Government of **Western Australia**
Office of the **Appeals Convenor**
Environmental Protection Act 1986

Appeals Convenor's Report to the Minister for Environment

Appeal against conditions of Works Approval W6678/2022/1 Mulga Rocks Uranium Mine, Stage 1 Works, Shire of Menzies

Appellant	Conservation Council of Western Australia (Inc)
Instrument holder	Narnoo Mining Pty Ltd
Authority	Department of Water and Environmental Regulation (DWER)
Appeal No.	042 of 2022
Date	April 2023

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Acknowledgement of Country

The Office of the Appeals Convenor acknowledges the traditional custodians throughout Western Australia and their continuing connection to the land, waters and community.

We pay our respects to all members of the Aboriginal communities and their cultures, and to Elders past, present and emerging.

Contents

1 Executive summary

1.1 Decision under appeal

Narnoo Mining Pty Ltd (now owned by Deep Yellow Limited) holds Works Approval W6678/2022/1 authorising the construction of wastewater treatment plants and a putrescible landfill at Mulga Rock Uranium site on Mining Tenement M39/1104, approximately 240 km east-northeast of Kalgoorlie–Boulder in the Shire of Menzies. Figure 1 below shows the location of the premises.

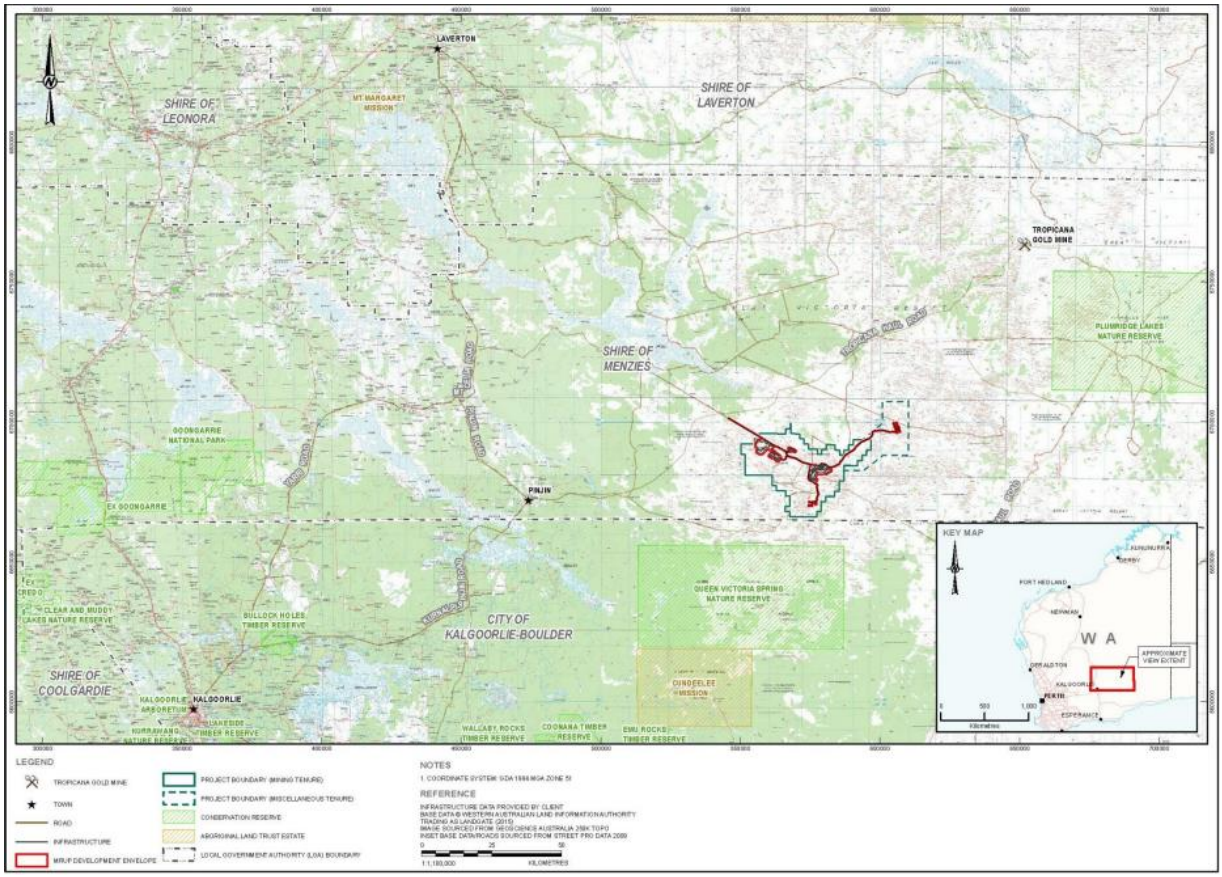

Figure 1 Location of Mulga Rock Uranium project, EPA Report 1576

The Department of Water and Environmental Regulation (DWER) granted the works approval in December 2022, which represents stage 1 of the uranium mining project, and is limited to the construction of the following prescribed premises:

