmental fate monitoring regime will collect groundwater quality data for:

- Assessing the environmental fate of mining fluids in the subsurface, and
- Validating of predictive environmental fate models.

Monitoring would continue for a minimum of 3 years post mine closure.

The monitoring regime provides timely data to meet the regulations under the Mining Act 1971 that require the following: “where attenuation is to be relied upon to demonstrate achievement of groundwater closure outcomes a process must be provided for validation of predictive attenuation modeling” Draft Management Plan for Uranium Recovery Using ISR (Mining Act 1971), 2011).

Environmental fate monitoring is undertaken in 3 Provinces, each of which provides data regarding the environmental fate of mining fluids in the subsurface. Figure 8.4 presents the conceptual setting, whilst the monitoring network for each Province is summarised in Table 8.4. The provinces are described as follows:

Province 1: Wellfield process fluids

Monitoring and comparison of injected BLS and extracted PLS provide immediate information regarding environmental fate of mining fluids following flow through the aquifer. For instance, comparison of PLS and BLS to date in December 2012 shows:

- A reduction in hydrocarbon concentration (Groundwater Science, 2012b),
- A reduction in acidity; and
- pH control of mobility of metals is observed (metals are not mobilised whilst pH remains above 4).
- Acid consumption of the host rock can also be calculated.

Province 2: Near wellfield perimeter monitoring

Monitoring at leading indicator wells in proximity to the active wellfield provides data regarding the fate of mining fluids as it migrates out from the active wellfield at a slower velocity than Province 1.

Province 3: Liquid waste disposal zone

Monitoring of wells in proximity to the liquid disposal well or wells provides data regarding the fate of liquid disposal fluid as it moves through the aquifer. For instance, recent data from well WBLDCM1, located 12m from the liquid disposal well LDW3, exhibits:

- An order of magnitude reduction in total petroleum hydrocarbons (TPH), and
- Significant retardation of acidity and dissolved metal concentration during flow through the subsurface.

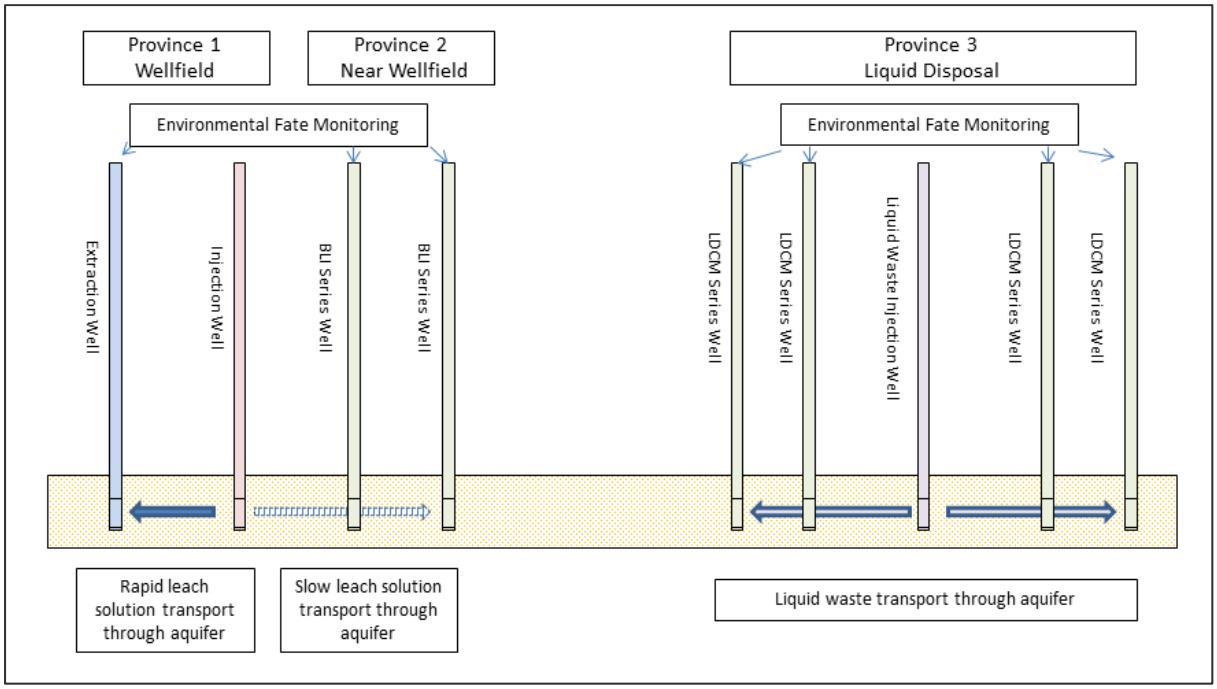

Figure 8.4 Conceptual layout of environmental fate monitoring

Province	Monitoring Points	
	Contaminant Source Characterisation	**Environmental Fate Characterisation**
Wellfield Process Fluids	Injected BLS (BLS trunkline)	Extracted PLS (wellfield extraction manifolds)
Near Wellfield Perimeter	Injected BLS (BLS trunkline)	Wellfield leading indicator wells (BLI series wells)
Liquid Waste Disposal Zone	Injected liquid disposal fluid (sampling point on liquid disposal pond pump)	Liquid disposal zone compliance monitoring wells (LDCM series wells)

Table 8.4 Environmental fate monitoring network

Groundwater Natural Attenuation Modelling

Natural attenuation models are described in Section 6.5. The models predictions provide leading indicators and outcome measurement criteria for mine closure outcomes.

Outcome measurement criteria for mine closure outcomes comprise outputs of predictive natural attenuation models validated against environmental fate monitoring data. Validation of natural attenuation models is a critical step in demonstrating compliance with outcomes.

Model validation and assessment against outcomes will be undertaken and reported annually. Validation will be undertaken and assessed in accordance with published standards (ASTM D5981 – 96 (2008) Standard Guide for Calibrating a Groundwater Flow Model Application).

