



Report and recommendations of the Environmental Protection Authority



Wiluna Uranium Project

Toro Energy Limited

Report 1437

May 2012

Public Environmental Review

Environmental Impact Assessment Process Timelines

Date	Progress stages	Time (weeks)
16/11/09	Level of assessment set	
21/06/10	Environmental Scoping Document (ESD) released for public review	31
05/07/10	Public review period for ESD closed	2
17/09/10	Final ESD approved	11
25/07/11	Environmental Review Document (ERD) released for public review	
31/10/11	Public review period for ERD closed	14
15/03/12	Final Proponent response to ERD issues raised	17
21/05/12	Publication of EPA report	9
5/06/12	Close of appeals period	

Timelines for an assessment may vary according to the complexity of the project and are usually agreed with the proponent soon after the level of assessment is determined.

In this case, the Environmental Protection Authority met its timeline objective in the completion of the assessment and provision of a report to the Minister.



Dr Paul Vogel

Chairman

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Summary and recommendations

This report provides the Environmental Protection Authority's (EPA's) advice and recommendations to the Minister for Environment on the proposal by Toro Energy Limited to develop the Wiluna Uranium Project to mine the Centipede deposit 30 km south and Lake Way deposit 15 km south-east of Wiluna in Western Australia.

Section 44 of the *Environmental Protection Act 1986* (EP Act) requires the EPA to report to the Minister for Environment on the outcome of its assessment of a proposal. The report must set out:

- the key environmental factors identified in the course of the assessment; and
- the EPA's recommendations as to whether or not the proposal may be implemented, and, if the EPA recommends that implementation be allowed, the conditions and procedures to which implementation should be subject.

The EPA may include in the report any other advice and recommendations as it sees fit.

The EPA is also required to have regard for the principles set out in section 4A of the EP Act.

Key environmental factors and principles

The EPA decided that the following key environmental factors relevant to the proposal required detailed evaluation in the report:

- (a) Radiation (impact to groundwater, surface water, air quality, non-human biota, bush tucker);
- (b) Transport;
- (c) Mine closure and rehabilitation;
- (d) Groundwater and water supply;
- (e) Surface water;
- (f) Air quality;
- (g) Flora and vegetation;
- (h) Fauna and habitat; and
- (i) Aboriginal heritage.

There were a number of other factors which were relevant to the proposal, but the EPA is of the view that the information set out in Appendix 3 provides sufficient evaluation.

The following principles were considered by the EPA in relation to the proposal:

- (a) Principle 1: The precautionary principle;
- (b) Principle 2: The principle of intergenerational equity;
- (c) Principle 3: The principle of the conservation of biological diversity and ecological integrity; and
- (d) Principle 5: The principle of waste minimisation.

Conclusion

The EPA has considered the proposal by Toro Energy Limited to develop the Wiluna Uranium Project to mine the Centipede deposit 30 km south of Wiluna and the Lake Way deposit 15 km south-east of Wiluna in Western Australia.

Radiation

Groundwater

Radiological emissions can impact the biophysical environment including groundwater, surface water, air quality, non-human biota and bush tucker which indirectly could impact human health.

Groundwater quality can potentially be affected by seepage of uranium, other heavy metals and radionuclides from the tailings storage facility (TSF) and below ore grade uranium material stockpiles. The potential for uranium and radionuclides to enter groundwater is dependent on the integrity of the TSF for long-term containment of tailings.

The Department of Mines and Petroleum (DMP) has reviewed the modelling and proposed design of the TSF and advised the EPA that the 'proposed TSF can be constructed and operated to contain tailings and limit leaching of radionuclides over the long term'.

The EPA considers that, on the advice of the DMP, the proposed TSF can be constructed and operated in a manner that would ensure the potential risk to groundwater quality is environmentally acceptable.

The EPA also considers that the proposed monitoring, maintenance and contingency response in relation to the management and operation of the TSF is environmentally acceptable.

Surface water

The EPA considers that, with the placement of engineered bunds around waste storage areas, and the commitment to manage natural flood events by designing perimeter bunds for a 1 in 100 year event, it is unlikely that surface water quality would be significantly impacted by radionuclides.

Air quality

Radionuclides in dust and radon decay products (RDPs) in air can impact the environment and, as a result, human health. Baseline studies and modelling for radionuclides in dust, radon gas, and RDPs have been undertaken.

The risk to human exposure is determined by the total dose exposure which is based on the inhalation of RDPs and radionuclides in dust. Modelling data indicates that the total dose exposure to nearby receptors ranged from 0.005 to 0.047 mSv/year. This exposure level is significantly less than the internationally accepted radiation exposure limit of 1 mSv/year set for members of the public (ICRP 1990).

Baseline studies were also carried out to determine radon concentration in air. The observed background levels at Lake Way were approximately 27 Bq/m³. Modelling predicted that radon concentrations at the sensitive receptors could increase by a small amount above background level from the implementation of the project (approximately 0.09 Bq/m³ at Lake Way Station to 1.23 Bq/m³ at the Apex Village (Table 3). The EPA considers that with the placement of a two metre cover on the TSF which includes a radiation control layer, radon release into the environment would be minimised to an acceptable level.

The EPA considers that it is unlikely that radiological emissions from the mine site would affect air quality around the mine site.

Non-human biota

Radiation exposure to non-human biota was assessed using a program called *Environmental Risk from Ionising Contaminants: Assessment and Management* (ERICA). ERICA was developed by the European Commission and is a program recognised by the International Commission on Radiological Protection (ICRP). This program has been used at other uranium mines in Australia.

The ICRP recently introduced the requirement to assess radiation exposure of non-human species (animals and plants). International best practice is to assess directly absorbed dose rates to non-human biota using a 'reference organism' approach, which involves the use of reference animals and plants (ICRP 2008).

The Australian Radiation Protection and Nuclear Safety Agency (ARPANSA) is working towards a national framework for the assessment of radiation protection in Australian environmental conditions. It is currently reviewing models and methodologies developed internationally for assessing ionising radiation risks to non-human biota, together with associated data, to evaluate their applicability to the range of Australian climatic zones and biota. This will assist ARPANSA to develop a national framework and assessment approach for radiation protection of the environment not only consistent with world's best practice, but also relevant to Australian conditions and our unique biotic types (ICRP 2008).

The risks to most of the types of animal groups were found to be low. The EPA considers that it is unlikely that non-human biota would be significantly impacted by radiological emissions.

Bush tucker

The local Indigenous community raised concerns regarding the potential impact of radiological emissions on bush tucker (food). The proponent has undertaken a survey in consultation with local Indigenous people to determine what type of native food was consumed in the area. The objective of the survey was to develop a catalogue of bush tucker plants used by Traditional Owners residing in the Wiluna area.

A health risk assessment carried out was carried out to assess the potential risk of radiation on bush tucker. This study indicates that the potential exposure was low compared to the annual dose limit of 1 mSv per year recommended by the ICRP (2007) for human exposure.

Transport

Uranium oxide concentrate (UOC) would be transported by road from the mine to the Western Australia border for road/rail transport to South Australia for export. The Radiological Council of Western Australia and the DMP are the key government agencies responsible for regulating transport of UOC.

The EPA considers that monitoring of radiation exposure along the transport route should be carried out. The EPA understands that the most effective way of achieving this would be by monitoring the exposure to transport personnel such as drivers, who are the most exposed people along the transport route.

All monitoring data and plans should be made publicly available by the approving agency, subject to any legislative constraints. Vehicles transporting UOC should be required to have Global Positioning Systems (GPS) to ensure they adhere to approved routes.

The EPA considers that the existing regulatory framework is comprehensive in regard to transport of UOC and therefore considers it unnecessary to recommend conditions in regard to transport.

Matters relating to monitoring as well as public availability of plans and results can be addressed under existing legislation.

Mine closure and rehabilitation

All mineralised waste from both the Centipede and Lake Way deposits would be stored in an in-pit tailings storage facility (TSF) constructed at the Centipede mined out pit. Waste rock would either be used to cover the TSF or disposed of in-pit at Lake Way.

Mining would initially take place at the Centipede pit and afterwards relocate to the Lake Way pit. This would allow for progressive mine rehabilitation to take place two years into mining and give an indication of rehabilitation success during the early stages of mining. There would be no above ground waste storage structures, stockpiles or elevated landforms remaining after closure. The land would be recontoured and revegetated using local provenance species.

The EPA notes that a monitoring programme would be undertaken, including dust and radiation monitoring, to ensure the TSF is safe during and after operations. An annual assessment of the mine closure outcomes will be

completed by the proponent and a contingency response plan would be developed.

Based on the design, monitoring and maintenance information provided by the proponent and the advice provided by the DMP, the EPA is satisfied that the TSF can be operated and managed in a safe and secure manner, and can be adequately regulated by the DMP and the Radiological Council. The EPA considers the factor of mine closure and rehabilitation to be adequately addressed and that the environmental objectives for this factor can be met.

Groundwater and water supply

The EPA notes that the project requires 2.5 GL per annum (GL/a) of water supply for the life of mine (14 years). This water supply would be sourced from the West Creek borefield (0.7 GL/a) and the balance from pit dewatering. Water supply for the first six years of operation would meet the water supply requirements of 2.5 GL/a.

The EPA notes however that from year seven onwards, the total water supply would be 1.1 GL/a sourced from mine dewatering (0.4GL/a) and the West Creek borefield (0.7 GL/a). The balance of water required (1.4 GL/a) would be from alternative regional groundwater resources.

The EPA considers, based on the amended dewatering plan and the advice of the Department of Water, that there is a viable source of water supply for the 14 year life of mine and that the access of this supply from both the West Creek borefield and dewatering can be managed in an environmentally acceptable manner.

Surface water

The proposed mining areas are within the Lake Way catchment and the lake is typically a large closed basin with extensive internal drainage. There are smaller sub-catchments to the north and north-west of Lake Way and Lake Way receives intermittent inflows from these sub-catchments, particularly during high rainfall events.

Mining activities and construction of infrastructure such as the TSF and haul road has the potential to affect surface water flows. Inappropriate design of storage facilities for solid and liquid waste management could also potentially affect surface water quality if spillage of waste was to occur.

The EPA considers that, based on the proposed engineering design of diversion drainage systems including the bund design around waste storage areas and the proposed management of natural floods, it is unlikely that surface water flows would be affected.

Air quality

Air quality can potentially be affected by dust, inorganic gases and radiological emissions. Radiological emissions such as dust, radon and radon decay products (RDPs) are considered to pose the greatest risk to air quality. Radiological impacts to air quality are assessed under the 'Radiation' factor.

The Nganganawili community and the Toro accommodation village are the closest sensitive receptors to the mining area (Figure 3).

A power station (12 MW) would be constructed to generate power for ore processing using natural gas as the main fuel source.

The EPA notes that air quality modelling indicates that NO_x, SO_x, CO and VOC concentrations would be low. The EPA also notes these levels are below the NEPM standards at the sensitive receptors.

The EPA considers that the proposed Dust Management Plan is environmentally acceptable and would ensure that dust levels are maintained to low levels.

Flora and vegetation

Approximately 1530 ha of native vegetation would be cleared for mining and infrastructure purposes. The two largest areas of clearing include the Centipede deposit (580 ha) and the Lake Way deposit (700 ha).

Clearing and dewatering activities have the potential to affect flora and vegetation including groundwater dependent vegetation at the mine site and at the West Creek borefield.

No currently listed Declared Rare Flora, threatened ecological communities or priority flora species were identified during flora surveys.

The EPA considers that it is unlikely that the known *Tecticornia* species would be significantly affected by the proposal as these species occur inside and outside the mining footprint and some are widespread.

The EPA notes however that some *Tecticornia* species could have very specific habitat requirements based on hydrology, salinity and landform, and that a considerable number of specimens collected in the surveys could not be identified as known species within the existing taxonomic knowledge on *Tecticornia* species and are likely to represent some new species. This included specimens collected within the direct disturbance area and the area of groundwater drawdown. The EPA understands that the identification of *Tecticornia* species is complex, mainly because of the physical characteristics of the plants such as variation in morphology within a single species and habitat preference.

Based on the current extent of surveys and taxonomic knowledge of *Tecticornia* species, the DEC has advised that the proposal could result in the loss of unidentified *Tecticornia* species from direct disturbance or groundwater drawdown.

To further address risks, the EPA has also recommended condition 7 which requires the proponent to develop a Groundwater Drawdown Monitoring and Management Plan, including the implementation of a barrier system to limit impacts to *Tecticornia* species within the primary drawdown area of 0.5 metre.

Residual impacts

While the risk management and protection measures indicated above should ensure that the proposal does not have unacceptable impacts on *Tecticornia* species and vegetation, it will have residual impacts. The EPA considers that an offset should be provided to mitigate for the residual impacts on *Tecticornia* species and vegetation. The EPA has therefore recommended that the plan

required by condition 8 should also include survey and research measures to improve the knowledge of Tecticornia species and vegetation.

The EPA considers that it is likely that the EPA's objectives would be achieved for flora and vegetation provided there is satisfactory implementation by the proponent of the recommended conditions 6, 7 and 8.

Fauna and habitat

Calcrete aquifers in inland arid Australia, notably those around Lake Way, contain a rich and diverse assemblage of stygofauna species which are totally dependent on the subterranean water bodies (Humphreys et al. 2009). In recognition of the rich diversity on a global standard the calcrete stygofaunal communities around the Lake Way region were nominated for listing as threatened ecological communities in 2008 and are currently identified as priority ecological communities.

No threatened ecological communities or fauna were identified within the project areas.

The EPA considers that stygofauna species found within the pit areas are likely to be more widespread, because:

- there are large areas of suitable stygofauna habitat outside of the pit areas, such as the Hinkler Well and Uramurdah Lake calcretes;
- many species found within the pit areas have also been found outside, and
- the species identified in the pit areas were encountered at low abundances and there is uncertainty in the sampling of stygofauna with low abundances in multiple locations.

The EPA notes that a number of stygofauna species were identified within the pit drawdown areas (greater than 0.5 m) and that these intersect the identified priority ecological communities. The EPA considers that controlling the groundwater drawdown around the pits would minimise the potential risk to the stygofauna species near the pits.

The EPA considers that, with the implementation of the recommended condition 7 which requires the proponent to develop a Groundwater Drawdown Monitoring and Management Plan including the implementation of a barrier system to control groundwater drawdown, the impacts to stygofauna would be minimised.

The EPA notes that a number of stygofauna species were identified at the West Creek borefield which could potentially be affected by drawdown. Most of these species were collected at low abundances. The stygofauna assemblages surveyed within the borefield area were similar to assemblages outside. The calcrete aquifer at the West Creek borefield has an average saturated thickness of 10 to 15 m with a maximum saturated thickness of approximately 20 m and the EPA notes that the predicted groundwater drawdowns are not large compared to the saturated calcrete aquifer thickness.

On this basis it is unlikely that any species of stygofauna will be threatened by extinction as a result of the mining or dewatering for the proposal

Aboriginal heritage

Wiluna is an important area in terms of Aboriginal culture in the Western Desert region. It is traditionally a major law centre and plays a central role at law time with people travelling from as far away as Docker River to conduct rituals in and around Wiluna (Sackett, L, 1977).

The proponent has consulted with indigenous people of the region based on advice from traditional owners, Native Title Claimants represented by the Central Desert Native Title Services (CDNTS), and their representative bodies.

The EPA notes that prior to mining, the proponent would require a Section 18 approval from the Department of Indigenous Affairs where disturbance of a known Aboriginal heritage site may occur. The EPA also notes that the approval to mine would also be subject to a mining agreement between the Native Title Claimants and the proponent.

The EPA considers, based on the information provided in the environmental review document (ERMP), submissions received, the proponent's response to submissions and the need for the proponent to obtain a section 18 approval from the Department of Indigenous Affairs, that it is likely the proposal can be implemented to meet the EPA's objective for the environmental factor of Aboriginal heritage.

Recommendations

That the Minister for Environment:

1. Notes that the proposal being assessed is for the development of the Wiluna Uranium project to mine the Centipede and Lake Way deposits in Wiluna, Western Australia.
2. Considers the report on the key environmental factors and principles as set out in Section 4;
3. Notes the EPA has concluded that it is likely that the EPA's objectives would be achieved, provided there is satisfactory implementation by the proponent of the recommended conditions set out in Appendix 4 and summarised in Section 5;
4. Imposes the conditions and procedures recommended in Appendix 4 of this report; and
5. Notes the EPA's other advice presented in Section 6 in relation to the regulatory framework and public availability of plans and reports.

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1. List of submitters
2. References
3. Summary of identification of key environmental factors
4. Recommended Environmental Conditions and nominated Decision-Making Authorities
5. Summary of submissions and proponent's response to submissions (CDs attached to inside back cover)

1. Introduction and background

This report provides the advice and recommendations of the Environmental Protection Authority (EPA) to the Minister for Environment on the key environmental factors and principles for the proposal by Toro Energy Limited, to develop the Wiluna Uranium Project.

Toro Energy Limited proposes to develop the Centipede deposit and the Lake Way deposit located 30 kilometres (km) south and 15 km south-east of Wiluna, Western Australia respectively (Figure 1). The project area is located within the Lake Way and Millbillillie pastoral leases. The main components of the proposal include the mining, processing and transport of uranium oxide concentrate (UOC) product from the mine to the Western Australian border. The project involves mining up to two million tonnes (Mt) of mineralised ore per year over the 14 year life of mine. Production of 1200 tonnes per annum (tpa) of UOC is expected.

The proposal is being formally assessed because it relates to uranium mining and transport of UOC through Kalgoorlie to the Western Australian border for either rail or road transport to South Australia or Northern Territory for export. The potential risks of uranium mining, processing and transport include impacts to the biophysical environment including groundwater, surface water, air quality and non-human biota (flora and fauna). Further, some of the impacts on the biophysical environment could impact human health.

The project is considered by the Commonwealth of Australia to be a controlled action under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) because the proposal triggers ‘nuclear action’ as “mining or milling uranium ore” activity under the EPBC Act.

The project is also subject to assessment as a mining proposal by the Department of Mines and Petroleum (DMP) under the Western Australian *Mining Act 1978*. The regulatory framework for uranium mining particularly in relation to transport and radiation management would be under the provisions of the *Mine Safety and Inspection Act 1994* and the Western Australian *Radiation Safety Act 1975*. Specific activities that would be regulated under this legislation include:

- management of process waste including its safe and secure long-term containment in an in-pit tailings storage facility;
- radiation management to protect environmental and public exposure;
- mine closure planning, operation and post-closure; and
- compliance monitoring and auditing in relation to incidents management of transportation of UOC.

Further details of the proposal are presented in Section 2 of this report. Section 3 discusses the regulatory framework for transport and radiation management. Section 4 discusses the key environmental factors and principles for the proposal. The conditions to which the proposal should be subject, if the Minister determines that it may be implemented, are set out in

Section 5. Section 6 provides other advice by the EPA and Section 7 presents the EPA's recommendations.

Appendix 5 contains a summary of submissions and the proponent's response to submissions and is included as a matter of information only and does not form part of the EPA's report and recommendations. Issues arising from this process, and which have been taken into account by the EPA, appear in the report itself.

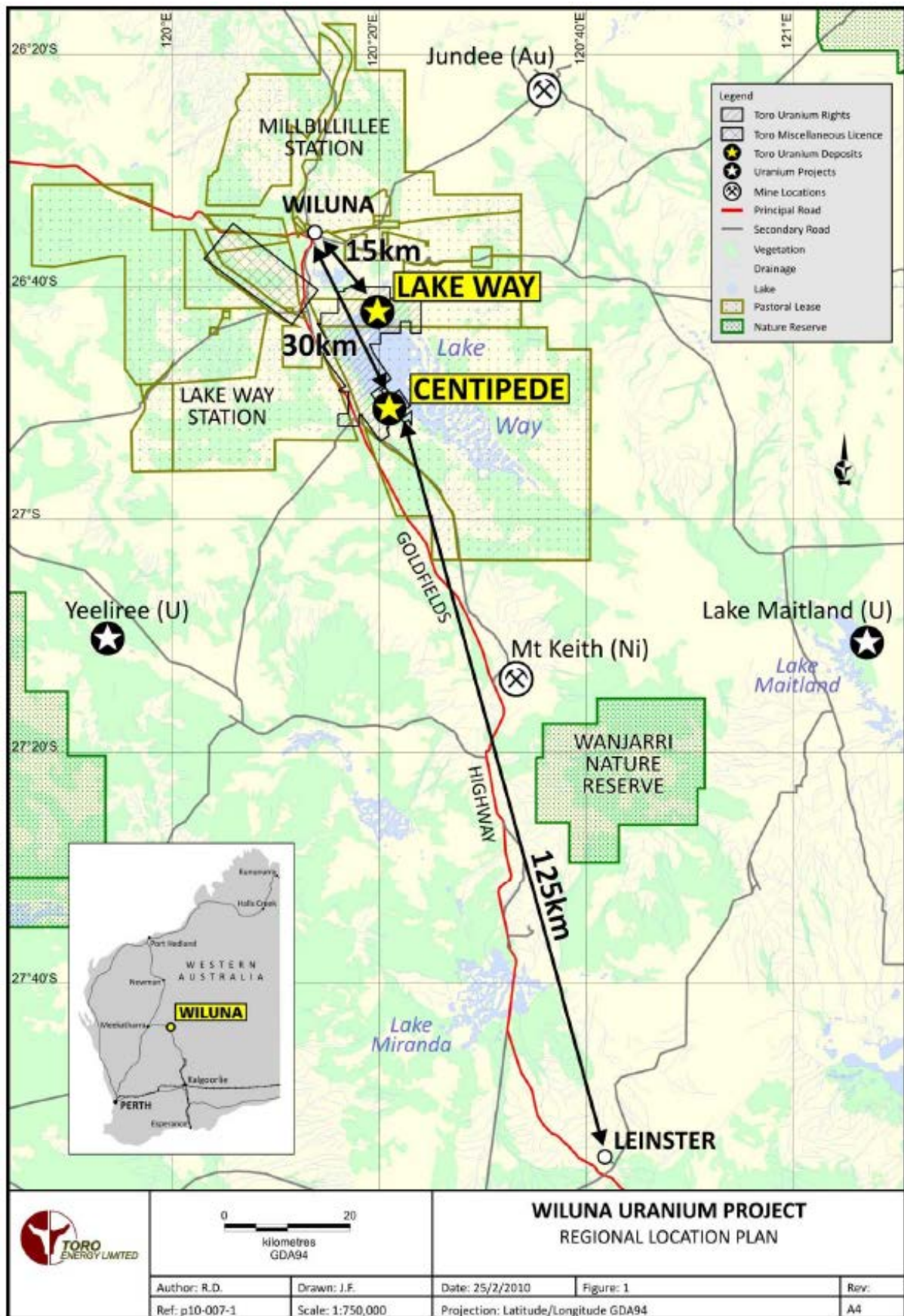


Figure 1: Regional location of Wiluna Uranium Site

2. The proposal

Toro Energy Limited proposes to develop the Centipede deposit and the Lake Way deposit. The Centipede deposit is located 30 km south of Wiluna, near the centre west margin of the Lake Way play. The Lake Way deposit is at the northern part of the Lake Way play and is located 15 km south-east of Wiluna (Figure 2).