- Sewage facilities (Category 54) comprised of two wastewater treatment plants (WWTPs) with a total production capacity of 400 m^3 per day (200 m^3/day at each)
- Class II putrescible landfill site (Category 89), with a total design capacity of 650 tonnes per annum.

The works approval holder may also conduct time limited operations for the infrastructure:

- for a period not exceeding 180 calendar days; or
- until such time as a licence for that item of infrastructure is granted in accordance with Part V of the *Environmental Protection Act 1986* (EP Act), if one is granted before the end of the period specified.

1.2 Grounds of appeal and appellant concerns

On 20 December 2022, the Conservation Council of WA (the appellant) submitted an appeal against the conditions of the works approval concerned about the risk of radioactivity in the wastewater discharged from two proposed WWTPs. The appellant submitted that the works approval should include a requirement to monitor for radiation at the WWTP as radiological particles may be transported on workers' clothes from the mine site once mining of ore commences.

1.3 Key issues and conclusions

We have identified two questions at the heart of the appeal which have shaped our investigation. We summarise our conclusions for these questions below. Section 2 of this report details the reasoning for our recommendation and discusses issues outside the scope of the appeal but nonetheless relevant for the Minster's consideration. Section 3 provides supporting information, including the scope of the EP Act in respect to the appeal grounds.

What is the risk of radiological emissions from activities authorised by the works approval?

Based on the available information, we accept DWER's advice that the risk of radiation from emissions to the broader environment during the construction works and time limited operations authorised by this works approval is low. DWER's decision was on the basis that the works are limited to stage 1 supporting infrastructure including a landfill and two wastewater treatment plants only. At this stage, mining of uranium ore will not commence, and therefore ore will not be exposed. While not considered in DWER's decision report, we also understand that radionuclides can be naturally present in the surrounding environment, including the groundwater which will be used in mining operations and the accommodation village, and this should be considered in determining the total level of risk of radioactivity. In this regard, we note that the background level of radioactivity at the premises is low.

Are the conditions of the works approval adequate?

Based on the level of risk determined above, we consider that at this time further monitoring and controls are not warranted and that the conditions of the works approval are adequate. We note DWER's advice that at later stages of the project, the radiation risk profile may change, and agree that any assessment of future Part V applications, including works approvals to construct other mining infrastructure, should address relevant controls and processes for the safe disposal of wastewater with elevated radionuclide concentrations.

While we accept that at this stage, further regulatory controls are not warranted, we note the works approval holder's advice that given a wastewater monitoring program will be established under the works approval anyway, it is practical to add monitoring of radionuclides as additional parameters. The works approval holder advised that it intends to undertake ongoing monitoring of radiation in stage 1, to ensure any potential pathways for radiation exposure are detected.

1.4 Recommendation to the Minister

We recommend that the appeal be dismissed.

2 Reasons for recommendation

2.1 What is the risk of radiological emissions from activities authorised by the works approval?

Based on the available information, we agree with DWER that the risk of radiation during the construction and time limited operations authorised by this works approval is low. We consider however that further stages of the project, including the ongoing operation of the facilities constructed in this stage, will potentially present a radiation risk to the environment.

Stage 1 does not involve uranium mining

Stage 1 of the Mulga Rock Uranium Project, described in Section 1, involves the construction and time limited operations (environmental commissioning) of two WWTPs and a landfill site. We understand that the appellant's concerns are related to the WWTPs rather than the landfill.

The purpose of the WWTPs is to remove contaminants from untreated sewerage and industrial wastewater to allow safe disposal via two irrigation spray fields. The works approval holder has advised that wastewater is also likely to be recycled and reused on site.