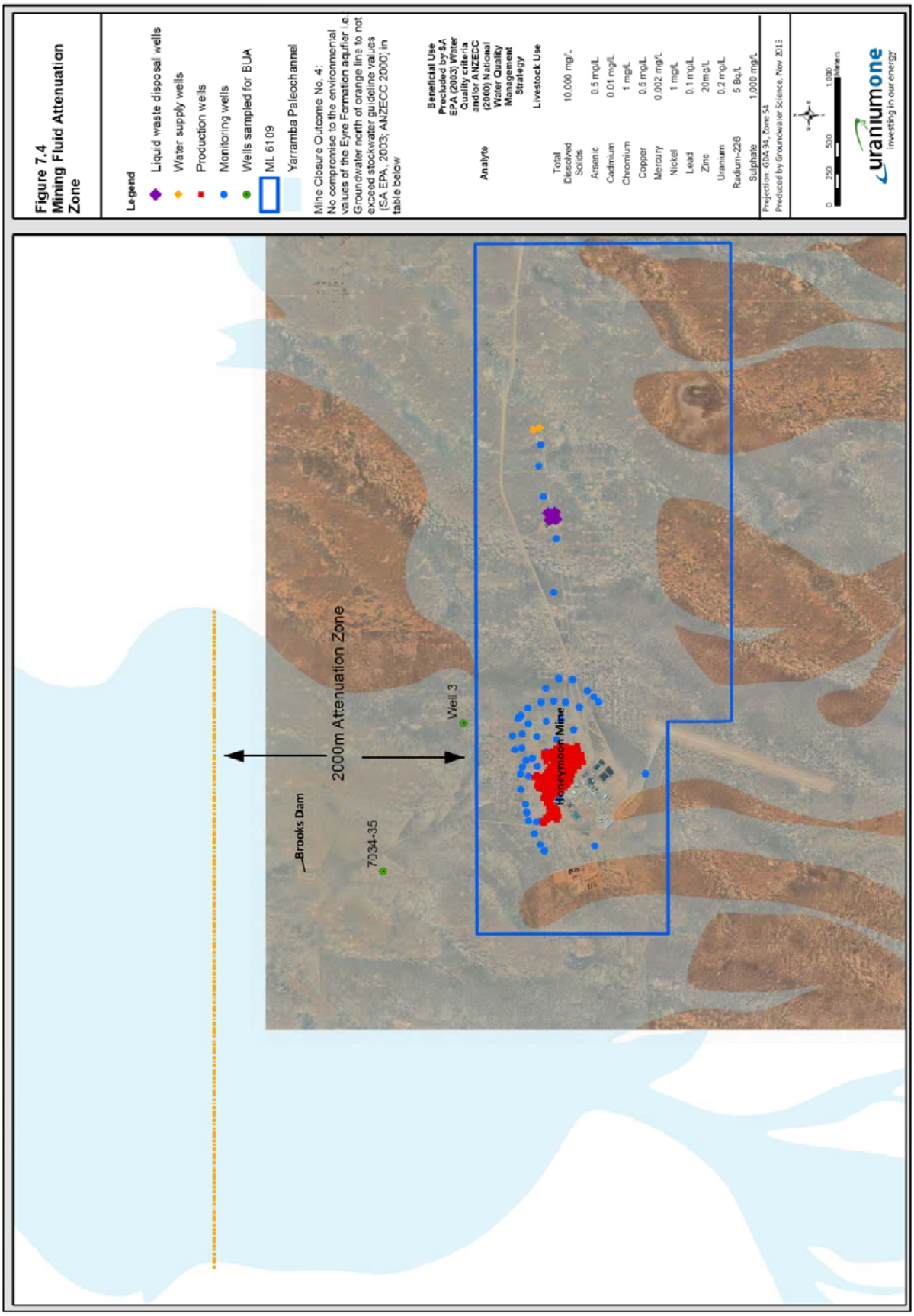

Figure 8.5 Mining Fluid Attenuation Zone

Mine closure outcomes will be demonstrated when outside the attenuation zone, contaminants will not exceed stock water guideline values as a result of mining, with the exception of parameters which already naturally exceed stock water guidelines i.e. salinity and sulphate concentrations. The attenuation zone is defined as an area 2 km down-gradient (north) of the mine lease where the detailed BUA (LWC, 2012) has confirmed that the water is naturally unsuitable for stock use. Contaminant concentration limits and baseline values determined through the BUA are presented in Table 8.5.

Analyte	Baseline groundwater concentration range measured during BUA (mg/L)	Beneficial Use Precluded by SA EPA (2003) Water Quality criteria and/or ANZECC (2000) National Water Quality Management Strategy - Livestock Use
Total Dissolved Solids	11,000 to 13,000	10,000
Arsenic	<0.001 to 0.002	0.5
Cadmium	<0.0002 to 0.0005	0.01
Chromium	<0.001	1
Copper	0.003 to 0.006	0.5
Mercury	<0.001	0.002
Nickel	<0.0001	1
Lead	0.008 to 0.017	0.1
Zinc	0.02 to 0.063	20
Uranium	0.003 to 0.028	0.2
Radium-226	0.137 to 0.995 mSv/yr	-
	0.67 to 4.87 Bq/L	5 Bq/L -
Sulphate	1860 to 2130	1,000

Notes: < denotes below the laboratory limit of reporting. Units are in mg/L unless stated otherwise. Highlighted cells indicate values where baseline groundwater already exceeds water quality criteria for livestock use.

Table 8.5 Baseline groundwater chemical concentrations in the attenuation zone down-gradient of the Honeymoon mine.

Groundwater Natural Attenuation Model Validation

In order to validate the propensity of the aquifer to 'self-clean' via monitored natural attenuation, the data collected both in the operational and post closure phases of the Mine needs to be assessed with respect to predicted model outputs to iteratively validate the predicted fate and transport of the mining and liquid disposal solutions.

The data collected across the provinces thus needs to be assessed against predicted outputs from:

- The metals/inorganic model predictions
- The organics model predictions

Should the collected analytical data vary from the predicted values (i.e. concentrations or distance from source) during either the operational or post closure phase, then the models will need to be recalibrated to match the observed data. Predictive simulation will need to be re-run using the updated model and compared against closure criteria. The approach is presented in Figure 8.6.

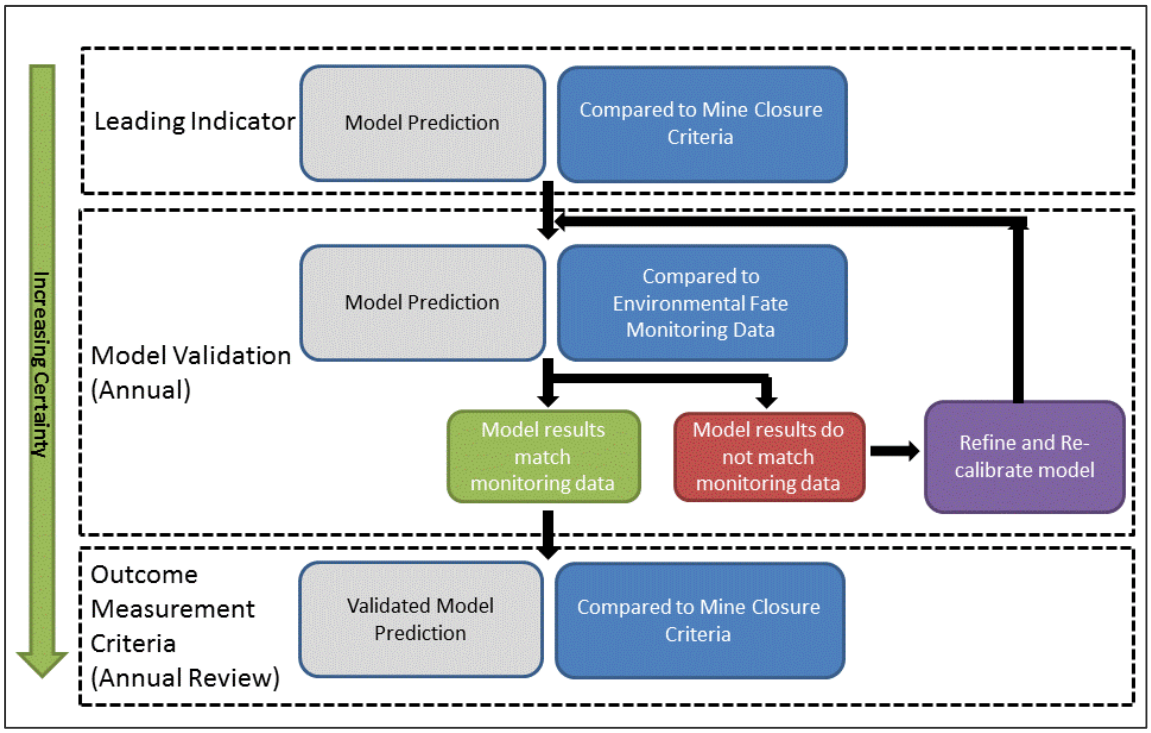

Figure 8.6 Overview of validation methodologies for natural attenuation predictive models

Effective achievement of the mine closure outcome will be defined as:

Natural attenuation models, validated against monitoring data to relevant published industry standards (e.g. ASTM D5981 – 96 (2008) Standard Guide for Calibrating a Groundwater. Flow Model Application), demonstrate that outside an attenuation zone, contaminants will not exceed stock water guideline values as a result of mining with the exception of parameters which already naturally exceed stock water guidelines, i.e. salinity and sulphate concentrations.

Stock water guideline concentrations are presented in Table 8.5

Groundwater monitoring and model validation will continue for a minimum of three years after mine closure.

8.11 Mine Closure Schedule

A conceptual mine closure schedule is presented in Table 8.6. This schedule is based on the rehabilitation of the ML and the ancillary infrastructure contained within the MPLs, and assumes no extension to the currently identified resources.