The main components of the project include mining, processing and transport of UOC from the mine to the Western Australian border.

The main characteristics of the proposal are summarised in Table 1 below. A detailed description of the proposal is provided in Part 1, Section 2 of the ERMP (Toro Energy Limited 2011a).

Table 1: Summary of key proposal characteristics

Proposal Definition		Extent Authorised
Element development/infrastructure	Location of element	
Centipede deposit	Figure 3	Clearing of up to 700 ha of vegetation, including 280 ha of low heath vegetation unit of <i>Tecticornia</i> species.
Lake Way deposit	Figure 3	Clearing of up to 580 ha of vegetation, including 340 ha of low heath vegetation unit of <i>Tecticornia</i> species.
Ancillary infrastructure	Figure 3	Clearing of up to 250 ha of vegetation.

ha = hectares

Modifications made to the proposal by the proponent following release of the ERMP include:

- processing of uranium ore would occur via agitated tank leaching;
- modified dewatering plan for the Lake Way deposit to commence dewatering in year three and not year six as suggested in the ERMP; and
- additional design details of the tailing storage facility.

The potential impacts of the proposal initially predicted by the proponent in the ERMP document and their proposed management are summarised in Table 97 of the proponent's document (Toro Energy Limited 2011a).

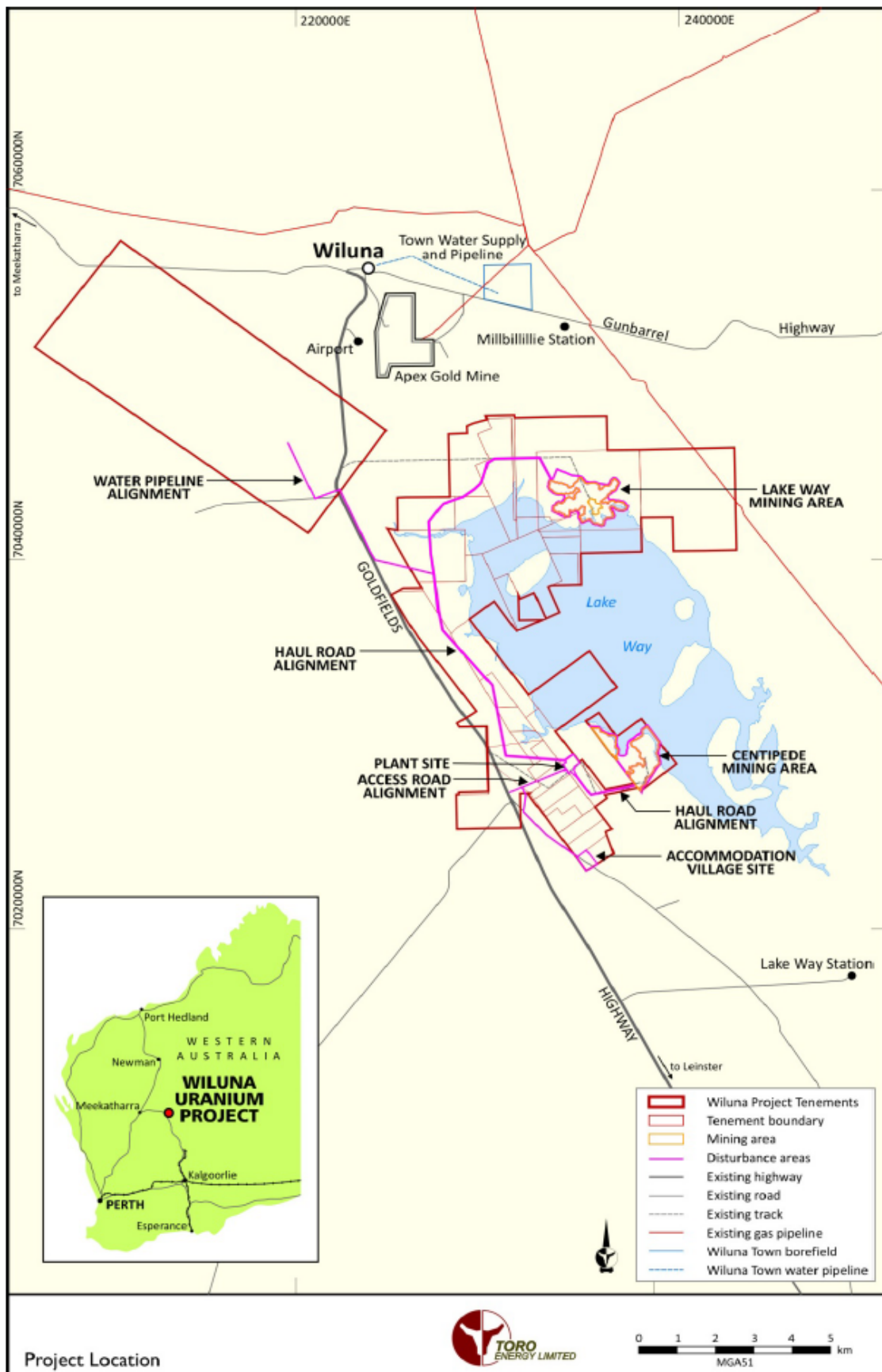
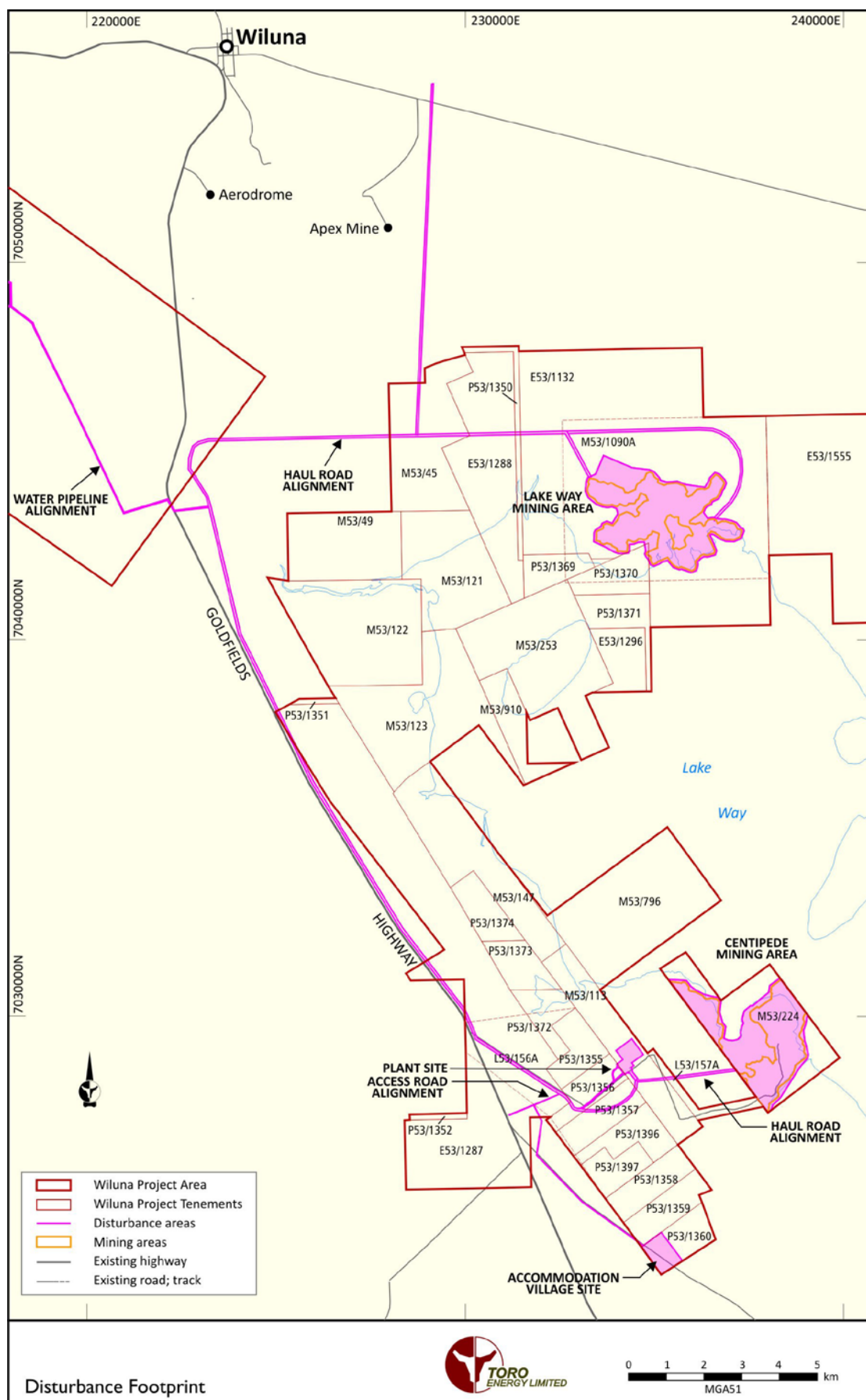


Figure 2: Mine layout showing the Centipede and Lake Way pits



3. Regulatory framework for radiation management and transport

International/National Framework for Uranium Mining

The International Atomic Energy Agency (IAEA) is responsible for developing best practice international radiation protection standards and guidelines for regulation of radiation across the world. The International Commission on Radiological Protection (ICRP) and the United Nations Scientific Committee on the Effects of Atomic Radiation (UNSCEAR) are responsible for providing recommendations to the IAEA through worldwide scientific research and findings.

The Australian Radiation Protection and Nuclear Safety Agency (ARPANSA) is the national Australian body responsible for administration of the *Australian Radiation Protection and Nuclear Safety Act 1998*. ARPANSA sets codes and standards for best practice radiation protection in Australia conditions based on IAEA standards and guidelines.

The Australian Safeguards and Non-Proliferation Office (ASNO) manages the Nuclear Non-Proliferation Treaty (NPT) and is responsible for the issue of conditional permits to mine operators for the production, transportation, handling and storage of uranium oxide concentrate (UOC). The permit requires the proponent to maintain records of production, material transfer and maintaining documentary evidence and export shipments. Mine operators are required to lodge a Transport Plan covering routes to be used for transportation of the UOC from mine site to point of export. The ASNO in conjunction with the relevant State government approves such plans.

Radiation management

Radiation management is an important aspect of uranium mining proposals. Radiation could affect the biophysical environment including groundwater, surface water, air quality, non-human biota and bushtucker. Further, some of the impacts on the biophysical environment could impact human health.

Radiation sources include:

- gamma radiation;
- radon and radon decay products in air;
- radionuclides in dust;
- radionuclides in surface and ground water; and
- radionuclides in non-human biota including bushtucker.

The Radiological Council of Western Australia (Radiological Council) and the Department of Mines and Petroleum (DMP) are the key agencies responsible for the regulation of this industry to ensure that radiation is managed within acceptable standards to protect human and environmental health.

Uranium mining activities such as mining, processing and transport would be closely regulated by the DMP and Radiological Council through the *Mining Act 1978*, Mines Safety and Inspection Regulations 1995 (MSIR) and the

Radiation Safety Act 1975 in relation to radiological aspects on occupational health, public and environmental exposure. The MSIR specifically address long term management of radioactive waste material.

Both agencies have legislation and powers in relation to management of radiation at the mine site which could result in public exposure. The DMP under the *Mine Safety and Inspection Act 1994* and associated regulations has powers to ensure a member of the public is not exposed to a radiation dose, as a result of the mine, exceeding one milliSievert per year (mSv/yr). The DMP requires the preparation of a Radiation Management Plan that must consider measures that can be taken to control the exposure of members of the public to radiation associated with the mining activity, both on and off the mining lease. The legislation also provides for applying penalties for offences.

The Radiological Council under the *Radiation Safety Act 1975* and associated regulations requires appropriate authorisation for the mining of ore. The Radiological Council also requires the submission of a Radiation Management Plan and the operation of a mine in accordance with the national code of practice.

Mine closure and rehabilitation would be guided by the principles and objectives of the Minerals Council of Australia strategic framework for mine closure (Australian and New Zealand Minerals and Energy Council (ANZMEC) 2000). The radiological aspects of mine closure and rehabilitation would also be in accordance with the *Code of Practice and Safety Guide for Radiation Protection and Radioactive Waste Management in Mining and Mineral Processing* (ARPANSA 2005) and the *DMP/EPA Guidelines for Preparing Mine Closure Plans* (2011).

The EPA considers that the existing regulatory framework is comprehensive with respect to the regulation of the uranium mine and transport of UOC.

It is important that the regulatory agencies responsible for the regulation of transport and radiation management liaise closely to ensure integrated and consistent application of their powers to ensure the risk of exposure to radiation is managed to meet State and National standards.

The EPA considers that all environmental management plans should be made publicly available by the approving agency subject to any legislative constraints.

Transport

Toro Energy's Wiluna uranium proposal involves the road transport of UOC from the mine to the WA border for road/rail transport to South Australia. The transport of UOC by rail and/or road to Port Adelaide for export is not part of the Western Australian EPA assessment.

The Radiological Council and the DMP are the key government agencies responsible for regulating transport of UOC. Both agencies have adequate legislation and powers in relation to transport including packing, handling and storage of UOC. The DMP has primary responsibility on the mine site and the Radiological Council has primary responsibility off-site. The Commonwealth also has legislation and powers in relation to transport.

The legislation provides for monitoring of exposure to radiation along the transport route. This would be carried out through the use of dosimeters placed on transport personnel such as drivers who are the most exposed people along the transport route. Periodic checks to measure radiation levels at set distances from transport vehicles would also be undertaken to assess potential public exposure. Monitoring of exposure using external meters placed along the transport route is not generally used as it is difficult to differentiate between background radiation and the radiation from a moving vehicle.

The EPA considers that the results of radiation measurements at set distances from transport vehicles should be made publicly available.

The EPA also considers that vehicles transporting UOC should be required to have Global Positioning Systems (GPS) to ensure they adhere to approved routes.

The Transport Management Plan (TMP) would include an Emergency Management Plan for response by the carrier. The Fire and Emergency Services Authority (FESA) would coordinate the State's emergency response (unless a terrorist involvement is suspected) with the assistance from the Department of Health (DoH). The DoH under the WESTPLAN – HAZMAT would:

- provide a representative when requested;
- monitor the radioactive environment and define contaminated areas;
- provide laboratory analysis of air, water, food and fodder samples;
- establish and direct measures to mitigate the radiological impact on public health;
- establish human exposure criteria and assess the public health impact of radiation levels;
- recommend measures to limit the spread of radioactive contamination;
- direct and assist in collection of ingestion pathway samples;
- establish procedures and make recommendations for the use of substances to prevent or reduce the effects of contamination; and
- advise and assist on decontamination measures.

The police would undertake the emergency response should terrorist involvement be suspected under WESTPLAN – Chemical, Biological, Radiological and Nuclear.

In the development of the TMP, the proponent should consult with the local community and any communities along the proposed transport route to ascertain their concerns and develop a risk communication strategy that addresses these concerns.

Should the risk communication strategy involve the publication of data obtained during routine monitoring, the Department of Health has advised it will undertake to provide, where appropriate, independent advice on any potential health impact.

4. Key environmental factors and principles

Section 44 of the EP Act requires the EPA to report to the Minister for Environment on the key environmental factors relevant to the proposal and the conditions and procedures, if any, to which the proposal should be subject. In addition, the EPA may provide other advice and make recommendations as it sees fit.

The identification process for the key factors selected for detailed evaluation in this report is summarised in Appendix 3. The reader is referred to Appendix 3 for the evaluation of factors not discussed below. The factors listed below are relevant to the proposal, but the EPA is of the view that the information set out in Appendix 3 provides sufficient evaluation.

It is the EPA's opinion that the following key environmental factors for the proposal require detailed evaluation in this report:

- (a) Radiation (impact to groundwater, surface water, air quality, non-human biota, bush tucker)
- (b) Transport;
- (c) Mine closure and rehabilitation;
- (d) Groundwater and water supply;
- (e) Surface water;
- (f) Air quality;
- (g) Flora and vegetation;
- (h) Fauna and habitat; and
- (i) Aboriginal heritage.

The above key factors were identified from the EPA's consideration and review of all environmental factors generated from the ERMP document and the submissions received, in conjunction with the proposal characteristics set out in Table 1.

Details on the key environmental factors and their assessment are contained in sections 4.1 - 4.9. The description of each factor shows why it is relevant to the proposal and how it will be affected by the proposal, taking into consideration environmental impact management by the proponent. The assessment of each factor is where the EPA decides whether or not a proposal meets the environmental objective set for that factor.

The following principles were considered by the EPA in relation to the proposal:

- (a) Principle 1: The precautionary principle;
- (b) Principle 2: The principle of intergenerational equity;
- (c) Principle 3: The principle of the conservation of biological diversity and ecological integrity; and
- (d) Principle 5: The principle of waste minimisation.

4.1 Radiation

Uranium mining has the potential to produce radiological emissions such as:

- gamma radiation;
- radon and radon decay products in air;
- radionuclides in dust;
- radionuclides in surface and ground water; and
- radionuclides in non-human biota including bush tucker.

Radiological emissions can impact the biophysical environment including groundwater, surface water, air quality, non-human biota and bush tucker.

Human health can be affected through exposure to radiation. Exposure may occur when a member of the public is exposed to gamma radiation released during mining, processing or transportation of UOC. Exposure can also occur via inhalation of dust, radon and radon decay products (RDPs), and digestion of food and water.

This section discusses the potential impacts of radiological emissions to groundwater, surface water, air quality, non-human biota and bush tucker.

The EPA's environmental objective for this factor is to ensure that radiological impacts to the public and environment are kept as low as reasonably achievable and comply with acceptable standards.

4.1.1 Groundwater

Description

Groundwater aquifers present in the northern Goldfields region are discussed under the '*Groundwater and Water Supply*' environmental factor in section 4.4.

This section specifically addresses the potential impact of radiation on groundwater quality. Groundwater quality can be affected by leaching of uranium, heavy metals and radionuclides from the solid (tailings) and liquid (pregnant liquor) storage areas (TSF and PLS).

The potential for uranium and radionuclides to enter groundwater is dependent on a number of factors. These include the integrity of the TSF used for long-term containment of tailings using best practice design based on the ALARA (As Low As Reasonably Achievable) principle, and the chemical and physical characteristics of the tailings.

Design of TSF and PLS facilities

Tailings produced via the agitated tank process would be deposited in an in-pit TSF which would be constructed in the Centipede pit area. The pit would have a depth of between four to six metres and the walls would have a crest width of five metres. The perimeter embankment would be constructed using clay and/or structural fill materials consisting of silt/sand gravel. Cell walls inside each facility would be constructed from structural fill and treated with an

erosion protection layer. The base of each tailings cell would be scarified, conditioned with moisture if necessary, and compacted prior to the deposition of tailings. The TSF would be designed with a clay liner with a 300 mm minimum thickness. The clay would be sourced from either the existing clay material underlying the ore or imported from other areas of the mining pits. The compacted clay liner has the potential to remove uranium from the leachate through adsorption, and therefore minimise the movement of contaminants to groundwater.

The pregnant liquor produced from the uranium extraction process would be stored in the PLS pond. The PLS would be constructed with a multi-layered geotextile liner and a leak detection layer between low permeability liners. If leakage occurs, the processing plant would be shut down to allow the repair of the pond.

Tailings characteristics

Geotechnical investigations have been undertaken to assess the physical characteristic of the tailings such as permeability, consolidation, strength and viscosity. Studies indicate that the tailings would have low permeability with a hydraulic conductivity of 8×10^{-8} m/s.

Studies have also been undertaken to assess the leachability of the tailings. Results indicate that approximately 38.5 mg/L of uranium leach from the tailings. Further, modelling was undertaken to predict the movement (fate and transport) of uranium and other solutes from backfilled tailings material, if they were to enter groundwater. The PHREEQC¹ model was used to predict movement of uranium over a 1000 and 10 000 year period.

Modelling results indicate that after 1000 years, the predicted uranium concentration in groundwater would be less than 0.4 mg/L approximately 18 metres from the pit. The predicted uranium concentration after 10 000 years would be less than 0.4 mg/L approximately 100 metres from the pit (Toro Energy Limited 2012). By comparison, the current uranium concentration in groundwater in the project area ranges up to 0.673 mg/L with a mean of 0.05 mg/L.

Testwork by the Australian Nuclear Science and Technology Organisation (ANSTO) showed that all radionuclides in the U-238 decay chain were significantly less soluble than uranium in alkaline carbonate solutions. For this reason, ANSTO concluded uranium could be regarded as a 'worst case scenario' indicator for radionuclide mobility in this environment.

Assessment

The EPA's environmental objective for this factor is to ensure that radiological impacts to the public and environment (groundwater) are kept as low as reasonably achievable and comply with standards.

Groundwater quality can potentially be affected by seepage of uranium, other heavy metals and radionuclides from the TSF and PLS facilities.