The WWTPs are proposed for two separate sites: the accommodation village and the mine operational support site. The future use and location of the two WWTPs is as follows:

- Accommodation village (Figure 2): This is where workers will live. The WWTP will disinfect and treat effluent from the workers accommodation. The village and WWTP will be isolated from the mining operations, and protocols set out in management plans will ensure no radioactive material to be brought in (see section 2.3).
- Mining operations / support (Figure 3): The WWTP will treat the effluent from the change rooms, ablutions, and other services within the mining support facilities.

Aspects of the project proposed to be built in successive stages are in section 3.1 of this report. Importantly, at the construction (and time limited operations) phase of stage 1 (authorised by this works approval), mining of ore will not have commenced.

In its consideration of the works approval application, DWER undertook an assessment of potential risks related to the construction and time limited operations related to stage 1.

DWER did not assess the level of risk of radiation, as it did not consider radioactive contamination as a potential risk at this stage. While DWER has required the monitoring and discharge limits for several parameters in the wastewater (see below), it did not require monitoring/ discharge limits for radiation. This is explained by DWER's response to submissions:

> Construction of the [mine] site, including pre-strip of high-grade deposits, will take 18 months to complete, after project commencement. During this period, no ore will be exposed, resulting in no radiation hazards to the workforce. Radioactive particles, heavy metals and Potentially Acid Forming (PAF's) have not been included in the list of parameters as the risk of contamination is considered low during Stage 1 construction.[1]

In response to the appeal, the works approval holder also stated that there will be no radiation risks related to stage 1 works, "as the ore body won't be disturbed".[2]

[1] DWER, Works Approval Decision Report W6678/2022/1, 14 December 2022, page 26
[2] Deep Yellow Limited, Response to Appeal, 3 February 2023, page 2

As discussed previously, we understand that at the time of works for stage 1, operation of the mine, processing and transportation of ore, and other radiological materials will not occur. This is reflected in the works approval holder's Radiation Management Plan (RMP) (see section 2.3 for further explanation) which identifies and segregates the mine premises based on the radiological risk, and that during construction, including construction works authorised by this works approval, the whole premises is considered a 'non-supervised area', which means the potential exposure rates are not expected to exceed background radiation levels.[3]

In response to the appeal, DWER confirmed that exposure to radiation or potentially radioactive materials is not intended to occur in stage 1 works:

> Due to the limited scope of works covered under this Works Approval, the potential risk for radiological particles to be present on mine workers clothes is negligible as mining and processing operations are not captured in this stage of works. This potential risk is more relevant to subsequent stages of work.[4]

Background radiation levels at the premises is low

Having regard for DWER's advice that the risk of radioactivity is low due to the limited scope of works at this stage, we note that DWER's decision report does not explicitly address the existing background levels of radionuclides in the environment, which we consider is a necessary consideration when determining the level of risk in emissions and discharges from the infrastructure operated at the premises.

In this regard, the works approval holder's Public Environmental Review (PER) document provides data on the background radiation concentrations in the air, soil, and groundwater at the premises (based on monitoring occurring since 2007). The PER states:

> The findings from these environmental radiation studies are that the MRUP [Mulga Rock Uranium Project] area has radiation levels similar to the rest of inland Australia, with gamma, airborne radon and radon decay products, and soil radionuclide measurements all within the normal range. This is not surprising given the uranium orebody does not outcrop to surface and is covered by at least 35m of overburden.[5]

Based on specific analysis of air, soil, and groundwater, the PER concludes:

> …The measured radioactivity levels in the environmental media (water, soils and air) in the vicinity of the MRUP is lower than in the wider region. The orebody is overlain by a substantial layer of non-mineralised soils which limit the surface radioactivity observed at the site. [6]

We understand that the project will access groundwater for processing and potable water for mine workers. This groundwater will eventually be discharged from the WWTP and therefore the level of radionuclides in the groundwater is relevant to the risk of radiation in the wastewater. From the PER we understand that the project will utilise water from the Kakarook Borefield, which is "hydraulically disconnected" from the uranium deposits.[7] Groundwater quality data for this borefield indicates that uranium and thorium levels are low (see section 3.4). According to ANZECC 2000 Water Quality Guidelines[8], the uranium target for non-potable groundwater (suitable for livestock but not human consumption) is 0.2 mg/L. The monitoring at the premises indicates an average uranium level of 0.03 mg/L.