Domain	Closure Year No.						
	1	2	3	4	5	6	7
Domain 1: Process Infrastructure							
Wellfields							
Processing Plant							
Waste Facilities							
Pest Management							
Domain 2: Associated Infrastructure							
Camp Facilities							
Laundry and Ablutions							
Septic and STP's							

Domain	Closure Year No.						
	1	2	3	4	5	6	7
Domain 1: Process Infrastructure							
Domain 3: Miscellaneous Purpose Licence							
MPL 92: Removal of the ETL							
MPL 15: Airstrip							

Table 8.6 Mine Closure Schedule

8.12 Licence & Lease Relinquishment

Table 8.6 identifies the mine closure schedule and the proposed timeframe for the relinquishment of specific domains or domain components. The relinquishment of any area would require the agreed completion criteria to be met to the satisfaction of DSD.

Once relinquishment has been agreed, concrete markers and GPS coordinates will be installed, and details provided to DSD and the SA EPA Radiation Protection Branch to ensure adequate records of the site are preserved for future land use planning.

8.13 Mine Closure Costs

8.13.1 Closure Cost Calculations

Mine closure costs as of 31 December 2013 are provided in Table 8.7.

Closure cost calculations were initially calculated on the NSW Department of Primary Industries Rehabilitation V1.7 ESB26: DPI-MR Cost Calculation Tool with DSD-supplied unit costs (adjusted for CPI). The closure cost calculations have however been revised to more accurately account for increased costs associated with decommissioning radiological materials and structures, as well as known and researched costs for the construction and closure of waste facilities that will be used for the disposal of the majority of the mine site infrastructure.

The cost estimate is based on the assumption that all decommissioning and rehabilitation works are undertaken by a third party.

Item	2013 - Revised Bond
Domain 1	$5,071,690
Domain 2	$1,011,500
Domain 3	$878,000
Domain 1-3 Subtotal	**$3,095,741**
Contingency	$775,000
Ongoing Monitoring	$487,000
Third Party Project Management	$1,000,000
Contingency Management and Monitoring subtotal	**$2,262,000**
Updated Bond Total	**$4,023,515**
Total Security (excluding GST)	**$9,223,190**

Table 8.7 Cost estimates (AUD) for closure

8.13.2 Financial Provisions

Closure costings will be updated every two years and submitted to DSD for independent review based on the revised conceptual closure plan. This will ensure that ongoing and actual costs to close and rehabilitate the site are reflected in the bond held by DSD.

9 Management System and Capabilities

Uranium One Inc. is an established mining company and one of the largest focused uranium companies in the world. Uranium One has management systems necessary to develop and operate major mining ventures.

Experience internationally has shown that an integrated approach to management systems development is the most effective, and Uranium One Australia Pty Ltd (Uranium One) will use an Integrated Management System (IMS) as a management framework for all operational components of the Honeymoon mine. The Safety, Health, Environment and Radiation Management System (SHER MS) is one component of the IMS.

9.1 Safety, Health, Environment and Radiation Management System

The SHER MS is a system that considers all safety, health, environment and radiation aspects of Uranium One operations, as well as contractors and other third parties operating at the Honeymoon site.

The SHER MS represents a formalisation of policy, system documents, statutory operating procedures and standard work practices to ensure the mitigation of risks during commissioning and operations. Specific procedures, system documents, standard operating procedures, work instructions and job safety and environment analysis have been compiled so that all the tasks associated with SHER operational activities are conducted safely and efficiently and with minimal impact on the environment.

The Uranium One SHER MS structure is represented diagrammatically as shown in Figure 9.1.

Figure 9.1 SHER MS Structure

The purpose of the SHER MS is to:

1. Provide an operational management framework to ensure the requirements of the relevant safety, health, environmental and radiation legislation are met.
2. Ensure procedures and work instructions are developed and implemented in line with Uranium One SHER strategy.
3. Provide a method of tracking safety, health, environmental and radiological protection behaviours, and performance and risk profiles.
4. Promote application and consistency of SHER programs across Uranium One's Honeymoon operation.
5. Provide an auditable trail of Uranium One's SHER procedures and work instructions, defining the activities undertaken at Uranium One's Honeymoon site.
6. Promote application and consistency of SHER programs across the Honeymoon operations.

7. Be consistent with International and Australian Standards, National and International codes of practice, guidelines and policies for safety, radiation environmental and risk management.
8. Provide a means to check and develop corrective actions.
9. Provide a basis for management review and planning.
10. Promote leading practice.

The Uranium One SHER MS is divided into specific disciplines, with each discipline outlining the objectives and expected outcomes in SHER related activities undertaken by Uranium One. The following disciplines are covered by Uranium One's SHER MS:
Safety

- Occupational Health & Hygiene
- Safety
- Physical Environmental
- Community and Native Title
- Occupational & Environmental Radiation

An internal overarching Safety, Health, Environment and Radiation Management System with associated management plans and online database have been drafted to outline all standard operating procedures, work instructions and initiatives to meet these expected outcomes. As part of the continuous improvement process these expected outcomes are used as the audit protocol to check compliance and assist in developing targeted improvement opportunities.

The environmental management of the Honeymoon site will be in accordance with the Uranium One SHER MS, which is modelled on the requirements of the Australian Standard for environmental management systems, AS/NZS ISO 14001. Key elements of the SHER MS are:

- Commitment
- Policies
- Risk evaluation
- Planning
- Implementation
- Audit and review

The interaction of these elements is shown in Figure 9.2 and discussed in the following sections.

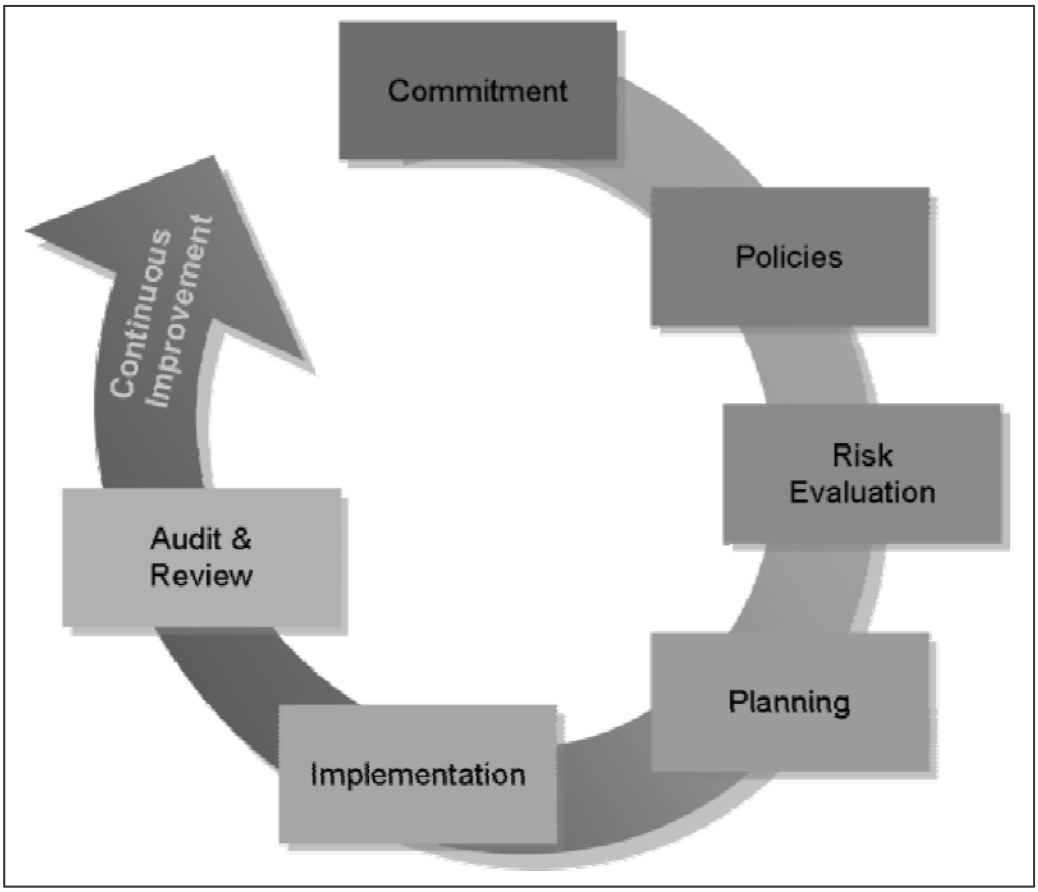

Figure 9.2 SHER MS Elements

9.1.1 Document Management System

As part of the Uranium One IMS, a Document Management System (DMS) has been developed and implemented across every Uranium One department and area. The DMS is a framework used for developing, maintaining and distributing effective organisational documentation that is controlled at every stage of the document lifecycle.

