MURRAY BASIN MINERAL SANDS

RADIATION MANAGEMENT PLAN

September 2020

Rev. #	Date	Owner / Reviewer	Detail of Change
0		J.Virgo	Original Document *(Formerly "Tronox Mining East Radiation Management Plan")*
1	3/7/2018	J.Virgo/Joe Slechta (HVRS)	Appointed radiation expert review with addition of Atlas-Campaspe development
2	2/4/2019	J.Virgo/B.Isaacs	Changes to address comments from appointed radiation expert and document structure changes
3	20/5/2019	J.Virgo/B.Isaacs	Minor changes to address comments by NSW EPA.
4	5/5/2020	Tronox/GHD	Changes to address comments of NSW EPA and DPIE
5	08/09/2020	Tronox/GHD	Changes to address comments of DPIE (3 August 2020)

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Tables

1 Definitions

ARPANSA	Australian Radiation and Nuclear Safety Agency
NORM	Naturally Occurring Radioactive Material
RMP	Radiation Management Plan
RWMP	Radiation Waste Management Plan
RSO	Radiation Safety Officer
EPA	Environment Protection Authority
EMP	Environmental Management Plan
DAC	Derived Air Concentration

2 Purpose

This Radiation Management Plan (RMP) specifies how Tronox Mining Australia Limited (Tronox) manages radioactivity encountered in mining and processing of mineral sands as part of their Murray Basin Operations. The plan addresses the requirements for occupational dose control and environmental impact, transport regulations, and formal reporting.

This RMP satisfies the requirements in the Development Consents for each mine for a "Radioactive Waste Management Plan" and conditions that surround radiation management in applicable approvals as listed in Table 2.

This RMP takes into account the move from dredge-based mining to dry open pit mining at Atlas-Campaspe project.

3 Consultation

In accordance with the Development Consent Conditions for the Ginkgo, Snapper and Atlas-Campaspe projects. The Applicant shall prepare and implement a Radiation Management Plan/Radioactive Waste Management Plan for each mine to the satisfaction of the Secretary. This plan must:

(a) Be prepared in consultation with the EPA by a suitably qualified expert/s whose appointment has been approved by the Secretary.

A draft revision of the RMP was prepared by Mr Joe Slechta of Hunter Valley Radiation Services Pty Ltd (HVRS) whose appointment was approved by the Secretary on 21st August 2018. Joe Slechta holds a Consulting Radiation Expert (CRE) status with NSW EPA (HVRS, July 2019).
The revised plan was submitted to the NSW Environment Protection Authority (EPA) and the Department of Planning Industry and Environment for comment on 11 April 2019.

Comments were received on the revised RMP from the NSW EPA on 15 May 2019 and DPIE on 8 August 2019.

A further revised RMP, integrating comments from NSW EPA, DPIE and HVRS was provided to NSW EPA and DPIE in May 2020 with further comments received from DPIE on 3 August 2020. The current version of the RMP addresses the comments made by DPIE, August 2020.

Consultants and other expertise involved in the development of this RMP include:

CONSULTANT/EXPERT	AREA OF EXPERTISE	ROLE IN DEVELOPMENT OF RMP
HVRS	Compliance auditing	Compliance Audit against ARPANSA, 2005
Telfer Consulting (Andy Telfer)	Statutory audit (compliance with conditions of approval)	Review as per scope of annual statutory audit for compliance with conditions of regulatory approvals (refer to Table 3)
GHD	Audit and technical consultancy	Technical support to review and update RMP
Mark Sonter		Review of fixed radiation gauges

4 Scope

This RMP covers all present and proposed future Tronox Murray Basin Operations. These comprise of the present Ginkgo, Crayfish and Snapper mines and at the new Atlas and Campaspe mines near Balranald, NSW.

The RMP covers initial mining activities at the mine sites, transport by road and rail to, and operations at, the Broken Hill Mineral Separation Plant (MSP) and transport of waste by road and rail back to mine sites followed by final in-pit disposal.

This RMP is designed to cover all Murray Basin sites as there is a close relationship with the processing, handling and transportation between the sites.

5 Statutory requirements and project environmental approvals

5.1 Legislation

NSW Legislation and Regulations specifically applicable to the Radiation Management Plan include the *Radiation Control Act 1990* and the *Radiation Control Regulation 2013*, which are administered by the NSW EPA.
Further legal and other requirements (some of which may be applicable to radiation management by Tronox as part of mining operations in NSW) are documented in the Environmental Legal and Planning Register, which is attached to the Environmental Management Strategy (EMS, 2016) as Appendix D.

5.2 Code of Practice for Radiation Protection and Radioactive Waste Management in Mining and Mineral Processing (2005)

This RMP has been created to address the radiation-specific requirements for management and is consistent with the Code of Practice and Safety Guide for Radiation Protection and Radioactive Waste Management in Mining and Mineral Processing (ARPANSA, 2005 – the Mining Code).

The consistency of this RMP with the Mining Code was audited by Luke Slechta (Compliance Manager - Hunter Valley Radiation Services Pty Ltd (HVRS). The audit findings and audit report (June 2019) were peer reviewed by Joe Slechta (Consulting Radiation Expert (CRE), accredited by NSW EPA, accreditation number A/46 as listed on NSW EPA website https://www.epa.nsw.gov.au/your-environment/radiation/accreditation-of-cres/accredited-cres). This RMP was updated (REV 4, May 2020) to incorporate the HVRS audit findings to improve compliance with the Mining Code.

A summary of how this RMP conforms to the Mining Code is provided in Table 1.

Table 1 Code of Practice for Radiation Protection and Radioactive Waste Management in Mining and Mineral Processing (ARPANSA, 2005)

Mining Code Section	Addressed in the RMP
Section 2.7.1 Radiation Management Plan **Before commencement of any stage of an operation to which this Code applies, a Radiation Management Plan (RMP) for that stage must be devised and presented to the relevant regulatory authority for approval. The Plan must be directed towards meeting the objectives of this Code and must be in accordance with best practice technology and take into account the potential dose delivery pathways**	This RMP was prepared to address the requirement of Conditions of Development Consents for Ginkgo (DA 251-09-01), Snapper (Da 06-0168) and Atlas-Campaspe (SSD_5012). This most recent version of the RMP was prepared to meet the requirement of Schedule 3, Condition 29 of the Atlas-Campaspe Development Consent (Table 2). Approval was obtained before commencement of Ginkgo and Snapper for a prior version of the RMP (although formal documented approval cannot be located). This RMP has been directed towards meeting the objectives of the Code (section 2). This RMP was developed and audited by suitably qualified experts to be in accordance with best practice technology (section 3). Dose delivery pathways are in section 10.
Section 2.7.2 Radiation Management Plan **The Radiation Management Plan must include a description of the operations to which it applies, and the measures that are intended to be taken to control the exposure of employees and members of the public to radiation at or from the practice including:** **a) demonstrated access to appropriate professional expertise in radiation protection** **b) a plan for monitoring radiation exposure and for assessing the doses received by exposed employees** **c) the provision of appropriate equipment, staffing, facilities and operational procedures** **d) details of induction and training courses** **e) record keeping and reporting** **f) a plan for dealing with incidents, accidents and emergencies involving exposure to radiation; and** **g) a system of periodic assessment and review of the adequacy and effectiveness of procedures instituted under the Radiation Management Plan to ensure currency and to facilitate a process of continual improvement.**	Section 4 provides a summary of the operations to which this RMP applies and the mine locations and haulage routes are shown in Appendix 1. This RMP include measures to control exposure of employees and members of the public to radiation at or from the mines including: a) development and review of documents by radiation experts (section 3) and appointment and training of Radiation Safety Officer and Radiation Isolation Officer (sections 20 and 24) b) monitoring for radiation exposure and assessment of doses received by employees (section 14) c) provision of equipment (sections 14 and 23), staffing (sections 24 - 25), facilities (sections 15 – 17 and 23) and operational procedures (Table 6 and as referenced throughout) d) induction and training courses (sections 20, 24 – 25) e) record keeping and reporting (sections 20 and 21) f) incidents, accidents and emergencies (section 22) g) a system of periodic assessment and review of adequacy and effectiveness of the RMP as summarised in section 26.

Mining Code Section	Addressed in the RMP
Section 2.8.1 Radioactive Waste Management Plan **A Radioactive Waste Management Plan (RWMP) must be developed to provide for the proper management of radioactive waste arising from the operations. Before the commencement of any stage of an operation, a RWMP for that stage must be presented to the relevant regulatory authority (see Annex A) for approval. The Plan must be directed towards meeting the objectives of this Code and must be in accordance with best practicable technology and take into account the potential dose delivery pathways.**	This RMP addresses the requirement for a RWMP. Approval was obtained before commencement of Ginkgo and Snapper for a prior version of the RMP (although formal documented approval cannot be located). This RMP has been directed towards meeting the objectives of the Code (section 2). This RMP was developed and audited by suitably qualified experts to be in accordance with best practice technology (section 3) and provided to relevant regulatory authorities for review (as per section 3 and Appendix 1). Dose delivery pathways are in section 10.
Section 2.8.2 Radiation Waste Management Plan **The Radioactive Waste Management Plan must provide for the proper management of radioactive waste arising from the operation and will include:** **a) an outline of the processes generating waste, and a description of the waste generated;** **b) a description of the environment into which the waste will be discharged or disposed, including the baseline radiological characteristics;** **c) a description of the proposed system for waste management including the facilities and procedures involved in the handling, treatment, storage and disposal of radioactive waste;** **d) prediction of environmental concentrations of radionuclides and radiation doses to people from the proposed waste management practices, including demonstration that the radiation protection requirements of this Code will be met both now and in the future as determined by the relevant regulatory authority;** **e) a program for monitoring and concentration of radionuclides in the environment and assessment of radiation doses to members of the public arising from the waste management practices;** **f) contingency plans for dealing with accidental releases, or circumstances which might lead to uncontrolled releases of radioactive waste, to the environment;** **g) a schedule for reporting on the operation and results of monitoring and assessment required by this plan;** **h) a plan for decommissioning the operation and the associated waste management facilities and rehabilitating the site; and**	This RMP includes details to address each requirement as summarised: • Sections 15 – 18 address the requirements of a) to c) • Sections 10 – 14 address the requirements of d) and e) • Section 22 addresses the requirements of f) • Sections 11, 12, 13 and 21, address the requirements of g) Requirement h) will be addressed prior to the decommissioning and rehabilitation of sites (not yet applicable), rehabilitation of in-pit waste disposal is addressed in section 17. Section 26 addresses requirement i).

Mining Code Section	Addressed in the RMP
i) a system of periodic assessment and review of the adequacy and effectiveness of procedures instituted under the Radioactive Waste Management Plan to ensure currency and to take account of potential improvements consistent with best practice technology.	
2.9 Approvals and authorisations	
2.9.1 Prior to the commencement of any stage of an operation to which this Code applies, the operator must obtain approval for the Radiation Management Plan and the Radioactive Waste Management Plan appropriate for the proposed activities at that stage.	This RMP was prepared to address the requirement of Conditions of Development Consents for Ginkgo (DA 251-09-01), Snapper (Da 06-0168) and Atlas-Campaspe (SSD_5012). This most recent version of the RMP was prepared to meet the requirement of Schedule 3, Condition 29 of the Atlas-Campaspe Development Consent (Table 2). Approval was obtained before commencement of Ginkgo and Snapper for a prior version of the RMP (although formal documented approval cannot be located). This RMP has been directed towards meeting the objectives of the Code (section 2). This RMP was developed and audited by suitably qualified experts to be in accordance with best practice technology (section 3). No decommissioning has occurred (not yet applicable) and will be addressed prior to any mine decommissioning. Tronox do not remove from or bring into the operation any radioactive material outside the exception limits without authorisation from the regulatory authority and will maintain radiation levels to that provided in and approved in this RMP.
2.9.2 An operator must not commence construction of any part of a mine, processing plant or waste management facility to which this Code applies without authorisation from the relevant regulatory authority (see Annex A)	
2.9.3 An operator must not commence operation of any part of the mine, processing plant or waste management facility to which this Code applies without authorization from the relevant regulatory authority	
2.9.4 An operator must not commence decommissioning or rehabilitation of any part of a mine, processing plant or waste management facility to which this Code applies without authorization from the relevant regulatory authority.	
2.9.5 The relevant regulatory authority must be informed of any proposal for significant changes to an operation to which an approved Radiation Management Plan or Radioactive Waste Management applies. The relevant regulatory authority may, on receipt of such notification, direct that a new Radiation Management Plan and/or Radioactive Waste Management Plan or part thereof must be submitted, and that those changes must not be brought into operation without authorization.	
2.9.6 The operator must review the Radiation Management Plan and the Radioactive Waste Management Plan, and submit any revised plans for approval, at intervals determined by the relevant regulatory authority.	
2.9.7 Radioactive material, above exemption limits defined by the relevant regulatory authority, must not be removed from or brought into any operation to which this Code applies without authorization from the regulatory authority.	

Mining Code Section	Addressed in the RMP
2.10.1 Responsibilities - Operator/Employer **The operator and employer must:** **a) ensure that the workplace and work procedures are designed, constructed, and operated so as to keep exposures to ionizing radiation as low as reasonably achievable, economic and social factors being taken into account, and below the limits set in Schedule 1;** **b) ensure that waste is managed by means of best practice technology, and that exposures to ionizing radiation resulting from waste are as low as reasonably achievable, economic and social factors being taken into account;** **c) obtain all necessary approvals and authorisation from the relevant regulatory authority (see Annex A) prior to commencing the operational aspects to which they apply;** **d) ensure that appropriate expertise in the fields of radiation protection and radioactive waste management is available, and appoint a Radiation Safety Office who has qualifications and experience acceptable to the relevant regulatory authority;** **e) construct and operate all facilities in accordance with the approved RMP and RWMP, and any other requirements of this Code;** **f) ensure that sufficient resources are available to allow the requirements of the RMP and the RWMP to be fully implemented;** **g) notify the relevant regulatory authority promptly of any changes in operation, or operating conditions or other matters which are likely to significantly increase radiation exposures to workers or members of the public, or requirements for the management of radioactive waste, and which are not provided for in approvals or authorisations;** **h) report any unauthorized effluent discharges to the relevant regulatory authority;** **i) investigate promptly any defect, due to design or malfunction discovered in plant equipment or working procedures which is likely to significantly increase radiation exposures to workers or members of the public, or endanger the security of waste management facilities, and record the result of such an investigation;** **j) ensure that any defect referred to above is promptly remedied, and the situation resulting from the defect is brought under control;** **k) undertake ongoing reviews of the RMP and RWMP as determined by the relevant regulatory authority and revise them as required;**	These requirements are addressed by the following RMP sections: b) procedures and operations to keep exposures as low as reasonably achievable and below limits • Section 10 – potential dose pathways – potential exposures and controls and procedures to minimise exposure • Section 11, 12 and 13 – level monitoring • Section 14 – assessing, monitoring and reporting worker exposure • Section 16 – 19 – minimizing exposure and radiation levels during transport, storage and disposal. c) approvals and authorisations – as described in this table under 2.9 d) and f) section 24 and 25 e) as audited most recently in 2019 (HVRS, 2019) and sections 21 and 26 g), h), i) and j) as per incidents, accident and emergency response procedures (section 22), fixed radiation gauges (section 23) and periodic review and audit (section 26) k) as per section 26 l) and m) as per sections 20, 24 and 25 n) as per section 21 o) and p) as per Table 9 and procedures referenced therein

Mining Code Section	Addressed in the RMP
l) ensure than all employees are, upon commencing work, properly instructed in the radiation aspects of their work and in the precautions necessary to control their exposure to radiation and avoid radiation incidents, and that reinstruction of employees is undertaken at appropriate intervals; **m) ensure that employees are properly supervised in the performance of their work and ensure that they act in accordance with approvals and authorisations, and the requirements of this Code** **n) keep records of results of all measurements, monitoring and assessment required by this Code or by approvals and authorisations;** **o) provide employees with copies of their dose records on request and at the termination of employment; and** **p) encourage employees to inform the employer when they are pregnant, and when so informed, take steps to limit exposure of the foetus as required in Schedule 1.**	
2.10.2 Responsibilities - Employees **Employees who may be exposed to radiation, or perform duties which may affect the radiation exposure of others, must to the extent to which they are capable, comply with all reasonable measures to control and assess exposure to radiation, or to manage radioactive waste. The employee must:** **a) follow radiation protection and waste management practices specified in approvals or authorisations, and other regulatory requirements** **b) comply with the legitimate instructions of the employer, or the employers agents;** **c) participate in training programs required under this Code, and make proper use of such training;** **d) make proper use of plant and equipment supplied for radiation protection, or for the monitoring and assessment of radiation exposures;** **e) not engage in any careless or reckless action which might result in unnecessary radiation exposure to themselves or others, or compromise the management of radioactive waste;** **f) report to the employer any defects of which they become aware, in plant equipment or procedures, which may compromise radiation protection or the management of radioactive waste;** **g) report all incidents or accidents to the employer; and** **h) advise the employer of previous employment involving occupational exposure to radiation, and cooperate in obtaining records of such previous exposure.**	Tronox employees are required to follow the radiation protection and waste management practices specified in this RMP and supporting procedures. Tronox provides radiation ware training to all employees with additional training provided to essential key personnel who have a requirement to assess or isolate fixed radiation gauges, or, oversee the compliant and safe operations undertaken by others (i.e., radiation safety officer, refer to sections 24 and 25).