¹ The acronym PHREEQC stands for the most important parameters of the model; namely PH (pH), RE (redox), EQ (equilibrium), C (programming language) (Parkhurst and Appelo, 1999)

The EPA notes that all mineralised waste from both the Centipede and Lake Way deposits would be stored in an in-pit TSF. The TSF would be constructed to include a compacted clay liner of minimum 300 mm thickness.

The PLS facility would be constructed with a multi-layered geotextile liner and a leak detection layer between low permeability liners. If leakage occurs, the processing plant would be shut down to allow the repair of the pond.

The EPA notes that approximately 38.5 mg/L of uranium could potentially leach to groundwater. The EPA also notes that fate and transport modelling of the leachable uranium and other solutes from backfilled tailings material indicate that after 1000 years, the predicted uranium concentration in groundwater would be low and the distance travelled would not be significant. Movement of other radionuclides would be considerably less. Consequently, radiological impacts on groundwater would be restricted to the immediate vicinity of the mine site.

The DMP has reviewed the modelling and proposed design of the TSF and advised the EPA that the 'proposed TSF can be constructed and operated to contain tailings and limit leaching of radionuclides over the long term'. The EPA considers, based on the advice of the DMP in relation to:

- permeability of the clay barrier;
- leachability potential of the tailings material;
- contaminant fate modelling; and
- proposed mitigation plans should the target permeability and leachability not be met,

that the proposed tailings storage facility can be constructed and operated to contain the tailings and limit leaching of radionuclides over the long term.

The EPA considers that the use of clay on the base and perimeter embankments of the TSF would ensure that permeability would be low and therefore it is unlikely that seepage would pose a significant risk to groundwater quality over the long term.

The EPA also considers based on the advice of DMP that the proposed monitoring, maintenance and contingency response in relation to the management and operation of the TSF is environmentally acceptable.

Summary

The EPA considers the key environmental factor of radiation (groundwater) has been adequately addressed and the EPA's objective(s) for this factor can be achieved provided the following matters are regulated under the *Mining Act 1978*, *Mines Safety and Inspection Act 1994* and the *Radiation Safety Act 1975* to the satisfaction of the DMP and the Radiological Council.

- The construction of the in-pit TSF;
- Minimise leaching of tailings into groundwater; and
- Compliance monitoring, auditing and reporting of the TSF to ensure the long term integrity of the TSF.

4.1.2 Surface water

Description

The project area is located at the western and northern edges of Lake Way, an upstream salt lake which extends to the south-east. Both the Centipede and Lake Way deposits are located within the floodplain of Lake Way. Surface watercourses in the project area do not flow naturally year round and therefore the main risks for surface water contamination would be during intense rainfall events and if the bunds and the diversion drain systems were ineffective. Radionuclides in surface water can enter the food chain and pose a risk to the public.

Further project details of surface water were discussed under the “*Surface Water*” environmental factor in section 4.5.

Assessment

The EPA’s environmental objective for this factor is to ensure that radiological impacts to the public and environment (surface water) are kept as low as reasonably achievable and comply with standards.

Surface water quality can potentially be affected by radionuclides as a result of loss of solid and/or liquid waste from waste storage areas.

The EPA notes that the proponent has prepared a Water Environmental Management Strategy document to address surface water management. Proposed management strategies include:

- placement of engineered bunds and diversion drains around the mining areas;
- design bunds to address inundation during flood events to prevent natural runoff due to overflows from bunded areas containing process wastes;
- intercepting natural drainage and redirecting it away from the mining area; and
- reinforcing the outside banks of the perimeter bund with riprap to minimise scouring of bunds walls.

Maximum predicted depths of water in a 100 year average recurrence interval event and probable maximum precipitation rainfall event at the proposed bund location are 1.3 m and 3.2 m respectively. Bunding would be constructed one metre above these estimated flood heights to account for water level variations about the modelled water levels.

Natural drainages would be intercepted and redirected away from the mining area. Internal site drainage systems would be used to separate water from stockpiles. Potentially contaminated water would be retained and used for dust suppression, other operational use or evaporated in situ.

During a significant rainfall event stormwater would be stored until it could be used or evaporated. If water is in surplus, the proponent would ensure it

consults with the relevant government authority to ensure that any potential release of stormwater is environmentally acceptable prior to discharge.

The EPA considers that, with the placement of engineered bunds around waste storage areas and the commitment to manage natural flood events by designing perimeter bunds for a 1 in 100 year event, it is unlikely surface water quality would be significantly impacted by radionuclides. The EPA therefore considers that surface water quality can be managed to meet the EPA's objective for radiation.

Summary

The EPA considers the key environmental factor of radiation (surface water) has been adequately addressed and the EPA's objective(s) for this factor can be achieved provided the proponent implements the Water Environmental Management Strategy in relation to the management of natural drainage, waste storage areas and natural flood events.

4.1.3 Air quality

Description

The presence of radionuclides in dust and radon decay products (RDPs) in air can impact the environment, particularly soils and vegetation and human health. RDPs are produced from the breakdown of radon which is naturally present in uranium. Public exposure is based on calculating dose from inhalation of radionuclides in dust and RDPs.

The Nganganawili community and the two accommodation villages are the closest sensitive receptors near the mining pits (Figure 4).

Radionuclides in dust

Dust can be generated by mining activities, stockpiles, wind erosion of tailings deposits and transport of material. Dust storms are characteristic of the Northern Goldfields region and the predominant wind direction in the Wiluna area during the day is towards the east and north-east. At night, wind directions tend to be in a south-easterly direction.

Dust samples were analysed to determine background radionuclide concentrations in air. Levels of Uranium (U-238), Thorium (Th-230), Radium (Ra-226), Lead (Pb-210) and Thorium (Th-228) were measured.

Table 2 shows radionuclide concentrations in dust at two locations: Centipede site and Toro House (administration centre). Toro House is located approximately 9.4 km north-west of the Lake Way mining area. Radionuclide levels observed at Toro House are generally similar to those observed at the Centipede mining area.

Table 2: High volume dust sampling results 2010

Location	Radionuclide Concentration ($\mu\text{Bq}/\text{m}^3$)				
	U-238	Th-230	Ra-226	Pb-210	Th-228
Centipede site	23	<150	11.8	690	4
Toro House	13	<170	7.5	670	6

Radon

Radon has a half life of 3.8 days and is produced from the decay of radium which occurs naturally in uranium. Uranium mining can increase the level of radon in the atmosphere and can lead to health effects due to its radioactive properties.

A potential source of radon emanation is the TSF. A well designed and engineered cap to the TSF would significantly minimise the potential risk of radon emanation. Baseline radon monitoring was conducted at the Lake Way and Centipede deposits in 2010. Results indicate that the average radon concentration in the project area during sampling period was 27 Becquerels per cubic metre (Bq/m^3) which is similar to that observed at other Australian uranium mine sites. Modelling predicted that radon concentrations at the sensitive receptors could increase by a small amount above background levels from implementation of the project (approximately 0.09 Bq/m^3 at Lake Way Station to 1.23 Bq/m^3 at Apex Village) (Toro Energy Limited 2011c; Air Assessments 2011).

Typical concentrations of radon in the atmosphere can vary between 1 and 100 Bq/m^3 , with the worldwide average being 10 Bq/m^3 (UNSCEAR, 2000).

In 1990, scientists from the Australian Radiation Laboratory (now part of ARPANSA) conducted a nation-wide survey of more than 3,300 homes to determine the average annual radiation dose to the Australian population from exposure to natural background radiation. The results show that the average concentration of radon in Australian homes is about 11 Bq/m^3 . This compares to a global average indoor measure of 40 Bq/m^3 (ARPANSA, 2011b).

Radon decay products

Baseline studies to determine RDP concentrations in air were undertaken for the Centipede region. Typical average RDP concentrations in air ranged from 0.02 to $0.03 \mu\text{J/m}^3$. RDP concentrations can peak up to 10 times the average at night time due to inversion conditions (Toro Energy Limited 2011a).

Public exposure is determined by calculating the dose from inhalation of radionuclides in dust and RDP. Table 3 shows the predicted total dose at sensitive receptors near the project area. The total dose ranged from 0.005 to 0.047 milliSieverts per year (mSv/year) which is significantly less than the internationally accepted radiation dose limit of 1 mSv/year set for members of the public (ICRP 1990).

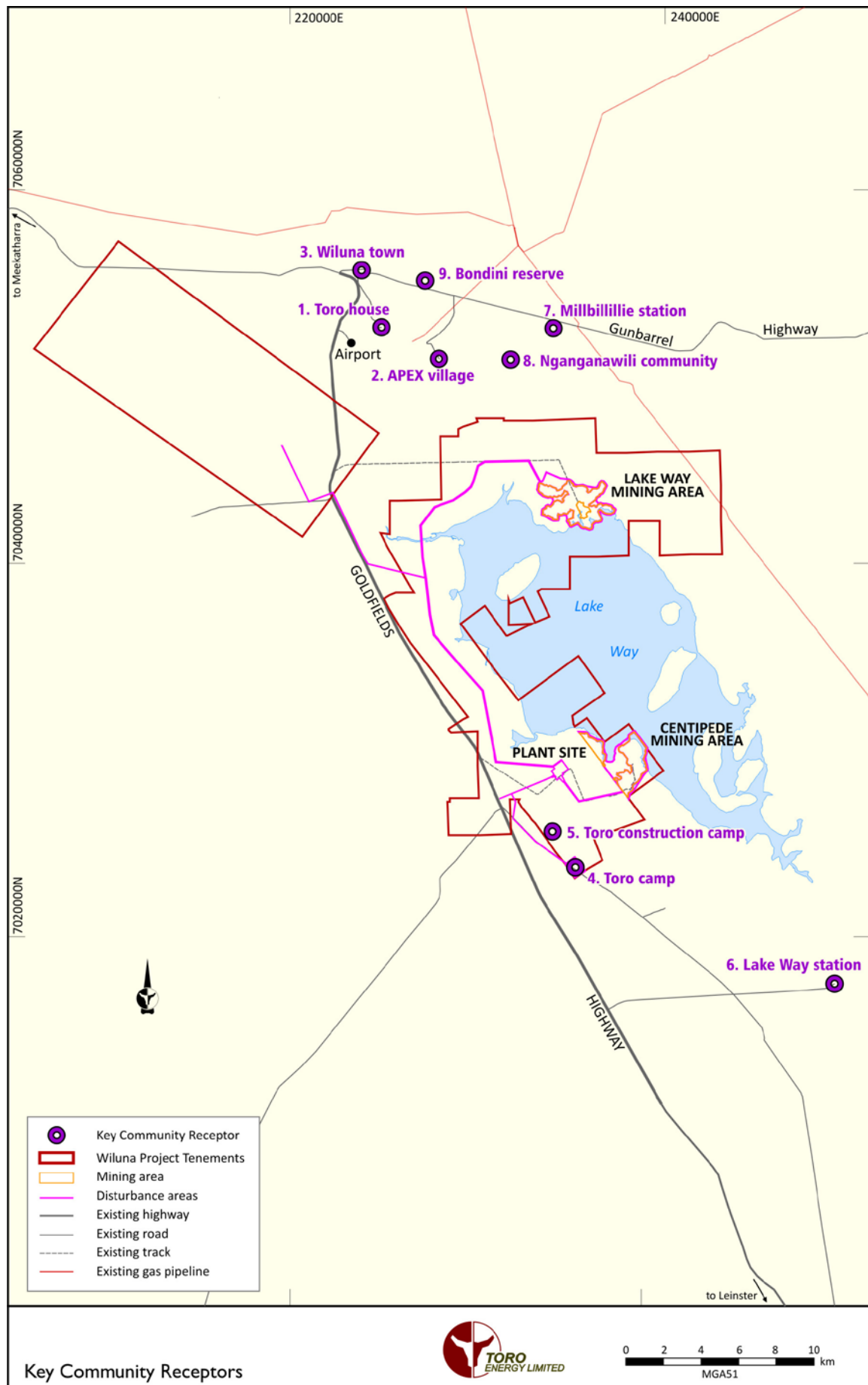


Figure 4: Location of sensitive receivers

Table 3: Radiation dose pathways at sensitive receptor locations near project area

Key Receptor Locations	Dose From Pathway (mSv/y) (for highest year of emissions)			
	Inhalation of RDP	Inhalation of radionuclides in dust	Gamma radiation	Total dose
Wiluna Township	0.020	0.002	0	0.022
Bondini Reserve	0.015	0.001	0	0.015
Ngangganawili Community	0.031	0.003	0	0.034
Millbillillie Station	0.020	0.001	0	0.021
Lake Way Station	0.005	0.000	0	0.005
Apex Village	0.042	0.005	0	0.047
Toro construction camp	0.031	0.002	0	0.033
Toro operations camp	0.015	0.001	0	0.016

Table 4 shows a number of common sources of radiation exposure (ARPANSA, 2011a) and average annual exposures to people in Australia and the world. The medical sources of exposure include x-rays and CAT scans. The worldwide average dose of radiation is higher than the Australian dose. A study undertaken of 10,000 homes found that Australian homes contain less radiation when compared to homes in other continents such as Europe and North America (after ARPANSA, 2010).

Table 4. Common sources of radiation

Source of exposure	Exposure (mSv/y)
Seven hour plane flight	0.05
Medical	0.8
Australian background	1.5
Worldwide background	2.4

Assessment

Radionuclides in dust and radon decay products in air can impact the environment. The EPA notes that baseline studies and modelling for radionuclides in dust, radon gas, and RDPs have been undertaken.

The calculated risk of public exposure is based on the dose from inhalation of radionuclides in dust and RDPs. The EPA notes that high volume sampling for radionuclides in dust were carried out at the mine site (Table 2).

The EPA notes that the total dose to humans is based on the inhalation of RDPs and radionuclides in dust. Modelling data indicates that the total dose to nearby receptors ranged from 0.005 to 0.047 mSv/year. This exposure level is significantly less than the internationally accepted radiation dose limit of 1 mSv/year above natural background, set for members of the public (ICRP

1990). As a comparison, the EPA notes that background dose of radiation in Australia is approximately 1.5 mSv/y and that a dose of radiation from an aeroplane flight could be approximately 0.05 mSv/y (ARPANSA, 2010).

The EPA notes that baseline studies were carried out to determine radon concentration in air and that the observed background level at Lake Way was approximately 27 Bq/m³. Predicted exposure levels at the sensitive receptors ranged from 0.09 Bq/m³ at the Lake Way Station to 1.23 Bq/m³ at the Apex Village. These levels were less than five percent of the measured background level.

The EPA understands that the TSF is a potential source for radon emanation and considers that, with the placement of a two metre cover which includes a radiation control layer, radon release into the environment would be minimised to an acceptable level.

The EPA considers that it is unlikely that radiological emissions from the minesite would affect air quality around the mine site.

Summary

The EPA considers the key environmental factor of radiation (air quality) has been adequately addressed and the EPA's objectives for this factor can be achieved provided the following are implemented:

- a Dust Management Plan; and
- appropriate cover design for the TSF.

4.1.4 Non-human biota (flora and fauna)

Description

The main risks of radiation exposure to non-human biota would be from dust inhalation, gamma radiation and digestion of food and water.

Radiation exposure to non-human biota was assessed using a program called *Environmental Risk from Ionising Contaminants: Assessment and Management* (ERICA). ERICA was developed by the European Commission and is consistent with the ICRP framework. ERICA was used at Olympic Dam in South Australia and has been proposed for use by other uranium mining proponents in Western Australia for assessing radiation exposure to non human biota. The program assesses exposure to a number of different types of animal and plant groups such as lichens and bryophytes, shrubs, trees, small and large herbivores and carnivores.

ERICA uses a reference dose rate of 10 micro Grays per hour (μGy/hr) to assess radiation impacts to non-human biota. This is the estimated absorbed dose rate of radiation an organism would receive from the environment. This value was developed to protect 95% of species in an ecosystem from radiation exposures (Garnier-Laplace et al. 2008).

The reference exposure value is conservative and considerably lower than those proposed previously by the International Atomic Energy Agency (1992) and UNSCEAR (1996) who suggested that no measurable effects would be

observed at values less than 400 $\mu\text{Gy/h}$ for terrestrial plants and less than 40 $\mu\text{Gy/h}$ for terrestrial animals.

Modelling data from the air quality studies were used to determine radiation exposure in ERICA. The exposure to all animal and plant groups, except for bryophytes and lichens was found to be below 10 $\mu\text{Gy/hr}$. The exposure to bryophytes (e.g. mosses, liverwort etc) and lichens was found to be 35 $\mu\text{Gy/hr}$. Bryophytes and lichens have poorly developed root structures and tend to absorb most of their nutrient requirements from atmospheric deposition e.g. dust deposition. As dust was the major radiation exposure pathway to non-human biota, this plant group was likely to be the most exposed group of all the animals and plants and for this reason was found to exhibit the highest exposure.

Assessment

The EPA notes that the ERICA program was used to assess the potential impact to non-human biota and that different types of animal and plant groups were used.

The EPA notes that results indicate that the exposure to all plant and animal groups except bryophytes and lichen was below 10 $\mu\text{Gy/hr}$. However, the exposure to bryophytes (e.g. mosses, liverwort etc) and lichens was found to be 35 $\mu\text{Gy/hr}$. The EPA considers the risk to this plant group to be low because they have a high tolerance to higher doses of radiation (UNSCEAR 1996; Garnier-Laplace et al. 2008).

Whilst there are appropriate Australian and International guidelines to assess potential impacts of uranium and radionuclides on water and air quality, there is no specific criteria for radiological protection of non-human biota per se. The long standing practice has been that if adequate protection of human health is achieved, then the environment would be protected.

The ICRP recently introduced the requirement to assess radiation exposure of non-human species (animals and plants). International best practice is to assess directly absorbed dose rates to non-human biota using a 'reference organism' approach, which involves the use of reference animals and plants (ICRP 2008).

The Australian Radiation Protection and Nuclear Safety Agency (ARPANSA) is working towards a national framework for the assessment of radiation protection in Australian environmental conditions. It is currently reviewing models and methodologies developed internationally for assessing ionising radiation risks to non-human biota, together with associated data, to evaluate their applicability to the range of Australian climatic zones and biota. This will assist ARPANSA to develop a national framework and assessment approach for radiation protection of the environment not only consistent with world's best practice, but also relevant to Australian conditions and our unique biotic types (ICRP 2008).

The EPA considers that it is unlikely that groundwater dependent vegetation and stygofauna would be affected by groundwater as the potential for radionuclides to enter groundwater is low, based on fate and transport studies of radionuclides in groundwater.

The EPA considers that it is unlikely that non-human biota would be significantly impacted by radiological emissions.

Summary

The EPA considers the key environmental factor of radiation (non-human biota) has been adequately addressed and the EPA's objective for this factor can be achieved by minimising radiological emissions to the environment.

4.1.5 Bush tucker

Description

Bush tucker

There was concern by the local Indigenous community that bush tucker (food) could be impacted by radiological emissions. The proponent has undertaken a survey in consultation with local Indigenous people to determine what type of native food was consumed in the area. The objective of the survey was to develop a catalogue of bush tucker plants used by Traditional Owners residing in the Wiluna area.

The proponent carried out a Health Risk Assessment (HRA) to assess the potential risk of radiation on bush tucker. The HRA considered the movement and accumulation of radionuclides through the food chain.

As part of this analysis air quality modelling was used to determine the deposition rate of radionuclides into the environment from mining operations. The radionuclide concentration in soil was determined by calculating the maximum amount of dust that would accumulate in soils over the 14 year operational life of mine. From this data, concentration levels of radionuclides in vegetation and animals were calculated.

Assessment

The EPA notes that the proponent consulted the local Indigenous community in relation to bush tucker and carried out a risk assessment to assess radiation exposures from ingestion of bush tucker. The EPA notes that the radiation dose from bush tucker ingestion was estimated to be very low and below the acceptable dose limit of 1 mSv/year for public exposure. The EPA considers that bush tucker is not a significant pathway of radiation exposure to the public.

Summary

The EPA considers the key environmental factor of radiation (bush tucker) has been adequately addressed and the EPA's objective for this factor can be achieved through access controls to the mine and minimising radiological emissions to the environment.

Summary of radiation factor

Overall the EPA considers that its environmental objective for radiation, which is to ensure that radiological impacts to the public and environment are kept as low as reasonably achievable and comply with standards, can be achieved should the proposal be implemented.

As discussed in Section 3, the EPA also considers that the regulatory framework for regulation of radiation is adequate and therefore considers it is not necessary to apply conditions in regard to radiation management activities and transport under the EP Act.

4.2 Transport

Description

Uranium oxide concentrate (UOC) product would be transported by road from the mine to the Western Australian border for rail and/or road transport to a South Australian for export (Figure 5). The transport of UOC by rail and/or road to Port Adelaide for export is not part of the Western Australian EPA assessment.

The risks of UOC transportation include the potential for radiation exposure to public and the environment mainly due to accidental spillage.

Transport Management Plan

Proponents who propose to transport UOC for export purposes are required to satisfy Federal and State requirements. One such requirement is for the proponent to prepare a Transport Management Plan (TMP) which provides specific information including details of an emergency response plan in the event of accidental loss of UOC.

The TMP establishes the framework the proponent plans to adopt for the safe transport of UOC containers to an Australian port for export shipment and is required to include the following details:

- Quantity (volume) of UOC, number of trucks and frequency;
- Routes approved by Australian Safeguards and Non-Proliferation Office (ASNO) between the project site and nominated Australian export port(s) in South Australia; and
- Management systems and controls for the transport activities.

The proponent has prepared a TMP which would include an Emergency Response Plan (ERP) to address incident management in the event of spillage. The proponent has committed to consult with relevant government agencies and the City of Kalgoorlie-Boulder in the preparation of the ERP.

The TMP addresses the following:

- Volume to be transported;
- Number of vehicles and frequency;
- Regulatory requirements (State and Australian);
- Permits for the transport;
- Transport freight service provider and its responsibility;
- Community engagement;
- Packaging, labelling, placarding;
- Management controls (contamination, incident spills);
- Approved transport routes;
- Communication and security during transport;
- Emergency management and response;
- Security;
- Training;
- Monitoring systems; and
- Review of TMP.