The DMS is integrated with the SHER MS to provide an operational management framework where procedures and work instructions are developed and implemented in line with Uranium One's SHER guidelines.

As the DMS is founded upon continuous improvement it supports the key elements of the SHER MS. These elements are shown diagrammatically in Figure 9.2 and discussed in the following sections.

9.2 Commitment and Leadership

Uranium One is committed to achieving best practice outcomes through:

- High operating standards in all aspects of its activities to minimise environmental impact and prevent environmental harm.
- Communication and consultation with all stakeholders.
- Employee awareness of sound environmental practice as part of day-to-day activities.
- Continuous improvement through measurement of environmental performance.
- Regular audits and review of systems and procedures.
- Compliance with applicable legislation.

This commitment is demonstrated through the company' corporate governance principles and appointment of a suitably qualified well-resourced SHER department.

Compliance with SHER requirements will be emphasised in the company's training and induction program, and regulated through inspection, auditing and reporting.

9.3 SHER Objective

Management of Uranium One's Honeymoon operation is governed by the performance objectives, associated management modules and regulatory documents; Program for Environmental Protection and Rehabilitation (PEPR), Radioactive Waste Management Plan (RWMP) and Radiation Management Plan (RMP). Both the policy and management plans provide objectives for sustainable development and sound environmental stewardship.

Uranium One will comply with all applicable environmental laws, regulations, approvals and industry codes of practice as set out in Section 6 of this PEPR. Uranium One will also educate their employees and contracts about SHER matters and associated responsibilities to ensure employees and contractors have the appropriate degree of awareness, environmental skills and training.

Uranium One's Honeymoon operation has adopted the SHER Policy by developing site-specific procedures and documentation that will support the implementation of the environmental policy. These will include the following:

- Safety, health, environment and radiation commitments, procedures, objectives and targets.
- Environmental management plans.
- Standard operating procedures (SOPs).
- Internal audit and work place inspections.

The Uranium One management team is committed to the implementation of the SHER Policy and developing processes and documentation that reflect the safety, health, environment, radiation, social and regulatory setting specific to the Honeymoon mine.

9.4 Organisation, Resources and Documentation

The Honeymoon mine is owned and operated by Uranium One.

The Mine Manager will be responsible for ensuring that all operational activities are conducted in full compliance with statutory regulations and are consistent with Uranium One's SHER Policy, management systems and plans. In addition, all Uranium One and contractor personnel will be responsible for SHER performance of their activities and compliance with relevant environmental management procedures. Figure 9.3 shows the organisation structure for the Honeymoon mine.

9.5 Key Roles and Responsibilities

The Mine Manager will ensure that sufficient resources are allocated to implement and maintain the environmental procedure during operations at Honeymoon mine.

The responsibilities of the SHER Manager are to:

1. Ensure that the safety, health, radiation and environment and community relations aspects of Uranium One's SHER systems and management plans are implemented, and are revised and maintained as required (all managers responsible).
2. Implement the environmental management plans (SHER Manager to oversee with other managers having responsibilities within this for their areas of operations.
3. Implement induction procedures and appropriate training (SHER Manager to oversee this process all managers to ensure it occurs).

4. Ensure environmental, radiation and safety compliance with licence and lease conditions, management systems and company policy.
5. Continue to develop the conceptual closure plan (with support from the Maintenance, Processing, Geology/Wellfield Managers where appropriate).
6. Undertake internal site environmental and safety audits.
7. Provide advice on Safety, Health, Environmental and Radiological matters to other personnel (all managers).
8. Liaise with stakeholders.

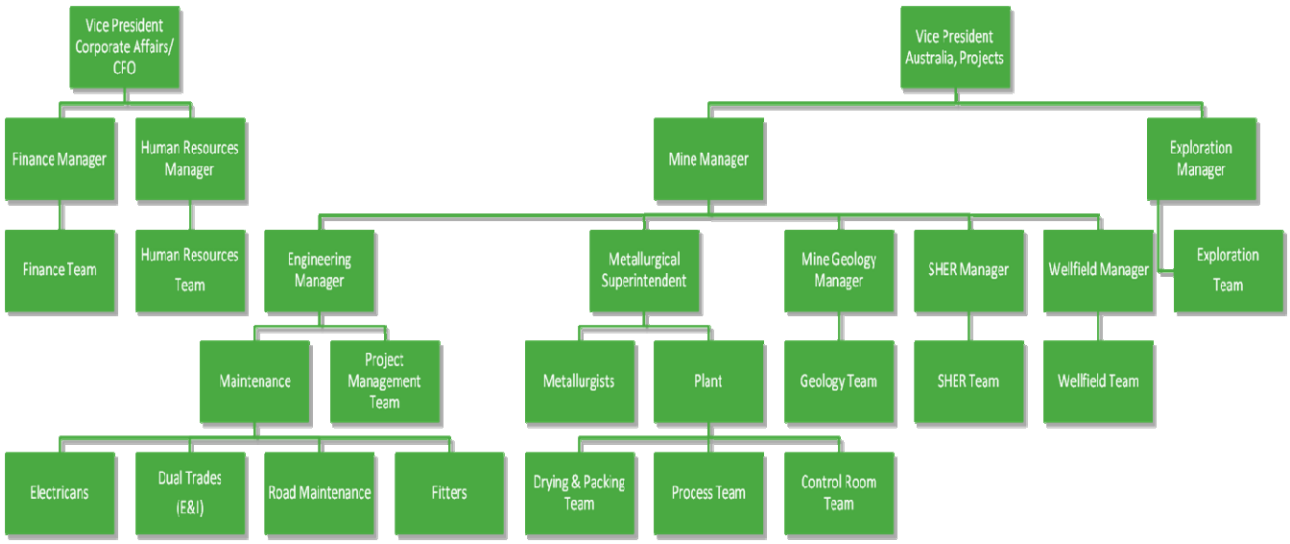

Figure 9.3 U1A's Organisational Structure

9.5.1 Communication

The Mine Manager (or delegate) will ensure that the operational risk register is updated as required, and the actions, policies and procedures to manage risks and communicate these to all employees, contractors and visitors. Communication will be achieved by various means including inductions, training and the OHS&W Committee.

9.5.2 Inductions

Following appointment, each employee and contractor will undergo a formal site induction to ensure they have the appropriate knowledge concerning, health, safety, environment, radiation and community relations procedure. The induction will address areas including, but not limited to:

- Background to operational approvals.
- Legislation obligations of both individual and company.
- Uranium One SHER overview.
- Traffic management plan.
- Key environmental issues on site.
- Key radiation issues on site.
- Outline of environmental management plan and obligations.
- Structure of the environment, radiation and community relations sections.
- Site environmental management policies and procedures.
- Site safety and occupational health policies, procedures and employee obligations.
- Emergency services and procedures.
- Site security.
- Cultural heritage.
- Employment policies and conditions of employment.

9.5.3 Training

In addition to general inductions, specific training will be provided in each work area based on relevant radiological, safety and environmental risks and management requirements.