Mining Code Section	Addressed in the RMP
Schedule 1 ARPANSA's recommendations for limiting exposure to Ionizing Radiation (2002) – Dose Limits	Limits of Schedule 1 are complied with, as noted in this plan: • Occupational limit - 20 mSv per year, averaged over a period of 5 consecutive calendar years • Public – 1 mSv in a year Controls in place to minimise exposure is provided in sections 11 – 19, monitoring of radiation dose of employees are given in section 14.

5.3 Environmental Guidelines for solid waste classification management and landfilling

Tronox's Conditions of Development Consent (refer to Table 4) require this RMP to meet the environmental goals listed in Environmental Guidelines: Solid Waste Landfills (NSW EPA, 2016). The environmental goals outlined in the guidelines, and how this RMP meets this requirement, is summarised in Table 2.

Table 2 Environmental Goals – Environmental Guidelines: Solid Waste Landfills (NSW EPA, 2016)

EPA Guideline goal	Relevance to the RMP	RMP section(s)
Should be sited, designed, constructed and operated to cause minimum impacts to the environment, human health and amenity	This requirement broadly applies to the development of engineered landfill cells in accordance with the guidelines. In the context of this RMP, Tronox are required to comply with specific conditions of their EPLs and Conditions of Development Consents for each site (as detailed in Table 2), which puts limits on: • The average concentration of radioactive material at the site • The radiation level of any material deposited (no greater than 0.7 microGray per hour, measured one metre above the surface of the material being deposited) • The required background radiation following backfill to the mine void and reinstatement (i.e., no detectable change above background measured at the surface) • Limits on the tonnage of waste disposed per annum in the mine void (300,000 tonnes/annum, Ginkgo EPL condition L2.7 and 130,000 tonnes/annum, Snapper EPL condition L2.5).	Sections 11 - 19
The waste mass should be stabilised, the site progressively rehabilitated and the land returned to productive use as soon as possible	Section 17 of this RMP details the in-pit waste disposal and decommissioning for material returned to the Ginkgo mine void. The Ginkgo mine void has been progressively backfilled and rehabilitated throughout mining operations, as mining is completed behind the dredge vessel within the mine path.	Section 17
Wherever feasible, resources should be extracted from the waste and beneficially reused	Returning the blended mine waste to the mine void is beneficial reuse as it facilitates the rehabilitation of the mine void. Section 18 details how inert process waste may be suitable for reuse for other purposes.	Sections 17 and 18
Adequate data and other information should be available about any impacts from the site, and remedial strategies should be put in place where necessary.	Tronox undertakes radiation monitoring to meet the specific requirements of ARPANSA (2015) and conditions of Development Consents and EPLs. Details on monitoring are provided in sections 10 – 17 of this RMP.	Sections 10 - 17
All stakeholders should have confidence that appropriately qualified and experienced personnel are involved in the planning, design and construction of landfills to high standards.	Broadly, this requirement relates to the design and construction of engineered landfill cells as required by the guidelines, which is not applicable to the backfilling of the mine void taken in compliance with this plan. Tronox controls the backfill and rehabilitation of the mine void in accordance with their approved Mine Rehabilitation Plan and Conditions of Development Approval, and the limits on the volume of backfilled material that can be deposited in the mine void each year (300,000 tonnes/annum, Ginkgo EPL, condition L2.7 and 130,000 tonnes/annum, Snapper EPL, condition L2.5).	Section 17, Sections 20 and 24.

5.4 Project regulatory approvals

The regulatory approval documents for Tronox's Murray Basin operations are provided in Table 3. The radiation specific requirements of these regulatory approvals to be addressed in this RMP are provided in Table 4.

This RMP has been created to address the radiation-specific requirements for management and is consistent with the Code of Practice and Safety Guide for Radiation Protection and Radioactive Waste Management in Mining and Mineral Processing (ARPANSA, 2005). The consistency with ARPANSA has been audited by Luke Slechta of Hunter Valley Radiation Services Pty Ltd (HVRS) with a report finalised in July 2019. Luke Slechta performs the role of Compliance Manager for HVRS. Joe Slechta holds a Consulting Radiation Expert (CRE) status with NSW EPA. Joe Slechta holds accreditation number A/46 as listed on NSW EPA website https://www.epa.nsw.gov.au/your-environment/radiation/accreditation-of-cres/accredited-cres. The audit findings were peer reviewed by Joe Slechta for purpose of quality and validation of findings. These audit findings were implemented into the RMP.

Table 3 Tronox Murray Basin regulatory approvals

Approval Document	Document Number	Current revision date
Ginkgo Mineral Sands Mine Development Consent	**DA 251-09-01**	**December 2017**
Ginkgo Mining Lease	ML 1504	**6 March 2002**
Ginkgo-Crayfish Mineral Sands Mining Operation Plan	-	**February 2016**
Ginkgo Mine Environment Protection Licence	EPL 12264	**18 December 2015**
Crayfish Mining Lease	ML 1735	**April 2016**
Snapper Mineral Sands Mine Development Consent	DA 06-0168	**20 March 2015**
Snapper Mining Lease	ML 1621	**10 July 2008**
Snapper Mineral Sands Mining Operation Plan	-	**April 2016**
Snapper Mine Environment Protection Licence	EPL 12799	**10 July 2012**
Atlas-Campaspe EPBC Act Referral	EPBC 2012/6447	**3 May 2016**
Atlas-Campaspe Mineral Sands Mine Development Consent	SSD_5012	**6 June 2014**
Atlas Mining Lease	ML 1767	**2 February 2018**
Atlas Mineral Sands Mining Operation Plan (Clearing & Construction)	-	**February 2018**
Atlas Mine Environment Protection Licence	EPL 21007	**21 December 2017**
Broken Hill MSP Development Consent	DA 345-11-01	**October 2017**
Broken Hill MSP Environment Protection Licence	EPL 12314	**16 November 2017**
Radiation Management Licence	**5061302**	**January 2019**

Table 4 Requirements of regulatory approvals addressed in the RMP

Condition number	Condition details	Section in RMP
Ginkgo (DA 251-09-01)		
Schedule 3, Condition 27, Operating Conditions	The Applicant shall ensure that wastes are landfilled in a manner to ensure: a. the average concentration of radioactive material in landfill at the site would not exceed the average concentration of radioactive material in the original orebody;	Section 17
	b. the radiation level of any material deposited to land is no greater than 0.7 microGray per hour measured 1 metre vertically above the surface of the material being deposited;	
	c. that the topsoil of the landfilled area has an average salinity level no greater than the average salinity level of topsoil in other part if the site; and	
	d. there is no detectable change from the original natural background radiation level measured at the ground surface.	
Schedule 3, Condition 28, Radiation Management Plan	The Applicant shall prepare and implement a Radiation Management Plan for the development to the satisfaction of the Secretary. This plan must: (a) be prepared in consultation with the EPA by suitably qualified expert whose appointment have been endorsed by the Secretary; (b) be submitted to the Secretary for approval within 6 months of the date of consent for MOD 9, unless otherwise agreed with the Secretary; (c) generally meet the environmental goals listed in Environmental Guidelines: Solid Waste Landfills (DEC, 1996 or its latest version); (d) be consistent with the Code of Practice and Safety Guide for Radiation Protection and Radioactive Waste Management in Mining and Mineral Processing (ARPANSA, 2005); (e) include: • a description of operation and control measures; • design and operation details of waste disposal areas; • a management program for back loaded MSP process waste; • a system to monitor the movement of back loaded MSP waste; • a description of waste generating processes and waste; • details of radiation monitoring; • details of appropriate equipment, staff, facilities and operational procedures; • a description of induction and training courses; • reporting and periodic review procedures; • emergency plans; • baseline radiological information; • description of the waste management system; • radioactive waste monitoring; and • a conceptual decommissioning plan.	
	(a) be prepared in consultation with the EPA by suitably qualified expert whose appointment have been endorsed by the Secretary;	Section 3

Condition number	Condition details	Section in RMP
	(b) be submitted to the Secretary for approval within 6 months of the date of consent for MOD 9, unless otherwise agreed with the Secretary;	Section 3
	(c) generally meet the environmental goals listed in Environmental Guidelines: Solid Waste Landfills (DEC, 1996 or its latest version);	Section 5.3
	(d) be consistent with the Code of Practice and Safety Guide for Radiation Protection and Radioactive Waste Management in Mining and Mineral Processing (ARPANSA, 2005);	Section 5.2
	(e) include: • a description of operation and control measures; • design and operation details of waste disposal areas; • a management program for back loaded MSP process waste; • a system to monitor the movement of back loaded MSP waste; • a description of waste generating processes and waste; • details of radiation monitoring; • details of appropriate equipment, staff, facilities and operational procedures; • a description of induction and training courses; • reporting and periodic review procedures; • emergency plans; • baseline radiological information; • description of the waste management system; • radioactive waste monitoring; and • a conceptual decommissioning plan.	As summarised in Table 1 in section 5.2
Snapper (DA 06-0168)		
Schedule 3, Condition 7, Landfill Management Measures	The Landfill Management Measures must: (a) generally meet the environmental goals listed in Environmental Guidelines: Solid Waste Landfills (DEC, 1996 or its latest version) and; (b) include: • design and operation details of waste disposal areas; • a management program for back loaded MSP process waste; • a system to monitor the movement of back loaded MSP waste; and • disposal techniques and handling practices consistent with the Code of Practice and Safety Guide for Radiation Protection and Radioactive Waste Management in Mining and Mineral Processing (ARPANSA, 2005 or its latest version).	Table 2 in Section 5.3, Section 15 and 17
Schedule 3, Condition 9, Radiation Management Plan	The Proponent shall prepare and implement a Radiation Management Plan for the project to the satisfaction of the Secretary. This plan must:	
	(a) be prepared in consultation with the EPA by suitably qualified expert/s whose appointment/s have been approved by the Secretary;	Section 3
	(b) be submitted to the Secretary for approval prior to carrying out any development on the site;	Section 3
	(c) be consistent with the Code of Practice and Safety Guide for Radiation Protection and Radioactive Waste Management in mining and Mineral Processing (ARPANSA, 2005); and	Section 5.2

Condition number	Condition details	Section in RMP
	(d) include: • a description of operation and control measures; • a description of waste generating processes and waste; • demonstration of access to professional expertise; • details of radiation monitoring; • details of appropriate equipment, staff, facilities and operational procedures; • a description of induction and training courses; • reporting and periodic review procedures; • emergency plans; • baseline radiological information; • description of the waste management system; • radioactive waste monitoring; and • a conceptual decommissioning plan.	As summarised in Table 1 in section 5.2
Atlas-Campaspe (SSD_5012)		
Schedule 3, Condition 29, Radiation Management Plan	The Applicant shall prepare and implement a Radioactive Waste Management Plan for the development to the satisfaction of the Secretary. This plan must:	
	(a) be prepared in consultation with the EPA by a suitably qualified expert/s whose appointment has been approved by the Secretary;	Section 3
	(b) be submitted for approval 6 months prior to the commencement of the transport of MSP process waste to the site for disposal;	Section 3
	(c) generally meet the environmental goals listed in *Environmental Guidelines: Solid Waste Landfills* (DEC, 1996 or its latest version);	Section 5.3
	(d) be consistent with the *Code of Practice and Safety Guide for Radiation Protection and* *Radioactive Waste Management in Mining and Mineral Processing* (ARPANSA, 2005);	Section 5.2
	(e) include: • a description of potential sources of dose delivery pathways and potential doses; • a description of operation and control measures; • design and operation details of waste disposal areas; • a management program for backloaded MSP process waste; • a system to monitor the movement of backloaded MSP waste; • a description of waste generating processes and waste; • demonstration of access to professional expertise in radiation protection; • details of radiation monitoring; • details of appropriate equipment, staff, facilities and operational procedures; • a description of induction and training courses; • reporting and periodic review procedures; • emergency plans; • baseline radiological information; • description of the waste management system; • radioactive waste monitoring; and • a conceptual decommissioning plan; and	As summarised in Table 1 in Section 5.2