[3] DWER, Appeal Response W6678/2022/1, 1 March 2023, page 3
[4] DWER, Appeal Response W6678/2022/1, 1 March 2023, page 3
[5] Vimy Resources, Mulga Rock Uranium Project, Public Environmental Review, December 2023, page 304
[6] Ibid, page 308
[7] Ibid, page 136
[8] ANZECC Water Quality Guidelines 2000

Based on the above, we consider that DWER's conclusion, that the risk of radiation is low during this phase of works, is justified.

2.2 Are the controls on the works approval adequate?

Relative to the risk discussed above, we consider that the controls on the works approval are adequate.

Monitoring of radiological emissions is not warranted at this stage of the project

The works approval requires the measurement and monitoring of effluent discharge in accordance with the *Guidelines for the Non-potable uses of Recycled Water in Western Australia.*

DWER has required inflow and outflow meters on the wastewater irrigation to monitor operational (volume) limits, as well as monitoring of treated wastewater discharge concentrations as a regulatory control. The works approval:

- sets discharge limits for several parameters (see below)
- requires monitoring of these parameters during commissioning and time limited operations; and
- requires the reporting of discharge monitoring results to the CEO of DWER.

Discharge limits are required for the following parameters:

- five-day biochemical oxygen demand (BOD_5)
- Total suspended solids (TSS)
- Total Dissolved Solids (TDS)
- Total Nitrogen (TN)
- Total Phosphorus (TP)
- pH range
- E. coli

The appellant has acknowledged that its concerns largely relate to the future use of the stage 1 facilities, at a time when uranium ore is exposed and handled, and the radiological risk is elevated. On this basis and having regard for the regulatory controls applied to the works approval, we consider that no further regulatory controls or monitoring of radiation is required on the works approval.[9]

Notwithstanding, we note DWER's advice that there may be a risk at later stages (proposed stages 2 and 3), and that controls should be applied to manage the safe disposal of contaminated wastewater during operational stages of the proposal. DWER advised:

> …the Department acknowledges that [exposure to radiation or potentially radioactive materials] may be a potential risk considered in stage 2 (which has yet to be approved under Part V of the EP Act).[10]

DWER went on to advise:

> Any future Part V applications relating to stages 2 and 3 should address relevant processes and controls for the safe disposal of potentially contaminated wastewater. [11]

[9] Ongoing monitoring including baseline monitoring may be required by the works approval holder via other instruments
[10] DWER, Appeal Response W6678/2022/1, 1 March 2023, page 3
[11] DWER, Appeal Response W6678/2022/1, 1 March 2023, page 4

We take this to mean that given the elevated risk of exposure to radioactive materials (including wastes) at the premises once mining of ore commences, monitoring and discharge limits for radiological emissions should be considered as part of the assessment of any further regulatory instruments, for example, works approvals for the construction of stage 2 infrastructure, and licences for the operation of stage 1 infrastructure. We understand that screening for levels of radioactivity (for example gross alpha and beta concentrations), with triggers for more detailed monitoring if levels are exceeded, is consistent with the Australian Drinking Water Guidelines,[12] and may be appropriate once stage 2 and 3 operations commence.

During the investigation, the works approval holder advised that given a wastewater monitoring program will be established under the works approval anyway, it is practical to add monitoring of radionuclides as additional parameters. It advised that it intends to undertake ongoing monitoring of radiation in stage 1, to ensure any potential pathways for radiation exposure are detected.

2.3 Other matters

Radiation risk from WWTP discharges may increase once mining of ore commences

We understand that the appellant's main concern is that the wastewater elevated in radionuclides will be discharged onto land (via the spray field) once mining of ore commences. These discharges will then pose an elevated risk to native fauna in addition to creating a contamination risk to soil. The appellant raised the issue of mine workers returning to the accommodation village with work clothes containing radiological dust particles, and these being transferred to the WWTP through washing and laundry. This is the basis of their request for additional monitoring, commencing at stage 2 of the project.

While worker safety is regulated under different legislation, we understand that the works approval holder commissioned studies to better understand risk[13] and has detailed controls in place to segregate the premises.

The PER identifies the following measures which will be adopted to ensure worker dose limits are not exceeded:

- Worker notification of radiation sources
- Work procedures and protective clothing to limit worker dose
- Incorporating radiological controls into the design of the plant and mine
- Application of engineering controls where appropriate
- Worker training to control and reduce worker dose
- A worker dosimetry program to measure the workers' doses received
- Reporting of worker doses to the regulatory authorities.