Specific environmental training will be provided to personnel involved in:

1. Risks posed to the environment through operational activities, and specific control measures (i.e., procedures) that have exist or will be set out to ensure risks are avoided, mitigated or managed.
2. Specific regulatory requirements (i.e., Mining Lease Conditions) and responsibilities of all personnel to comply.
3. Job Safety and Environmental Analysis.
4. Storing and handling hazardous materials.
5. Appropriate intervention measures for environmental incidents e.g., fuel spills.
6. Incident reporting.

Occupational Health, Safety and Welfare Committee

Uranium One has an OHS&W committee on the mine site and in the Adelaide head office. The site committee is formed from representatives from across the site and assist with internal communications and encouraging fellow workers to adopt safe work practices, following environmental requirements and identify when activities may cause community concern. The committee will also assist with the reporting of environmental policy requirements through the preparation of formal minutes following each meeting.

Ongoing Community Consultation

Uranium One's community consultation program is ongoing and will continue through the life of operations to ensure due consideration of all operation-related opportunities and concerns. Details about the program are provided in Sections 5, 6 , 7 and 8 of this document.

9.6 Planning

9.6.1 Environmental Monitoring and Management Plan

The risk-based environmental monitoring management plan (EMMP) presented in Section 6 will assist in managing credible impacts resulting from mine commissioning and operation, and documents Uranium One Australia's management commitments, Mining Lease conditions and approved control measures.

The EMMP is supported by a number of standalone documents, these include:

- Groundwater Monitoring and Management Plan (GMMP).
- Native Vegetation Management Plan (NVMP).
- Stakeholder Engagement Plan.
- Waste Management

Other procedural documents have been prepared to cover:

- Air quality
- Traffic
- Rehabilitation & revegetation

The Uranium One SHER Manager is responsible for implementing the EMMP.

9.6.2 Emergency Response

Uranium One has an Emergency Response Plan that establishes specific actions to manage significant events such as medical emergencies, fires, car accidents and major spills of chemicals or radioactive liquids or solids.

All incidents, both major and minor, will be recorded in the incident register that forms part of the SHER management system documentation.

Uranium One has an emergency response team (ERT)[21] that is trained to respond to emergencies, lead evacuations and administer first aid. They are also trained to manage large spills of process water and chemicals used on site.

During routine operations, medical support in the event of an emergency is provided by a minimum of three occupational first aiders (OFA's) on duty 24 hours a day. These OFA's will be provided with a system of ongoing medical training and emergency support from a remote area specialist doctor.

A fully-equipped first aid room is provided on the mine site and first aid boxes are kept throughout the site and in all Uranium One vehicles.

A fire engine is also located on site to provide fire protection. High risk areas of the process plant have advanced automated fire systems installed, and other areas of the plant include fire hydrants. Portable fire extinguishers are fitted on all buildings and strategic areas on site. Smoke detectors are located in all transportable buildings, control rooms and switch rooms.

9.7 Implementation, Recording and Monitoring

9.7.1 Management and Recording

The primary method for implementing the requirements of the PEPR will be through the implementation of the EMMP (as described in previous sections).

Uranium One has a preferred software management solution to assist with implementing the EMP and thereby managing the environmental risks associated with the operations of Honeymoon mine. This system will house the following documents and records:

- Approved Program for Environmental Protection and Rehabilitation (PEPR).
- Environmental Management Plan.
- Environmental monitoring reports.
- Audit reports.
- Incident register.
- Complaints register.
- Risk register.

Incidents will be recorded and reported in line with internal Uranium One requirements, Occupational Health, Safety and Welfare Act 1986, The Dangerous Substances Act 1979, Environment Protection Act 1993 and the Criteria and Procedures for Recording and Reporting Incidents at SA Uranium Mines (Bachman Criteria, 2003).

The electronic management system will also assist in Uranium One demonstrating compliance with AS 4801 Occupational Health and Safety Management System, AS/NZS 4360 Risk Management.

9.7.2 Monitoring

Section 6 describes the monitoring program for the operation which has three main components; compliance monitoring, leading indicator monitoring and operational monitoring. Detailed procedures for monitoring form part of the EMMP.

[21] During operational phases

9.7.3 Inspections

Uranium One will conduct regular inspections of operational activities to ensure that environmental management requirements have been undertaken. The frequency of inspection will depend on the potential risks associated with the activity and will be undertaken by and/or with guidance from the SHER department.

9.8 Audit, Review & Reporting

9.8.1 Audits/Management Review

Internal audits on SHER systems are conducted by Uranium One Inc on an annual basis. Audits are undertaken to ensure the environmental management system is correctly implemented and management plans are effective in managing the potential environmental impacts of operations.

Any environmental procedures found to be deficient as a result of an audit or investigation or reportable environmental incident will be revised and the EMMP updated to reflect any amendments to existing procedures or new procedures required.

9.8.2 Reporting

Periodic

The SHER Department are required by Uranium One Corporate to submit monthly reports on SHER leading and lagging indicators, ongoing review and improvements and compliance with regulatory requirements. The internal monthly reporting includes:

- Details of contractor and employee safety (e.g., injuries, near miss, loss time injuries and occupational fatalities).
- Details of occupational health.
- Summary and details of environmental incidents, which are further classified into categories of seriousness ranging between one and five (one being the least serious and five being the most serious). These categories include reporting on:
  - Contaminant spillage.
  - Compliance breaches or issues.
  - Reputational or public concerns.
- Description of radiation incidents, reportable and non reportable.
- List of the Environmental, Radiation, Safety, Health and Community tasks that have been achieved in the previous reporting month.
- List of planned Environmental, Radiation, Safety, Health and Community tasks for the new reporting month.

Non-Compliance

If non-compliance with the Mining Lease conditions and/or measurement criteria occurs, Uranium One will verbally notify the Director of Mines within 24 hours after it has first become aware of the non-compliance. A written report will then be provided within three days of such time period as approved by the Director of Mines.

9.8.3 Document Management

Document reviews are carried out every year during operations as part of the Document Management System (DMS), allowing corrections to be implemented and updates made in a structure formed for such functions. The review is a formal inspection or evaluation of the documents by a team of reviewers who are identified as subject matter experts.

9.9 Lease Conditions

Uranium One will implement and/or comply with the lease conditions specified in Table 9.1 Lease conditions. Uranium One will also ensure that their risk-based environmental management plans are maintained and updated regularly.

Lease Conditions		PEPR Section
Mining Lease 6109		
First Schedule		
1.	Mining operations authorised by this lease must only be for the recovery of Uranium associated with the mining operation known as Honeymoon Uranium Mine as outlined in the : a. Southern Cross Resources Pty Ltd, Honeymoon Uranium Project, Environmental Impact Statement, Main Report of May 2000; and b. Southern Cross Resources Pty Ltd, Honeymoon Uranium Project, Environmental Impact, Response Document Supplement, of November 2000.	Section 1 details relevant legislation
2.	In accordance with Regulation 86(1)(a) the Lessee must provide a Compliance report every year, within 2 months after the anniversary of the date the Lease was granted, or at some other time agreed with the Minister.	N/A
3.	The Lessee agrees to the approved PEPR (section 70B (5)) and the Compliance report (regulation 86) and any reportable incident reports (regulation 87) being made available for public inspection.	N/A
4.	In accordance with Regulation 90 (1) the Lessee must, prior to commencing operations under this Lease and for the duration of the lease maintain public liability insurance to cover all operations under the Lease in the name of the Lessee for a sum not less than $50 million or such greater sum as specified by the Minister, and make such amendments to the terms and conditions of the insurance as the Minister may required.	N/A
5.	In requesting a review of the bond required under the Mining Act 1971, the Minister may request that written quotes from an independent third party approved by the Minister are obtained by the Lessee for the cost of rehabilitating the site the requirements specified in the approved Program under Regulation 65(2).	N/A
6.	The Lessee must meet all the charges and costs in obtaining and maintaining the Bond.	N/A
7.	The lessee is authorised under section 10A (1) of the Mining Act 1971 to conduct mining operations to recover radioactive minerals.	N/A
8	The lessee is authorised by the Ministers under section 10A (4) of the Mining Act 1971 to dispose and sell radioactive minerals.	N/A
Second Schedule		
1.	For the purposes of preparation of the Program for Environment Protection and Rehabilitation under section 70B(2) and associated Regulations of the Mining Act 1971, the following environmental and mine rehabilitation outcomes must be included:	
1A	**Aboriginal and European heritage** The Lessee must, in constructing and operating the Lease,	Section 6.7