Condition number	Condition details	Section in RMP
	(f) ensure wastes are landfilled in a manner to ensure: • the average concentration of radioactive material in landfill at the site would not exceed the average concentration of radioactive material in the original orebody; • the radiation level of any material deposited to land is no greater than 0.7 microGray per hour measures 1 metre vertically above the surface of the material being deposited; and • there is no detectable change from the original natural background radiation level measures at the ground surface.	Section 17
Broken Hill MSP (DA 345-11-01)		
Schedule 2, Condition 3.12, Waste Management	*Classification of controlled waste* *(m) The Applicant must accurately identify the waste, in accordance with Condition 6.4(c)(viii), and determine if the waste is a controlled waste within the meaning of the NEPM.* *Application for a consignment authorisation* *(n) If the waste is transported from the Premises to another participating State or Territory, the Applicant must comply with all Conditions attached to the consignment authorisation issued by an agency or a facility delegated by an agency in the destination State or Territory.* *Note: The waste producer is required by the Protection of the Environment Operations (Waste) Regulation 2005 to obtain, prior to the waste being dispatched, a consignment authorisation from an agency, or a facility delegated by an agency, in the destination State or territory to allow the movement of controlled waste.* *Waste movements* *(o) If the waste is transported from the Premises to another participating State or Territory, the Applicant must ensure that the waste is transported to a place that can lawfully be used as a waste facility for that waste.* *(p) The Applicant must ensure that the waste transporter is licensed as required by the agency of each participating State or Territory through which the waste is transported.* *(q) The Applicant must:* • *retain a copy of the waste transport certificate for the waste for a period of not less than four years from the time the form was completed, and* • *make the copy of the waste transport certificate available for inspection by an authorised officer on request.* *Note: The waste producer is required by the Protection of the Environment Operations (Waste) Regulation 2005 to complete a waste transport certificate for the waste. This should be done in accordance with the instructions printed on the certificate and the required copy of the waste transport certificate should be forwarded to the agency in the State of destination.* *Waste Management* *(s) The Applicant must not cause, permit or allow any waste generated outside the Premises to be received at the Premises for storage, treatment, processing, reprocessing or disposal or any waste generated at the Premises to be disposed of at the Premises, except as expressly permitted by a licence under the POEO Act 1997.* *(t) This Condition only applies to the storage, treatment, processing, reprocessing or disposal of waste at the Premises if it requires an environment protection licence under the POEO Act 1997.* *(u) Except as provided by any other Condition of this Consent, only the hazardous, industrial or group A waste listed below may be generated or stored at the Premises.*	Sections 15, 16, 19

Condition number	Condition details	Section in RMP
	Note: Radioactive waste assessed as hazardous or industrial waste under Section 3.5 of the Wastes Guidelines.	
Schedule 2, Condition 3.16, Transport of Hazardous Materials	(a) Material to be transported shall be classified and transported in accordance with the NSW Radiation Control Regulation 2003 and the Code of Practice for the Safe Transport of Radioactive Material published by the Australian Radiation Protection and Nuclear Safety Agency, 2001; and (b) Process waste is to be transported by heavy vehicles otherwise transporting mineral and heavy mineral concentrates, as backloads on return trips, wherever practicable.	Section 16
Schedule 2, Condition 4.7, Requirement to monitor radiation	The Applicant must monitor radiation levels in accordance with the requirements set out in the Environmental Protection Licence issued by the EPA. The Applicant must ensure that blended waste to be disposed of outside the premises is analysed to ensure characterisation in accordance with EPA waste disposal guidelines and is disposed of at a place licensed by the EPA to lawfully accept that class of waste.	Sections 15, 16, 17 & 18
Ginkgo EPL 12264		
L2.6	The licensee must ensure that only the following types of waste generated off-site are disposed of at the premises: Waste permitted to be landfilled within the Ginkgo Mineral Sands Mine void: 1. Waste generated outside the premises from the processing of mineral concentrates produced at the premises, Snapper Mine or the Atlas-Campaspe Mine that is assessed as General Solid Waste (non-putrescible), following the technical procedure outlined in Waste Classification Guidelines, Part 1: Classifying Waste or that is specified as General Solid Waste (non-putrescible), in Schedule 1 of the Protection of the Environment Operations Act 1997; OR 2. Waste generated outside the premises from the processing of mineral concentrates produced at the premises, Snapper Mine or the Atlas-Campaspe Mine that is assessed as hazardous waste on the basis it contains radioactive substances from the premises, Snapper Mine or the Atlas-Campaspe Mine and except for this radioactive component would be classified as General Solid Waste (non-putrescible), following the technical assessment procedure outlined in Waste Classification Guidelines, Part 1: Classifying Waste. Note: Condition O5 requires waste permitted to be disposed at the premises to be processed to a solid waste prior to being landfilled.	Section 15
L2.7	The total tonnage of waste disposed of at the Ginkgo Mineral Sands Mine void (the premises) must not exceed 300,000 tonnes/per annum.	Section 16
O4.2	The licensee must prepare and implement a Radiation Management Plan for the premises. Note: The Radiation Management Plan must be prepared and implemented to ensure compliance with the conditions of this Licence and relevant environmental legislation.	As provided throughout this RMP, summarised in Sections 5.1 – 5.4
O5.1	Waste must be landfilled in a manner to ensure that: a) the average concentration of radioactive material in the landfill at the premises will not exceed the average concentration of radioactive material in the original orebody; b) the radiation level of any material deposited to land is no greater than 0.7 microGray per hour measured 1 metre vertically above the surface of the material being deposited, and c) the topsoil of the landfilled area has an average radiation level no greater than the average radiation level of topsoil in other parts of the premises.	Section 17

Condition number	Condition details	Section in RMP
Snapper EPL 12799		
L2.4	1. Waste generated outside the premises from the processing of mineral concentrates produced at the premises or the Ginkgo Mine, AND 2. Waste that is assessed as General Solid Waste (non-putrescible), following the technical procedure outlined in Waste Classification Guidelines, Part 1: Classifying Waste or that is specified as General Solid Waste (non-putrescible), in Schedule 1 of the Protection of the Environment Operations Act 1997; OR 3. Waste that is assessed as hazardous waste on the basis it contains radioactive substances from the premises and except for this radioactive component would be classified as General Solid Waste (non-putrescible), following the technical assessment procedure outlined in Waste Classification Guidelines, Part 1: Classifying waste. Note: Waste permitted to be disposed at the premises must comply with item 1 and at least one other item in this list, either item 2 or 3. Note: Condition O5 requires waste permitted to be disposed at the premises to be processed to a solid waste prior to being landfilled.	Section 15, 16
L2.5	The total tonnage of waste disposed of at the premises must not exceed 130,000 tonnes/per annum.	Section 16
O4.2	The licensee must prepare and implement a Radiation Management Plan for the premises. Note: The Radiation Management plan must be prepared and implemented to ensure compliance with this Licence and relevant environment legislation.	As provided throughout this RMP, summarised in Sections 5.1 – 5.4
O5.1	Waste must be landfilled in a manner to ensure that: (a) the average concentration of radioactive material in the landfill at the premises will not exceed the average concentration of radioactive material in the original orebody; (b) the radiation level of any material deposited to land is no greater than 0.7 microGray per hour measured 1 metre vertically above the surface of the material being deposited, and (c) the topsoil of the landfilled area has an average radiation level no greater than the average radiation level of topsoil in other parts of the premises.	Section 17
Broken Hill MSP EPL 12314		
L4.1	The licensee must not cause, permit or allow any waste to be received at the premises, except the wastes expressly referred to in the column titled “Waste” and meeting the definition, if any, in the column titled “Description” in the table below. Any waste received at the premises must only be used for the activities referred to in relation to that waste in the column titled “Activity” in the table below. Any waste received at the premises is subject to those limits or conditions, if any, referred to in relation to that waste contained in the column titled “Other Limits” in the table below.	Section 15

<table>
<tr><th>Condition number</th><th>Condition details</th><th>Section in RMP</th></tr>
<tr><td></td><td>This condition does not limit any other conditions in this licence.
<table>
<tr><th>Code</th><th>Waste</th><th>Description</th><th>Activity</th><th>Other Limits</th></tr>
<tr><td>NA</td><td>General or Specific exempted waste</td><td>Waste that meets all the NA conditions of a resource recovery exemption under Clause 51A of the Protection of the Environment Operations (Waste) Regulation 2005</td><td>As specified in each particular resource recovery exemption</td><td>NA</td></tr>
<tr><td>NA</td><td>Waste</td><td>Any waste received on site that is below licensing thresholds in Schedule 1 of the POEO Act, as in force from time to time</td><td>-</td><td>NA</td></tr>
</table></td><td></td></tr>
<tr><td>L4.2</td><td>The quantity of hazardous and/or restricted solid waste generated and/or stored at the premises must not exceed 300,000 tonnes per year.</td><td>Section 16</td></tr>
</table>

Tronox initially identified key environmental legal and other requirements through the environmental impact assessment and approvals processes for Tronox's operations in the Murray Basin in NSW. Legal and other requirements are documented in the Environmental Legal and Planning Register, which is attached to the Environmental Management Strategy (EMS, 2016) as Appendix D.

Changes to legal and other requirements are identified through regular consultation with key stakeholders (such as the Department of Planning, Industry and Environment, EPA, Department of Regional NSW, Division of Resources and Geoscience, Environment, Energy and Science Group and NSW Office of Water) and others and industry newsletters. Tronox seeks external, professional advice, where required, regarding legislative requirements.

Tronox will review and, if required, update the Environmental Legal and Planning Register annually, in response to updates received on legislation, regulations, guidelines and policies and following changes to activities. The environmental department (Environmental Compliance Officer) is responsible for maintaining the currency of the Environmental Legal and Planning Register.

6 Responsibilities

Table 5 Responsibilities

Role	Responsibility
General Manager Operations (Operators Representative)	▪ Ensure the human and material resources are available to develop, implement, review and audit the Radiation Management Plan. ▪ Provide leadership and/or commitment to the maintenance of the Radiation Management Plan
Department Managers	▪ The MSP Manager is responsible for tracking MSP waste streams ▪ Ensure the Radiation Management Plan is developed, implemented, maintained, reviewed and audited ▪ Identify roles and responsibilities within their department relevant to radiation management ▪ Maintain systems within their departments for identification, evaluation and management of risks, in accordance with the Radiation Management Plan ▪ Provide training and support to improve knowledge and communication of radiation management ▪ Ensure that plant and equipment are designed, constructed, operated, commissioned, maintained and decommissioned in accordance with the Radiation Management Plan
Superintendents / Supervisors	▪ Ensure persons, associated with installation, commissioning, repairs & maintenance, testing & overhaul of radiation equipment are doing so in accordance with the requirements of the Radiation Management Plan ▪ Monitor tasks to ensure compliance with this RMP and any relevant procedures or safe work instructions that may have been developed for their particular task
All Persons	▪ Follow relevant Standards, Procedures and Rules at all times. ▪ Exercise great caution with plant and equipment. Any unsafe installations or equipment should be immediately isolated and reported to their supervisor
Maintenance and Trade personnel	▪ Required to have a license or recognised qualification ▪ Required to have site familiarisation, competency assessment and authorisation for the operations they are undertaking ▪ Carry out preventative maintenance ▪ Maintain plant and equipment as safe and fit for purpose
Radiation Safety Officer (RSO)	▪ Ensure safe isolation of fixed radiation gauges ▪ Monitor the removal of any gauge ▪ Ensure the safe transportation of any radioactive source and applicable permits and documentation ▪ Ensure the safe storage and security of any radioactive source
Radiation Isolation Officer	▪ Ensure the safe isolation of fixed radiation gauges

7 Description of Operations

Tronox Mining Australia Limited (Tronox) is the local arm and contains the main mining operations of Tronox, which has as its primary purpose the commercial production of high quality titanium source materials and associated by-products including zircon and other Heavy Mineral concentrates for world markets.

Ore at Ginkgo and Snapper mines is dredge mined. Ore at Atlas will be open pit dry mined with dredge mining at the Campaspe deposit. The ore undergoes an initial on-site beneficiation of ore by wet gravity concentrator to produce a Heavy Mineral Concentrate (HMC), then further on-site separation by Wet High Intensity Magnetic Separation (WHIMS) plant to produce separate magnetic and non-magnetic mineral concentrates. These concentrates are transported via road, and rail from Atlas-Campaspe, transport to the Broken Hill MSP for production of final separated mineral concentrates.

The MSP further separates mineral concentrates to produce the saleable minerals ilmenite, leucoxene, rutile and zircon. The MSP is currently approved to process up to 650,000 tonnes per annum (TPA) of mineral concentrate produced by the Snapper and Ginkgo-Crayfish Mines. As these mines reach depletion, production from Atlas and then Campaspe will take over.

All radionuclide bearing process waste generated at the MSP operations is combined with inert waste and back-loaded to the Ginkgo or Snapper Mine for further dilution and disposal. When Ginkgo and Snapper close, disposal will be into Campaspe pit.

8 Measuring Radioactivity

The measures of radioactivity used in this Management Plan are bequerels, grays and sieverts.

The **bequerel** is a measure of the amount of radiation emitted by a substance. The ore and waste material at Tronox are measured in bequerels per gram (Bq/g). Material that is 100 Bq/g or greater is defined as radioactive in NSW.

The **gray** is defined as the absorption of one joule of ionizing radiation by one kilogram (1 J/kg) of matter, e.g. human tissue. The Development Consents, Gingko, Snapper and Atlas-Campaspe specify the level of residual radiation allowed in completed mine rehabilitation no greater than 0.7 microGray per hour (µG/hr) at 1 m above surface.

The **sievert** is a measure of the amount of potential damage to the body from a given amount of radiation. The NSW Radiation Control Regulations provide maximum radiation dosages in sieverts per period of time, for example maximum dosage for people should be less than 1 mS/hr. Freight containers giving dose rates of less than 5 µSv/hr on the external surface may be transported as an ‘Excepted Package, UN2910’.

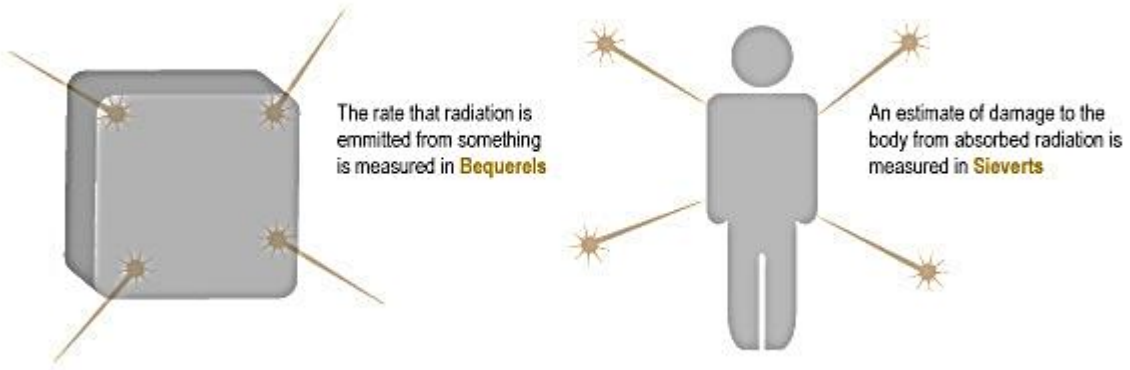


Figure 1: Graphical depiction of bequerels measuring radiation emitted and sieverts measuring radiation absorbed.
(source** http://www.tsukubascience.com/2011/04/understanding-radiation-becquerels-and-sieverts/**)

9 Radioactivity of Murray Basin Materials

Several components of heavy mineral sands (monazite, leucoxene, xenotime) contain naturally occurring radioactive materials (NORM). The primary two elements of NORM found in mineral sands is thorium and uranium. Thorium and uranium are the 'parents' of three series of radioactive elements which are present in the ore and in the HMC, and they report mainly into the MSP waste.

Several of the radioactive elements are emitters of gamma radiation, which is similar to x-rays. Other radionuclides are alpha emitters. These can only deliver a dose to a person following their ingestion or inhalation. Beta emitters are not generally a concern in mineral sands because controls which are put in place for gamma and alpha emitters are also effective in controlling beta radiation.