In this regard, the works approval holder explained, that in its view, the risk of radiation at the worker's accommodation will continue to be low throughout the operation of the project, including the proposed stages 2 and 3. This is on the basis that the accommodation village is isolated from the mining operations site:

> …mining operations are designed so that when a mine worker or other visitor enters the operations site, they will put on their work gear and/personal protective equipment before

[12] NHMRC, NRMMC (2011) *Australian Drinking Water Guidelines Paper 6 National Water Quality Management Strategy*. National Health and Medical Research Council, National Resource Management Ministerial Council, Commonwealth of Australia, Canberra.
[13] For example, Sonter, Mark, *Radiation and occupational hygiene in the Mulga Rock Project*, June 2010

> entering the designated radiological zones. Upon completion of the person's shift or visit, they will change their clothes and shower, if necessary, before exiting the operations site "clean". The water that is used for decontamination, such as wash down water, will either be reused in the process plant or will be discharged to the in-pit tailings storage facilities – all within the operations site boundary. All potentially contaminated clothes, boots etc. will not leave the mining operations site.[14]

DWER also expanded on the level of risk at the different WWTPs in its response to the appeal. It advised that the mine is segregated based on radiation risks to reduce the exposure of workers to elevated radiation levels and radioactive materials. According to the RMP, the accommodation village will remain a designated 'non-supervised area' beyond construction, where radiation exposure rates are not expected to exceed background radiation levels. Mining support areas will be considered a 'supervised area' once mining of ore begins, where special procedures to control exposure to radiation are not normally necessary, but will continually be reviewed. All other areas are considered 'controlled' or 'restricted' areas with strict procedures for controlling radiation exposure.

The segregation is implemented as follows:

> The RMP includes provisions for personnel moving between the different classed areas, including the need for personnel leaving a Controlled Area to remove clothes and shower before moving to clean areas to prevent cross-contamination and potentially transferring radioactive materials into Supervised or Non-Supervised Areas. Work clothes from Controlled Areas are to be laundered daily. The Department understands that the Mine Support Wastewater Treatment Plant would be servicing showering and laundering points within Controlled Areas as it will cover change-rooms and related ablutions.[15]

We note that when the proposal was assessed by the EPA in 2016 (see section 3.1) the EPA sought advice from the Department of the Mines and Petroleum (DMP – now DMIRS) on the radiological aspects of the project as a whole:

> The DMP advised the EPA that there were no issues with respect to the adequacy of radiological assessments undertaken to model radiation exposure and that the exposure risk to employees and the public is considered to be low and acceptable for a uranium mine…
>
> …The Council further notes that the risks associated with radiation will be managed through a Radiation Management Plan and can be adequately monitored and managed under that plan.[16]

Regarding the appellant's concerns about the spray fields creating radiation contaminated dust, in meeting with the works approval holder, the works approval holder advised that while the works approval authorises the construction of the WWTP with spray fields to dispose of treated water, during operational stages it proposes to reuse the water in the mining process where possible, rather than dispose of it via the spray field.[17] [18]

[14] Deep Yellow Limited, Response to Appeal, 3 February 2023, page 3
[15] DWER, Appeal Response W6678/2022/1, 1 March 2023, page 3
[16] EPA, EPA Report 1576 Mulga Rocks Uranium Project, December 2016, page 40
[17] Deep Yellow, pers comm, 21 March 2023
[18] We note that the environmental assessment of the overall proposal conducted by the EPA and subject to MS1046 anticipated that excess mine dewater would be reinjected into the groundwater aquifer within the premises, with reject process water disposed of with the tailings.

Noting this and having regard for the potential radiological risks related to the mine support WWTP once stage 2 and 3 operations commence, the appropriateness of the spray field as a discharge site for the mine support WWTP should be reassessed by DWER in issuing a licence, and prior to the commencement of mining of ore. This consideration of the future use of spray fields as permitted discharge locations should be confirmed through an assessment of the risk based on the expected treated wastewater quality, including its radionuclide concentration.

Based on the above, and in particular if spray fields are authorised for use during later stages of the project, we find that monitoring of radionuclides in wastewater at the WWTPs, including baseline monitoring should be considered for a future licence for operating the infrastructure.

The works approval holder added in response to the appeal:

> After the completion of the time limited operations phase regulated by the Works Approval, operational monitoring of the WWTPs will be carried out in accordance with the conditions attached to a licence issued under the EP Act and imposed by DWER (which licence will be sought at the appropriate time) and Department of Health Guidelines for the Non-potable Uses of Recycled Water in Western Australia.[19]

Radiation Management Plan

By its appeal, the appellant suggested that wastewater monitoring conditions could be included in the RMP. The appellant raised concerns about the lack of transparency and public availability of the RMP and the resulting lack of oversight as the public cannot review or comment on the document.