Lease Conditions		PEPR Section
	ensure that there is no disturbance to Aboriginal or European sites, objects or remains unless prior approval under the relevant legislation is obtained.	
1B	**Native vegetation** The Lessee must, in constructing and operating the Lease ensure no loss of abundance or diversity of native vegetation on or off the Lease through: • Clearance, • Dust/contamination deposition, • Fire, or • Other damage Unless prior approval under the relevant legislation is obtained.	Section 6.3 & 7.2
1C	**Groundwater and surface water** The Lessee must, in constructing and operating the lease ensure that there is no compromise to the environment values of the Eyre Formation aquifer outside of the Mining Lease. (*Environment Values will be defined according to: The environment values recognised in 'ANZECC & ARMCANZ 2000. Australian and New Zealand guidelines for fresh and marine water quality. National Water Quality Management Strategy Paper Nov 4, Australian and New Zealand Environment and Conservation Council & Agriculture and Resource Management Council of Australia and New Zealand, Canberra'*)	Sections 6.5, 7.2 & 8.9.2
1D	**Waste disposal and hazardous substances** The Lessee must, in constructing and operating the Lease ensure that no contamination and/or pollution of natural water drainage systems, streams and rivers, groundwater, land and soils occurs either on or off site is caused by waste products and hazardous materials used in the mine operations. The Lessee must, in constructing and operating the lease ensure that there are no adverse impacts to the environment due to radon release, uranium-bearing materials, or radiological aspects of seepages and spills.	Section 4.12
1E	**Weeds and pests (feral animals)** The Lessee must, in constructing and operating the Lease ensure no introduction of new species of weeds, plant pathogens or pests (including feral animals), nor sustained increase in abundance of existing weed or pest species in the Lease area compared to adjoining land. (*Weeds are defined in this condition as any invasive plant that threatens native vegetation n the local area or any species recognised as invasive in South Australia.)*	Section 6.3, 6.4 & 7.2
1F	**Public Safety** The Lessee must, in constructing and operating the Lease, ensure that unauthorised entry to the site does not result in public injuries and or deaths that could have been reasonably prevented.	Section 6.8, 7.2 & 8.6
1G	**Stormwater** The Lessee must, in constructing and operating the Lease ensure no water contaminated as a result of mining operations leaves the Lease area or results in loss of or contamination of soil on or off the Lease/Licence.	Sections 3.11, 4.7 & 6.9
1H	**Flooding/runoff**	Sections 3.11, 4.7,

Lease Conditions		PEPR Section
	The Lessee must, in constructing and operating the Lease ensure no water runoff from the Lease results in flooding of adjacent areas, to an extent greater than that that could be reasonable be expected to occur prior to mining operations being established on the Lease.	4.14 & 6.9
1I	**Soil** The Lessee must, in constructing and operating the Lease, ensure that the existing soil quality and quantity is maintained.	Section 6.2 & 7.2
1J	**Mine rehabilitation** The Lessee must demonstrate that the following outcomes (in so far as they may be affected by mining operations) are expected to be achieved indefinitely post mine closure to the satisfaction of the Director of Mines: a. No compromise to the environmental values of the Eyre Formation aquifer. b. The external visual amenity of the site is acceptable to relevant stakeholders. c. Risks to the health and safety of the public, native fauna and livestock are as low as reasonably achievable. d. Ecosystem and landscape function is resilient, self-sustaining and indicating that the pre-mining ecosystem and landscape function will ultimately be achieved. e. The site is physically stable. f. All waste materials left on site are chemically and physically stable.	Section 7
2.	**Waste Process Water** The Lessee shall ensure that waste process water, is held in appropriately constructed surface solids retention pond, or settling dam and may dispose of the liquor by re-injection via a disposal well or array of wells, or as they become available, into mined out areas of the Basal Sands ore zone aquifer, by an approved method to an approved location, to the satisfaction of the Minister.	
3.	**Waste disposal and hazardous substances** The Lessee must, in constructing and operating the Lease ensure that all commercial or industrial waste is disposed of in accordance with relevant legislation.	Section 4.12
4.	The Program for environment protection and rehabilitation prepared under section 70B(2) must: a. Outline the methodology to determine the location and number of injection and production boreholes and the monitoring boreholes used to detect excursions of leachate: b. establish corrective action plans to be implemented to arrest and reverse any lateral or vertical excursion of leachate from the controlled mining zone; c. describe techniques to be implemented for the progressive rehabilitation of land and bore fields and methodology to quantify the progressive extent of impact and completed rehabilitation.	Sections 4.5, 4.6, 4.8.2, 6.5.6 & 7.2
5.	**Borehole closure** The lessee shall ensure that upon closeout of mining and rehabilitation, boreholes to detect long-term fluid migration and water quality are monitored for an appropriate term to demonstrate achievement of the mine rehabilitation outcomes.	Sections 4.9, 6.5 & 8
6.	**Operational Controls** The Lessee shall implement best practice automation of	Sections 4.5, 4.6, 4.7,

Lease Conditions		PEPR Section
	operational controls for the monitoring and control of wellfield and processing operations. This will include *inter alia*: a. Continuous and automatic monitoring of pressures (including inter alia the hydrostatic pressures in injection wells), flow rates and any other parameters required for the prompt detection nod resolution of abnormal operating condition in the wellfield, processing plant and pipes connecting them; b. Continuous and automatic monitoring of process plant functions, including tank levels, flow rates, pressures and fluid quantities; c. The integration of data through a central computer-based monitoring system.	4.8
7.	**Adequate monitoring** The lessee shall ensure that an adequate number of perimeter monitoring boreholes be installed at sufficient distance from the pattern to be unaffected by operational flare but close enough to detect excursions which can be controlled during routine operations.	Section 4.9.1, 6.5.6, 6.5.9.
8.	The lessee shall ensure that overlying and any underlying aquifer monitoring boreholes, fitted with piezometers, are installed at adequate distance from the mineralised zone to ensure baseline water quality is sufficiently characterised and shall be used to monitor for mining fluid excursions.	Section 4.9.1, 6.5.6, 6.5.9
9.	**Trunklines** The lessee shall, where practicable lay trunk lines for the circulation of mining solutions on the surface of the ground, rather than bury the pipes, to avoid unnecessary ground disturbance, vegetation clearance and rehabilitation.	Section 4.6
10.	**Refuelling** Fuel storage to be bunded in accordance with Environment Protection Authority requirements.	Section 4
11.	**Other legislation** The above environmental outcomes do not derogate from the operation of any other Acts that may be applicable to this operation including (but not limited to): a. Aboriginal Heritage Act 1988 b. Environment Protection Act 1993	
Conditions of Miscellaneous Purposes Licence 15		
First Schedule		
1.	The Miscellaneous Purposes Licence (MPL) is for the purpose of construction and operation of an airstrip and services ancillary to the mining operation known as the Honeymoon Uranium Mine authorised under the mining tenement ML 6109.	
2.	In accordance with Regulation 86(1)(a) the licensee must provide a Compliance report every year, within 2 months after the anniversary of the date of the Licence was granted, or at some other time agreed with the Minister.	
3.	The lessee agrees to the approved PEPR (section 70B (5)) and the Compliance report (Regulation 86) and any reportable incident reports (Regulation 87) being made available for public inspection.	
4.	In accordance with Regulation 90(1) the Lessee must, prior to commencing operations under this Licence and for the	