Table 6 Levels of radiation emitting from Murray Basin product and waste streams

Material	Level of radiation (bequerels per gram)
Mineral sands ore from Murray Basin sites	1.8 Bq/g
Atlas Heavy Mineral Concentrate (HMC)	24.16 Bq/g
Campaspe HMC	42.33 Bq/g
Broken Hill MSP monazite waste derived from combined Snapper, Ginkgo and Atlas HMCs	190.0 Bq/g
Broken Hill MSP monazite waste derived from Campaspe HMC	332.91 Bq/g

The activity concentration of radioactive elements which classes a material as hazardous in NSW is 100 Bq/g. Table 4 shows that the Atlas and Campaspe HMCs and the waste monazite from all ores delivered to the MSP are hazardous and must be managed as such.

10 Potential Dose Delivery Pathways & Control Measures

There are five possible *pathways for delivery of radiation doses* to the human body from mineral sand mining that may require active control, they are:

- Direct irradiation ('shine') by gamma radiation from bulk thorium-bearing (i.e., primarily monazite bearing) materials. This is only significant if long periods are spent close to large volumes of these materials.
- Inhalation of radon progeny (radon daughters). This is only a concern in enclosed but unventilated volumes (such as warehouse full of bulker bags of monazite or leucoxene or xenotime concentrates).
- Inhalation of airborne dust containing long-lived alpha-emitting uranium, thorium, and radium.
- Ingestion of radioactive contamination transferred from hands to mouth when eating or smoking. This is controlled by personal hygiene (washing of hands and face before meals).
- Direct irradiation from damaged or malfunctioning Fixed Industrial Gauges (include detail on type of radiation and risk).

For the mineral sands industry radiation dose control therefore requires:

1 Dust minimisation and if necessary the use of respiratory protection;

2 Spillage control, effective clean-up of workplaces and personal hygiene; and

3 Planning to ensure that there are no major quantities of gamma-emitting materials which are close to continuously occupied workplaces.

Other dose controls as managed via the Eastern Operations Mine Safety Management System (AP_ME_4.4.04007) and MSP Waste Management Plan are summarised in the table below.

Table 7 Dose control measures

DOSE CONTROL	PURPOSE
Separate dust collection for the section of the circuit handling monazite	Minimise dust exposure
Industrial Vacuum System	Minimise dust exposure
Separate enclosure within MSP for equipment that handle elevated monazite contents	Minimise exposure
"Pugging" of dust collected	Eliminate dust at its source
Respiratory protection PPE	Prevent dust inhalation
Water spray dust minimisation	Prevent dust inhalation
Spill Kits	Effective spill clean-up
Dose meters (badges) personal radiation monitors	Monitor doses to MSP workers
Pre-blending of process waste with non-MAGs from wet plant prior to transport to the mine for disposal.	To get below 100 bql for transport and to protect mine workers from exposure.

10.1 Personal Hygiene Control

Safety is managed utilising the Eastern Operations Mine Safety Management System (AP_ME_4.4.04007). This includes an induction process - Tronox Mining Inductions (AP_CMA_SP_002), which includes a Tronox Employee Induction Program and Checklist (AP_CMA_FM_001).

Workers will be instructed to wash hands and face before meal breaks. Workers carrying out dirty work will be instructed to shower and change at the end of shift. Basic washing facilities are provided at the mine sites and at the MSP.

Workers will be required to wear dust masks if conditions are visibly dusty or if monitoring indicates airborne activity concentrations over approximately 25% of the Derived Air Concentration DAC.

10.2 Controlled and Supervised Areas

Supervised Areas are managed utilising the Eastern Operations Mine Safety Management System (AP_ME_4.4.04007). This includes an induction process - Tronox Mining Inductions (AP_CMA_SP_002), which includes a Tronox Employee Induction Program and Checklist (AP_CMA_FM_001).
The MSP is designated as a Supervised Area. This means that procedures for control of access and of radiation doses will be in place.

10.3 Storage and Signage

Any permanent storage areas for bulk radioactive material will be fenced, locked when responsible person contact details.

Temporary storage areas (such as Mineral Concentrate drainage/ drying piles) and location of returns at Ginkgo will also be signposted.

11 Background Radiation Monitoring

Prior to operations, background radiation levels are measured using a gamma dose rate meter (Ludlum Model 26-1 Frisker) to record background levels in the environment. Table 7 shows average background radiation levels measured at 1 m vertically above the ground surface.

Table 8 Baseline Radiation

Average baseline background radiation			
	Average µSv/h	**Standard deviation**	**95% Confidence Limit**
Ginkgo	0.230	0.05	0.02
Crayfish	0.204	0.06	0.02
Snapper	0.177	0.05	0.02
Atlas	0.205	0.05	0.01
Campaspe	TBA	TBA	TBA

Background radiation levels will be measured on areas post mining and rehabilitation to ensure levels are equal to or no greater than the original background radiation levels.

Results of monitoring will be reported in the Annual Environmental Management Report (AEMR).

Radiation monitoring will continue after mining ceases as determined in consultation with key government agencies and detailed in the mine closure plan.

12 Mine Radiation Monitoring

Gamma radiation monitoring will be undertaken every three months and results detailed in the Annual Report;

- in, and around, the WHIMS plant
- in the mine laboratory
- on the sand residue beach, and
- on the mine path after rehabilitation

For dose meter operation and survey procedures refer to Tronox Mining Operation of Radiation Survey Meters AP_ME_4.6.22022 [2] and Tronox Mining Area Gamma Radiation Survey AP_ME_4.6.22023 [2].

13 MSP Radiation Monitoring

Gamma radiation monitoring will be undertaken every three months wherever bulk quantities of mineralised material are collected and stored. Radiation monitoring at the MSP will be carried out as per Tronox Mining Operation of Radiation Survey Meters AP_ME_4.6.22022 [2] and Tronox Mining Area Gamma Radiation Survey AP_ME_4.6.22023 [2].

At the MSP process slurry lines are monitored by fixed radiation gauges more commonly referred to as density gauges. From time to time it may be necessary for maintenance personnel to have access to these gauges or to the equipment on which they are mounted. A qualified radiation person is required to isolate and test fixed radiation gauges prior to their removal. A list of relevant qualified Tronox personnel is shown in Table 7.

14 Monitoring Worker Exposure to Radiation

Process wastes generated from the separation process are:

- Silica and quartz from the feed preparation circuit;
- Monazite and silicate minerals from the ilmenite and leucoxene circuits; and
- Silicate minerals from the zircon and other dry circuits.

The monazite is radioactive. The monazite fraction of the Final MSP Rejects determines the overall radioactivity levels of the MSP waste streams.

Radiation badges are issued to relevant personnel working at the MSP for quarterly wearing periods. At the end of the monitoring period TLD badges are sent to APANSA for analysis and reporting of individual exposure doses. Tronox implements an information management system for data processing, non-conformance, reporting or results, data storage, etc.

Airborne alpha emitting dust (ore dust) concentrations will be measured at any potential dust-making activities. Personal dust monitoring will be performed on selected subset of workers.

Visual checks for contamination (dust) will be carried out on a regular basis, to ensure appropriate housekeeping and personal hygiene standards.

Radiometric surface alpha contamination monitoring will be performed biannually. Checks will cover office and plant tables and desks, ablutions area, and opportunistically, workers' hands, clothes, etc.

Table 9 Radiation Monitoring Program

Radiation Monitoring Program			
Method	**Monitoring**	**Frequency**	**Responsible**
Area Gamma survey (GM probe)	Wet concentrator, WHIMS, MSP: work areas, storage areas and rehabilitated lands. Refer to SmartSolve documents "Area Gamma Radiation Survey" AP_ME_4.6.22023 [2] and "Operation of Radiation Survey Meters" AP_ME_4.6.22022 [2]	Quarterly	**Environmental Officer**
TLD badges for gamma doses	Personal badge issue, all radiation workers (MSP) Mine workers on risk based program for verification of low exposure rates. Tronox implements an information management system for data processing, non-conformance, reporting or results, data storage, etc. Badge usage is managed via procedure AP_ME_15007 - MSP Thermoluminescent Dosimetry (TLD Badges) April 2020	3 month wearing period	**MSP Senior Safety Advisor**
Airborne radioactive dust (personal air sampler with count by alpha drawer assembly and scaler - rate meter	Workers in dusty areas: 6 hrs if possible. Fixed samplers for investigational studies. See SmartSolve document "Occupational Hygiene Monitoring Procedure" AP_ME_1083 [3]	As per Tronox's sampling schedule/plan	**MSP Senior Safety Advisor**
Surface alpha contamination (alpha probe)	• **Vehicles** • **Work surfaces** • **Crib room tables, Offices** • **Ablutions area** • **Workers' hands and clothes** **See SmartSolve document "Occupational Hygiene Monitoring Procedure" AP_ME_1083 [3] for operation of the alpha survey meter.**	**6 monthly**	**MSP Senior Safety Advisor**

15 Process Waste Management

Process wastes generated from the separation process are:

- Silica and quartz from the feed preparation circuit;
- Monazite and silicate minerals from the ilmenite and leucoxene circuits; and
- Silicate minerals from the zircon and other dry circuits.

The monazite is radioactive. The monazite fraction of the Final MSP Rejects determines the overall radioactivity levels of the MSP waste streams.

Process waste materials from the 'wet plant' and 'dry plant' have different radiation activity levels due to the handling of the monazite fraction. The dry plant removes monazite and other wastes (mostly quartz) which are classified as hazardous materials. The 'wet plant' however, does not remove the monazite from the mineral concentrate and therefore the resulting waste stream is not classified as hazardous waste in accordance with Waste Classification Guidelines Part 3: Waste containing radioactive material (2014).

Process wastes can be separated into the following waste streams:

- Final MSP Rejects;
- Inert Process Wastes;
- Stack discharge; and
- Baghouse dust.

MSP Rejects are disposed of at Ginkgo, or Campaspe upon the completion of the Gingko pit, by backfilling the mine path behind the dredge vessel. The MSP Rejects are made up of blended wastes from the 'wet' and 'dry' plants.

On separation from the product zircon mineral, the monazite reject stream is directed to a process sump where it is moistened and blended with other waste streams to produce MSP Rejects.

The MSP Rejects are then stored as a damp ("pugged" or slurried) waste material with a total activity level of up to 190 Bq/g. The predicted activity of waste material produced from the Campaspe ore body will be approximately 335 Bq/g. As the radiation level of this material exceeds 100 Bq/g, under NSW Waste Classification Guidelines Part 3: Waste containing radioactive material (2014) the waste is classified as hazardous and must be managed to minimise the risk to workers and the public.

The MSP Rejects are then stored in a concrete storage bay fitted with overhead sprinklers. The quantity of hazardous and/or restricted solid waste generated and/or stored at the premises must not exceed 300,000 tonnes per year as stated by the MSP Environment Protection Licence (EPL 12314) Condition L4.2. The MSP Rejects are dense and not prone to dusting, presenting an inherently a low hazard material. They do not require shielding and persons can work near it for an extended period (about 100 hours) before approaching or exceeding the Annual Radiation Dose Limit for Members of the Public (1 mSv) as set by the NSW Radiation Control Regulations 2013. The current limit of radiation exposure for workers is 20 millisieverts (mSv) per year averaged over five years, and not more than 50 mSv received in any one year for effective (whole body) dose. If there is no dust suspension in the air, then radiation dose by inhalation will not occur as a secondary pathway for whole body radiation exposure.

Please refer to section 23 which details the management of Fixed Industrial Radiation Gauges. The specific detail for disposal of Fixed Industrial Radiation Gauges is contained in section 23.5.

16 Waste Transport

Any samples or shipments of bulk products or wastes which are considered likely to be in excess of 100 Bq/g must be transported as radioactive material. The Radiation Control Regulation requires that any substance which is classified as 'radioactive' under the Act must in its transport, comply with the Code for the Safe Transport of Radioactive Material, 2018, issued by Australian Radiation Protection and Nuclear Safety Agency (herein referred to as the 'Transport Code').

The Regulations sets out rules for (i) labelling of packages containing radioactive materials; (ii) placarding of vehicles which transport them, and (iii) issue to driver of a briefing and consignment note describing the material being transported. The transport of waste is only with NSW and does not trigger the compliance obligations for transport of waste interstate. Only hazardous waste that has been issued a valid consignment authorisation number will be accepted at Ginkgo from the licensed transporter. The licensed transporter will provide a copy of forms for records at the Ginkgo Mine (EPL Licence is required by the transporter for the transport of hazardous waste). A copy of the waste receipt record for each waste collection at Ginkgo will be provided to MSP within 21 days of the date the waste is collected.

Freight containers giving dose rates of less than 5 µSv/hr on the external surface may be transported as an 'Excepted Package, UN2910'. This allows them to be sent without the package labelling or vehicle placarding designating it as "Radioactive" but does require labelling on the package and on the consignment note as "UN2910", and an internal warning notice visible when the package is opened, stating that it may contain radioactive material.

Waste less than 100 Bq/g is not captured under the scope of the ARPANSA and IAEA Transport Regulations and may be sent as general cargo, provided surface dose rate is under 5 µSv/hr.

Stockpiled “pugged” MSP Rejects are subsequently back-loaded into mineral concentrate trucks for disposal at the Ginkgo Mine or Campaspe Mine on completion of the Ginkgo pit. The Ginkgo & Snapper Development Consent allows for 300,000 tonnes per annum of waste to be transported and disposed of in either the Ginkgo or Snapper void. The Snapper Environment Protection Licence only allows 130,000 tonnes per annum to be deposited into the Snapper void. A licence variation would be required prior to depositing more than 130,000 tonnes of MSP waste into the Snapper void.

The Atlas-Campaspe Development Consent allows for the back loading of MSP waste to be deposited into the Campaspe void on completion of the Ginkgo and Snapper mines.

The MSP Rejects are transported by a contractor who is licensed by the NSW EPA to transport this material. Each truckload of MSP Rejects is sampled with a gamma radiation meter at 1 m and the reading recorded on the Shippers Declaration Form.

The MSP laboratory monitors the activity (Bq) of the waste stockpiles using XRF analysis and communicates the results to production operations. If the activity exceeds 100 Bq/g the waste is blended with inert silica sands produced from the non-mags circuit until the level is below 100 Bq/g.

Upon returning to the mine, the MSP Rejects are deposited in a designated stockpile prior to disposal in the mining void.

17 In-Pit Waste Disposal and decommissioning

Waste is disposed of in a way that the radiation level of any material being deposited to land is no greater than 0.7 µGy/h measured 1 m vertically above the surface of the material being deposited.

At Ginkgo, mine waste is placed in a shore based hopper, mixed with waste water from the salt washing facility, and then transported to the floating Wet Plant via a slurry pipe. This slurry joins the sand residue stream to be deposited on the sand residue beach. The slurry is disposed of above the groundwater table within the Ginkgo mine pit and covered under a minimum of 10 m (up to 35 m) of sand and clay overburden. Radiation monitoring during the activity is conducted and recorded to ensure radiation levels of the material being deposited is less than 0.7 µGy/hr as per procedure Eastern Operations Area Gamma Radiation Survey (AP_ME_4.6.22023).

Alternatively, the waste is paddock dumped in a designated area within the mining void and blended with inert material sourced from the mining pit (tailings sand or overburden). Radiation monitoring during the activity is conducted and recorded to ensure radiation levels of the material being deposited is less than 0.7 µGy/h.