We understand that the Department of Mines, Industry Regulation and Safety (DMIRS) and the Radiological Council are responsible for assessing and regulating radiation in Western Australia, for proposals where radioactive substances are involved. This is primarily through the development and approval of an RMP. An RMP for this project was approved by DMIRS on 9 December 2021.

The RMP, in addition to being a requirement of the Mines Safety Inspection Act and Regulations is also required by the national Code of Practice and Safety Guide for Radiation Protection and Radioactive Waste Management in Mining and Mineral Processing.[20] Consistent with the Code, a key component of the Radiation Management Plan is the Radioactive Waste Management Plan, which would be expected to address the following:

- Landfill controls for storage and disposal of very low level and low level radioactive wastes
- Management and control of processing radioactive wastes (tailings)
- Discharge of radioactive wastewater.

The Office of the Appeals Convenor has not seen the RMP for this project, as it was not authorised for release by DMIRS. While we cannot confirm if the RMP includes monitoring of radiation at the WWTPs, the works approval holder advised that in general, the RMP is unlikely to include this level of detail. Given the concerns raised by the appellant and the lack of visibility of the RMP, we consider it appropriate for future instruments issued under Part V of the EP Act to include such regulatory controls as monitoring of radionuclides in wastewater, unless confidence can be provided that the RMP adequately addresses public concerns.

[19] Deep Yellow Limited, Response to Appeal, 3 February 2023, page 2
[20] ARPANSA (2005), Code of Practice and Safety Guide for Radiation Protection and Radioactive

3 Supporting information

3.1 Project description

Background

Narnoo Mining Pty Ltd is the owner of the Mulga Rock project and the registered holder of the tenements associated with the project. Narnoo is a 100 per cent owned subsidiary of Deep Yellow Limited.

The project is located 240 km east-northeast of the city of Kalgoorlie-Boulder in the Shire of Menzies and will be operating on Mining Tenements M39/1104, L39/219, L39/252 and L39/253.

The proponent intends to construct the proposal in stages, with separate works approvals required for each. The stages are as follows:[21]

Stage 1 (this application) includes:
- Sewage facilities (Category 54) comprised of two WWTPs located on M39/1104 and L39/252
- Putrescible landfill site (Category 89) located on M39/1104

Proposed Stage 2 works approval application will include:
- Processing or beneficiation of metallic or non-metallic ore (Category 5)
- Mine dewatering (Category 6)
- Electric power generation (Category 52)
- Fuel-burning (Category 67)
- Bulk storage of chemicals (Category 73)

Proposed Stage 3 works approval application will include:
- Processing or beneficiation of metallic or non-metallic ore (Category 5) for the base metals plant.

3.2 Description of infrastructure from the works approval

Wastewater treatment plants

According to the works approval, two WWTPs will be constructed to treat sewage and wastewater from the accommodation village and mine support buildings.

At the accommodation village, a 200 m^3/d capacity containerised Submerged Aerated Filter (SAF) WWTP will be installed to treat effluent from the village. Sewage sludge removed from the WWTP will be dried in cement sumps and will be deposited into the proposed Class 2 Landfill. Treated wastewater will be disinfected and discharged via a 6 ha irrigation spray field.

At the mine support village, a 200 m_3/d capacity containerised SAF wastewater treatment plant will be installed to treat the combined volume of effluent from the change rooms, ablutions and other similar services within the mine support facilities. Wastewater will be treated to secondary standard and will be pumped to a 6 ha spray field north of the Processing Facility.

[21] DWER, Decision Report W6678/2022/1, 14 December 2022, page 2

Sludge removed from the WWTP will be dried in cement sumps and will be deposited into the proposed Class II Landfill. Treated wastewater will be disinfected and discharged via a 6 ha WWTP spray field.

Landfill

A Class II Putrescible Landfill Facility will be constructed to accept Type 1 Inert Waste and Putrescible Waste. 650 tonnes of landfill waste are expected to be generated per year from the accommodation village and the mine support buildings. The works approval includes a condition prohibiting the burial or storage of radioactive waste at the landfill.