Lease Conditions		PEPR Section
	duration of the lease maintain public liability insurance to cover all operations under the Licence (including sudden and accidental pollution) in the name of the Licensee for a sum not less than $20 million or such greater sum as specified by the Minister, and make such amendments to the terms and conditions of the insurance as the Minister may required.	
5.	In requesting a review of the bond required under the Mining Act 1971 the Minster may request that written quotes from and independent third party approved by the Minister are obtained by the Licensee for the cost of rehabilitating the site to the requirements specified in the approved Program under Regulation 65(2)	
6.	The lessee must meet all the charges and costs in obtaining and maintaining the Bond.	N/A

Lease Conditions		PEPR Section
Second Schedule		
1.	For the purposes of preparation of the Program for Environment Protection and Rehabilitation under section 70B(2) and associated Regulations of the Mining Act 1971, the following environmental and mine rehabilitation outcomes must be included: **Aboriginal and European heritage** The licensee must, in constructing and operating the Lease, ensure that there is no disturbance to Aboriginal or European sites, objects or remains unless prior approval under the relevant legislation is obtained. **Native vegetation** The licensee must, in constructing and operating the Lease ensure no loss of abundance or diversity of native vegetation on or off the Lease through: • Clearance, • Dust/contamination deposition, • Fire, or • Other damage Unless prior approval under the relevant legislation is obtained. **Weeds and pests (feral animals)** The licensee must, in constructing and operating the Lease ensure no introduction of new species of weeds, plant pathogens or pests (including feral animals), nor sustained increase in abundance of existing weed or pest species in the Lease area compared to adjoining land. (*Weeds are defined in this condition as any invasive plant that threatens native vegetation n the local area or any species recognised as invasive in South Australia.)* **Soil** The Licensee must, in constructing and operating the Lease ensure that the existing soil quality and quantity is maintained. **Mine rehabilitation** The licensee must demonstrate that the following outcomes (in so far as they may be affected by mining operations) are expected to be achieved indefinitely post mine closure to the satisfaction of the Director of Mines: a. The external visual amenity of the site is acceptable to relevant stakeholders. b. Ecosystem and landscape function is resilient, self-sustaining and indicating that the pre-mining ecosystem and landscape function will ultimately be achieved. c. The site is physically stable. d. No waste materials left on site.	Section 6.7 & 7.2 Section 6.3 & 7.2 Section 6.3, 6.4 & 7.2 Section 6.2 & 7.2 Section 8.6
Conditions of Miscellaneous Purposes' Licence 92		
First Schedule		
1.	The Miscellaneous Purposes Licence (MPL) is granted for the purpose of the construction and operation of a power line specifically for the conduct of mining operations in association with the mining operation known as Honeymoon Uranium Mine authorised under mining tenement(s) ML6109.	Section 1
2.	In accordance with Regulation 86(1)(a) the licensee must provide a Compliance report every year, within 2 months after the anniversary of the date of the Licence was granted, or at some other time agreed with the Minister.	

Lease Conditions		PEPR Section
3.	The lessee agrees to the approved PEPR (section 70B (5)) and the Compliance report (Regulation 86) and any reportable incident reports (Regulation 87) being made available for public inspection.	Section 6.7.6
4.	In accordance with Regulation 90(1) the Lessee must, prior to commencing operations under this Licence and for the duration of the lease maintain public liability insurance to cover all operations under the Licence (including sudden and accidental pollution) in the name of the Licensee for a sum not less than $20 million or such greater sum as specified by the Minister, and make such amendments to the terms and conditions of the insurance as the Minister may required.	
5.	In requesting a review of the bond required under the Mining Act 1971 the Minster may request that written quotes from and independent third party approved by the Minister are obtained by the Licensee for the cost of rehabilitating the site to the requirements specified in the approved Program under Regulation 65(2)	
6.	The lessee must meet all the charges and costs in obtaining and maintaining the Bond.	
Second Schedule		
1.	For the purposes of preparation of the Program for Environment Protection and Rehabilitation under section 70B(2) and associated Regulations of the Mining Act 1971, the following environmental and mine rehabilitation outcomes must be included: **Weeds and pests (feral animals)** The licensee must, in constructing and operating the Lease ensure no introduction of new species of weeds, plant pathogens or pests (including feral animals), nor sustained increase in abundance of existing weed or pest species in the Lease area compared to adjoining land. (*Weeds are defined in this condition as any invasive plant that threatens native vegetation n the local area or any species recognised as invasive in South Australia.)* **Native vegetation** The licensee must, in constructing and operating the Lease ensure no loss of abundance or diversity of native vegetation on or off the Lease through: • Clearance, • Dust/contamination deposition, • Fire, or • Other damage Unless prior approval under the relevant legislation is obtained. **Aboriginal and European heritage** The licensee must, in constructing and operating the Lease, ensure that there is no disturbance to Aboriginal or European sites, objects or remains unless prior approval under the relevant legislation is obtained. **Mine rehabilitation** The licensee must demonstrate that the following outcomes (in so far as they may be affected by mining operations) are expected to be achieved indefinitely post mine closure to the satisfaction of the Director of Mines: a. The external visual amenity of the site is acceptable to	Sections 6.3, 6.4 & 7.2 Section 6.3 & 7.2 Section 6.7 & 7.2 Section 8

Lease Conditions		PEPR Section
	relevant stakeholders. b. Risks to the health and safety of the public, native fauna and livestock are as low as reasonably achievable. c. Ecosystem and landscape function is resilient, self-sustaining and indicating that the pre-mining ecosystem and landscape function will ultimately be achieved. d. The site is physically stable. e. No waste materials left on site.	
2.	**Landholder Liaison** The licensee must ensure that the occupier of the land is fully advised of their program of activities, particularly in regard to the impact of operations on the land and rehabilitation progress.	Section 5 & 7.2
3.	**Other legislation** The above environmental outcomes do not derogate from the operation of any other Acts that may be applicable to this operation including (but not limited to): Aboriginal Heritage Act 1988 Environment Protection Act 1993	
Commonwealth of Australia Customs (Prohibited Exports) Regulations 1958 Permission to Export Natural Uranium.		
Conditions or Requirements		
1.	The natural uranium that may be exported by the Grantee under this permission shall be recovered from the Honeymoon Uranium Project.	N/A
2.	Natural uranium exported under this permission may only be shipped to an authorised recipient in a recipient country. This does not restrict the places where transhipment may occur.	N/A
3.	A shipment of natural uranium may only be exported under this permission by the Grantee if the Grantee is the holder of a permit to possess nuclear material under the Nuclear Non-Proliferation (Safeguards) Act 1987 in relation to the uranium comprising such shipment.	N/A
4.	A shipment of natural uranium may only be exported under this permission after the Grantee has been notified by the Australian Safeguards and Non-Proliferation Office (ASNO) that nuclear safeguards and security requirements in respect of the shipment have been satisfied and that there are no safeguards or security objections to the shipment. Shipment must take place in accordance with the arrangements to which ASNO's notification relates, including arrangements for transhipment.	N/A
5.	The Grantee may export natural uranium under this permission only where: the purpose of the export, at the time of the export, is to enable the Grantee to deliver natural uranium to an authorised recipient or authorised recipients, pursuant to a contract to which the Grantee is a party; the Grantee forwards to the Minister a copy of each new such contract or any variation is made to a previously forwarded such contract from time to time within 30 days of the execution of such contract or varied contract, and in all cases before any deliveries are made in a recipient country under such contract or varied contract; the contract referred to in paragraph (a) identifies the	N/A