The blended waste is covered under a minimum of 10 m of sand and clay overburden. The average salinity of topsoil in landfilled area will be no greater than average salinity level in other parts of the site. Refer to the rehabilitation plan for further information.

Further details regarding the design and operation of the waste disposal areas is contained in the MSP Waste Management Plan

Backfilled overburden areas are rehabilitated by means of subsoil and topsoil being replaced and native vegetation seeding. Rehabilitation areas are monitored (as per Eastern Operations Area Gamma Radiation Survey AP_ME_4.6.22023) to ensure there is no detectable change in original background radiation level measured 1 m above the ground surface. Conceptual decommissioning plans are included in the approved Mining Operation Plans for Ginkgo-Crayfish, Snapper and Atlas sites. See section 4.1 for the list of applicable approvals. The Mining Operation Plans and other approval documents can be viewed on the Tronox Mining website www.Tronox.com.

18 Inert Process Waste for Reuse

The activity concentration of radioactive elements which classes a material as hazardous in NSW is 100 Bq/g. Thus, any material that is below this limit will be classed as inert and not radioactive (Refer Part 1 Clause 5 NSW Radiation Control Regulation 2013).

With the approval of the applicable regulatory authorities there is potential to utilise these inert waste materials for other commercial purposes.

19 Waste Tracking

All process waste generated at the MSP is tracked as follows:

- The types of waste being transported from the MSP.
- A statement identifying the waste class will be provided in accordance with Schedule 1 of the Protection of the Environment Operations Act 1997.
- The volume of waste to which each consignment applies.
- The number of loads per consignment.
- The destination for each consignment.
- The total period required for transportation of the consignment.
- The date of dispatch and receiving dates of at least the first load in the consignment.

Information related to each consignment of waste is recorded and retained for a period of at least four years. Records will be maintained to ensure consignments sent to each destination can readily be identified and accessed. This includes all records relating to individual consignment authorisation numbers (including Waste Data Forms). The persons transporting the waste will be licensed to transport waste where required.

In addition, the following monitoring results will be maintained:

- Radiation readings from waste transport trucks
- Daily composite sample results
- Quarterly quantitative gamma spectrometry results

Waste tracking is the responsibility of the MSP Manager.

20 Radiation Safety Training

Radiation awareness is delivered via a web-based training package annually to all employees.

Any contractors working on site are managed through Tronox's Contractor Management Plan and radiation awareness is delivered by their contract manager.

Radiation Safety Officer (RSO) and Radiation Isolation Officer (RIO) training is provided to essential key personnel who have a requirement to assess or isolate fixed radiation gauges.

21 Record keeping and Reporting

All radiation monitoring results will be recorded and reported, both to workers and management. NSW EPA and Mining Inspectors will be provided access to these files as requested.

Background radiation monitoring will be included in the Annual Environmental Management Report (AEMR). The report will review the data and report on latest and planned activities as they relate to radiation monitoring and control.

Tronox are required to provide a report annually to EPA annually as a condition of each EPL issued by the EPA (Section 5.4).

On an annual basis, workers' doses will be estimated and reported as a result of the personal hygiene monitoring program.

Any incidents, such as a spill of radioactive material on a public road, will be reported promptly to the NSW EPA.

22 Incidents, Accidents and Emergencies

22.1 Radiation related emergencies

Tronox has developed plans for radiation related emergencies. Conceivable emergencies may include, an accident in transport resulting in spillage of radioactive material or damage to a fixed radiation gauge. Tronox has a transport accident response plan that will be amended to include coverage of rail movements as it relates to transport of mined materials to ports. The rail contractor (Bowmans Rail) and port operators in Port Adelaide also have procedures for emergency response including:

- Rail Operations Emergency Response Plan (Bowman's Rail, SEP 7.2, v14)
- Emergency Response Plan Standard (Bowman's Rail, STD 5.32, v2)
- ARTC Emergency Management (RLS-PR-004, June 2015)
- Flinders Logistics Radiation Management Plan (v2)

Emergency procedures need to be taken to protect human life, limit injury and provide first aid where required.

Radiation emergency procedures are outlined in the site emergency response plans for the mine sites and the Broken Hill MSP. These documents are located on Smart Solve Safety Management System.

- AP_ME_3.6.15003 [6] Mine Site Emergency Response Plan
- AP_ME_15005 [11] MSP Emergency Preparedness and Response

The below procedure for a radiation emergency should be followed after the site emergency response plan has been initiated and there is no further threat to human life.

After a radiation incident, the following procedures should be followed to bring the incident under control:

- Secure an area of at least 5 – 10 m radius from the radiation source as reasonably practicable), ensuring the radioactive source cannot be lost or carried away.
- Notify the Radiation Safety Officer
- Do not attempt to move or interfere with the radiation gauge or radioactive source unless directed by the RSO

The RSO or licensed and authorised person should;

- Assess the nature and scope of the radiation incident
- Where safe to do so, provide shielding to the source
- Establish access control to the area
- Monitor persons and equipment leaving the area
- Implement any further action required to bring the incident under control
- Investigate the circumstances of the incident including:
- Assessments, calculation and measurements of radiation
- Estimates of doses received by persons in vicinity
- Corrective action plan
- Prepare a report as soon as possible after the incident and submit to the EPA through the responsible person (employer)
- Advise the employer and EPA any changes required to prevent a recurrence of a similar incident.
- The list of emergency contacts should be checked at least every 12 months and updated as changes occur.

22.2 Incidents Involving a Fire

In the event of a major fire in the vicinity of a fixed radiation gauge, it is possible that the radiation source housing and radioactive source encapsulation may fail. The following procedure and precautions shall be implemented:

- Immediately notify the RSO who must notify the EPA that the incident is in progress
- The area is to be cordoned off
- If possible, provide water spray over radiation gauge
- Notify fire crew / brigade, breathing apparatus to be worn to prevent ingestion of any released radioactive particles
- RSO is to monitor radiation levels for duration of incident
- RSO to check those involved in incident for radiation contamination.

22.3 Incidents involving the Loss of a Radioactive Source

If a radiation source, such as a fixed radiation gauge, has been lost or suspected of being stolen, the RSO shall immediately be informed and a thorough search made using a radiation monitoring instrument. If the search fails to locate the device the RSO shall notify the EPA.

22.4 Incident reporting requirements

A radiation incident means an incident adversely affecting, or likely to adversely affect, the health or safety of any person because of the emission of radiation. A written incident report is to be produced by the Radiation Safety Officer and submitted through the employer or responsible person to the EPA within 48 hours of the occurrence of an incident. This report is to include the following particulars:

- Of the accident indicating, as far as is possible, the place where it occurred and the period during which emission of radiation was uncontrolled
- Of the area over which any radioactive substances may have been dispersed
- Of any steps taken to rectify the accident
- Of any personal injury or exposure that may have resulted

- Of any assessment of the radiation dose to which any person may have been exposed as a result of the accident

  Incident procedures are located on Smart Solve Safety Management System. Incidents and incident reporting are managed through procedure AP_ME_4.6001 [9] Eastern Operations Incident Reporting and Investigation.

23 Fixed Radiation Gauges

If the radiation sources used in fixed radiation gauges were not adequately shielded, the dose rates near them would generally be of a level that could constitute a significant health hazard. All fixed radiation gauges containing sealed radioactive sources (Regulated Material) must be registered with the NSW EPA, Hazardous Materials, Chemicals and Radiation Section.

Tronox Mining Australia must hold a current EPA Radiation Management Licence (RML). To register sealed radioactive substances in fixed radiation gauges, it is a requirement that they are in compliance with the NSW Radiation Control Act 1990, Regulations 2013 and the ARPANSA Code of Practice and Safety Guide for the Safe Use of Fixed Radiation Gauges 2007, Radiation Protection Series 13.

Tronox will ensure that:

- Before a new fixed radiation gauge is installed, the EPA is provided with details of the proposed disposal of the gauge or source(s) when no longer required
- Before any gauge is installed or relocated, the EPA is provided with detailed plans of the plant or equipment to which the gauge is to be attached and its location
- The installation, maintenance and repair of the a fixed radiation gauge is carried out by a person or company authorised by the EPA
- A radioactive source used in a fixed radiation gauge complies with the requirements for registration under Section 7 of the Act with the EPA
- The fixed radiation gauge source housing, shutter and source control mechanisms comply with the requirements for registration with the EPA
- No person receives radiation exposure from a fixed radiation gauge in excess of the limits outlined in schedule 2 of the Regulation
- That the fixed radiation gauge is permanently and durably marked with:
  - The serial number or unique identifying number
  - A radiation warning sign which complies with schedule 5 of the regulations
  - The name of the radioactive substance
  - The activity and assay date of the radioactive substance
  - The maximum radiation level at 1 metre (shutter closed) and the date of measurement
  - The name and address of the manufacturer of the fixed radiation gauge
- The fixed radiation gauge is checked and maintained in accordance with the manufacturer's recommendations and at intervals not exceeding 12 months which includes:
  - Location of the gauge is verified and recorded
  - Source housing has all of its component parts, is undamaged and in an acceptable condition
  - Radiation pattern in the vicinity of the source housing substantially conforms to that expected for the design and installed radiation source
  - Shutter or source control mechanisms operate correctly
  - Labels are intact and legible

- A wipe test is carried out at regular intervals not exceeding 24 months or at intervals determined by the EPA.
- records of inspection audits for each fixed radiation gauge be maintained for the life of the gauge
- if the source housing or shutter mechanism are damaged, or an unusual variation in radiation pattern occurs:
  - The EPA is notified
  - The fixed radiation gauge is not used until damage repaired
  - The fixed radiation gauge is tested for proper function
  - Any problem with radiation shielding is corrected
- following any catastrophic event such as fire, flood earthquake or similar:
  - The EPA is notified without delay
  - The gauge is inspected and, if necessary, tested to ensure that neither the source housing or its radiation source is damaged
  - The gauge and all its safety features are fully functional before using the gauge
- That approval from the EPA is obtained before disposing of any radioactive source.

All fixed radiation gauges installed the MSP are density gauges which are fully automated and require no interaction with personnel. They are located where no personnel would normally be in close proximity. Only those persons who are licensed under the Radiation Control Act 1990 and Regulations 2013 may repair or remove gauges. Unauthorised persons should not remove, or in any way interfere with, the radioactive substances or carry out any maintenance, adjustment or modifications to radiation gauges.

Any work that is required within close proximity to a fixed radiation gauge should be assessed by the site RSO to determine the likely radiation exposure to an employee and the possibility of a radiation incident occurring. The radiation dose limit for employees or members of the public is 1 mSv. The RSO should ensure that the following safety controls are implemented:

- Perform a radiation survey and inspection of the fixed radiation gauge as required by the Code of Practice and a record of results
- Assess the possibility of unauthorised interference with gauge
- Check the operation of the gauge shutter
- Locking the shutter beam ‘OFF’ and confirmation
- Supervise placement of personal Danger tags (or locks) or Out of Service as required
- Monitor the duration of the work

If significant amount of work is required on, near the gauge, or replacement of the pipe on which the gauge is mounted, the RSO may determine that removal of the gauge is required for the duration of the work. The gauge must be removed by a licensed and authorised person. The radiation gauge is to be securely stored in compliance with the Code of Practice (section 5). A list of qualified Tronox personnel is shown in Table 7.

23.1 Maintenance and Inspection of Fixed Radiation Gauges

Quality Assurance program is required for each fixed radiation gauge. The following inspections and procedures are to be performed and recorded for each fixed radiation gauge:

- Six Monthly Checks
  - Confirm location of gauge
  - Ensure legibility of warning signs and labels
  - Ensure correct operation of source shutter mechanism
  - Inspect condition of source housing
- 12 Monthly Checks (in addition to 6 monthly checks)
  - Measurement of radiation dose rates on the external surfaces of gauge at 50 mm and 1 m
  - Ensure the physical integrity of the gauge and that it is securely mounted
- Biennial Compliance Certification before the anniversary of initial compliance certification (in addition to six and 12 monthly checks)
  - Wipe testing of gauge external surfaces to check for indication of any leakage of radioactivity from the radioactive source
  - Fixed radiation gauges must be certified compliant by a consulting radiation expert (CRE) accredited by the EPA with the mandatory requirements published by the EPA.

23.2 Radiation Gauge Security

The owner is responsible for the security of all fixed radiation gauges or sealed source devices under their care. These devices may either be installed, in storage or being transported. The ARPANSA Code of Practice: Security of Radioactive Sources 2007 rps No.11 gives details of the requirements.

The categorisation for the aggregation of radioactive sources for each Tronox site is shown in APPENDIX 2. Tronox sites are calculated as low risk Category 4 sources where the measures in place for safety purposes are considered adequate for compliance with the code. If additional fixed radiation gauges are acquired the categorisation for the site will be reviewed. Security measures for Category 1, 2 and 3 sources are considerable more stringent than Category 4.

23.3 Radiation Gauge Storage

When a fixed radiation gauge containing one or more radioactive sources is placed in storage:

- The gauge must be clearly labelled as containing a radioactive source
- The gauge must be stored so that the likelihood of damage to the gauge is minimised
- The source control or shutter mechanism must be locked or otherwise secured in the ‘beam off’ position
- The gauge must be monitored to ensure that the radiation beam is properly attenuated with the shutter or source control mechanism in the ‘beam off’ position

Damage to a gauge in storage could result from a fall, collision, corrosion etc. A store used for the storage of a fixed radiation gauge containing one or more radioactive sources must:

- Be of solid construction and made of durable materials; and
- Be designed, located, constructed and, if necessary, shielded so that:
- The radiation levels at any accessible place outside the store do not result in an ambient dose equivalent rate or directional dose equivalent rate, as appropriate, exceeding 10 μsv/h; and

- No person will receive a radiation dose in excess of the appropriate limit;
- The resultant radiation dose rate in any occupied area is as low as reasonably achievable;
  - Be under the control of a person nominated by the Responsible Person;
  - Be kept locked;
  - Be subject to strict access control;
  - Not be used for other purposes;
  - When a radioactive source is in the store, display a conspicuous notice bearing the radiation hazard warning symbol, the letters and symbol of which must be in black on a yellow background.

A store for fixed radiation gauges must not be located:

- Near to explosives, combustible or corrosive materials;
- In an area prone to flooding or other potential hazard that may damage the store and/or its contents;
- In an area that allows unrestricted access to the public;
- In close proximity to an area where persons are working constantly.

23.4 Radiation Gauge Transport

The transport of radioactive substances is to be in compliance with the ARPANSA Code: Safe Transport of Radioactive Material (2014) rps No.C-2.

When a fixed radiation gauge containing one or more radioactive sources is packaged for transport, including transport within the Responsible Person's establishment, the Responsible Person must ensure that:

- The source control or shutter mechanism in the source container is locked in the 'beam off' position; and
- The package is monitored to ensure that:
  - The radiation beam is properly attenuated with the shutter or source control mechanism in the 'beam off' position before any action is taken to remove the fixing devices that hold the container in its installed location; and
  - The radiation exposure pattern is as expected; and
- The source container is:
  - Packed in an outer shipping container that is of strong, rigid construction; and
  - Effectively immobilised within the outer container; and
- The outer shipping container is labelled according to the requirements of the transport code and the EPA

During transport of a radioactive source in a vehicle the package must be:

- Located in the vehicle so that the radiation dose received by any person travelling in the vehicle is minimised; and
- Stowed securely to prevent it from shifting under normal transport conditions.
- Transport signs in compliance with the transport code are to be affixed to both sides and the rear of the vehicle.
- Only persons authorised by Tronox are to transport industrial gauges.