3.3 Other approvals and regulatory responsibility for radiological risk

In January 2014 that the Project was considered a "Controlled Action" and that would require assessment and approval under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). The assessment identified no residual environmental impact, and that all temporary impacts could be effectively managed through environmental conditions. The Commonwealth Environment Minister approval was granted in March 2017.

Ministerial Statement 1046 was approved for implementation by the Western Australian Minister for Environment in December 2016 after a Public Environmental Review (PER) level assessment by the EPA.

EPA Report 1576 states the following general observation, relevant to this appeal:

> The mining of uranium, treatment of ore to produce UOC [uranium oxide concentration], stockpiling of ore and waste rock, storage of contaminated waste, uranium transport and mine closure activities all increase the potential for workers or the public to be exposed to radiation.[22]

The EPA concluded the following regarding the proposal specifically:

> … radiation exposure to mine-site workers and members of the public would be well within regulatory dose limits and radiation could be adequately regulated. The EPA also notes that the DMP and the Radiological Council could regulate any potential impacts to human health.[23]

The EPA considered that the proposal can be managed to meet the EPA's objective for Human Health provided that a condition is imposed that requires a RMP that:

- considers measures to control the exposure of employees and members of the public to radiation at or from the mine through the appropriate use of equipment, facilities, operational procedures, monitoring programs, and procedures for assessment of dose and reporting of incidents; and
- includes a waste management system for the mine which includes details for the handling, treatment, storage and disposal of radioactive waste, and an outline for the decommissioning and rehabilitation of the mine.

The EPA Report also notes:

> …both DER and the DEE have legislation that can permit and regulate potential radiological impacts to Human Health.[24]

[22] EPA, EPA Report 1576 Mulga Rock Uranium Project, December 2016, page 37
[23] Ibid, page 6
[24] Ibid, page 41

In general, worker safety is not covered by the EP Act however impacts to human health are considered in the context of the Part V risk assessment for emissions such as impacts to human receptors from noise, air emissions, or water discharges. Broadly speaking the EP Act considers the impacts to the 'environment' where humans are part of the environment.

Therefore, in the context of this appeal, Part V has a role in regulating emission to environment and determining if these emissions pose a radiological risk.

3.4 Results of radiation monitoring

Table 13.2 Surface Soil Analysis

Sources of soil	Value	Radionuclide concentration				Number of Samples
		Uranium		Thorium		
		ppm	Bq/kg[1]	ppm	Bq/kg	
MRUP 1996 (<180µm fraction)	Range	0.06-0.85		0.02-2.4		214
	Average	0.18	4.6	0.43[2]	1.4	
MRUP 2014 (<180µm fraction)	Range	0.06-0.71		0.21-8.82		102
	Average	0.31	7.8	2.59	20.7	

1. Assuming a specific activity of 2528kBq/g for U and 8kBq/g for Th, and assuming secular equilibrium in both cases.
2. Partial leaches via cold dilute HCl.

As shown in Table 13.2 there is little evidence of significant mineralisation in the surface soils in the area. This is consistent with regional geochemical surveys in similar environmental settings in Australia. Generally speaking, the radionuclide levels are low across the Southwest Great Victoria Desert (where the MRUP is located) in comparison to world averages (UNSCEAR 2008), as shown by a regional geochemical soil survey carried out by the GSWA in 2010 (Morris 2013), and both regional and project-scale detailed airborne radiometric surveys.

Radionuclides in Groundwater

The water quality for the MRUP is hypersaline as detailed in Section 11 and accordingly is not fit for human consumption or livestock purposes. Notwithstanding, samples of groundwater were taken and the laboratory analysis of the groundwater sample taken at the MRUP site has yielded the results provided in Table 13.3.

Table 13.3 Groundwater Radionuclide Analysis

Sample Ref	Radionuclide concentration				
	Naturally Occurring U238 Series (Bq/L)				
	Uranium-238	Radium-226	Lead-210	Polonium-210	Thorium-230
RC1279	<0.02	2.01 ± 0.19	<0.19	0.025 ± 0.013	0.021 ± 0.014
NND5030	0.22 ± 0.02	1520 ± 110	<6.1	0.014 ± 0.010	0.277 ± 0.049
NND5036	1.5 ± 0.1	77.3 ± 5.5	1.06 ± 0.23	0.036 ± 0.016	2.56 ± 0.24
NND5040	0.30 ± 0.02	13.9 ± 1.0	0.34 ± 0.10	0.0105 ± 0.0089	0.271 ± 0.071
Bore #1	<0.07	0.178 ± 0.022	<0.15	0.0038 ± 0.0051	0.065 ± 0.031
Bore #2	<0.13	1.28 ± 0.16	<0.63	0.0090 ± 0.0071	0.0133 ± 0.0085
Bore #3	<0.13	1.27 ± 0.12	<0.54	0.0114 ± 0.0076	0.31 ± 0.11