Lease Conditions		PEPR Section
	authorised recipient referred to in clause 2 and contains a clause stating that uranium exported from Australia pursuant to the contract and nuclear material derived from it are subject to any inter-governmental agreement or agreements concerning nuclear safeguards to which Australia is a party and which is or are applicable also to the relevant recipient country and any other country or countries of destination of such uranium and nuclear material derived from it; and that the exportation of the said uranium from Australia is conditional on such agreement or agreements being in force and is subject to the provisions of such agreement or agreements.	
6.1	In order that the Minister may be satisfied that the Grantee has complied with clause 5, the Grantee is required to submit to the Minister a statement for the 6 months ending on 30 June and 31 December each year that contains the following information in respect of U3O8 contained in uranium ore concentrates recovered from the Honeymoon Uranium Project and exported, in relation to each authorised recipient to whom it is shipped: opening inventory; the total quantity exported under this permission; sales deliveries made during the statement period, including the name of the party to whom the uranium has been delivered and the amount of such delivery; adjustments to the inventory due to weighing, sampling and analysis in a recipient country; and closing inventory.	N/A
6.2	The amounts of U3O8 in the statement to be given in accordance with subclause (6.1) are to be expressed as tonnes and decimals thereof.	N/A
6.3	The statement to be given in accordance with subclause (6.1) is be submitted to the Minister no later than 3 months after the end of the respective 6 month period.	N/A
7.	The Grantee must comply with the following requirements: The Grantee is to annually estimate the cost of decommissioning the mine and rehabilitating the project area for assessment by South Australian regulatory authorities. The estimate is to include such reasonable contingency amount so as to cover the costs of repairing any unforseen environmental damage caused by the implementation of the project. The Grantee is to provide security, in a form acceptable to the relevant South Australian regulatory authority, to cover the costs of rehabilitation or environmental repair in the event that the Grantee is unable to carry out the required rehabilitation or environmental repair. The annual estimate of the cost of decommissioning the mine and rehabilitation will be subject to the relevant South Australian regulatory authority consulting with the Commonwealth on rehabilitation and environmental repair requirements and the appropriate level of security required. The Grantee is to monitor groundwater pressures, quality and the location and movement of the liquids disposal plume. The Grantee is to provide details of the monitoring results at least annually to the proposed uranium mining environmental consultative committee.	Section 8.11

Lease Conditions		PEPR Section
	In relation to the Honeymoon Uranium Project, the Grantee should participate in a proposed uranium mining environmental consultative committee to be established by the South Australian Government in cooperation with the Commonwealth Government and provide information as agreed that would be necessary to support the functions of that committee. The Committee will review the ongoing environmental performance of the mine and provide relevant information to stakeholders including the public. The range of monitoring options, in addition to those proposed to date should be kept under review and evaluated as part of the Environmental Management and Monitoring Plan (EMMP) process. The EMMP should include contingency measures and response plans and include periodic (at least annual) enhanced model simulations showing observed and predicted groundwater conditions in the proposed mining area, using up-to-date data from the mining and waste disposal operations.	

Table 9.1 Lease conditions

Acronyms

AHD	Australian height datum
Amine	Tri-octyl tertiary amine
ANZECC	Australian & New Zealand Environment and Conservation Council
ASNO	Australian safeguards and non-proliferation office
BLI	Basal leading indicator
BLS	Barren leach solution
DEHPA	Di-ethyl-hexyl phosphoric acid
DMS	Document management system
DSD	Department for State Development
EC	Electrical conductivity
ECL	Excursion control limit
EIS	Environmental impact statement
EFA	Ecosystem function analysis
Eh	Reduction-oxidation potential
EL	Exploration licence
EMMP	Environmental management and monitoring plan
EPA	Environment Protection Authority
GAB	Great Artesian Basin
GMMP	Groundwater monitoring and management plan
GRTP	Groundwater raffinate treatment plant
HAZOP	Hazard and operability study
HDPE	High density polyethylene
IMS	Integrated management system
ISO	Intermodal container built to ISO standard
ISR	In-situ recovery
IVCM	Inner vertical compliance monitoring

JORC	Joint ore reserves committee
LDP	Liquid disposal pond
LDW	Liquid disposal well
LFA	Landscape function analysis
LSA	Low specific activity
LWD	Liquid waste disposal
MARP	Mining and rehabilitation program
MCC	Motor control cabinet
ML	Mining lease
MPL	Miscellaneous purposes licence
NVMP	Native vegetation management plan
OBCM	Outer basal compliance monitoring
ORCM	Outer rock compliance monitoring
OVCM	Outer vertical compliance monitoring
PAH	Polycyclic aromatic hydrocarbons
PEPR	Program for environmental protection and rehabilitation
PIRSA	Primary Industries and Resources SA
PLS	Pregnant leach solution
PPE	Personal protective equipment
PVC	Polyvinylchloride
RCM	Regional compliance monitoring
RMP	Radiation management plan
RO	Reverse osmosis
RPC	Radiation protection committee
RWMP	Radioactive waste management plan
SA	South Australia
SEB	Significant environmental benefit
SWL	Standing water levels

SX	Solvent extraction
TALR	Target action leakage rate
TBP	Tri-butyl phosphate
TDS	Total dissolved solids
TMP	Transport management plan
TRH	Total recoverable hydrocarbons
UOC	Uranium oxide concentrate
Uranium One	Uranium One Australia Pty Ltd
UV	Ultraviolet
WONS	Weed of national significance

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10 List of Attachments

A. Beneficial use assessment of the Yarramba Paleochannel

Report prepared for Uranium One Australia Pty Ltd by Land and Water Consulting. December 2012.

B. Assessment of hydrocarbons in groundwater

Report prepared for Uranium One Australia Pty Ltd by Land and Water Consulting. December 2012.

C. Honeymoon Uranium Mine Regional Groundwater Model.

Report prepared for Uranium One Australia Pty Ltd by Groundwater Science Pty Ltd, October 2012.

D. Groundwater Management and Monitoring Plan

Report prepared for Uranium One Australia Pty Ltd by Groundwater Science Pty Ltd, December 2012.

E. Baseline Flora and Fauna Survey.

Document Prepared by Uranium One. 2010.

F. Weed and Pest Survey.

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G. Baseline Landscape Function Analysis - Honeymoon Uranium Project.

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H. Native Vegetation Management Plan - Honeymoon Mine Site.

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I. Solute Transport Modelling of Wellfield Operations and Liquid Waste Disposal.

Report prepared for Uranium One Australia Pty Ltd by Sinclair Knight Merz Pty Ltd. 2010.

J. Addendum to Solute Transport Modelling of Wellfield Operations and Liquid Disposal.

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K. Numerical Groundwater Flow and Solute Transport Model Reconstruction

Report prepared for Uranium One Australia Pty Ltd by Sinclair Knight Merz Pty Ltd. October 2008.

L. Honeymoon Uranium Deposit Groundwater Flow Model.

Memorandum prepared for Uranium One Australia Pty Ltd by Sinclair Knight Merz Pty Ltd. December 2010.

M. Full Scale Gypsum Repository Construction and Operational Management Plan.

Document prepared by Uranium One 2013.

N. Non-radioactive Waste Management Plan and Construction Procedure – Honeymoon Mine Site.

Document prepared for Uranium One Australia Pty Ltd by AEC Environmental Pty Ltd. 2011.

O. Natural Attenuation of Mining Fluids at Honeymoon Uranium Mine.

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P. Recommendation for the Development of an ISR Wellfield Monitoring Network in the Honeymoon Region of the Yarramba Paleochannel. Honeymoon ISR.

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Q. Geochemical Study Regarding the Entrainment of Organic Diluent in the Leach Solution Stream at Honeymoon Mine.

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R. Validation of Organic Fate and Transport Modelling

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S. Honeymoon Uranium Mine Regional Groundwater Model.

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T. Groundwater Monitoring Data Collected from the Honeymoon ISR Wellfield Monitoring Wells

Data collected and presented by Uranium One 2010.

U. Groundwater Management and Monitoring Plan – Addendum for Care and Maintenance

Document prepared for Uranium One Australia Pty Ltd by Groundwater Science Pty Ltd February 2014.