23.5 Radiation Gauge Disposal

If a fixed radiation gauge is to be sold, lent or hired, the responsible person must ensure that the proposed new owner has a licence to possess radioactive materials and an approval to acquire the radioactive substance.

If a radioactive source is to be disposed of, application must be made to the EPA Hazardous Materials, Chemicals and Radiation Section for approval. The disposal must be organised by companies approved by the EPA.

The approval of the EPA is to be sought and obtained prior to the relocation of radioactive substances to a place outside New South Wales. The Director General must be notified within seven (7) days after the device has been relocated.

It is a requirement that records be kept and maintained for each fixed radiation gauge. Each gauge has its own dedicated records folder which is maintained for the life of the gauge or until it is disposed of. All records are to be kept in a legible form or in a form that can be readily reproduced into a legible form and can be made available to the request of an authorised officer.

The owner must keep a record of the fixed radiation gauge location at all times. A register of radioactive sources is maintained in compliance with the conditions of registration with the EPA. The source register is updated as the result of new installation, relocation, registration renewal, or disposal of fixed radiation gauges. A radioactive source register for each site is attached in Appendix 2.

A summary of record keeping requirements should include the following:

- All maintenance and inspection reports and summaries of QA tests undertaken on fixed radiation gauges
- Copies of the radioactive source test certificates which includes the manufacturer's recommended working life
- The owner's Radiation Management Licence (RML) issued under the Radiation Control Act 1990 by the EPA
- The radioactive source register for each site
- A site sketch which shows the location of each fixed radiation gauge
- Acknowledgment of notification to the NSW Fire Brigades
- Copies of records for the fixed radiation gauge that show:
- Date received
- Name of the supplier/manufacturer
- Nominal activity of the radioactive source and assay date
- Calibration certificates for Radiation Survey Meters
- Incident reports
- Radioactive sources in storage

24 Radiation Safety Officer

The WHS Manager, Occupational Hygiene and Radiation Advisor and other required personnel will receive training to perform the role of Radiation Safety Officer and will then seek approval in that role from the regulatory authorities. The Radiation Consultant will be available as required for mentoring, review and advice.

The function of the RSO or responsible person is to advise and assist the employer to fulfil their responsibilities under the NSW Radiation Control Act 1990 and the Regulations 2013.

The RSO has the authority to:

- Stop any unsafe operations or proposed actions that come to their attention, and
- Implement any necessary urgent actions following the occurrence of an incident.

The responsibilities of the RSO include the following:

- The preparation and maintenance of the Tronox Radiation Management Plan.
- Be thoroughly familiar with the relevant Act, Regulations and Codes of Practice and ensure that all registration, licence and legislative requirements are adhered to.
- A detailed knowledge of working rules and emergency procedures.
- Organise personal monitoring devices for those persons at risk of radiation exposure.
- Preparation of dose reports.
- Ensure that radiation survey meters are suitable, calibrated and in good working order.
- Ensure that the likely maximum radiation doses a person could receive are within the limits prescribed by the Radiation Control Regulation 2013 and are as low as reasonably achievable.
- Arrange for all employees who work with ionising radiation or radioactive substances to be provided with appropriate induction and continuing radiation safety training, and maintain records of this training.
- Organisation, maintenance and preparation of audits on fixed radiation gauges and plant processes.
- Ensure that transport of fixed radiation gauges and radioactive materials complies with the relevant code of practice.
- Ensure a register of gauges at the site is maintained.
- Maintain and control a suitable radiation store at the site.
- Ensure contamination levels on equipment leaving the site and bound for use outside Tronox's operations are within acceptable limits.

The Tronox Mining RSO has assistance from other suitably qualified personnel as listed below.

25 Radiation Safety Structure

Table 10 Radiation Safety Structure

Name	Qualification		
	S7 Radiation Licence & RSO	Radiation Safety Officer (RSO)	Radiation Isolation Officer (RIO)
Jarda Virgo	Y		
Lachlan Roberts	Y		
David Smallacombe	Y		
Michael Smith	Y		
Anthony Barker		Y	
Brendan Isaacs		Y	
Jason Sealey		Y	
Linton Smith		Y	
Rohan Bawden			Y
Dylan Cross			Y
Clenton Crozier			Y
Danny Hunt			Y
Peter Kinleyside			Y
Lindsay Butcher			Y
Kelly Smyth			Y
Scott Garraway			Y
Thomas Meulemans			Y

26 Periodic Review and Audit

Each year the Radiation Safety Officer will review radiation data and evaluate the adequacy of radiation controls.

The Operations Manager will engage an external consultant to review the 'adequacy and effectiveness' of the Radiation Management Plan as required. This review will be made available to the regulators if required or requested.

Tronox will review the RMP at least once every three years and radiation management is audited once every three years for each site as part of the audit schedule required under the Conditions of Development Consent for each site.

The Environmental Management Strategy provides details of the processes for audit and review of all management plans and documentation issued under Conditions of Development Consent (section 5 and 6, Murray Basin Operations Environmental Management Strategy, November 2016).

REFERENCES

ARPANSA Code of Practice & Safety Guide – Radiation Protection and Radioactive Waste Management in Mining and Mineral Processing RPS No.9

Australian Standard AS 3640–2009 - Method for sampling and gravimetric determination of inhalable dust

ARPANSA Code of Practice & Safety Guide – Safe Use of Fixed Radiation Gauges RPS No. 13

ARPANSA Code of Practice & Safety Guide – Management of Naturally Occurring Radioactive Material (NORM) RPS No. 15

The National Road and Rail Dangerous Goods Transport Regulations

ARPANSA Code – Safe Transport of Radioactive Material RPS C-2

ARPANSA Code of Practice for the Security of Radioactive Sources RPS No. 11

NSW Radiation Control Act 1990 No. 13

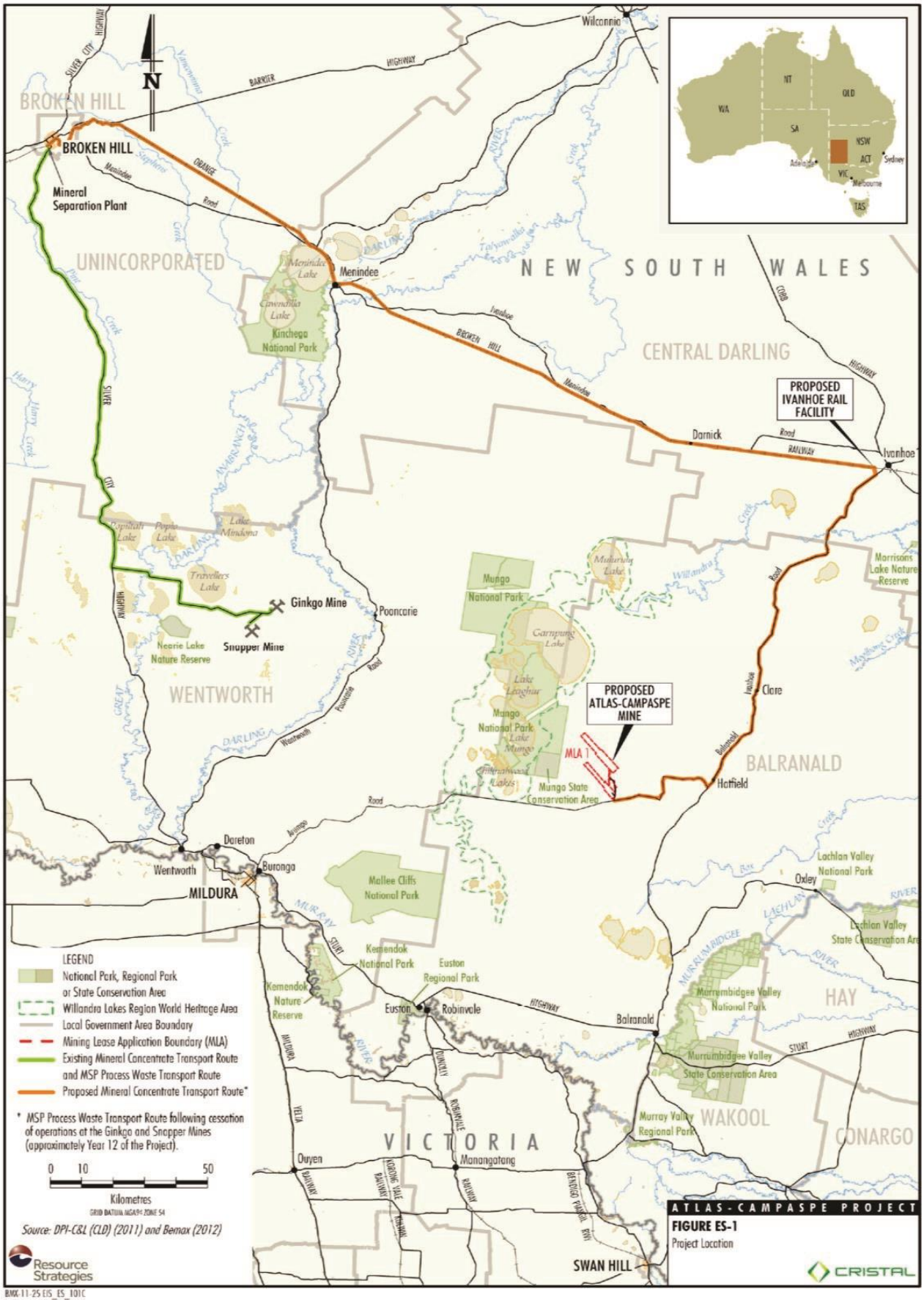
NSW Radiation Control Regulation 2013

Tronox EPA Radiation Management Licence RML5061302

NSW Work Health and Safety Regulations 2011

Tronox Waste Management Plan

APPENDIX 1 Tronox Murray Basin site locations and haulage routes.



APPENDIX 2 Register of Radioactive Sources

Table 1 Broken Hill MSP Register of Radioactive Sources

CRISTAL

BROKEN HILL MSP

REGISTER OF RADIOACTIVE SOURCES

EPA Radiation Management Licence No. 5061302

LOCATION DESCRIPTION	SOURCE MANUFACTURE DETAILS							Installation MEASUREMENT		SOURCE HOUSING				RML 5061302		ARPANSA Security Rating		
	ISOTOPE	ACTIVITY	DATE	ISO Class.	Working LIFE	Source Serial No.	EPA Component No.	Doserate @ 1m µSv/h	DATE	MAKE	MODEL	Serial No.	EPA Component No.	EPA RRM No.	EPA RRM Compliance date	ACTIVITY (A) GBq	*D GBq	A/D (Activity Ratio)
PRIMARY SPIRAL FEED	Cs137	740MBq	09/09/05	C65545	15 years	CSG-102-072	27847	1.0	10/10/05	Thermo Gammametrics	AM426/02-SM	**2080**	**26147**	**8721**	**5/05/2006**	0.74	100	0.0074
NON-MAGNETIC CONCENTRATE	Cs137	740MBq	09/09/05	C65545	15 years	CSG-102-114	27848	1.0	10/10/05	Thermo Gammametrics	AM426/02-SM	**2083**	**26148**	**8722**	**6/05/2006**	0.74	100	0.0074
UNDERFLOW SPIRAL FEED	Cs137	740MBq	09/09/05	C65545	15 years	CSG-102-074	27846	1.0	10/10/05	Thermo Gammametrics	AM426/02-SM	**2082**	**26146**	**8720**	**7/05/2006**	0.74	100	0.0074
OVERFLOW SPIRAL FEED	Cs137	740MBq	09/09/05	C65545	15 years	CSG-102-073	27850	1.0	10/10/05	Thermo Gammametrics	AM426/02-SM	**2081**	**26150**	**8724**	**8/05/2006**	0.74	100	0.0074
MSP REJECTS	Cs137	740MBq	09/09/05	C65545	15 years	CSG-102-116	27849	1.0	10/10/05	Thermo Gammametrics	AM426/02-SM	**2084**	**26149**	**8723**	**9/05/2006**	0.74	100	0.0074
																SUM A/D		**0.037**

HVRS *updated 8 May 2018 : J Slechta - Hunter Valley Radiation Services*

* D Value Table B.2

Cat 4 **1>A/D>0.01**

Table 2 Ginkgo Concentrator Register of Radioactive Sources

CRISTAL

GINKGO MINE - Wet Concentrator

REGISTER OF RADIOACTIVE SOURCES

EPA Radiation Management Licence No. 5061302

LOCATION DESCRIPTION	SOURCE MANUFACTURE DETAILS							Installation MEASUREMENT		SOURCE HOUSING				RML 5061302		ARPANSA Security Rating		
	ISOTOPE	ACTIVITY	DATE	ISO Class.	Working LIFE	Source Serial No.	EPA Component No.	Doserate @ 1m µSv/h	DATE	MAKE	MODEL	Serial No.	EPA Component No.	EPA RRM No.	EPA RRM Compliance date	ACTIVITY (A) GBq	*D GBq	A/D (Activity Ratio)
Rougher Mod 1 Pump Density	Cs137	1.85GBq	*26/05/1999	C66546	15 years	7727GQ	27189	0.7	16/09/05	SIS	SS200	2091	26007	8705	17/03/2006	1.85	100	0.0185
Rougher Mod 2 Pump Density	Cs137	1.85GBq	18/08/2005	C65445	15 years	0442/05	27394	0.7	16/09/05	SIS	SS200	2092	26006	8703	17/03/2006	1.85	100	0.0185
Cleaner Spirals Pump Density	Cs137	1.85GBq	16/08/2005	C65445	15 years	0443/05	27393	0.7	16/09/05	SIS	SS200	2093	26005	8702	17/03/2006	1.85	100	0.0185
Mids Spirals Pump Density	Cs137	1.85GBq	16/08/2005	C65445	15 years	0444/05	27392	0.7	16/09/05	SIS	SS200	2094	26004	8701	17/03/2006	1.85	100	0.0185
Re-Cleaner Spirals Pump Density	Cs137	0.74GBq	*03/05/2000	C65445	15 years	0024/00	27876	0.3	16/09/05	SIS	SS200	2088	26003	8700	17/03/2006	0.74	100	0.0074
Finisher Spirals Pump Density	Cs137	0.74GBq	*04/06/2001	C66546	15 years	0742CX	27190	0.3	16/09/05	SIS	SS200	2089	26002	8699	17/03/2006	0.74	100	0.0074
HMC Stage 2 Pump Density	Cs137	0.74GBq	21/01/2005	C65445	15 years	0041/05	27391	0.3	16/09/05	SIS	SS200	2090	26001	8697	17/03/2006	0.74	100	0.0074
Tailings Stage 1 Pump Density	Cs137	3.7GBq	2/06/2005	C65445	15 years	0242/05	27390	1.4	16/09/05	SIS	SS200	2095	26000	8696	17/03/2006	3.7	100	0.037
Dredge Slurry Discharge	Cs137	11.1GBq	30/03/06	C65445	15 years	0109/06	27157	4.0	24/04/06	SIS	SS200	2113	25999	8764	18/07/2006	11.1	100	0.111
DTMU DRY TITAN Discharge	Cs137	370 MBq	01/02/2012	TY994	15 years	TY994	27511	0.1	02/2012	Endress & Hauser	FQG61	EC0001011 3F	25362	9721	31/07/2012	0.37	100	0.0037
																SUM A/D		0.2479