The proponent has also undertaken a joint Desktop Transport Study to investigate and evaluate all transport options and recommend the most appropriate means of transporting UOC from their respective operations to the nominated destination. Part of this study has included a hazard and risk assessment to determine the potential impact of transport to communities, infrastructure emergency services and security.

The risk assessment identified that the main risks were injury to personnel during loading, road transport, loss of containment and security.

As part of the risk assessment the proponent has completed modelling studies to assess human exposure to radiation during the road transport of UOC.

For members of the public, the internationally accepted radiation exposure limit is 1 milliSievert per year (mSv/y) above natural background levels (ICRP 1990). The studies indicated that exposure to gamma radiation was the only potential exposure during transport. Modelling indicated that the exposures were significantly below the 1 mSv/y limit.

The handling, storage and transport of UOC between the mine and the Western Australian border would be carried out in accordance with the requirements of the Radiation Safety (Transport of Radioactive Substances) Regulations 2002. All transport of radioactive substances within Western Australia must comply with the *Radiation Safety Act 1975*, the Radiation Safety (General) Regulations 1983, and the Radiation Safety (Transport of Radioactive Substances) Regulations 2002.

The Australian Safeguards and Non-Proliferation Office (ASNO) is responsible for the issuing of permits for the transport of product along approved routes from the departure point in Australia to the destination port.

Submissions

Submissions raised concerns regarding the proposed transport route through the City of Kalgoorlie and adjacent areas.

Assessment

The EPA's environmental objective for this factor is to ensure that the transport of uranium oxide concentrate on Western Australia roads is carried out in such a manner that the risk to public and environmental health is managed to an acceptable level.



Figure 5: Transport route from project site to the Western Australian border

The EPA notes that UOC would be transported via road from the mine to the Western Australia border for road/rail transport to South Australia for export. There are requirements under State and Federal legislation for all proponents who transport UOC to prepare a TMP, which also includes an ERP.

In the development of the TMP, the proponent should consult with the local community and any communities along the proposed transport route to ascertain their concerns and develop a risk communication strategy that addresses these concerns.

Should the risk communication strategy involve the publication of data obtained during routine monitoring, the Department of Health has advised it

will undertake to provide, where appropriate, independent advice on any potential health impact.

The Radiological Council and the DMP are the key government agencies responsible for regulating transport. As discussed in Section 3, the EPA considers these agencies have adequate legislation and powers in relation to transport including packing, handling and storage of UOC.

These agencies are also responsible for radiation management and have appropriate powers to ensure that members of the public are protected from radiation and that exposure to radiation does not exceed 1 mSv/y.

The EPA considers that monitoring of exposure to radiation along the transport route should be carried out. The EPA understands that the most effective way of achieving this would be by monitoring the exposure to transport personnel such as drivers, who are the most exposed people along the transport route.

The EPA considers that all monitoring data and plans should be made publicly available by the approving agency, subject to any legislative constraints. Vehicles transporting UOC should be required to have Global Positioning Systems (GPS) to ensure they adhere to approved routes.

The EPA considers that the existing regulatory framework is comprehensive in regard to transport and radiation management and can meet the EPA's objectives for transport.

Summary

The EPA considers the key environmental factor of transport has been adequately addressed and the EPA's objective for this factor can be achieved provided there is appropriate implementation of the State and Federal regulatory framework. The EPA does not consider it necessary to recommend conditions under Part IV of the EP Act for transport of UOC.

4.3 Mine closure and rehabilitation

Description

The project involves mining of two uranium deposits; Centipede and Lake Way. The proposal would have a 14 year mine life and a disturbance area of approximately 1530 ha.

Centipede and Lake Way are shallow deposits and have a broad areal extent. Open pit mining would be used and all waste material returned to the mined out voids at Centipede. Mining would take place at Centipede first before commencing at Lake Way. This allows for progressive rehabilitation of tailings to take place. The maximum operational footprint at any one time would be less than 300 ha.

The potential radiation impacts of tailings wastes on the environment and human health is discussed under the 'Radiation' factor in section 4.1.

This section discusses the design, construction and operation of the TSF, mine closure, rehabilitation and post closure monitoring.

Waste management – In-pit TSF

All mineralised waste from both the Centipede and Lake Way sites would be stored in an in-pit TSF constructed at the Centipede mined out pit. Waste rock would either be used to cover the TSF or disposed of in-pit at Lake Way.

A total volume of approximately 15.5 million bulk cubic metres (MBCM) would be mined at Centipede. Accounting for 20 percent volume for construction of cell walls and also high sand points in the area, approximately 12 MBCM of this volume would be available for tailings storage. The combined tailings volume produced from both the Centipede and Lake Way deposits, including an extra 20 percent for swelling of ore, would be 9.1 MBCM. Hence, a spare capacity of 2.9 MBCM would exist as a contingency. The current mining plan is for the processing of high grade ore, although the TSF would be designed to also allow for the potential processing of low grade ore.

Mining operations would commence up to a year ahead of processing to allow for tailings storage cells to be constructed within the pit. The area inside the pit at Centipede would be divided into three facilities and each facility would be divided into three cells (Figure 6). Only one facility would be active at any one time. The pit would have a depth between four to six metres and walls for the facility would have a crest width of five metres. The perimeter embankment would be constructed using clay and/or structural fill materials consisting of silt/sand gravel material. Cell walls inside each facility would be constructed from structural fill and treated with an erosion protection layer. The base of each tailings cell would be scarified, conditioned with moisture if necessary, and compacted prior to tailings deposition. Drainage systems would be constructed at the TSF to reduce phreatic surface through the embankment and divert surface runoff from around the TSF area (Figure 7).

A minimum two metre cover would be placed over the dried out tailings. This cover would consist of a radiation control layer, a shaping layer, a capillary break layer, a surface shedding layer, a growth medium layer and topsoil. The proponent considers that the multiple layers would minimise radon release into the environment to an acceptable level and assist in contouring the surface topography to pre-mining appearance.

Closure

All batters would be reshaped to a suitable slope for rehabilitation. The closure cover would be placed and top surface contoured to prevent local ponding. Surface and slopes would be planted with suitable local provenance vegetation. Closure materials would be selected and designed to minimise long term erosion. No pipework or valves of tailings facility infrastructure would remain in the rehabilitated area. Mechanical plant and equipment would be decontaminated, and undergo radiation assessment before removal from site. All disturbed areas would be rehabilitated as close as practicable to the original topography, with vegetation communities similar to those in the Wiluna region.

A monitoring programme would be undertaken prior to and during operations and as part of the closure period. It would be developed to monitor the integrity of the TSF during and after operations. The plan would include survey pins to check for embankment movement, piezometers in

embankments to monitor the phreatic surface, monitoring bores and surface water sampling stations on the sides of the TSF, and also dust and radiation monitoring. A contingency response plan would also be developed as part of the monitoring programme.

Rehabilitation

In-pit tailings storage allows for progressive rehabilitation to take place and the first cell would be available for rehabilitation after two years. Major voids would not remain open for more than 12 months where operationally practicable. Each cell in the TSF would be capped and rehabilitated after it has been filled. Waste from the mine would be returned to the pits, hence there would be no above ground waste storage structures remaining post-closure. No stockpiles or elevated landforms would remain.

The proponent's key management actions for rehabilitation include:

- confining disturbance to already disturbed areas where practicable;
- ensuring that all clearing would comply with the proponent's vegetation clearing procedure;
- progressively rehabilitating mine voids at similar elevations and slopes to original topography;
- reserving top soil for rehabilitation; and
- avoiding off road driving.

The proponent has committed to recontouring and rehabilitating the mined areas in accordance with their Conceptual Mine Closure and Rehabilitation Plan. This would include ensuring that rehabilitated areas comply with safety and environmental standards.

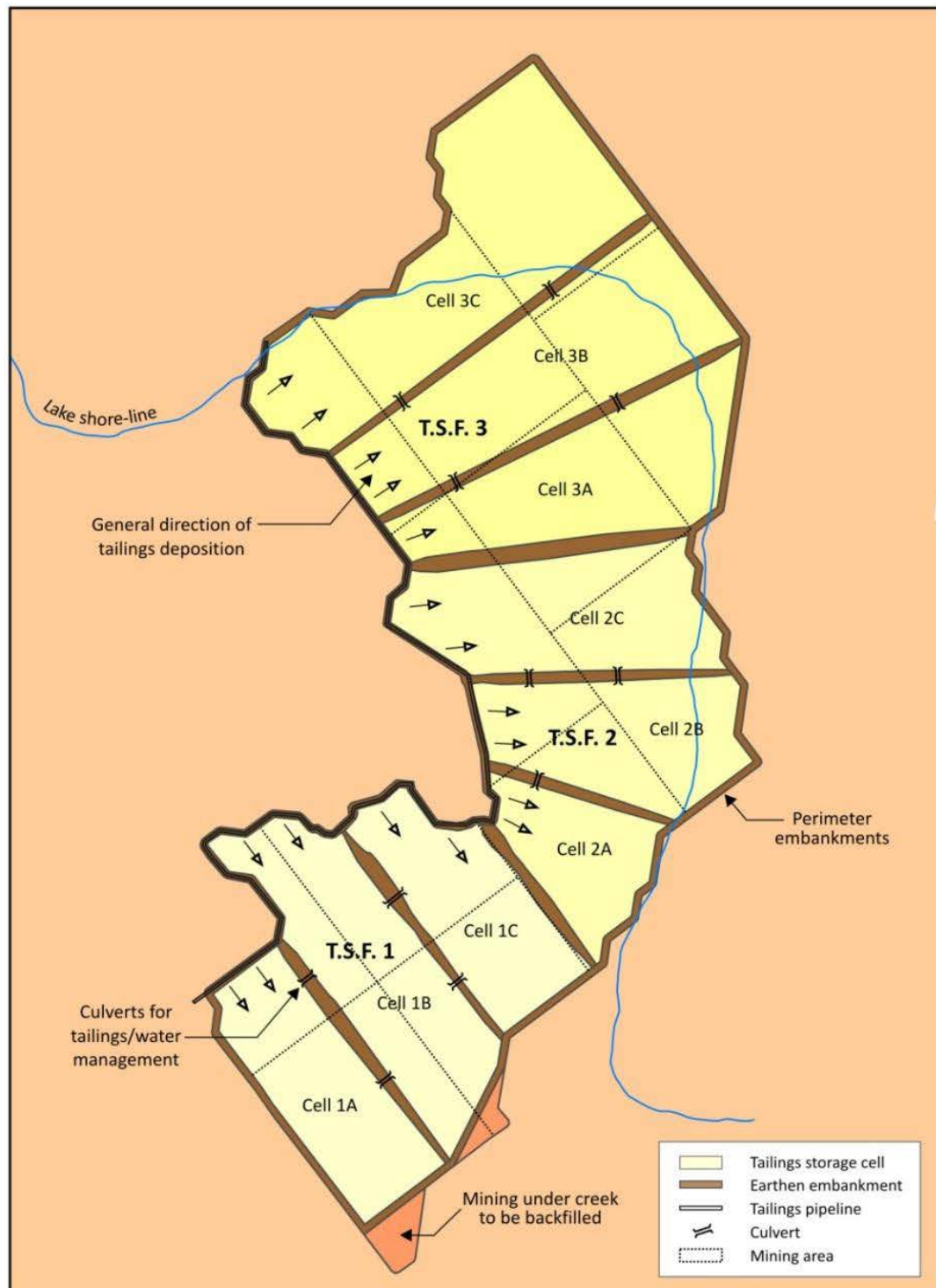
Post closure

An annual assessment of closure outcomes would be conducted by the proponent to ensure the TSF is operating in a safe and efficient manner. Independent external audits of mine closure performance would also be conducted three-yearly to align with the review of the Mine Closure Plan. The Mine Closure Plan is required to detail monitoring and maintenance for a period after closure to ensure that closure outcomes have been met (DMP/OEPA 2011). The DMP has the power under the *Mining Act 1978* to require a company to monitor the TSF post closure to ensure the integrity of the TSF and to impose tenement conditions to prevent or reduce injury to the land.

Submissions

The following issues were raised in submissions:

- the capacity of the TSF cover to reduce radon exhalation;
- the potential for plants to uptake radionuclides after rehabilitation;
- solubility of radionuclides and potential ingress of radionuclides in groundwater; and
- the modelling period.



Tailings Storage Facility - Plan View



Figure 6: Cell configuration for the Tailings Storage Facility

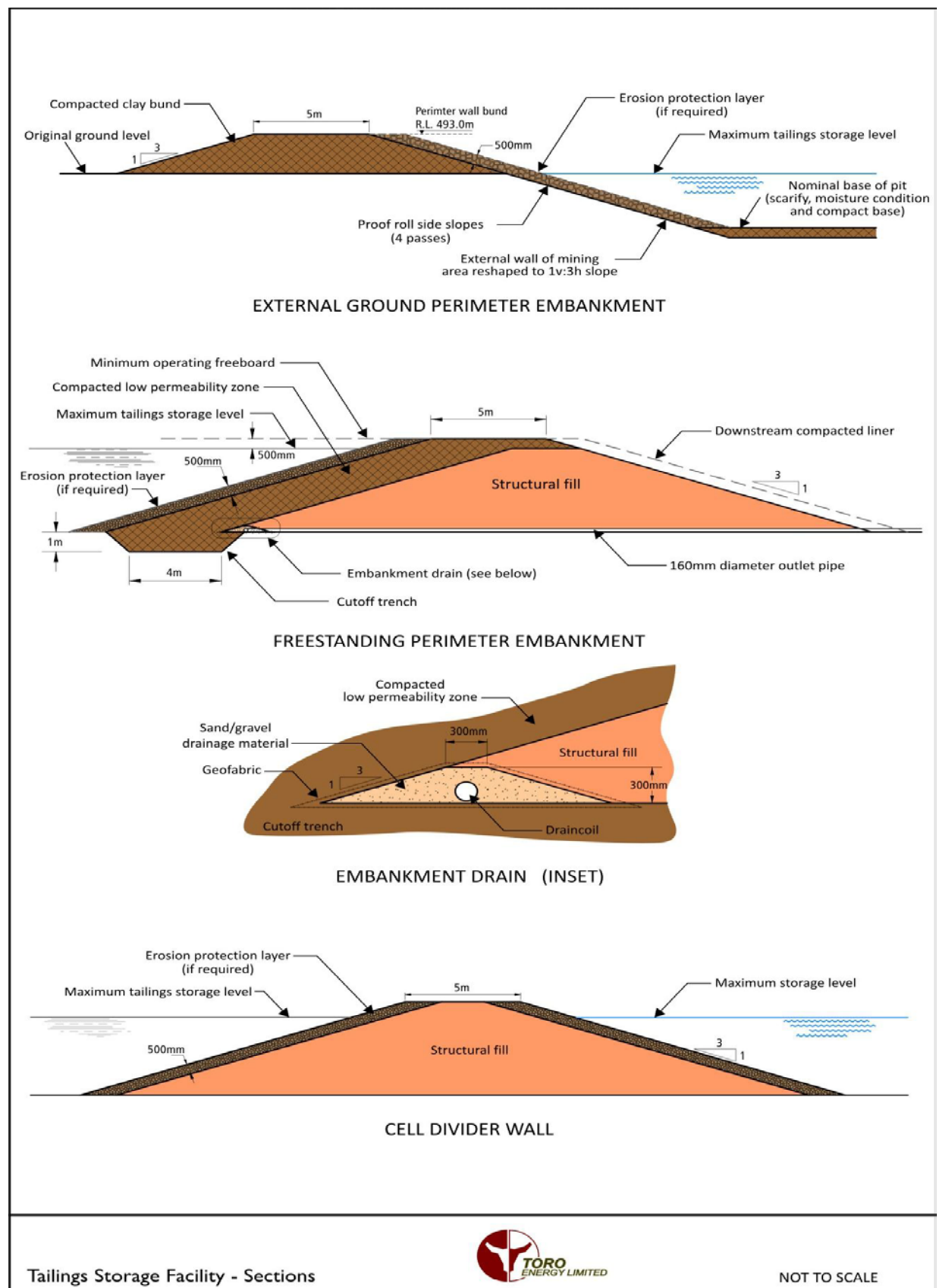


Figure 7: Design of the Tailings Storage Facility

Assessment

The EPA's environmental objectives for this factor are to:

- ensure that closure and rehabilitation achieves stable, non polluting and functioning landforms which are consistent with surrounding landscape and other environmental values; and
- ensure, as far as practicable, that rehabilitation achieves a stable and functioning landform which is consistent with the surrounding landscape and other environmental values.

Mining would initially take place at the Centipede pit and afterwards relocate to the Lake Way pit. The EPA notes that this would allow for progressive mine rehabilitation to take place two years into mining and give an indication of rehabilitation success during the early stages of mining.

The EPA notes that the proponent would be constructing a TSF at the mined out Centipede pit. A total combined tailings volume of 9.1 MBCM would be deposited in the TSF. The TSF would be constructed with a 300 mm compacted clay liner at the base and a minimum two metre cover to contain the tailings and prevent migration or radon emanation from the pit. Other waste material including non-mineralised waste rock would be stored in-pit at Lake Way or used to cap the tailings cells at Centipede.

There would be no above ground waste storage structures, stockpiles or elevated landforms remaining after closure. The land would be recontoured and revegetated using local provenance species. The EPA notes that a monitoring programme would be undertaken, including dust and radiation monitoring, to ensure the TSF is operating safely before, during and after operations. An annual assessment of the mine closure outcomes will be completed by the proponent and a contingency response plan would be developed.

The EPA notes that the proposal is subject to the requirements of the *Mining Act 1978* and the proponent would be required to prepare a Mine Closure Plan detailing closure objectives, management, monitoring, maintenance and contingencies. The proponent has currently developed a Conceptual Mine Closure Plan, guided by the DMP/OEPA guidelines (DMP/OEPA 2011). The EPA recognises that the DMP has adequate powers under the *Mining Act 1978* to require a company to monitor the TSF post closure and therefore recommends that post closure monitoring be carried out to ensure that the TSF is operating in a safe and secure manner.

Based on the design, monitoring and maintenance information provided by the proponent and the advice provided by the DMP, the EPA is satisfied that the TSF can be operated and managed in a safe and secure manner, and can be adequately regulated by the DMP and the Radiological Council. The EPA considers the factor of mine closure and rehabilitation to be adequately addressed and that the environmental objectives for this factor can be met.

Summary

The EPA considers the key environmental factor of Mine Closure and Rehabilitation has been adequately addressed and the EPA's objectives for

this factor can be achieved provided the following matters are regulated under the *Mining Act 1978*, *Mines Safety and Inspection Act 1994* and the *Radiation Safety Act 1975* to the satisfaction of the DMP and the Radiological Council:

- Construction and operation of the in-pit TSF;
- Closure of mine;
- Minimising leaching of tailings into groundwater;
- Minimising radon emanation; and
- Compliance monitoring and reporting of the TSF to ensure the long term integrity of the TSF.

The EPA also considers it important that agencies responsible for the regulation of radiation management liaise closely to ensure integrated and consistent application of their powers to ensure the risk of exposure is managed to meet State and National standards.

4.4 Groundwater and water supply

Description

The aquifers of the northern Goldfields region are comprised of alluvium (sand, silt and gravel), calcrete, palaeochannel sand and fractured rock. Regional groundwater flow in the project area forms part of the Carey palaeodrainage, which flows from northwest to southeast. Groundwater drains towards ephemeral creek lines (West Creek, Negara Creek, Abercromby Creek) from the surrounding higher lying areas, and then flows to the south and east, towards Lake Way.

The groundwater table is typically two to five metres below surface and the depth to water generally reduces with proximity to Lake Way. The uranium mineralisation ore occurs at or below the water table and dewatering of the open pits would be required. The project involves mining two deposits – Centipede and Lake Way. Groundwater inflows into the mining pits are significant and would need to be controlled to enable mining of the ore body. Toro proposes to use either a high density polyethylene liner or compacted clay barriers to minimise groundwater inflow into the mining areas. Groundwater from pit dewatering is an essential component of Toro's water supply needs and therefore the barrier performance would need to be managed to ensure that:

- groundwater inflow into the mine pits is maintained at a level to enable mining of the ore; and
- sufficient groundwater flows into the pit to allow pit-dewatering to occur and which would be used as water supply for the project.

The project requires 2.5 GL per annum of water supply for the life of mine (14 years). The operational life would be for 12 years following a two year construction period. The proposed water supply would be sourced from the West Creek Borefield, pit dewatering and other water sources in the region if required.

Groundwater abstraction

Groundwater abstraction can lower groundwater levels and pose a risk to groundwater dependent vegetation and stygofauna.

Potential impacts on groundwater dependent vegetation and stygofauna have been discussed in sections 4.7 – Flora and vegetation and 4.8 – Fauna and habitat respectively.

Groundwater quality and town water supply

Groundwater salinity in the project area is highly variable. Salinity increases along the regional flow path towards Lake Way and with depth. Groundwater quality in the calcrete aquifer systems including West Creek borefield and the southern and eastern borefields is generally brackish ranging from about 1500 to 5000 mg/L as total dissolved solids.

Groundwater in the shallow lake deposits is saline to hypersaline ranging from 25,000 to 240,000 mg/L total dissolved solids. Groundwater in the area also contains low concentration levels of nickel, lead and naturally occurring uranium (RPS Aquaterra 2011).

The Wiluna Town Water Supply (TWS) borefield supplies water to the Wiluna municipal scheme and to the Bondini Aboriginal Community. The Wiluna TWS borefield is located approximately 12 km north and upgradient of the mining areas.

Groundwater quality in the project area can potentially be affected by seepage of uranium, other heavy metals and radionuclides from solid (tailings) and liquid (pregnant liquor) storage facilities. The potential impact of radiation on groundwater quality is discussed under the factor of '*Radiation*' in Section 4.1.