Table 11.2 Groundwater Quality Data for the Kakarook Borefield

Parameter	Units	Kakarook Borefield		
		Min	Max	Average
Basic Properties				
pH		5.0	7.7	6.7
TDS	mg/L	1,500	9,200	5,527
Conductivity	uS/cm	2,340	14,400	8,640
ORP	mV	34	295	172
Redox	mV	-21.9	127.3	36.48077
Alkalinity	mg/L	2	120	40.04
Base Cations and Anions				
Cl	mg/L	222	6300	2423
Na	mg/L	146	3600	1313
K	mg/L	11	240	85
Ca	mg/L	10	250	125
Mg	mg/L	14	530	209
Fe	mg/L	0.05	8.30	0.71
HCO_3	mg/L	0.01	170	53.9
$CaCO_3$	mg/L	0.01	140	49.3
SO_4	mg/L	74	1,400	796
Cl/SO_4	-	1.9	4.0	3.1
NO_3	mg/L	0.7	20.7	7.3
Trace Metals and Metalloids				
As_mg_L	mg/L	0.008	0.28	0.057
B_mg_L	mg/L	1.5	4.3	2.179
Ba_mg_L	mg/L	0.019	0.075	0.043
Be_mg_L	mg/L	0.005	0.005	0.005
Cd_mg_L	mg/L	0.001	0.0039	0.002
Cr_mg_L	mg/L	0.005	0.3	0.105
Cu_mg_L	mg/L	0.005	0.061	0.021
Co_mg_L	mg/L	0.035	0.43	0.155
F_mg_L	mg/L	0.2	1.5	0.617
Hg_mg_L	mg/L	0.00007	0.00008	0.00008
Pb_mg_L	mg/L	0.005	0.23	0.053
Mn_mg_L	mg/L	0.021	1.3	0.247
Ni_mg_L	mg/L	0.012	0.43	0.066
Sn_mg_L	mg/L	0.005	0.042	0.014
Se_mg_L	mg/L	0.013	0.018	0.015
Th_mg_L	mg/L	0.005	8	2.672
U_mg_L	mg/L	0.008	0.15	0.035
Zn_mg_L	mg/L	0.01	1.7	0.095

3.5 Figures

Figure 2 Accommodation village and wastewater treatment plant constructed under this works approval

Figure 3 Mine layout with mine support infrastructure and wastewater treatment plant to be constructed under this works approval

Appendix 1 Appeal process

The Minister assesses the merits of a decision

The environmental appeals process is a merits-based process. Appeal rights in relation to a works approval are normally against the specifications of a works approval and whether the conditions of the works approval are adequate or appropriate to control the environmental impacts of the design and construction of the plant. Issues of whether the plant operates so as to manage or abate pollution and to ensure that it operates in an environmentally acceptable manner are normally considerations of the licensing process rather than a works approval.

An appeal against the requirements of a works approval cannot overturn the original decision to grant a works approval. But if the appeal is upheld, the works approval conditions might change.

We report to the Minister, as does the decision-making authority

To decide an appeal's outcome, the Minister for Environment must have a report from both:

- the Appeals Convenor [see section 109(3) of the EP Act], and
- the authority that originally made the decision under appeal [see section 106(1)].

To properly advise the Minister in our report, our investigation included:

- review of the appeal, DWER's Decision Report, and the works approval holder's application information
- review of the response to the appeal provided by the works approval holder
- review of the section 106 report from DWER
- video meeting with representatives of the appellant on 21 March 2023
- meeting with the works approval holder's representative on 21 March 2023

Table 1 Documents we reviewed in the appeals investigation

Document	Date
DWER, Works Approval and Decision Report W6678/2022/1	Dec 2022
DWER, Appeal Response W6678/2022/1	March 2023
Deep Yellow Limited, Response to Appeal	Feb 2023
Sonter, Radiation and occupational hygiene in the Mulga Rock Project	June 2010
EPA, Report 1576 – Mulga Rock Uranium Project	August 2016
Vimy Resources, Mulga Rock Uranium Project Public Environmental Review	Dec 2015