HVRS

updated 7 March 2019 : J Slechta - Hunter Valley Radiation Services

** EPA approval for extension of MRWL*

* D Value Table B.2

Cat 4 1>A/D>0.01

Table 3 Ginkgo WHIMS Register of Radioactive Sources

CRISTAL

GINKGO MINE - WHIMS Plant

REGISTER OF RADIOACTIVE SOURCES

EPA Radiation Management Licence No. 5061302

LOCATION DESCRIPTION	SOURCE MANUFACTURE DETAILS							Installation MEASUREMENT		SOURCE HOUSING				RML 5061302		ARPANSA Security Rating		
	ISOTOPE	ACTIVITY	DATE	ISO Class.	Working LIFE	Source Serial No.	EPA Component No.	Doserate @ 1m µSv/h	DATE	MAKE	MODEL	Serial No.	EPA Component No.	EPA RRM No.	EPA RRM Compliance date	ACTIVITY (A) GBq	*D GBq	A/D (Activity Ratio)
PRIMARY WASHING CYCLONE	Cs137	740MBq	09/09/05	C65545	15 years	CSG-102-065	27833	1.0	10/10/05	Thermo Gammametrics	AM426/02-SM	**2075**	**26137**	**8710**	**17/03/2006**	0.74	100	0.0074
SECONDARY WHIMS NON-MAG 1	Cs137	740MBq	09/09/05	C65545	15 years	CSG-102-067	27829	1.0	10/10/05	Thermo Gammametrics	AM426/02-SM	**2076**	**26133**	**8706**	**17/03/2006**	0.74	100	0.0074
PRIMARY WHIMS MAG 1	Cs137	740MBq	09/09/05	C65545	15 years	CSG-102-068	27832	1.0	10/10/05	Thermo Gammametrics	AM426/02-SM	**2077**	**26136**	**8709**	**17/03/2006**	0.74	100	0.0074
SECONDARY WHIMS NON-MAG 2	Cs137	740MBq	09/09/05	C65545	15 years	CSG-102-070	27831	1.0	10/10/05	Thermo Gammametrics	AM426/02-SM	**2078**	**26135**	**8708**	**17/03/2006**	0.74	100	0.0074
PRIMARY WHIMS MAG 2	Cs137	740MBq	09/09/05	C65545	15 years	CSG-102-141	27830	1.0	10/10/05	Thermo Gammametrics	AM426/02-SM	**2079**	**26134**	**8707**	**17/03/2006**	0.74	100	0.0074
																SUM A/D		**0.037**
HVRS	*updated 8 May 2018 : J Slechta - Hunter Valley Radiation Services*															* D Value Table B.2		
																Cat 4		**1>A/D>0.01**

Table 4 Snapper Register of Radioactive Sources

CRISTAL

SNAPPER MINE

REGISTER OF RADIOACTIVE SOURCES

Cristal EPA Radiation Management Licence No. 5061302

UNIT	LOCATION	SOURCE MANUFACTURE DETAILS					Installation MEASUREMENT		GAUGE DETAILS				RML 5061302		ARPANSA Security Rating		
		ISOTOPE	ACTIVITY	DATE	Serial No.	EPA Component No.	Doserate @ 1m µSv/h	DATE	MAKE	MODEL	Serial No.	EPA Component No.	EPA RRM No.	EPA RRM Compliance date	ACTIVITY (A) GBq	*D GBq	A/D (Activity Ratio)
DIT 2017	DESLIME CYCLONE FEED	Cs137	3700 MBq	01/01/2010	SG284	27493	1.0	11/2009	Endress & Hauser	QG20 YR2C	CB002D010E1	25373	9607	07/06/2011	3.7	100	0.037
DIT 2046	ROUGHER FEED	Cs137	1100 MBq	01/01/2010	SH843	27494	0.3	11/2009	Endress & Hauser	QG20 YR2C	CB002C010E1	25374	9608	07/06/2011	1.1	100	0.011
DIT 2062	MID SPIRAL FEED	Cs137	370 MBq	01/01/2010	SH840	27499	0.1	11/2009	Endress & Hauser	QG20 YR2C	CB002901 0E1	25375	9610	07/06/2011	0.37	100	0.0037
DIT 2066	TAILS CYCLONE FEED	Cs137	1850 MBq	01/01/2010	SH842	27500	0.4	11/2009	Endress & Hauser	QG20 YR2C	CB002B01 0E1	25376	9611	07/06/2011	1.85	100	0.0185
DIT 2091	CLEANER SPIRAL FEED	Cs137	370 MBq	01/01/2010	SH841	27501	0.1	11/2009	Endress & Hauser	QG20 YR2C	CB002A01 0E1	25377	9612	07/06/2011	0.37	100	0.0037
DIT 2121	RECLEANER SPIRAL FEED	Cs137	370 MBq	01/01/2010	SH839	27498	0.1	11/2009	Endress & Hauser	QG20 YR2C	CB002401 0E1	25370	9619	07/06/2011	0.37	100	0.0037
DIT 2161	FINISHER SPIRAL FEED	Cs137	185 MBq	01/01/2010	SH836	27497	0.1	11/2009	Endress & Hauser	QG20 YR2C	CB002601 0E1	25369	9618	07/06/2011	0.185	100	0.00185
DIT 2191	TAILS BOOM FEED	Cs137	740 MBq	01/01/2010	SH837	27496	0.2	11/2009	Endress & Hauser	QG20 YR2C	CB002701 0E1	25368	9617	07/06/2011	0.74	100	0.0074
DIT 2198	TAILS STACKER FEED	Cs137	740 MBq	01/01/2010	SH838	27495	0.2	11/2009	Endress & Hauser	QG20 YR2C	CB002801 0E1	25367	9616	07/06/2011	0.74	100	0.0074
DIT 2222	HMC TRANSFER PUMP	Cs137	110 MBq	01/01/2010	SH835	27503	<0.1	11/2009	Endress & Hauser	QG20 YR2C	CB002501 0E1	25379	9614	07/06/2011	0.11	100	0.0011
DREDGE	WET CONCENTRATOR FEED	Cs137	1100 MBq	01/07/2010	SN652	27502	0.3	05/2010	Endress & Hauser	QG20 YR2C	D50012010E1	25378	9613	07/06/2011	1.1	100	0.011

Neumann Contractors - EPA Radiation Management Licence No. 5061106

Neumann Mini Dredge	SLURRY DISCHARGE	Cs137	7400 MBq	02/07/2003	CSG-106-02	29472	4	10/07/2003	Thermogammametrics	AM426-02SM	1710	29471	10268	25/05/2016	7.4	100	0.074
															SUM A/D		0.18035

HVRS *updated 7 March 2019 : J Slechta - Hunter Valley Radiation Services*

* D Value Table B.2
Cat 4 1>A/D>0.01

Table 5 Atlas- Campaspe Register of Radioactive Sources

Register to be included after installation of fixed radiation gauges.

APPENDIX 3 Correspondence

NSW EPA advice on Radiation Management Plan (May 2019)

Hi Brendan

Please find attached the EPA's advice on the draft Radioactive Waste Management Plan. The advice has gone directly to Paul Freeman.

Please do not hesitate to telephone me if you wish to discuss.

Thanks

Craig Bretherton

Manager Regional Operations
Riverina Far West Region
South & West Branch, NSW Environment Protection Authority
☎ 02 6969 0700 Mobile ☎ 0427 223 516
craig.bretherton@epa.nsw.gov.au www.epa.nsw.gov.au @EPA_NSW
Report pollution and environmental incidents 131 555 (NSW only) or +61 2 9995 5555

Please send all official electronic correspondence to riverina.farwest@epa.nsw.gov.au

From: Len Potapof
Sent: Tuesday, 14 May 2019 2:33 PM
To: Paul Freeman <Paul.Freeman@planning.nsw.gov.au>
Cc: Craig Bretherton <Craig.Bretherton@epa.nsw.gov.au>
Subject: RE: Atlas Campaspe Radioactive Waste Management Plan

Hi Paul

Please find below comment on this matter for your consideration:

We believe that enquiries relate to **management of waste that contains radioactive materials**, principally mine spoil containing naturally occurring radioactive material (NORM).

Defined Radioactive Substances
In NSW a **radioactive substance** *means any natural or artificial substance whether in solid or liquid form or in the form of a gas or vapour (including any article or compound whether it has or has not been subjected to any artificial treatment or process) which emits ionising radiation spontaneously with a specific activity greater than the prescribed amount and which consists of or contains more than the prescribed activity of any radioactive element whether natural or artificial.* Campaspe needs to classify the mine site raw materials according to the Radiation Control Act 1990 (Act) and Regulations. From past experience this will presumably demonstrate that whilst the materials in question will have some radioactive content it should not trigger the *radioactive substances* definition prescribed in the Act and Regulation but will trigger the definition of *radioactive ore* in clause 4 of the Regulation.

Consultant for Campaspe
The development approval required a suitably skilled person – approved by the Secretary – draft the documentation waste management processes. We are not sure if this condition has been satisfied.

Waste Movement Off-site
Waste Disposal: There is no disposal path in NSW for material that is classified as a *radioactive substance*. For waste that contains some radioactivity, but is below the threshold of a radioactive substance then the waste must be classified on the basis of both its radioactive and other characteristics, according to the step-by-step procedure outlined in Waste Classification Guidelines Part 3: Waste containing radioactive material. A copy of this is available from https://www.epa.nsw.gov.au/-/media/epa/corporate-site/resources/wasteregulation/140797-radioactive-waste.pdf.

Application of Relevant Codes
This NHMRC document entitled *Radiation Safety Information Series No 12 Clean-Up and Disposal of Radioactive Residues From Commercial Operations Involving Mineral Sands*, published in 1984, created criteria for action level (external exposure pathway), remedial action, disposal area, and standards for the protection of disposal sites. RSIS 12 NHMRC has been recognised in the past for establishing maximum radiation levels from commercial operations involving mineral sands. Whilst the limits contained in RSIS-12 or extracts from RSIS-12 were used in the past eg. 0.7µGy/hour they should not be applied for new operations as new guidance is now available in the form of Radiation Protection Series (RPS) publications developed the Radiation Health Committee (RHC) of the Commonwealth Australian Radiation Protection and Nuclear Safety Agency (ARPANSA).

The two relevant publications with regard to mineral sand mining are *RPS No. 9 Code of Practice - Radiation Protection and Radioactive Waste Management in Mining and Mineral Processing* (2005) and *RPS No. 15 Safety Guide - Management of Naturally Occurring Radioactive Material (NORM) (2008)*.

These new contemporary documents that supersedes RSIS-12, assist regulators and industries in which radionuclide concentrations in NORM may be enhanced in managing NORM and assessing the need for radiation protection measures, including regulation.

The Safety Guide in particular provides advice on the type of radiation protection measures that may be required. Section 4.8 of the Guide describes the approach now taken to site remediation, which emphasises a risk based approach that includes an EIS in each case that "estimates of the dose contributions from potential exposure pathways taking into consideration different types of future land use - and compare these results with pre-mining/processing conditions". If the potential dose measured falls within the variations in natural background radiation levels that surround the affected area - typically 0.1-0.3 milli Sieverts (mSv) per annum - then no further remediation should be required.

It should also be noted that regulatory authority responsible for the administration of the Radiation Control Act with regard to radioactive ore at a declared mine site is the Department of Planning and Environment and not the EPA.

Happy to discuss if you have the need.

Regards

Len

DPIE advice on Radiation Management Plan (May 2019)

From: Paul Freeman
Sent: Thursday, 2 May 2019 3:21 PM
To: Len Potapof <Len.Potapof@epa.nsw.gov.au>
Cc: Phillipa Duncan <phillipa.duncan@planning.nsw.gov.au>
Subject: Atlas Campaspe Radioactive Waste Management Plan

Hi Len,
Thanks for your call.

As discussed, the approval for the Atlas-Campaspe Mineral Sands project requires a Radioactive Waste Management Plan to be prepared in consultation with EPA. I would therefore appreciate it if you could have a look at the plan and let me know if it meets the requirements of the condition below. It would be great to get your input in a week's time.

RADIATION MANAGEMENT
Radioactive Waste Management Plan
29. The Applicant shall prepare and implement a Radioactive Waste Management Plan for the development to the satisfaction of the Secretary. This plan must:
(a) be prepared in consultation with the EPA by a suitably qualified expert/s whose appointment has been approved by the Secretary;
(b) be submitted for approval 6 months prior to the commencement of the transport of MSP process waste to the site for disposal;
(c) generally meet the environmental goals listed in Environmental Guidelines: Solid Waste Landfills (DEC, 1996 or its latest version);
(d) be consistent with the Code of Practice and Safety Guide for Radiation Protection and Radioactive Waste Management in Mining and Mineral Processing (ARPANSA, 2005);
(e) include:

- *a description of potential sources of dose delivery pathways and potential doses;*
- *a description of operation and control measures;*
- *design and operation details of waste disposal areas;*
- *a management program for backloaded MSP process waste;*
- *a system to monitor the movement of backloaded MSP waste;*
- *a description of waste generating processes and waste;*
- *demonstration of access to professional expertise in radiation protection;*
- *details of radiation monitoring;*
- *details of appropriate equipment, staff, facilities and operational procedures;*
- *a description of induction and training courses;*
- *reporting and periodic review procedures;*
- *emergency plans;*
- *baseline radiological information;*
- *description of the waste management system;*
- *radioactive waste monitoring; and*
- *a conceptual decommissioning plan; and*

(f) ensure wastes are landfilled in a manner to ensure:

- *the average concentration of radioactive material in landfill at the site would not exceed the average concentration of radioactive material in the original orebody;*
- *the radiation level of any material deposited to land is no greater than 0.7 microGray per hour measures 1 metre vertically above the surface of the material being deposited; and*
- *there is no detectable change from the original natural background radiation level measures at the ground surface.*

If you have any further questions, feel free to call me on 9274 6587.

Kind regards

Paul Freeman
Team Leader, Resource Assessments
NSW Department of Planning & Environment
320 Pitt Street, Sydney NSW 2000
GPO Box 39, Sydney NSW 2001
(02) 9274 6587 0435 216 546
www.planning.nsw.gov.au

Murray Basin Mineral Sands
Post Approval Review

Plan name: **Murray Basin Mineral Sands Radiation Management Plan**
Reviewer: Paul Freeman paul.freeman@planning.nsw.gov.au
Date: 08/08/2019

Radiation Management Plan, condition 27 and schedule 3	**Satisfactory (Yes/No/Partial)**	**Document reference and comment**	**Action Required**	**Company Response**
Operating Conditions The Applicant shall ensure that wastes are landfilled in a manner to ensure:				
(a) the average concentration of radioactive material in landfill at the site would not exceed the average concentration of radioactive material in the original orebody;	Yes	**Satisfied**: Background radiation levels, measured prior to operations, are presented in Section 15. Background radiation levels will be measured on areas post mining and rehabilitation to ensure levels are equal to or no greater than the original background radiation levels. Results of monitoring will be reported in the Annual Environmental Management Report (AEMR).	No further action required.	
(b) the radiation level of any material deposited to land is no greater than 0.7 microGray per hour measured 1 metre vertically above the surface of the material being deposited;	Partial	**Not satisfied** Section 21 states that waste is disposed of in a way that the radiation level of any material being deposited to land is no greater than 0.7µGy/h measured 1 m vertically above the surface of the material being deposited. The 2 options for disposing waste are described: • within the Ginkgo mine pit and covered under a minimum of 10 m (up to 35 m) of sand and clay overburden. No monitoring is described. • paddock dumped in a designated area within the mining void and blended with inert material sourced from the mining pit (tailings sand or overburden). The blended waste is covered under a minimum of 10 m of sand and clay overburden and rehabilitated. Radiation monitoring during the activity is conducted and recorded to ensure radiation levels of the material being deposited is less than 0.7µGy/h.	Clarify the monitoring process for waste being deposited in the Ginkgo mine pit (first option listed).	