Submissions

Submissions raised issues that the proposed West Creek borefield water supply source may not provide sufficient water yield to service the entire proposal and that a totally independent contingency water source should be investigated and assessed, including assessment of additional groundwater sources.

Assessment

The EPA's environmental objective for this factor is to maintain the quality and quantity of groundwater water so that existing and potential uses, including ecosystem maintenance, are protected.

The project area lies within the East Murchison Groundwater Area proclaimed under the *Rights in Water and Irrigation Act 1914* and therefore any abstraction of groundwater for pit dewatering or water supply purposes would require a licence from the Department of Water (DoW).

Water supply

Groundwater at the project site and around the region is saline to hypersaline and is not generally used as a potable supply. The EPA notes that the Wiluna Town Water Supply borefield however is used to supply water to the Wiluna

municipal scheme and the Bondini Aboriginal Community. Based on advice from the DoW the EPA considers that it is unlikely that mining would impact this supply as the water supply is located approximately 12 km north and upgradient of the Lake Way deposit.

The EPA notes that the project requires 2.5 GL per annum (GL/a) of water supply for the life of mine (14 years). This supply would be sourced from the West Creek borefield (0.7 GL/a) and the balance from pit dewatering. The EPA notes the concerns raised regarding the potential shortfall in project water supply and that a contingency plan for additional groundwater sources should be fully investigated and assessed.

To address these issues, the proponent has amended its dewatering plan by commencing dewatering of Lake Way in year three and not year six as initially proposed in the Environmental Review document. Dewatering of Lake Way in year three would result in a total of approximately 1.8 GL/a being available from the Centipede and Lake Way deposits and up to 0.7 GL/a from the West Creek borefield for the first six years of operation. Water supply for the first six years of operation would meet the water supply requirements of 2.5 GL/a.

The EPA notes, however, that from year seven onwards the total water supply would be 1.1 GL/a sourced from mine dewatering (0.4 GL/a) and the West Creek borefield (0.7 GL/a). The balance of water required (1.4 GL/a) would need to be from alternative regional groundwater resources.

The EPA notes that the proponent has investigated alternative water supplies to meet the shortfall of 1.4 GL/a and has investigated a number of potential sources to ensure that it has adequate water supply for the 14 year life of mine (Aquaterra, 2010). These include:

- Wiluna Gold Mine Eastern Borefield;
- Wiluna Gold Mine Southern Borefield;
- Ward Well Aquifer;
- KH Morgan Palaeochannel;
- Abercromby Palaeochannel;
- Boo Boo Palaeochannel; and
- Apex Mine dewatering discharge.

These alternative water sources generally have relatively low salinity water and provide a sustainable and environmentally acceptable water supply for the duration of the project. The EPA considers, based on the amended dewatering plan and the advice of the DoW, that there is a viable source of water supply for the 14 year life of mine and that the access of this supply from both the West Creek borefield and dewatering can be managed in an environmentally acceptable manner.

Water quality

The EPA has considered the potential impacts of radiation on groundwater quality under the '*Radiation*' factor (section 4.1). The EPA has concluded that based on the characteristics of the tailings, the design of the tailings storage

facility, leachability of the tailings and the modelling undertaken to predict behaviour and movement of radionuclides, it is unlikely that groundwater quality would be significantly impacted and that groundwater quality can be managed to meet the EPA's objective for groundwater protection.

Summary

The EPA considers the key environmental factor of groundwater and water supply has been adequately addressed and the EPA's objective(s) for this factor can be achieved provided the following matters are regulated under the *Mining Act 1978*, *Mines Safety and Inspection Act 1994* and the *Radiation Safety Act 1975* to the satisfaction of the DMP, the Radiological Council and the DoW.

- The construction of the in-pit tailings storage facility (TSF);
- Minimise leaching of tailings into groundwater;
- Compliance monitoring, auditing and reporting of the TSF to ensure the long term integrity of the TSF; and
- Licensing and monitoring of groundwater abstraction.

4.5 Surface water

Description

The proposed mining areas are located in the catchment of Lake Way, the most upstream salt lake of a salt lake palaeoriver system. Lake Way is about 36 km long and up to 10 km wide, with a surface area of 245 km². Lake Way receives surface water flow from the surrounding 11,000 km² drainage basin.

Lake Way is an example of a playa lake. This type of salt lake is typically a large, closed basin with extensive internal drainage. Playa lake systems are common in arid and semi-arid parts of Australia. Two smaller playa lakes, Lake Violet and Lake Uramurdah, are also located within the project area.

Surface flows

Surface water flow is ephemeral and highly dependent on high rainfall events. The dominant Lake Way sub-catchments are located to the north and north-west of the lake. These larger catchments have poorly defined drainage and only flow after infrequent major rainfall events. Lake Way itself receives intermittent inflows from the surrounding catchments. Dewatering discharges from existing and historic mining operations such as the Apex Gold mine in the northern part of Lake Way have, for some years, caused continuous surface discharge of water to Lake Way (Toro Energy Limited 2011a).

No surface discharge from dewatering would occur. Water from pit dewatering would be used for the process water supply. Disposal of any excess water is planned through the use of evaporation ponds. External surface water runoff and floodwater would be bunded away from mining areas. Sufficient storage would be implemented to contain runoff should a significant rainfall event occur.

The proponent has prepared a Water Environmental Management Strategy Document to address surface water management (Toro Energy Ltd, 2011). Surface water would be managed via engineered bunds and diversion drains around the mining areas. Bunding around operation areas would be constructed to prevent water ingress into the pit, particularly during creek diversion, to allow mining to take place. These bunds would also prevent inundation during flood events and mixing of natural runoff with site runoff.

Maximum predicted depths of water in a 100 year average recurrence interval event and probable maximum precipitation rainfall event at the proposed bund location are 1.3 m and 3.2 m respectively. Bunding would be constructed one metre above these estimated flood heights to account for water level variations about the modelled water levels.

Natural drainages would be intercepted and redirected away from the mining area. Internal site drainage systems would be used to separate water from stockpiles. Potentially contaminated water would be retained and used for dust suppression, other operational use or evaporated in situ. The proponent has committed to manage natural flood events by designing perimeter bunds for a 1 in 100 year event. The outside banks of the perimeter bund will be reinforced with riprap to minimise scouring of bund walls.

The proponent would also limit land disturbance and restore pre-mining surface hydrology.

Surface water quality

Surface water quality may be affected by radionuclide contamination from on-site waste storage facilities such as the in-pit tailings storage and the pregnant liquor storage facilities. The potential impact of radiation on surface water is discussed under the factor of '*Radiation*' in section 4.1.

Submissions

Submissions raised issues on the impact to surface water quality from mining activities and the management of surface water.

Assessment

The EPA's environmental objectives for this factor are to:

- maintain the quality and quantity of surface water so that existing and potential uses, including ecosystem maintenance are protected; and
- maintain the integrity, ecological function and environmental values of watercourses and sheet flow, and to ensure that alterations to surface drainage do not adversely impact native vegetation or flow regimes.

The EPA notes that the proposed mining areas are within the Lake Way catchment and that the lake is typically a large, closed basin with extensive internal drainage. The EPA also notes that there are smaller sub-catchments to the north and north-west of Lake Way and that Lake Way receives intermittent inflows from these sub-catchments, particularly during high rainfall events.

Mining activities and construction of infrastructure such as the tailings storage facilities and haul road has the potential to affect surface water flows. Inappropriate design of storage facilities for solid and liquid waste management could also potentially affect surface water quality, if spillage of waste was to occur.

The EPA notes that the proponent has prepared a Water Environmental Management Strategy document to address surface water management. Proposed management includes:

- Placement of engineered bunds and diversion drains around the mining areas;
- Design of bunds to address inundation during flood events to prevent natural runoff due to overflows from bunded areas containing process wastes;
- Intercepting natural drainage and redirecting it away from the mining area; and
- Reinforcing the outside banks of the perimeter bund with riprap to minimise scouring of bund walls.

The EPA considers that, based on the proposed engineering design of diversion drainage systems including the bund design around waste storage areas and the proposed management of natural floods, it is unlikely that surface water flows would be affected.

The EPA notes that no discharge of dewater would occur and therefore it is unlikely that surface water quality would be affected by potentially contaminated dewater.

The EPA has also considered the potential impacts of radiation on surface water quality under the '*Radiation*' factor (section 4.1). The EPA has concluded that, with the placement of engineered bunds around waste storage areas and the commitment to manage natural flood events by designing perimeter bunds for a 1 in 100 year event, it is unlikely surface water quality would be impacted by radionuclides. The EPA therefore considers that surface water quality can be managed to meet the EPA's objective for surface water protection.

Summary

The EPA considers the key environmental factor of surface water has been adequately addressed and the EPA's objective(s) for this factor can be achieved through the implementation of the proposed Water Environmental Management Strategy to manage diversion water and to avoid spillage from waste storage areas by placement of best design engineering bunds.

The mining infrastructure including bunding would also be subject to approval by the DMP under the *Mining Act 1978*.

4.6 Air quality

Description

Background air quality can potentially be affected by dust, inorganic gases and radiological emissions. Radiological emissions such as dust, radon and RDPs are considered to pose the greatest risk to air quality and are discussed in Section 4.1 under 'Radiation'. Natural events such as bushfires and dust storms which are characteristic of the northern Goldfields region can also elevate background levels of dust and particulate matter.

The predominant wind direction in the Wiluna area during the day is from the east and north-east. At night, wind directions tend to be in a south-easterly direction.

There are a number of sensitive receptors around the mine site. The Nganganawili community and the Toro accommodation village are the closest to the mining area (Figure 4).

A power station (12 MW) would be constructed to generate power for ore processing using natural gas as the main fuel source. Air quality modelling indicates that ambient concentrations of NO_x, SO_x and volatile organics would be low.

The greatest concentrations of nitrogen oxides and carbon monoxide were predicted at the Toro construction camp. The predicted maximum 1-hour concentration for NO₂ is 9.8 µg/m³, which is approximately four percent of the Ambient Air Quality NEPM Standards (1998) of 246 µg/m³. The predicted maximum 8-hour concentration for CO is 5.0 µg/m³, which is well below the NEPM standard of 11,240 µg/m³. As the main fuel source is natural gas, SO_x emissions and particulates are predicted to be negligible.

Submissions

The DEC commented that the:

- key issues pertaining to dust management and monitoring have been adequately addressed; and
- air quality goal for dust should be no exceedances of the PM₁₀ even though NEPM does allow for exceedances for PM₁₀ for natural events.

Assessment

The EPA's environmental objective for this factor is:

- to ensure that emissions do not adversely affect environmental values or the health, welfare and amenity of people and land uses by meeting statutory requirements and acceptable standards; and
- to minimise emissions to levels as low as practicable on an on-going basis and consider offsets to further reduce cumulative emissions.

Air quality can be affected by emissions from power generation and dust.

The EPA notes that air quality modelling undertaken indicates that NO_x, SO_x and CO concentrations would be low. The EPA also notes these levels are below the NEPM standards at the sensitive receptors.

The EPA notes that the proponent has prepared a Dust Management Plan which would be implemented to manage dust emissions related to the proposal. Measures include:

- Application of water to haul and access roads within the mining lease as necessary;
- Application of water to ROM and applying ALARA in design;
- Utilisation of water sprays;
- Use of waste material from the mine immediately in backfilling operations, minimising double handling; and
- Prompt progressive rehabilitation (including rehabilitation) of inactive mining and tailings areas.

The EPA considers that the proposed Dust Management Plan is acceptable and would ensure that dust levels are maintained at low levels.

The EPA has also considered impacts of radiological emissions on air quality under the '*Radiation*' factor discussed in Section 4.1.3 and has concluded that it is unlikely that radiological emissions would affect air quality.

The EPA considers that the impacts to air quality can be managed to meet the EPA's objectives for this factor.

Summary

The EPA considers the key environmental factor for air quality has been adequately addressed and the EPA's objectives for this factor can be achieved provided that the following are implemented:

- A Dust Management Plan; and
- Appropriate cover design for the TSF.

The EPA notes that the mining operations, including dust management will be subject to regulation by the DMP under the *Mining Act 1978*.

4.7 Flora and vegetation

Description

The project is located within the Eastern Murchison (MURI) bioregion of the Interim Biogeographic Regionalisation for Australia (IBRA – Thackway and Cresswell 1995). The Eastern Murchison bioregion is dominated by Mulga woodlands, rich in ephemeral species, hummock grasslands, saltbush and samphire shrublands and covers 7,847,996 ha (Cowan 2001).

Approximately 1530 ha of native vegetation would be cleared during implementation of the project. The two largest areas of clearing include the Centipede deposit (580 ha) and the Lake Way deposit (700 ha). Infrastructure

such as haul roads, an accommodation village, and water and pipelines will account for clearing of approximately 250 ha.

Clearing and dewatering activities have the potential to affect flora and vegetation including groundwater dependent vegetation at the mine site and at the West Creek borefield.

Flora and vegetation studies have included desktop reviews, a baseline survey in 2007 and a level 2 survey in 2010 (Outback Ecology 2008; Niche 2011). The broad groups of vegetation found included playa vegetation, fringing vegetation, dune vegetation, plains vegetation, calcrete vegetation and clay-pan vegetation.

A peer review of the flora and vegetation studies indicated that a number of *Tecticornia* species were identified around Lake Way which potentially could be impacted (Actis Environmental, 2012). There are approximately 6600 ha of *Tecticornia* dominated vegetation around the Lake Way system and the proposal would require clearing approximately 620 ha (9%) of the *Tecticornia* vegetation (Figure 8). Specimens of the *Tecticornia* plants collected during surveys from both within the project area and regionally were presented to the Department of Environment and Conservation's Western Australian Herbarium for taxonomic identification.

The surveys identified that a number of known species occur inside and outside the mining footprint. Some of these species were widespread.

However, a considerable number of specimens could not be identified as known species within the existing taxonomic knowledge on *Tecticornia* species and are likely to represent some new species. There is concern that these potentially new species could be of conservation significance.

Tecticornia species are potentially groundwater dependent and could have very specific habitat preferences based on hydrology, salinity and landform.

The Centipede pit would be mined first before the Lake Way pit. Dewatering of the Centipede pit would occur for three years before the Lake Way pit is dewatered. The combined dewatering rate of both pits would be approximately 1.3 GL/a on average. Modelling studies have been carried out to determine the magnitude and extent of groundwater drawdown based on the proposed dewatering rate of 1.3 GL/a (Figure 9) (RPS Aquaterra 2011a, 2011b).

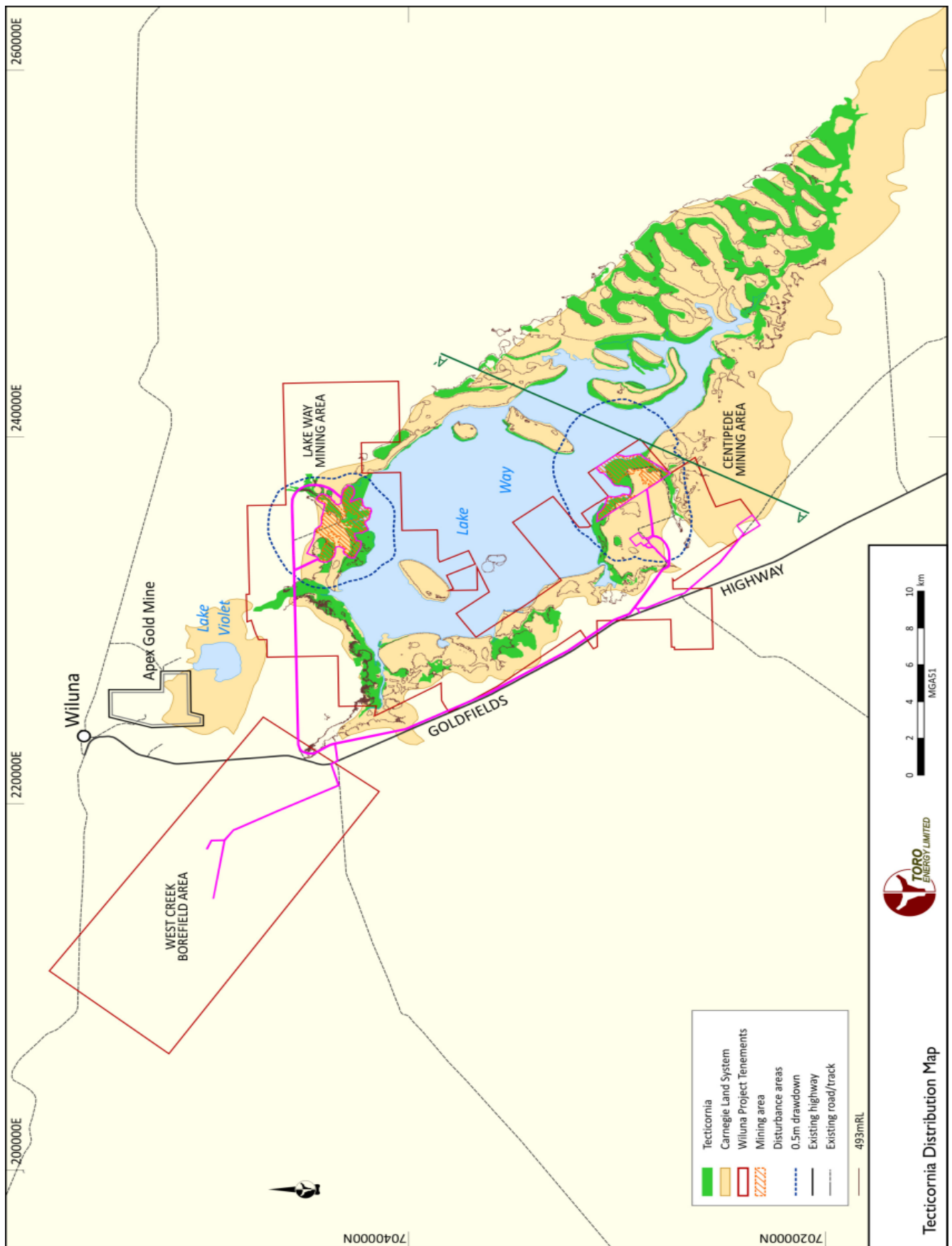


Figure 8. A map of Tecticornia vegetation around the Lake Way system

Submissions

The DEC provided the following comments in its submission:

- it is unlikely that the proposal would impact on currently listed priority flora;
- the unidentified species of *Tecticornia* should be identified and impacts on this vegetation assessed;
- further investigations on groundwater dependent vegetation (GDV) should be carried out and the following considered:
 - extent of impact on GDV;
 - water requirements of GDV; and
 - impacts on high conservation GDV.

The federal Department of Sustainability, Environment, Water, Population and Communities (DSEWPaC) advised that:

- the extent of potential impacts on GDV needs further consideration;
- monitoring, adaptive management and contingency measures for GDV needs to be considered; and
- further details of vegetation on drainage lines and efforts to reinstate the vegetation in new drainage lines needs to be provided.

Assessment

The EPA's environmental objective for this factor is to:

- maintain the abundance, diversity, geographic distribution and productivity of flora at species and ecosystem levels through the avoidance or management of adverse impacts and improvement in knowledge; and
- protect the environmental values of areas identified as having significant environmental attributes.

Approximately 1530 ha of native vegetation would be cleared for mining and infrastructure purposes. The two largest areas of clearing include the Centipede deposit (580 ha) and the Lake Way Deposit (700 ha).

Clearing and dewatering activities have the potential to affect flora and vegetation including groundwater dependent vegetation at the mine site and at the West Creek borefield.

No currently listed declared rare flora were identified in the surveys. A few currently listed priority species were identified in the surveys. The surveys identified that the currently listed priority species which were identified within the mining areas had significantly larger populations outside the mining areas or were only found outside the mining area.

The key flora and vegetation issue for the proposal is the potential impact on *Tecticornia* species and vegetation.

The EPA considers that it is unlikely that the known *Tecticornia* species would be significantly affected by the proposal as survey data indicated that these species, some of which were widespread, occurred inside and outside the mining footprint.

The EPA notes however that some *Tecticornia* species could have very specific habitat requirements based on hydrology, salinity and landform, and that a considerable number of specimens collected in the surveys could not be identified as known species within the existing taxonomic knowledge on *Tecticornia* species and are likely to represent some new species. This included specimens collected within the direct disturbance area and the area of groundwater drawdown. The EPA understands that the identification of *Tecticornia* species is complex mainly because of the physical characteristics of the plants such as variation in morphology within a single species and habitat preference.

Based on the current extent of surveys and taxonomic knowledge of *Tecticornia* species, the DEC has advised that the proposal could result in the loss of unidentified *Tecticornia* species from direct disturbance or groundwater drawdown.

To address this risk, the EPA has recommended condition 8 which requires the proponent to develop a survey and research plan, which implements risk management measures. Importantly, the plan must include details for storage, preservation and research of propagation techniques for any *Tecticornia* species and unidentified specimens located only within the disturbance area and area of groundwater drawdown greater than 0.5 m to conserve these species which may be at risk.

To further address risks, the EPA has also recommended condition 7 which requires the proponent to develop a Groundwater Drawdown Monitoring and Management Plan, including the implementation of a barrier system to limit impacts to *Tecticornia* species within the primary drawdown area of 0.5 m.

Managing the groundwater drawdown will also maintain the ecophysiological conditions in the drawdown area as much as practical, thereby providing potential habitat for propagation of *Tecticornia* species as part of the survey and research plan required by condition 8 and also potentially reduce groundwater recovery time.

The EPA also considers that further monitoring of flora and vegetation should be required to ensure that there is no significant impact to *Tecticornia* dominated vegetation outside the 0.5 m groundwater drawdown areas. Condition 6 has been recommended to require monitoring and provide information on the potential impact on the vegetation through the identification of trigger levels and management response should trigger levels be exceeded.

Residual impacts

While the risk management and protection measures indicated above should ensure that the proposal does not have unacceptable impacts on *Tecticornia* species and vegetation, it will have residual impacts. The EPA considers that an offset should be provided to mitigate for the residual impacts on *Tecticornia*

species and vegetation. The EPA has therefore recommended that the plan required by condition 8 should also include survey and research measures to improve the knowledge of *Tecticornia* species and vegetation. The plan must include:

1. implementation of further surveys to collect *Tecticornia* specimens within and outside the project areas within the associated lake system and immediate adjoining areas;
2. conducting research on *Tecticornia* specimens collected for taxonomic resolution;
3. provision of distribution and abundance data to enable determination of the conservation status of identified *Tecticornia* taxa including relative representation within and outside the project areas;
4. storage, preservation and propagation techniques for any *Tecticornia* taxa and unidentified specimens located only within the disturbance area and area of groundwater drawdown greater than 0.5 m;
5. ecophysiological characterisation and assessment of habitat requirements of different *Tecticornia* taxa within and outside the project area, including an assessment of potential impacts from changes in groundwater quality and quantity, and with main emphasis on those taxa identified as occurring within the disturbance areas; and
6. conducting research on requirements and techniques for re-establishing *Tecticornia* vegetation communities and conservation significant taxa in rehabilitating disturbance areas.

This information should be applied to rehabilitation of the mining areas where practicable.

The EPA considers that it is likely that the EPA's objectives would be achieved for flora and vegetation provided there is satisfactory implementation by the proponent of the recommended conditions 6, 7 and 8.

Summary

The EPA considers the key environmental factor of flora and vegetation has been adequately addressed and the EPA's objective(s) for this factor can be achieved provided that conditions are imposed requiring the proponent to address:

- conducting research on *Tecticornia* specimens;
- provision of distribution and abundance data;
- storage, preservation and propagation techniques;
- ecophysiological characterisation and assessment of habitat;
- conducting research on requirements and techniques for re-establishing *Tecticornia* vegetation;
- Prepare a Groundwater Drawdown Monitoring and Management Plan;
- Monitoring impacts on *Tecticornia* outside the mine area and drawdown areas; and

- Implementing remedial actions if vegetation health triggers are exceeded.

4.8 Fauna and habitat

Description

Lake Way is typical of the salt lakes in the northern Goldfields region, which are formed as a result of sedimentation and act as basins for the build up of salts. The lakes in the region are connected to the regional and local groundwater systems and this is often reflected in the ecology in and around the lakes (Outback Ecology 2011). Ecological studies on the salt lake indicate that the lake is similar to other lakes in the Goldfields region (Outback Ecology 2011).

Clearing and dewatering activities at the Centipede and Lake Way pits and at the West Creek borefield have the potential to impact directly and indirectly on fauna and their habitat. Direct impacts may include excavation of a pit which can remove stygofauna. Indirect impacts may include groundwater drawdown resulting in a subsequent loss of stygofauna habitat.

The proponent has carried out surveys on terrestrial vertebrates, short-range endemics, subterranean fauna including stygofauna and troglobitic fauna.

Terrestrial vertebrates

Surveys for vertebrate fauna have included a summer reconnaissance survey in 2009 and a detailed autumn survey in 2010. Surveys identified 216 species of vertebrate fauna including 31 mammals (20 native), 105 birds, 75 reptiles, and five amphibians.

No threatened fauna species listed under the *Environment Protection Biodiversity Conservation Act 1999* (EPBC Act), *Wildlife Conservation Act 1950* or Priority Fauna Species were recorded.

Two migratory species of birds listed under the EPBC Act were identified during the 2010 survey; one species was observed during an opportunistic sighting. Twelve migratory bird species listed under the EPBC Act were recorded on Lake Way during a large flooding event in 1978 (Outback Ecology 2011).

Lake Way is not listed as a wetland of significant importance for migratory bird species at a national or international level (Outback Ecology 2011).

Short range endemics (invertebrates)

An autumn survey for short range endemics (SREs) was carried in 2010 (Outback Ecology, 2011). Specimens of mygalomorph spiders, centipedes, scorpions, molluscs, and pseudoscorpions were collected during the surveys. Five potential SREs were identified in the project areas. Those species which are likely to be directly impacted by clearing were also identified outside the project areas, or have habitat types which are well represented outside the project areas.

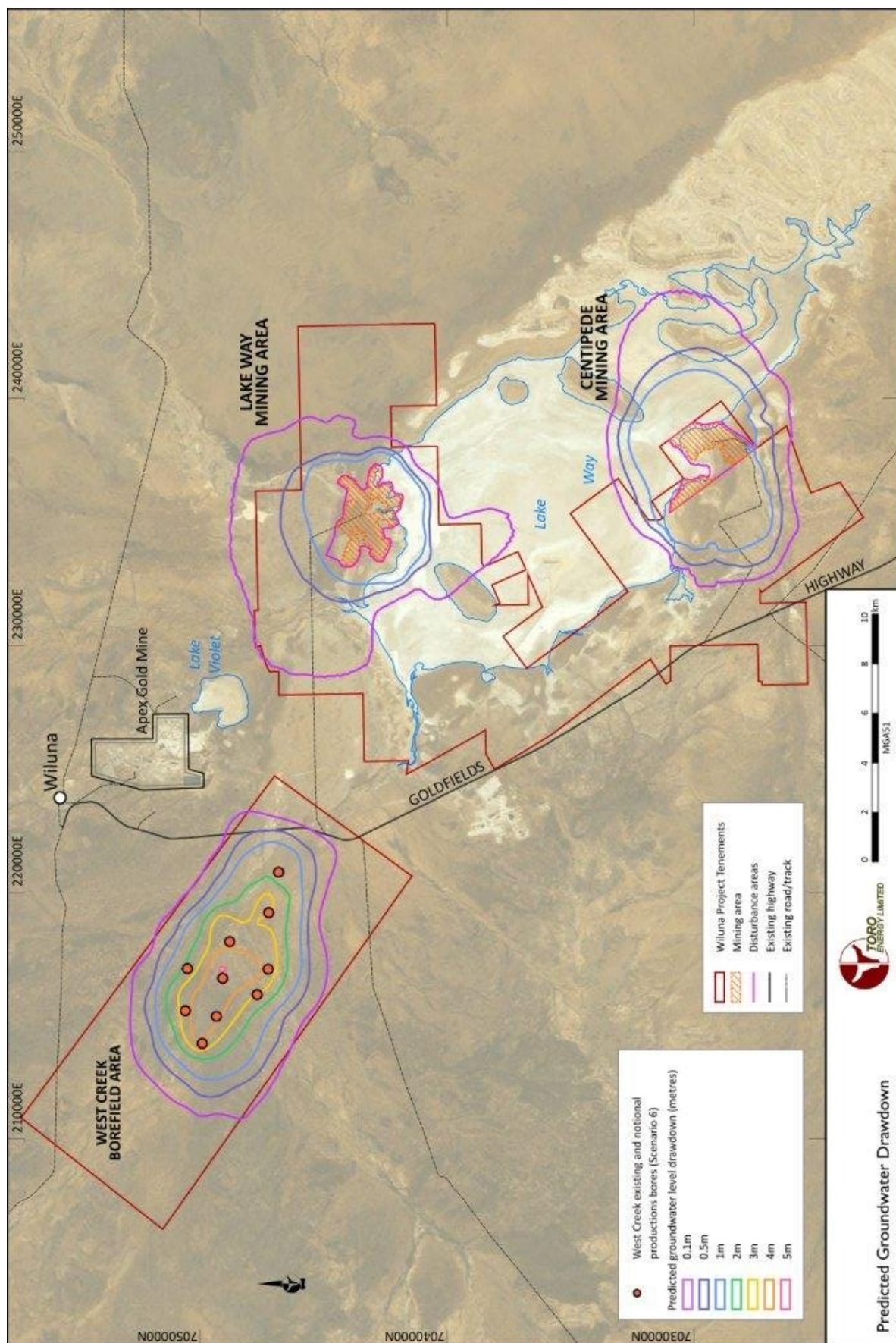


Figure 9: Drawdown contours for Centipede Pit, Lake Way and West Creek Borefield.

Subterranean fauna

Three stygofauna surveys were carried out at the Centipede deposit between 2007 and 2010. A number of surveys were also carried out at the Lake Way deposit and West Creek borefield between 2009 and 2010. Additional surveys of the Centipede and Lake Way deposits, and West Creek borefield were carried out in November 2011 and January 2012.

Survey data indicates that the majority of stygofauna species were found inside and outside of the mining areas. However, some stygofauna species could potentially be impacted due to mining activities such as excavation of the pits and pit dewatering.

Troglobitic fauna surveys were carried out at the Centipede and Lake Way deposits between November 2009 and May 2010, however at the West Creek borefield a pilot study was undertaken. No species clearly definable as troglotauna were collected at West Creek borefield.

Submissions

The DEC raised issues regarding:

- the extent of the surveys; and
- the potential impact of groundwater drawdown on stygofauna.

The SEWPaC raised issues regarding the extent of surveys and habitat assessment for stygofauna.

Assessment

The EPA's environmental objective for this factor is to:

- maintain the abundance, diversity, geographic distribution and productivity of fauna at species and ecosystem levels through the avoidance or management of adverse impacts and improvement in knowledge; and
- protect the environmental values of areas identified as having significant environmental attributes.

No threatened ecological communities or fauna were identified within the project areas.

Calcrete aquifers in inland arid Australia, notably those around Lake Way, contain a rich and diverse assemblage of stygofauna species which are totally dependent on the subterranean water bodies (Humphreys et al. 2009). In recognition of the rich diversity on a global standard the calcrete stygofaunal communities around the Lake Way region were nominated for listing as threatened ecological communities in 2008 and are currently identified as priority ecological communities.

The EPA notes that three stygofauna surveys were carried out at the Centipede deposit between 2007 and 2010. A number of surveys were also carried out at the Lake Way deposit and West Creek borefield between 2009 and 2010. Further surveys were also carried out in November 2011 and

January 2012. Preliminary findings have been provided on these pending completion of all taxonomic work.

The EPA considers that stygofauna species found within the pit areas are likely to be more widespread, because:

- there are large areas of suitable stygofauna habitat outside of the pit areas, such as the Hinkler Well and Uramurdah Lake calcretes;
- many species found within the pit areas have also been found outside, and
- the species identified in the pit areas were encountered at low abundances and there is uncertainty in the sampling of stygofauna with low abundances in multiple locations.

The EPA notes that the proponent has carried out groundwater modelling to determine the magnitude and extent of groundwater drawdown at the pits. The predicted drawdown from dewatering at the Centipede and Lake Way pits included a worst case scenario with no effective barrier in place.

The EPA notes that a number of stygofauna species were identified within the pit drawdown areas (greater than 0.5 m) and that these intersect the identified priority ecological communities. The EPA considers that controlling the groundwater drawdown around the pits would minimise the potential risk to the stygofauna species near the pits.

The EPA considers that with the implementation of the recommended condition 7 which requires the proponent to develop a Groundwater Drawdown Monitoring and Management Plan, including the implementation of a barrier system to control groundwater drawdown, the impacts to stygofauna would be minimised.

The EPA notes that a number of stygofauna species were identified at the West Creek borefield which could potentially be affected by drawdown. Most of these species were collected at low abundances. The stygofauna assemblages surveyed within the borefield area were similar to assemblages outside. The calcrete aquifer at the West Creek borefield has an average saturated thickness of 10 to 15 m with a maximum saturated thickness of approximately 20 m and the EPA notes that the predicted groundwater drawdowns are not large compared to the saturated calcrete aquifer thickness.

On this basis it is unlikely that any species of stygofauna will be threatened by extinction as a result of the mining or dewatering for the proposal.

Summary

The EPA considers the key environmental factor of fauna has been adequately addressed and the EPA's objective(s) for this factor can be achieved, provided that conditions are imposed requiring the proponent to:

- prepare a Groundwater Drawdown Monitoring and Management Plan;
- design and implement a suitable groundwater barrier system; and
- monitor groundwater drawdown.

4.9 Aboriginal heritage

Description

Wiluna is an important area in terms of Aboriginal culture in the Western Desert region. It is traditionally a major law centre and plays a central role at law time with people travelling from as far away as Docker River to conduct rituals in and around Wiluna (Sackett, L, 1977). Aboriginal people of the Western Desert began visiting and residing in the Wiluna Township in the late 1940s.

There are 15 Aboriginal heritage sites recorded on the Department of Indigenous Affairs (DIA's) Aboriginal heritage register within or potentially within the project tenements (Figure 2). Eight are listed as archaeological artefacts, six are described as ethnographic and one is recorded as ethnographic-archaeological.

Toro has consulted with Indigenous people of the region based on advice from traditional owners, Native Title Claimants represented by the Central Desert Native Title Services (CDNTS), and their representative bodies. Toro has provided assistance to CDNTS to undertake ethnographic cultural mapping in the area.

Toro has agreed a general project configuration with CDNTS. Importantly the project configuration avoids one of the sites (Uramurdah Creek) which is considered particularly significant to the local Indigenous people. The site has been protected from mining operations by a buffer on either side.

The project has potential to affect other registered sites through roads and infrastructure. Detailed surveys will be undertaken in consultation with the local Indigenous people in finalising routes for these to avoid sites where practicable. Toro is required to make a section 18 application under the *Aboriginal Heritage Act 1972* to obtain permission to disturb any site.

Toro has committed to:

- negotiate a mining agreement with traditional owners which would include commitments to cultural heritage protection; on-going consultation with Aboriginal people through the life of the project; and cross cultural awareness training for all employees and contractors;
- make an application under section 18 of the *Aboriginal Heritage Act 1972* for disturbance of any registered cultural heritage site. Toro would ensure this was done in consultation with traditional owners, and, where requested to do so, implement site salvaging work and any other reasonable mitigation measures;
- continue to discuss with traditional owners the application of Indigenous ecological knowledge in environmental monitoring and management; and
- undertake further bush tucker surveys with the involvement of the traditional owners as part of their ongoing environmental monitoring program.

Submissions

Central Desert Native Title Services

- CDNTS made a submission regarding management actions and Indigenous ecological knowledge of the Native Title Claimants. The submission advised that Toro is working closely with the Native Title Claimants to develop a Heritage Management Plan to protect the large number of culturally significant sites around the proposed project. It further advised that Toro recognise the Native Title Claimants management of country through, but not limited to the expression of their native title rights and cultural use of country in traditional burning, cultural heritage management, hunting around and access to the proposed project as well as identification and use of culturally significant flora.

Department of Indigenous Affairs

- The DIA has advised that a section 18 application will need to be submitted to ensure that appropriate permissions are obtained for disturbance of any Aboriginal heritage sites.

Assessment

The EPA's environmental objective for this factor is to ensure that changes to the biophysical environment do not adversely affect historical and cultural associations and comply with relevant heritage legislation.

The EPA's *Guidance No 41 – Assessment of Aboriginal Heritage* sets out that where Aboriginal heritage is a relevant environmental factor the proponent should demonstrate that the relevant Aboriginal heritage issues have or will be identified and that the proponent has properly considered how to minimise any adverse impact by the proposal on heritage values.

The Guidance identifies the following actions that may be pertinent to the factor of Aboriginal heritage:

- Consult with staff of the DIA and review any site records (desk-top review) in accordance with the *Aboriginal Heritage Act 1972*.
- Undertake an Aboriginal heritage survey (if it is noted from a desk-top review that an adequate survey has not been undertaken for an area to be developed) which should include both consultation with appropriate Aboriginal people, which may include an anthropological survey, and, if necessary, an archaeological survey.
- Inform the relevant Aboriginal people about details of the proposed development, including potential environmental impacts.
- Consult with relevant Aboriginal people to enable them to make known to the proponent their concerns in regard to environmental impacts as they affect heritage matters.
- Demonstrate that any concerns raised by Aboriginal people have been adequately considered by the proponent in its management of environmental impacts, and any changes as a result of this process are made known to the relevant Aboriginal people.

The EPA notes that prior to mining, the proponent would require a section 18 approval from the DIA where disturbance of a known Aboriginal heritage site may occur. The EPA also notes that the approval to mine would also be subject to a mining agreement between the Aboriginal Title Claimants and the proponent.

The EPA considers based on the information provided in the Environmental Review document, submissions received, the proponent's response to submissions and the need for the proponent to obtain a section 18 approval from the DIA, that it is likely the proposal can be implemented to meet the EPA's objective for the environmental factor of Aboriginal heritage.

Further, the EPA considers there are other processes under the *Aboriginal Heritage Act 1972* and the *Native Title Act 1993* to manage issues regarding Aboriginal heritage such that it is not necessary to recommend a condition for this environmental factor.

Summary

The EPA considers the key environmental factor of Aboriginal Heritage has been adequately addressed and the EPA's objective(s) for this factor can be achieved.

4.10 Environmental principles

In preparing this report and recommendations, the EPA has had regard for the object and principles contained in s4A of the EP Act. Appendix 3 contains a summary of the EPA's consideration of the principles.

5. Conditions

Section 44 of the EP Act requires the EPA to report to the Minister for Environment on the key environmental factors relevant to the proposal and on the conditions and procedures to which the proposal should be subject, if implemented. In addition, the EPA may make recommendations as it sees fit.

5.1 Recommended conditions

Having considered the information provided in this report, the EPA has developed a set of conditions that the EPA recommends be imposed if the proposal by Toro Energy Limited to develop the Wiluna Uranium Project is approved for implementation.

These conditions are presented in Appendix 4. Matters addressed in the conditions include the following:

Condition 6 'Flora and vegetation – *Tecticornia*' addresses any potential impacts on *Tecticornia* species outside the 0.5 m drawdown area. It requires monitoring and reporting on the potential impact on the vegetation through the identification of trigger levels and management responses should trigger levels be exceeded.

Condition 7 'Groundwater drawdown' addresses potential impacts on *Tecticornia* and stygofauna within the 0.5 m drawdown area. It requires the proponent to develop a Groundwater Drawdown Monitoring and Management Plan, including the implementation of a barrier system to limit impacts to stygofauna and *Tecticornia* species within the primary drawdown area of 0.5 m.

Condition 8 'Residual impacts and risk management measures' requires the proponent to develop a survey and research plan, which addresses the residual impacts from the proposal and implements risk management measures. The plan must include:

1. implementation of further surveys to collect *Tecticornia* specimens within and outside the project areas within the associated lake system and immediate adjoining areas;
2. conducting research on *Tecticornia* specimens collected for taxonomic resolution;
3. provision of distribution and abundance data to enable determination of the conservation status of identified *Tecticornia* taxa including relative representation within and outside the project areas;
4. storage, preservation and propagation techniques for any *Tecticornia* taxa and unidentified specimens located only within the disturbance area and area of groundwater drawdown greater than 0.5 m;
5. ecophysiological characterisation and assessment of habitat requirements of different *Tecticornia* taxa within and outside the project area, including an assessment of potential impacts from changes in groundwater quality and quantity, and with main emphasis on those taxa identified as occurring within the disturbance areas; and
6. conducting research on requirements and techniques for re-establishing *Tecticornia* vegetation communities and conservation significant taxa in rehabilitating disturbance areas.

5.2 Consultation

In developing these conditions, the EPA consulted with the proponent, the Department of Mines and Petroleum, Department of Health/Radiological Council of Western Australia, Department of Environment and Conservation, Department of Water and the Commonwealth Department of Sustainability, Environment, Water, Population and Communities, in respect of matters of fact and matters of technical or implementation significance.

6. Other advice

The EPA considers that the existing regulatory framework provides a comprehensive legislative system for the regulation of the uranium mine and transport of uranium oxide concentrate, and therefore considers it not necessary to recommend conditions in regard to transport and radiation management activities under the EP Act.

It is important that the regulatory agencies responsible for the regulation of transport and radiation management liaise closely to ensure integrated and consistent application of their powers to make sure the risk of exposure to radiation is managed to meet State and National standards.

The EPA considers that all environmental management plans and documents required for regulatory approval should be made publicly available by the approving agency subject to any legislative constraints.

Uranium Advisory Group report

The EPA notes that the report and recommendations of the Uranium Advisory Group (UAG) and the DMP's response to these recommendations were released on 14 May 2012.

The EPA supports the responses made by the DMP to the UAG's recommendations. In particular, the EPA notes the DMP's commitment to improve transparency and adopt the risk-based and outcome-based approaches to environmental regulation including compliance monitoring. The EPA considers that these matters are important components in moving towards world's best practice regulation.

The UAG's report and the DMP's response are available at <http://www.dmp.wa.gov.au/15426.aspx>.

7. Recommendations

That the Minister for Environment:

1. Notes that the proposal being assessed is for the development of the Wiluna Uranium project to mine the Centipede and Lake Way deposits in Wiluna, Western Australia.
2. Considers the report on the key environmental factors and principles as set out in Section 4;
3. Notes the EPA has concluded that it is likely that the EPA's objectives would be achieved, provided there is satisfactory implementation by the proponent of the recommended conditions set out in Appendix 4 and summarised in Section 5;
4. Imposes the conditions and procedures recommended in Appendix 4 of this report; and
5. Notes the EPA's other advice presented in Section 6 in relation to the regulatory framework and availability of plans and reports to the public.

Appendix 1

List of submitters

Government organisations:

Department of Sustainability, Environment, Water, Population and Communities

Department of Environment and Conservation

Department of Health

Department of Indigenous Affairs

Department of Mines and Petroleum

Department of Water

Radiological Council (WA)

Main Roads WA

City of Kalgoorlie-Boulder

Non-Government organisations:

Avon Valley Environmental Society

Environment Centre NT

Kalgoorlie-Boulder Chamber of Commerce and Industry Inc.

People for Nuclear Disarmament (WA)

Conservation Council (WA)

Australian Conservation Foundation

Friends of the Earth – Australia

The Wilderness Society

Greenpeace Australia Pacific

Arid Lands Environment Centre

Environment Victoria

Conservation Council (NSW)

EnergyScience Coalition

Public Health Association of Australia

Australian Nuclear Free Alliance

Medical Association for Prevention of War Beyond Nuclear Initiative Australian Peace Committee

Japanese for Peace

Beyond Nuclear Initiative and Australian Peace Committee

Central Desert Native Title Services Ltd

Anti-Nuclear Alliance of WA

Individuals:

Senator Scott Ludlam

Hon Alison Xamon MLC

Hon Robin Chapple MLC

Hon Giz Watson MLC

25 private submissions

Appendix 2

References

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Appendix 3

Summary of identification of key environmental factors and principles

Preliminary Environmental Factors	Proposal Characteristics	Government Agency and Public Comments	Identification of Key Environmental Factors
BIOPHYSICAL			
Flora and Vegetation	<p>The proposal will require clearing of vegetation from an area of 1530 ha. Groundwater drawdown around the mining areas may impact on groundwater dependent vegetation.</p> <p>No Declared Rare Flora (DRF), threatened ecological communities or priority ecological communities would be impacted by the project.</p> <p>A peer review on <i>Tecticornia</i> species identified that some specimens could be significant because they could not be identified to a species level.</p>	<p><u>Government Agencies</u></p> <p>DEC advises that it is unlikely that the proposal would have impacts on priority flora.</p> <p>DEC recommends that the unidentified species of <i>Tecticornia</i> are identified and impacts on this vegetation are assessed.</p> <p>DEC recommends that further investigations on groundwater dependent vegetation (GDV) include:</p> <ul style="list-style-type: none"> • the extent of impact on GDV; • the water requirements of GDV; and • identify the impacts on high conservation GDV. <p>DEC recommends the proponent agree to groundwater drawdown</p>	<p>The EPA considers that Flora and Vegetation is a key environmental factor. This is further discussed in Section 4.7 of this report.</p>

		<p>limits and impacts to GDV, including the development of triggers (e.g. water level and plant stress) and management actions to meet the limits.</p> <p>SEWPaC advises that:</p> <ul style="list-style-type: none">• the impacts on GDV need to be quantified; and• further details of vegetation on drainage lines and efforts to reinstate the vegetation in new drainage lines needs to be provided. <p>SEWPaC advises that monitoring, adaptive management and contingency measures for GDV need to be provided.</p>	
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Fauna	Terrestrial invertebrate (including short range endemics (SREs))	<p>Invertebrate fauna such as mygalomorph spiders, centipedes, scorpions, molluscs, and pseudoscorpions may be impacted by direct clearing and mining excavations.</p> <p>Five potential SREs were identified in the project areas. Those species which are likely to be directly impacted were also identified outside the project areas, or have habitat types which are represented outside the impacted areas.</p>		The EPA considers that Fauna is a key environmental factor. This is further discussed in Section 4.8 of this report.
	Terrestrial vertebrate	<p>Invertebrate fauna such as birds and mammals may be impacted by direct clearing and infrastructure development.</p> <p>No threatened fauna, ecological communities or priority terrestrial fauna were found on the site during surveys.</p>	<p>Government Agencies</p> <p>SEWPaC advises that the proponent needs to describe the mechanisms and procedures to control bird life from entering the evaporation ponds.</p> <p>Public</p> <p>The evaporation pond is likely to be the open water body in the region with water. It is likely to attract birds regardless of whether they find the</p>	

			solution too salty.	
	Salt lake ecology	<p>Contaminated surface water runoff and groundwater pollution have the potential to impact on the Lake Way ecosystem.</p> <p>Studies on Lake Way indicate it has an ecology similar to other salt lakes in the northern Goldfields region.</p>	<p>Government Agencies</p> <p>DEC advises the salt lake ecology should be re-assessed after a 1 in 20 year 72 hour rainfall event in the region, when the lake contains a suitable quantity of water.</p>	
	Subterranean fauna (including stygofauna and troglofauna)	<p>Impacts on stygofauna may occur through habitat excavation and groundwater drawdown. Troglofauna may be impacted from excavation.</p> <p>Several stygofauna surveys have been carried out on West Creek borefield, and the Centipede and Lake Way deposits. The surveys indicate that some species are widespread in the region and occur in different calcrete habitats.</p>	<p>Government Agencies</p> <p>DEC advises that the proponent needs to complete:</p> <ul style="list-style-type: none"> • additional sampling of stygofauna reference sites for the West Creek borefield and potentially Lake Way; • assessment of likely stygofauna habitat within the drawdown areas taking into account salinity; and • assessment of the potential 	

			<p>impacts on stygofauna from tailings storage.</p> <p>DEC advises that the proponent needs to develop and implement a suitable stygofauna monitoring and management plan including the development of suitable triggers and management actions.</p> <p>The DEC advises that further work is required including:</p> <ul style="list-style-type: none"> • assessment of whether species within the mining footprint are troglafauna; and • habitat assessment to confirm if the habitat of known troglafauna within the mining footprint also occurs outside the mining footprint. <p>SEWPaC advises that further evidence is required to demonstrate:</p> <ul style="list-style-type: none"> • stygofauna species only found in the mining areas occur 	
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			<p>outside the mining areas; and</p> <ul style="list-style-type: none"> the impact of water abstraction on stygofauna species will be moderate. <p>Public</p> <p>A limited number of samples were taken from the Uramurdah and Lake Violet calcrete systems. Not enough consideration of stygofauna movement and distribution against stygofauna size, habitat differences and salinity.</p> <p>Each calcrete system needs to be assessed as a separate unit and connectivity between units needs to be further proven. Not all of the potential habitats and connectivity between these systems have been explored.</p> <p>Not enough evidence to support that many of the species were soil dwelling and not troglafauna.</p>	
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			Troglofauna collected in the mining area need to be identified outside the mining area. Potential habitats for troglofauna have not been fully explored.	
Surface Water	<p>Project lies near the western and northern edges of Lake Way. The surface watercourses are ephemeral and dependent on high rainfall events.</p> <p>Surface water quality may be affected by radionuclide contamination from on-site waste storage facilities such as the in-pit tailings storage and the pregnant liquor storage facilities.</p> <p>Bunding around operation areas would be constructed to account to prevent water ingress into the pit and prevent inundation from flood events.</p>	<p>Government Agencies</p> <p>The DoW is satisfied with the level of flood protection proposed. However, recommendations were made for emergency response planning to be developed in the event that levees used for flood protection are breached.</p> <p>Public</p> <p>Submissions raised concerns that there is lack of baseline data collected for surface water samples. Concerns were also raised that redirecting of the creek bed for construction and mining would result in substrate and stream morphological changes, which could potentially have secondary impacts including changes in the benthic</p>	The EPA considers that Surface Water is a key environmental factor. This is further discussed in Section 4.5 of this report.	

		environment.	
Groundwater and Water Supply	<p>Mining of uranium would occur typically 2 to 5 m below surface. The uranium mineralisation ore occurs at or below the water table and dewatering of the open pits would be required.</p> <p>The lowering of groundwater could potentially affect neighbouring bores and the health of groundwater dependent ecosystems and/or subterranean biota</p> <p>Groundwater quality in the project area could also potentially be affected by seepage of uranium, other heavy metals and radionuclides from solid (tailings) and liquid (pregnant liquor) storage facilities.</p> <p>The project would require</p>	<p><u>Government Agencies</u></p> <p>SEWPaC commented that there appears to be a shortfall in water supply and that alternative sources should be determined well before the project is considered for approval to ensure that the West Creek borefield is not depleted. Further information is required to demonstrate that these locally-endemic species (stygo fauna) are found outside of the immediate areas of mine disturbance.</p> <p>The DoW is concerned that the proposed West Creek borefield water supply source may not provide sufficient water yield to service the entire proposal and a totally independent contingency water source should be investigated and assessed, including assessment of additional groundwater sources.</p> <p>The DEC is concerned that there is uncertainty in the potential impacts of drawdown on groundwater</p>	<p>The EPA considers that Groundwater and Water Supply is a key environmental factor. This is further discussed in Section 4.4 of this report.</p> <p>Issues relating to groundwater dependent vegetation and subterranean fauna are discussed in Section 4.7 Flora and Vegetation and Section 4.8 Fauna and Habitat.</p>

	<p>2.5 GL per annum of water supply for the life of mine. This would be sourced from the West Creek borefield and pit dewatering. A potential shortfall exists for the water supply.</p>	<p>dependent vegetation communities at the three sites. The ERMP does not include an assessment of the potential for groundwater drawdown impacts on PECs (stygo fauna). The proposal has the potential to have a significant impact on the PECs (stygo fauna) due to change in groundwater levels.</p> <p>Public</p> <p>The public are concerned that Lake Way is only 7 km from the borefield supplying the Wiluna town's water supply and that there may potentially be risk of contamination.</p> <p>The public are also concerned that water is a scarce commodity and that the project would require 2.5 GL of water each year.</p>	
Landforms and Soils	<p>Project implementation would involve 1530 ha of ground disturbance. The project area is characterised by subdued terrain. Parts of the project area provide a habitat for soil</p>	<p>Government Agencies</p> <p>No submissions received on landform.</p>	<p>The proponent has committed to management of disturbed areas to a safe and stable condition compatible to pre-mining land uses. A series of management procedures</p>

	<p>dwelling invertebrates.</p> <p>There is a risk of mobilising soil bound contaminants as a result of mining disturbance. Other potential impacts to soil could results from spills of reagents and radionuclides through dust. Erosion and loss of seed bank may also reduce rehabilitation potential.</p> <p>Baseline studies have shown that some aside from some locally elevated concentrations of vanadium, the concentrations of trace elements such as cadmium, arsenic and lead are low in soil and overburden.</p>	<p>Public</p> <p>Public are concerned that uranium mining causes environmental degradation and poisons aquifers and soils.</p>	<p>would be implemented in the event of a spill or leak.</p> <p>Rehabilitation will be discussed in Section 4.3 Mine Closure and Rehabilitation. Radionuclide impacts will be discussed in Section 3.1 Radiation.</p> <p>The EPA does not consider Landforms and Soils to be a key environmental factor.</p>
POLLUTION			
Air Quality	<p>Mining operations including excavation, processing and mechanical handling may contribute to the release of airborne emissions. These include particulates, nitrogen, sulphur oxides and radon gas.</p>	<p>Government Agencies</p> <p>Government agencies have recommended that further detailed information regarding radon monitoring results is required, including sampling frequency and seasonal variability.</p>	<p>The EPA considers Air Quality to be a key environmental factor. This is further discussed in Section 4.6 of this report.</p> <p>Radiological emissions are specifically discussed</p>

	<p>Potential impacts from airborne emissions include smog formation, damage to vegetation and increased health risks.</p> <p><i>Radon</i></p> <p>Historical data conducted by AAEC in 1979 exists for radon emanation rates and radon decay products (RDP) concentrations in the Wiluna region. Additional baseline sampling was undertaken in 2010 by the proponent to determine radon emanation rates from materials existing in the region including soils and ores. Real time monitoring was also conducted to characterise RDP concentrations.</p> <p>Radon gas dispersion was modelled for year four operations at Centipede and year eight operations at Lake Way.</p>	<p>Also, the allowable exceedences for PM₁₀ under NEPM standards account for natural events. The DEC advised that the goal should be to have no exceedences.</p> <p>Public</p> <p>The Ngangganawili Community is only 5.2 km from the proposed mine site and may be subject to operations related airborne emissions and contaminants.</p> <p>The public were also concerned that no specific dust performance criteria was required for the accommodation village.</p>	<p>in Section 4.1 on Radiation.</p>
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	<p><i>Nitrogen oxides</i></p> <p>The main fuel source for the project would be natural gas, which produces lower amounts of sulphur dioxide and nitrous oxides than any other hydrocarbon fuels. Hence, sulphur oxides, nitrogen oxides, carbon monoxides and volatile organic carbon emissions produced would be modest. NO₂ concentrations produced from power generation were modelled.</p>		
Dust	<p>Dust storms are characteristic of the Northern Goldfields region. Mining operations and wind erosion may contribute to elevated ambient levels of dust. Due to the nature of mining proposed, airborne dust may also contain radionuclides.</p> <p>Nine locations have been identified as nearest sensitive receivers to the proposed development. The Ngangganawili Community</p>	<p>Government Agencies</p> <p>The DEC advised that key issues pertaining to dust management and monitoring have been adequately addressed. However, the DMP recommended the proponent investigate further alternative options for effective dust control as dust management is critical throughout the life of the mine.</p> <p>Public</p> <p>High volume air sampling was limited</p>	

	<p>would be located 5.2 km north west from the proposed site location.</p> <p>The predominant wind direction in the Wiluna area during the day is easterly and north-easterly. At night, wind directions tend to occur south-easterly.</p> <p>Potential impacts resulting from dust may include contamination of soils and vegetation, reduced amenity and respiratory health risks.</p> <p>Real time dust monitoring of PM₁₀ was conducted in 2007 and 2008 to quantify dust concentrations. Further dust sampling using both active and passive methods was undertaken in 2010 to assess dust concentrations and radionuclide levels in dust.</p>	<p>for the 2010 sampling period. There is concern that the baseline data is limited to judge the impacts of radioactive dust and radon fallout.</p>	
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	<p>Modelling for PM₁₀, PM_{2.5} and TSP concentrations for year 4 and year 8 of operations was undertaken to predict airborne dust concentrations during mining.</p> <p>Dust containing radionuclides generated through mine operations has the potential to affect the environment and subsequently human health.</p>		
Greenhouse Gases	<p>Emissions of greenhouse gases may occur from power generation for mining and processing of uranium ore, and transport of goods and people. Loss of carbon uptake may also occur from clearing of vegetation.</p> <p>A 12 MW power station would be used to supply the power source for mining and processing of the ore. The preferred option is to use natural</p>	<p>Government Agencies</p> <p>The DEC recommended that estimates of annual greenhouse gas emissions be provided for the proposal. Evaluation of the significance of emissions associated with the project cannot be made without this information. Due consideration should also be given to offsets to minimise greenhouse emissions.</p>	<p>Natural gas would be used as the power source. The EPA does not consider Greenhouse Gases to be a key environmental factor.</p>

	gas rather than diesel, which would reduce greenhouse gases over the life of the project by 20 percent.	Public The public are concerned that greenhouse emissions from mining and milling of uranium would become substantial and approach levels close to gas-fired power plants.	
SOCIAL SURROUNDINGS			
Aboriginal Heritage	<p>Wiluna is important in Aboriginal culture for traditional rituals and Lake Way has sites of significance to original local groups.</p> <p>There are 15 Aboriginal heritage sites recorded on the DIA's Aboriginal heritage register within or potentially within the project tenements. There are eight sites listed as archaeological artefacts, six sites described as ethnographic and one site is recorded as ethnographic-archaeological.</p> <p>The project has potential to affect other registered sites through roads and</p>	Government The DIA has advised that a Section 18 application would need to be submitted to ensure that appropriate permissions are obtained for disturbance of any Aboriginal heritage sites. Public Central Desert Native Title Services made a submission regarding Management Actions and Indigenous Ecological knowledge of the Native Title Claimants. The submission advised that Toro is working closely with the Native Title Claimants to develop a Heritage Management Plan to protect the large number of culturally significant sites around the proposed project.	The EPA considers that Aboriginal heritage is a key environmental factor. This is further discussed in Section 4.9 of this report.

	infrastructure.	It further advised that Toro recognise the Native Title Claimants management of country through, but not limited to the expression of their native title rights and cultural use of country in traditional burning, cultural heritage management, hunting around and access to the proposed project as well as identification and use of culturally significant flora.	
European Heritage	Two sites of heritage significance occur within the general project locality. Development of this project would not affect these two sites.	No submissions were received in relation to European heritage.	The EPA does not consider European Heritage to be a key environmental factor.
Transport	<p>Transport of uranium oxide concentrate (UOC) would be via road from the mine site to the Goldfields Highway through to Norseman via Leonora, Menzies, Kalgoorlie-Boulder Kambala. From Norseman, the product would be transported via Eyre Highway to the WA/SA border.</p> <p>Potential impacts from transport</p>	<p>Government Agencies</p> <p>SEWPaC believe that further information is required to better understand the impact on driver dose from the behaviour of drivers over the distance travelled and the variability of transport trucks used, and also how doses are derived.</p> <p>Main Roads WA raised the concerns that the residual risk to loss of containment has been identified as low risk by the proponent. Main</p>	The EPA considers that Transport is a key environmental factor. This is further discussed in Section 4.2 of this report.

	<p>of product would include increased noise and traffic volumes, and risk of increased radiation exposure in the event of product spillage.</p>	<p>Roads' view is that the residual risk is moderate, even after taking into consideration the good management controls the company has indicated it will put in place due to the significant distance between the mine site and the shipment. Consideration should also be given to monitoring radiation levels along the transport route throughout the life of the project.</p> <p>The City of Kalgoorlie-Boulder raised the concern that the Emergency Response Plan (ERP) to be developed by the company should be available for stakeholder comment prior to approval. Consultation with other uranium mining companies should be undertaken in the development of the ERP and a uniform approach to emergency response should be adopted in Western Australia. The transport route of UOC should not pass through residential areas or sensitive receptors including hospitals and schools within the municipality of Kalgoorlie-Boulder. Also, the results of reporting and monitoring programs, as well as any incidents</p>	
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		<p>involving the transport of uranium should be made publicly available.</p> <p>Public</p> <p>The public are concerned about traffic accidents while transporting uranium product from the mine site to the WA border.</p>	
Visual amenity	Mine site is located in remote location, 15 and 30 km south of Wiluna.	No submissions were made in relation to Visual Amenity.	<p>Due to the remote location, the EPA does not consider Visual Amenity to be a key environmental factor.</p> <p>The proponent has also committed to rehabilitation of the land to pre-mining appearance.</p>
OTHER			
Mine closure and rehabilitation	Waste would be returned to mine voids or used for the cover of the completed in pit tailings. The tailings storage facility (TSF) would be lined with a 300 mm clay liner with a minimum two metre cover.	<p><u>Government Agencies</u></p> <p>Government agencies advised that further information to support the feasibility of in-pit disposal is required, including materials and methods for constructing the TSF.</p>	The EPA considers that Mine Closure and Rehabilitation is a key environmental factor. This is further discussed in Section 4.3 of this report.

	<p>The combined tailings volume produced from both the Centipede and Lake Way deposits (including a 20 percent swelling of ore) would be 9.1 million bulk cubic metres. A TSF would be constructed in the mined out pit at Centipede for containment of all mineralised waste. The Centipede tailings repository would have 12 million bulk cubic metres available for storage.</p> <p>Other non-mineralised waste would be stored in the mine void at Lake Way or used to cap the TSF. After capping, the contours of the land will be rehabilitated to resemble pre-mining landscapes.</p> <p>Potential impacts from ineffective mine closure may include seepage from TSF to groundwater and radon</p>	<p>The DMP has considered the conceptual Mine Closure Plan and notes that the proponent will be developing a detailed plan to satisfy DMP requirements.</p> <p>Detailed investigations and geotechnical designs must be undertaken to ensure the safety and stability of the TSF. The following should be included in an expanded version:</p> <ul style="list-style-type: none"> • Detailed strategies and commitments for unexpected closure, care and maintenance; • Details on chemical interaction of plant waste/tailings with the lake sediments/lake water; • Closure of tailings storage facilities. <p>SEWPaC advised that long term management of tailings and data to support the claim that there no radon exhalation from covered tailings</p>	
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	<p>exhalation.</p>	<p>would need to be demonstrated.</p> <p>In particular, data is required to demonstrate:</p> <ul style="list-style-type: none"> • The effectiveness of the tailings cover to reduce radon exhalation; • Potential radionuclide uptake in plants after rehabilitation; • Solubility of radionuclides and potential ingress of radionuclides in groundwater. <p>Current data provided is insufficient and modelling should be completed for a minimum of 10,000 years to provide some level of assurance.</p> <p>Public</p> <p>Public submissions raised the concern that tailings should be isolated for a minimum of 10,000 years, consistent with conditions set for the Ranger uranium mine.</p>	
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		<p>The public are also concerned that the proponent plans on complete relinquishment after ten years. Ongoing monitoring and maintenance is crucial to ensure tailings and other hazardous materials are effectively isolated.</p>	
Radiation	<p>Uranium mining produces radiological emissions. These emissions may impact groundwater, surface water, air quality, non-human biota including bush tucker.</p> <p>Further, some of the impacts on the biophysical environment could impact human health.</p>	<p>Government Agencies</p> <p>SEWPaC were concerned that seepage of radionuclides leading from the TSF were not assessed adequately and further work is required for long term radionuclide migration from the TSF. Modelling should be done to at least 10,000 years to provide some level of assurance that there is no significant seepage of radionuclide from the tailings to the groundwater and that there is no unacceptable risk to people or the environment.</p> <p>In addition to this, SEWPaC were concerned that only the scenario of radionuclide uptake by foodstuffs has been considered. Dust settling onto foodstuffs, like leafy green vegetables and herbs, could present</p>	<p>The EPA considers that Radiation is a key environmental factor. This is further discussed in Section 4.1 of this report.</p>

		<p>a significant pathway of contamination of foodstuffs and further evaluation of other potential pathways evaluates.</p> <p>Public The public are concerned about the carcinogenic effects from radon gas. Concerns were also raised that to date in Australia, no uranium mine has been successfully rehabilitated to the point where radiological conditions are stable and no ongoing monitoring and maintenance is required.</p>	
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PRINCIPLES		
Principle	Relevant Yes/No	If yes, Consideration

<p>1. The precautionary principle</p> <p><i>Where there are threats of serious or irreversible damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation.</i></p> <p><i>In application of this precautionary principle, decisions should be guided by –</i></p> <p>(a) <i>careful evaluation to avoid, where practicable, serious or irreversible damage to the environment; and</i></p> <p>(b) <i>an assessment of the risk-weighted consequences of various options.</i></p>		
	Yes	There is uncertainty over the level of impacts to subterranean fauna and <i>Tecticornia</i> dominated vegetation. Impacts to stygofauna and <i>Tecticornia</i> dominated vegetation are considered in the assessment and a precautionary approach adopted.
<p>2. The principle of intergenerational equity</p> <p><i>The present generation should ensure that the health, diversity and productivity of the environment is maintained and enhanced for the benefit of future generations.</i></p>		
	Yes	The proposal has the potential to impact on the environment particularly in regard to the storage and management of tailings wastes. The assessment has considered the potential long-term impacts of the tailings storage facility to ensure that the tailings are managed in a manner for long-term safety and security.
<p>3. The principle of the conservation of biological diversity and ecological integrity</p> <p><i>Conservation of biological diversity and ecological integrity should be a fundamental consideration.</i></p>		
	Yes	The proposal has the potential to impact stygofauna and <i>Tecticornia</i> . The potential impact of excavation and groundwater drawdown have been considered in the

		assessment.
<p>4. Principles relating to improved valuation, pricing and incentive mechanisms</p> <p><i>(1) Environmental factors should be included in the valuation of assets and services.</i></p> <p><i>(2) The polluter pays principles – those who generate pollution and waste should bear the cost of containment, avoidance and abatement.</i></p> <p><i>(3) The users of goods and services should pay prices based on the full life-cycle costs of providing goods and services, including the use of natural resources and assets and the ultimate disposal of any waste.</i></p> <p><i>(4) Environmental goals, having been established, should be pursued in the most cost effective way, by establishing incentive structure, including market mechanisms, which enable those best placed to maximize benefits and/or minimize costs to develop their own solution and responses to environmental problems.</i></p>		
	No	
<p>5. The principle of waste minimisation</p> <p><i>All reasonable and practicable measures should be taken to minimize the generation of waste and its discharge into the environment.</i></p>		
	Yes	Radiological emissions to the environment should be avoided or minimised. The assessment considers aspects of radiological emissions from mining, processing and transportation of the uranium oxide concentrate.

Appendix 4

Identified Decision-making Authorities and Recommended Environmental Conditions

Identified Decision-making Authorities

Section 44(2) of the *Environmental Protection Act 1986* (EP Act) specifies that the EPA's report must set out (if it recommends that implementation be allowed) the conditions and procedures, if any, to which implementation should be subject. This Appendix contains the EPA's recommended conditions and procedures.

Section 45(1) requires the Minister for Environment to consult with decision-making authorities, and if possible, agree on whether or not the proposal may be implemented, and if so, to what conditions and procedures, if any, that implementation should be subject.

The following decision-making authorities have been identified for this consultation:

Decision-making Authority	Approval
1. Minister for Water	<i>Rights in Water and Irrigation Act 1914</i>
2. Minister for Environment	<i>Wildlife Conservation Act 1950</i>
3. Minister for Mines and Petroleum	<i>Mining Act 1978</i>
4. Minister for Indigenous Affairs	<i>Native Title Act 1993</i>
5. Radiological Council	<i>Radiation Safety Act 1975</i>
6. State Mining Engineer	<i>Mine Safety and Inspection Act 1994</i>
7. Department of Environment and Conservation	Works Approval and Licence
8. Shire of Wiluna	Planning approval

Note: In this instance, agreement is only required with DMAs 1-4 since these DMAs are Ministers.

RECOMMENDED ENVIRONMENTAL CONDITIONS
STATEMENT THAT A PROPOSAL MAY BE IMPLEMENTED
(PURSUANT TO THE PROVISIONS OF THE
***ENVIRONMENTAL PROTECTION ACT 1986*)**

WILUNA URANIUM MINE, 30 KM SOUTH AND 15 KM SOUTH-EAST OF WILUNA
SHIRE OF WILUNA

Proposal: The proposal is to construct and operate a uranium mine consisting of two deposits Centipede and Lake Way at mining tenements M53/224 and MLA53/1090, located approximately 30 kilometres south and 15 kilometres south-east of Wiluna (Figure 1). The proposal is to mine uranium by open cut mining as defined in Schedule 2.

The proposal is further documented in schedule 1 of this statement.

Proponent: Toro Energy Limited

Proponent Address: Level 2, 35 Ventnor Avenue
WEST PERTH WA 6005

Assessment Number: 1819

Report of the Environmental Protection Authority: Report 1437

The proposal referred to in the above report of the Environmental Protection Authority may be implemented. The implementation of that proposal is subject to the following conditions and procedures:

1 Proposal Implementation

1-1 The proponent shall implement the proposal as documented and described in schedule 1 of this statement subject to the conditions and procedures of this statement.

Published on

2 Proponent Nomination and Contact Details

- 2-1 The proponent for the time being nominated by the Minister for Environment under sections 38(6) or 38(7) of the *Environmental Protection Act 1986* is responsible for the implementation of the proposal.
- 2-2 The proponent shall notify the Chief Executive Officer of the Office of the Environmental Protection Authority of any change of the name and address of the proponent for the serving of notices or other correspondence within 30 days of such change.

3 Time Limit of Authorisation

- 3-1 The authorisation to implement the proposal provided for in this statement shall lapse and be void five years after the date of this statement if the proposal to which this statement relates is not substantially commenced.
- 3-2 The proponent shall provide the Chief Executive Officer of the Office of the Environmental Protection Authority with written evidence which demonstrates that the proposal has substantially commenced on or before the expiration of five years from the date of this statement.

4 Compliance Reporting

- 4-1 The proponent shall prepare and maintain a compliance assessment plan to the satisfaction of the Chief Executive Officer of the Office of the Environmental Protection Authority.
- 4-2 The proponent shall submit to the Chief Executive Officer of the Office of the Environmental Protection Authority the compliance assessment plan required by condition 4-1 at least six months prior to the first compliance report required by condition 4-6, or prior to implementation, whichever is sooner.

The compliance assessment plan shall indicate:

- 1 the frequency of compliance reporting;
- 2 the approach and timing of compliance assessments;
- 3 the retention of compliance assessments;
- 4 the method of reporting of potential non-compliances and corrective actions taken;
- 5 the table of contents of compliance assessment reports; and

6 public availability of compliance assessment reports.

- 4-3 The proponent shall assess compliance with conditions in accordance with the compliance assessment plan required by condition 4-1.
- 4-4 The proponent shall retain reports of all compliance assessments described in the compliance assessment plan required by condition 4-1 and shall make those reports available when requested by the Chief Executive Officer of the Office of the Environmental Protection Authority.
- 4-5 The proponent shall advise the Chief Executive Officer of the Office of the Environmental Protection Authority of any potential non-compliance within seven days of that non-compliance being known.
- 4-6 The proponent shall submit to the Chief Executive Officer of the Office of the Environmental Protection Authority the first compliance assessment report fifteen months from the date of issue of this Statement addressing the twelve month period from the date of issue of this Statement and then annually from the date of submission of the first compliance assessment report.

The compliance assessment report shall:

- 1 be endorsed by the proponent's Managing Director / General Manager / Chief Executive Officer or a person delegated to sign on the Managing Director's / General Manager's / Chief Executive Officer's behalf;
- 2 include a statement as to whether the proponent has complied with the conditions;
- 3 identify all potential non-compliances and describe corrective and preventative actions taken;
- 4 be made publicly available in accordance with the approved compliance assessment plan; and
- 5 indicate any proposed changes to the compliance assessment plan required by condition 4-1.

5 Public Availability of Data

- 5-1 subject to condition 5-2, within a reasonable time period approved by the Chief Executive Officer of the issue of this Statement and for the remainder of the life of the proposal the proponent shall make publicly available, in a manner approved by the Chief Executive Officer, all validated environmental data (including sampling design, sampling methodologies, empirical data and derived information products (e.g. maps)) relevant to the assessment of this proposal and implementation of this Statement.
- 5-2 If any data referred to in condition 5-1 contains particulars of:
 - i. A secret formula or process; or

ii. Confidential commercially sensitive information

The proponent may submit a request for approval from the Chief Executive Officer to not make this data publicly available. In making such a request the Proponent shall provide the Chief Executive Officer with an explanation and reasons why the data should not be made publicly available.

6 Flora and Vegetation - *Tecticornia*

Protection of Tecticornia vegetation outside the mining area and groundwater drawdown (0.5 m) area

- 6-1 The proponent shall manage the proposal in a manner that ensures there is no adverse impact to *Tecticornia* dominated vegetation outside the 0.5 m groundwater drawdown contours as defined in Figure 2.
- 6-2 Prior to ground-disturbing activities unless otherwise approved by the Chief Executive Officer, the proponent shall prepare a Vegetation and Flora Monitoring Plan for approval by the Chief Executive Officer on the advice of the Department of Environment and Conservation.

The monitoring plan shall include:

1. identification of potential-impact monitoring and control sites;
 2. design of a survey to acquire baseline biotic and environmental data;
 3. definition of health and abundance parameters;
 4. definition of critical correlative environmental parameters, including groundwater drawdown as detailed in condition 7;
 5. definition of monitoring frequency and timing;
 6. identification of criteria to measure decline in health; and
 7. definition of trigger levels and management responses required should a trigger level be exceeded.
- 6-3 The proponent shall implement the approved Vegetation and Flora Monitoring Plan of condition 6-2 until advised otherwise by the Chief Executive Officer.
- 6-4 Should results of monitoring from the implementation of the monitoring plan of condition 6-2, indicate a decline in the health compared with the control sites, the proponent shall provide a report to the Chief Executive Officer within 21 days of the decline being identified which:

1. describes the decline;
 2. provides information which allows determination of the likely cause of the decline; and
 3. proposes remedial actions to suitably address the identified decline.
- 6-5 If the decline in health identified in condition 6-2 is determined by the Chief Executive Officer to be caused by activities undertaken in implementing the proposal the proponent shall, implement the actions identified in condition 6-4(3) and continue to implement such actions until the Chief Executive Officer determines that the remedial actions may cease.

7 Groundwater Drawdown

Management of Groundwater Drawdown Impacts on stygofauna and Tecticornia within the groundwater drawdown (0.5 m) area

- 7-1 Prior to groundwater abstraction for dewatering, unless otherwise approved by the Chief Executive Officer, the proponent shall prepare a Groundwater Drawdown Monitoring and Management Plan for approval by the Chief Executive Officer to limit potential impacts on stygofauna and *Tecticornia* dominated vegetation through the design and implementation of a suitable groundwater barrier system around the Project mining areas. The plan shall include:
1. development of trigger levels for groundwater drawdown levels; and
 2. design and implementation details of a barrier system to control groundwater drawdown so that the trigger levels are not exceeded.
- 7-2 The proponent shall implement the approved Groundwater Drawdown Monitoring and Management Plan of condition 7-1, until otherwise advised by the Chief Executive Officer.
- 7-3 Should the results of monitoring from the implementation of the groundwater drawdown program show that trigger levels identified in condition 7-1(1) have been reached or exceeded, the proponent shall provide a report to the Chief Executive Officer within 21 days of the trigger levels being reached or exceeded which:
1. describes the event resulting in the trigger level being reached or exceeded;
 2. provides information which allows determination of the likely root cause of the trigger levels being reached or exceeded; and
 3. if the trigger levels being reached or exceeded are determined by the Chief Executive Officer to be the result of activities undertaken in implementing the proposal, the proponent shall propose actions and associated timelines to

remediate the trigger values becoming reached or exceeded to the requirement of the Chief Executive Officer.

- 7-4 The proponent shall, on approval by the Chief Executive Officer, implement the actions identified in condition 7-3(3) until the Chief Executive Officer determines that the remedial actions may cease.

8 Residual Impacts and Risk Management Measures

Conservation and Improvement of the knowledge of Tecticornia

- 8-1 Given the residual impacts and risks (permanent and temporary) of the proposal to *Tecticornia* species, prior to ground-disturbing activities and within twelve months of the ministerial statement unless otherwise approved by the Chief Executive Officer, the proponent shall prepare a survey and research plan for approval by the Chief Executive Officer on advice of the Department of Environment and Conservation, to conserve and improve the scientific knowledge of *Tecticornia*. The survey and research plan shall include:
1. implementation of further surveys to collect *Tecticornia* specimens within and outside the project areas within the associated lake system and immediate adjoining areas;
 2. conducting research on *Tecticornia* specimens collected for taxonomic resolution;
 3. provision of distribution and abundance data to enable determination of the conservation status of identified *Tecticornia* taxa including relative representation within and outside the project areas;
 4. storage, preservation and propagation techniques for any *Tecticornia* taxa and unidentified specimens located only within the disturbance area and area of groundwater drawdown greater than 0.5 m;
 5. ecophysiological characterisation and assessment of habitat requirements of different *Tecticornia* taxa within and outside the project area, including an assessment of potential impacts from changes in groundwater quality and quantity, and with main emphasis on those taxa identified as occurring within the disturbance areas; and
 6. conducting research on requirements and techniques for re-establishing *Tecticornia* vegetation communities and conservation significant taxa in rehabilitating disturbance areas.
- 8-2 The plan of condition 8-1 shall include survey and research work of a total monetary value of \$900,000 (GST exclusive) at the date this condition comes into effect.

- 8-3 The plan of condition 8-1 will include an implementation and reporting schedule for each project and the proponent will provide a copy of the findings to the Chief Executive Officer and the Department of Environment and Conservation within three months of completion of each project.
- 8-4 The proponent shall commence implementation of the approved plan of condition 8-1 prior to ground-disturbing activities, unless otherwise approved by the Chief Executive Officer.
- 8-5 Where practicable, the proponent shall take into account the findings of research from implementation of the plan from condition 8-1 in its operations, including:
1. establishment of the ecophysiological habitat and other requirements of *Tecticornia* vegetation communities; and
 2. establishment of viable populations of *Tecticornia* taxa deemed at risk from implementation of the proposal.

Schedule 1

The Proposal (Assessment No. 1819)

The proposal is to construct and operate a uranium mine consisting of two deposits Centipede and Lake Way located approximately 30 kilometres south and 15 kilometres south-east of Wiluna (Figure 1).

The main characteristics of the proposal are summarised in Table 1 below. A detailed description of the proposal is provided in the project referral document prepared by Toro Energy Ltd, Adelaide, South Australia.

Table 1: Summary of key proposal characteristics

Proposal Definition		Extent Authorised
Element – development/infrastructure	Location of element	
Centipede deposit	Figure 3	Clearing of up to 700ha of vegetation, including 280 ha of low health vegetation unit with <i>Tecticornia</i> species
Lake Way deposit	Figure 3	Clearing of up to 580 ha of vegetation, including 340 ha of low health vegetation unit with <i>Tecticornia</i> species
Ancillary infrastructure	Figure 3	Clearing of up to 250 ha of vegetation

ha = hectares



Figure 1 Location of all project components

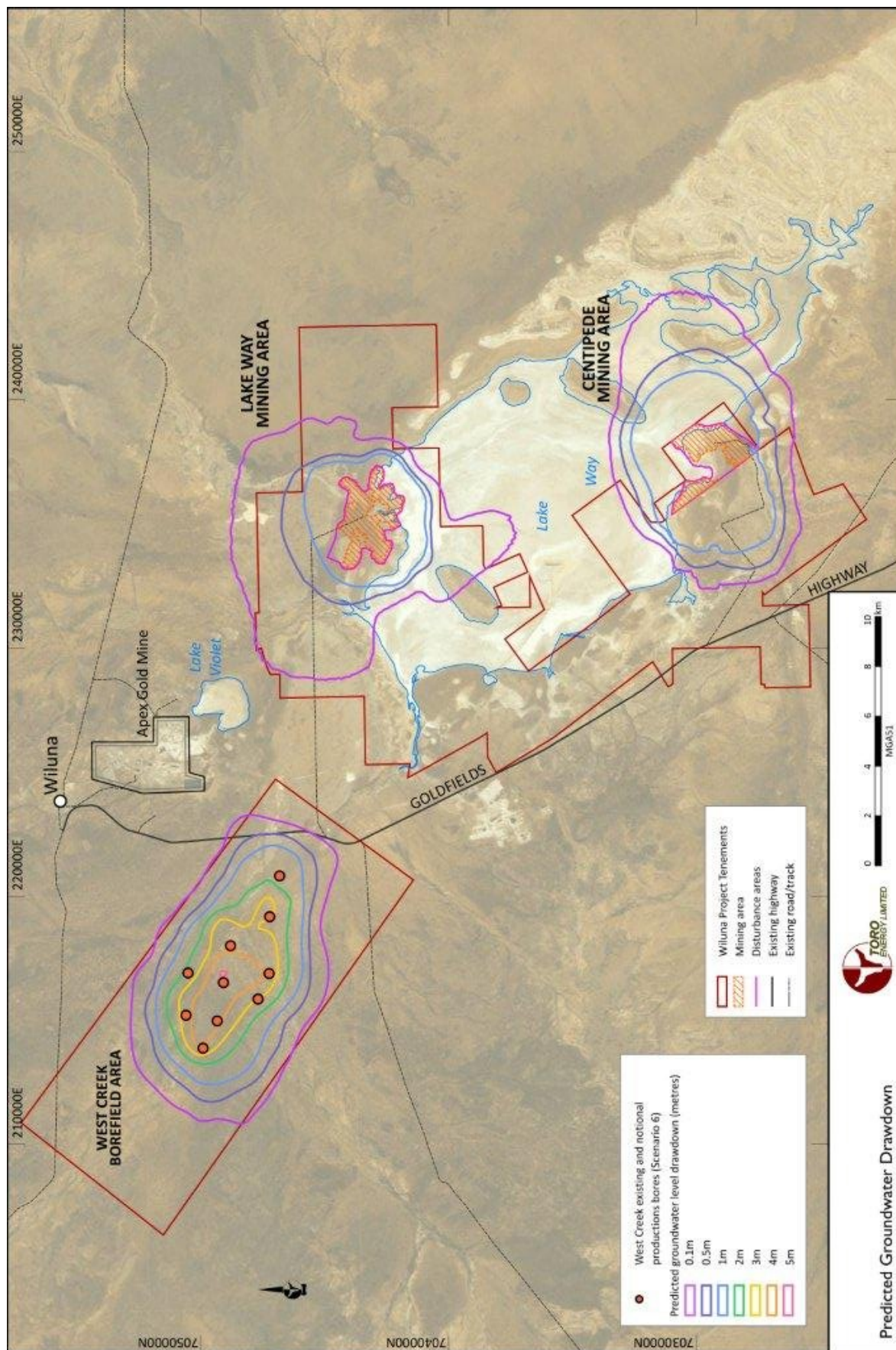


Figure 2 Drawdown contours for Centipede Pit, Lake Way and West Creek borefield

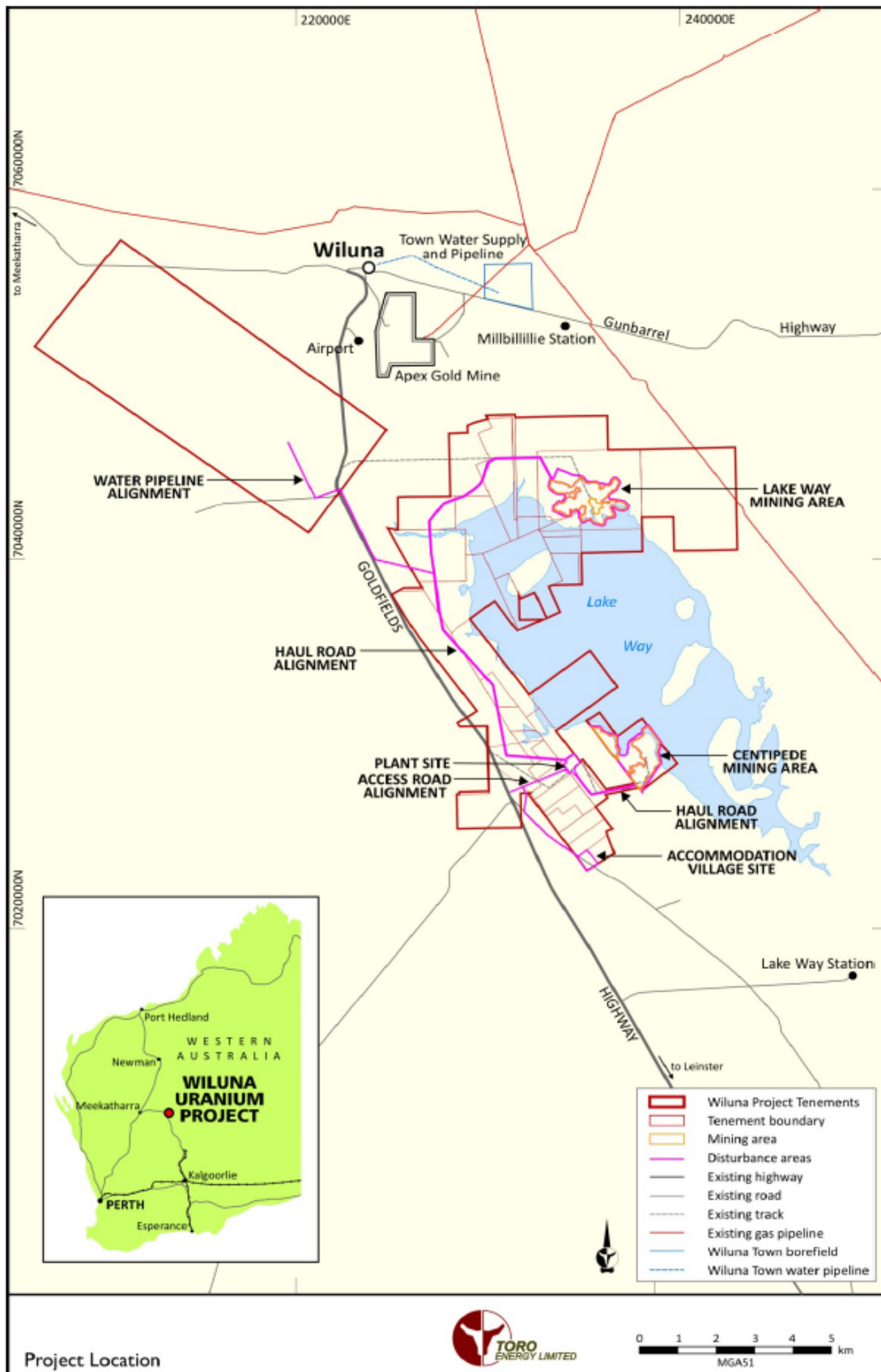


Figure 3 Mine layout showing the Centipede and Lake Way pits

Appendix 5

Summary of Submissions and Proponent's Response to Submissions