Plan name: **Murray Basin Mineral Sands Radiation Management Plan**
Reviewer: Paul Freeman paul.freeman@planning.nsw.gov.au
Date: 08/08/2019

(c) that the topsoil of the landfilled area has an average salinity level no greater than the average salinity level of topsoil in other part if the site; and	No	**Not satisfied** This condition is incorrect in the compliance table (Table 2). Table 2 states *"that the topsoil of the landfilled area has an average radiation level no greater than the average radiation level of topsoil in other part if the site; and" rather than "salinity"* Salinity does not appear to be addressed in the RMP.	Update the table to include the correct condition. Address the condition in the RMP.	
(d) there is no detectable change from the original natural background radiation level measured at the ground surface.	Yes	**Satisfied** (see note) Section 21 states that rehabilitation areas are monitored to ensure there is no detectable change in original background radiation level measured 1 m above the ground surface. Reference is made to the conceptual decommissioning plans that were included in the approved Mining Operation Plans for Ginkgo-Crayfish, Snapper and Atlas sites. (note: these documents were not reviewed). There is no mention of the frequency that monitoring will be conducted, or the duration.	Clarify the frequency of monitoring and the duration, as required/ relevant.	
General comments:				
• These requirements are incorrectly cross referenced in the compliance table (Table 2). The table references Sections 10, 11 and 16 which is incorrect. • Cross reference in Table 2 where **each** of the individual conditions are addressed in the RMP. • Check section numbering throughout Table 2. • Include references to the legislation/ Codes/ Guidelines etc that the RMP addresses and/or is in conformance with.				
Ginkgo (DA 251-09-01) ***Radiation Management Plan (RMP), condition 28 and schedule 3***	**Satisfactory (Yes/No/Partial)**	**Comment**	**Action Required**	

Plan name: **Murray Basin Mineral Sands Radiation Management Plan**

Reviewer: Paul Freeman paul.freeman@planning.nsw.gov.au

Date: 08/08/2019

Radiation Management Plan The Applicant shall prepare and implement a Radiation Management Plan for the development to the satisfaction of the Secretary. This plan must:				
(a) be prepared in consultation with the EPA by suitably qualified expert whose appointment have been endorsed by the Secretary;	No	**Not satisfied** Consultation with the EPA is referenced, however no details are provided. No details provided that a suitably qualified expert prepared the plan and no evidence of Secretary endorsement.	Include details of consultation with the EPA, comments received and how they have been addressed. Include professional details of the person preparing the Plan, and the date of endorsement.	
(b) be submitted to the Secretary for approval within 6 months of the date of consent for MOD 9, unless otherwise agreed with the Secretary;		No able to determine	Include details of RMP approvals over time within the context of the mine approvals.	
(c) generally meet the environmental goals listed in Environmental Guidelines: *Solid Waste Landfills* (DEC, 1996 or its latest version);	No	**Not satisfied** The RMP does not reference the application of Guidelines, or what goals would be met and how. This review could not determine if the implementation of the RMP would ensure that the goals would be 'generally' met.	Specify the environmental goals listed in Environmental Guidelines: *Solid Waste Landfills.*	
(d) be consistent with the *Code of Practice and Safety Guide for Radiation Protection and Radioactive Waste Management in Mining and Mineral Processing* (ARPANSA, 2005);	No	**Not satisfied** The ARPANSA *Code of Practice and Safety Guide for Radiation Protection and Radioactive Waste Management in Mining and Mineral Processing* has not been referenced in the RMP.	Clarify how the ARPANSA *Code of Practice* has been applied in the development of the RMP and associated procedures and processes.	

Plan name: **Murray Basin Mineral Sands Radiation Management Plan**
Reviewer: Paul Freeman paul.freeman@planning.nsw.gov.au
Date: 08/08/2019

(e) include:	Partial	**Not satisfied:**	See below.	
• a description of operation and control measures;	No	**Not satisfied:** • Operation and control measures are discussed in brief in Sections 12 (Personal Hygiene Control), 13 (Controlled and Supervised Areas) and 14 (Storage and Signage). • Section 13 refers to procedures for control of access and of radiation doses, however these are not discussed. • No reference to design controls.	Provide further detail regarding procedures for control of access and of radiation doses in Controlled and Supervised Areas. details of any design controls.	
• design and operation details of waste disposal areas;	Partial	**Partial:** there is a brief description in Section 21 of waste disposal processes. The design of the areas is not detailed and there is no reference to Standards/ Guidelines being applied/ met in the design and operation of the waste disposal areas.	Include details of the design of the waste disposal areas, including conformance details with any relevant Standards/ Codes/ Guidelines.	
• a management program for back loaded MSP waste;	Yes	**Satisfied:** Section 20 Stockpiled "pugged" MSP Rejects are subsequently back-loaded into mineral concentrate trucks for disposal at the Ginkgo Mine and Snapper Void, or Campaspe Mine on completion of the Ginkgo pit.	No further action required.	
• a system to monitor the movement of back loaded MSP waste;	Yes	**Satisfied**: waste tracking to monitor the movement of back loaded MSP waste is covered in Section 23.	No further action required.	
• a description of waste generating processes and waste;	Yes	**Satisfied:** waste generating processes and waste are covered in Sections 8, 10 and 19.	No further action required.	
• details of radiation monitoring;	Yes	**Satisfied**: details of radiation monitoring are provided in Section 17, 16 Mine Radiation Monitoring and 18 Worker Exposure to Radiation.	No further action required.	
• details of appropriate equipment, staff, facilities and operational procedures;	Yes	**Satisfied**: Radiation gauges (Section 27), Personal Hygiene Control (Section 12), Controlled and Supervised Areas (Section 13), Storage and Signage (Section 14), Radiation Safety Officer (Section 28), Radiation Safety Structure (Section 25).	No further action required.	

Plan name: **Murray Basin Mineral Sands Radiation Management Plan**
Reviewer: Paul Freeman paul.freeman@planning.nsw.gov.au
Date: 08/08/2019

• a description of induction and training courses;	Yes	**Satisfied**: Radiation safety training Section 24. Responsibility of the Radiation Safety Officer (Section 28). All employees who work with ionising radiation or radioactive substances are to be provided with appropriate induction and continuing radiation safety training, and records maintained of this training.	No further action required.	
• reporting and periodic review procedures;	Partial	**Partial**: Section 22.4 Incident reporting requirements, Section 26 Periodic Review and Audit and Section 25 Record keeping and Reporting. Does not refer to Annual reporting against the EPL.	Include details of EPL reporting in Section 26.	
• emergency plans;	Yes	**Satisfied**: Emergency plans and response is covered in Section 26. The following have been prepared: Mine Site Emergency Response Plan and MSP Emergency Preparedness and Response (not reviewed).	No further action required.	
• baseline radiological information;	Yes	**Satisfied**: Background radiation levels, measured prior to operations, are presented in Section 15.	No further action required.	
• description of the waste management system;	Yes	**Satisfied**: the waste management system is described in Sections 19 – 23.	No further action required.	
• radioactive waste monitoring; and	Yes	**Satisfied**: radioactive waste monitoring. The MSP laboratory monitors the activity (Bq) of the waste stockpiles using XRF analysis and communicates the results to production operations. If the activity exceeds 100Bq/g the waste is blended with inert silica sands produced from the non-mags circuit until the level is below 100Bq/g (Section 20).	No further action required.	
• a conceptual decommissioning plan.	Yes	Section 21 states that Conceptual decommissioning plans are included in the approved Mining Operation Plans for Ginkgo-Crayfish, Snapper and Atlas sites.	No further action required.	

Plan name: **Murray Basin Mineral Sands Radiation Management Plan**
Reviewer: Paul Freeman paul.freeman@planning.nsw.gov.au
Date: 08/08/2019

General comments:				
• Section numbering throughout RMP is incorrect.				
Snapper (DA 06-0168) ***Radiation Management Plan (RMP), condition 7 and schedule 3***	**Satisfactory (Yes/No/Partial)**	**Comment**	**Action Required**	
Landfill Management The Landfill Management Measures must:				
(a) generally meet the environmental goals listed in Environmental Guidelines: *Solid Waste Landfills* (DEC, 1996 or its latest version) and;	No	**No satisfied** The RMP does not reference the application of Guidelines, or what goals would be met and how. This review could not determine if the implementation of the RMP would ensure that the goals would be 'generally' met.	Specify the environmental goals listed in Environmental Guidelines: *Solid Waste Landfills.*	
(b) include:				
• design and operation details of waste disposal areas;	Partial	• **Partial:** there is a brief description in Section 21 of waste disposal processes. The design of the areas is not detailed and there is no reference to Standards/ Guidelines being applied/ met in the design and operation of the waste disposal areas.	Include details of the design of the waste disposal areas, including conformance details with any relevant Standards/ Codes/ Guidelines.	
• a management program for back loaded MSP process waste;	Yes	• **Satisfied:** Section 20 Stockpiled "pugged" MSP Rejects are subsequently back-loaded into mineral concentrate trucks for disposal at the Ginkgo Mine and Snapper Void, or Campaspe Mine on completion of the Ginkgo pit.	No further action required.	
• a system to monitor the movement of back loaded MSP waste; and	Yes	**Satisfied**: waste tracking to monitor the movement of back loaded MSP waste is covered in Section 23.	No further action required.	

Plan name: **Murray Basin Mineral Sands Radiation Management Plan**
Reviewer: Paul Freeman paul.freeman@planning.nsw.gov.au
Date: 08/08/2019

• disposal techniques and handling practices consistent with the Code of Practice and Safety Guide for Radiation Protection and Radioactive Waste Management in Mining and Mineral Processing (ARPANSA, 2005 or its latest version).	Partial	**Not satisfied:** The ARPANSA *Code of Practice and Safety Guide for Radiation Protection and Radioactive Waste Management in Mining and Mineral Processing* has not been referenced in the RMP. Refer to Ginkgo DA condition 28(c).	Specify the environmental goals listed in Environmental Guidelines: *Solid Waste Landfills.*	
Snapper (DA 06-0168) ***Radiation Management Plan (RMP), condition 9 and schedule 3***	**Satisfactory (Yes/No/Partial)**	**Comment**	**Action Required**	**Company Response**
Radiation Management Plan The Proponent shall prepare and implement a Radiation Management Plan for the project to the satisfaction of the Secretary. This plan must:				
(a) be prepared in consultation with the EPA by suitably qualified expert/s whose appointment/s have been approved by the Secretary;	Yes	**Satisfied** Consultation with the EPA is referenced, however no details are provided. No details provided that a suitably qualified expert prepared the plan and no evidence of Secretary endorsement.	Include details of consultation with the EPA, comments received and how they have been addressed. Include professional details of the person preparing the Plan, and the date of endorsement.	
(b) be submitted to the Secretary for approval prior to carrying out any development on the site;		Not able to determine.	Include details of RMP approvals over time within the context of the mine approvals.	
(c) be consistent with the Code of Practice and Safety Guide for Radiation Protection and Radioactive Waste Management in mining and Mineral Processing (ARPANSA, 2005); and	No	**Not satisfied** The ARPANSA *Code of Practice and Safety Guide for Radiation Protection and Radioactive Waste Management in Mining and Mineral Processing* has not been referenced in the RMP.	Clarify how the ARPANSA *Code of Practice* has been applied in the development of the RMP and associated procedures and processes.	

Plan name: **Murray Basin Mineral Sands Radiation Management Plan**
Reviewer: Paul Freeman paul.freeman@planning.nsw.gov.au
Date: 08/08/2019

(d) include:		See for Ginkgo DA condition 28 (e)		
• a description of operation and control measures;	No	**Not satisfied:** • Operation and control measures are discussed in brief in Sections 12 (Personal Hygiene Control), 13 (Controlled and Supervised Areas) and 14 (Storage and Signage). • Section 13 refers to procedures for control of access and of radiation doses, however these are not discussed. • No reference to design controls.	Provide further detail regarding procedures for control of access and of radiation doses in Controlled and Supervised Areas. details of any design controls.	
• a description of waste generating processes and waste;	Partial	**Partial:** there is a brief description in Section 21 of waste disposal processes. The design of the areas is not detailed and there is no reference to Standards/ Guidelines being applied/ met in the design and operation of the waste disposal areas.	Include details of the design of the waste disposal areas, including conformance details with any relevant Standards/ Codes/ Guidelines.	
• demonstration of access to professional expertise;	Yes	**Satisfied**: Section 28 discusses the role and responsibilities of the Radiation Safety Officer. Suitably qualified personnel are listed in Section 25.	No further action required.	
• details of radiation monitoring;	Yes	**Satisfied**: details of radiation monitoring are provided in Section 17, 16 Mine Radiation Monitoring and 18 Worker Exposure to Radiation.	No further action required.	
• details of appropriate equipment, staff, facilities and operational procedures;	Yes	**Satisfied**: Radiation gauges (Section 27), Personal Hygiene Control (Section 12), Controlled and Supervised Areas (Section 13), Storage and Signage (Section 14), Radiation Safety Officer (Section 28), Radiation Safety Structure (Section 25).	No further action required.	
• a description of induction and training courses;	Yes	**Satisfied**: Radiation safety training Section 24. Responsibility of the Radiation Safety Officer (Section 28). All employees who work with ionising radiation or radioactive substances are to be provided with appropriate induction and continuing radiation safety training, and records maintained of this training.	No further action required.	

Plan name: **Murray Basin Mineral Sands Radiation Management Plan**
Reviewer: Paul Freeman paul.freeman@planning.nsw.gov.au
Date: 08/08/2019

• reporting and periodic review procedures;	Partial	**Partial**: Section 22.4 Incident reporting requirements, Section 26 Periodic Review and Audit and Section 25 Record keeping and Reporting. Does not refer to Annual reporting against the EPL.	Include details of EPL reporting in Section 26.	
• emergency plans;	Yes	**Satisfied**: Emergency plans and response is covered in Section 26. The following have been prepared: Mine Site Emergency Response Plan and MSP Emergency Preparedness and Response (not reviewed).	No further action required.	
• baseline radiological information;	Yes	**Satisfied**: Background radiation levels, measured prior to operations, are presented in Section 15.	No further action required.	
• description of the waste management system;	Yes	**Satisfied**: the waste management system is described in Sections 19 – 23.	No further action required.	
• radioactive waste monitoring; and	Yes	**Satisfied**: radioactive waste monitoring. The MSP laboratory monitors the activity (Bq) of the waste stockpiles using XRF analysis and communicates the results to production operations. If the activity exceeds 100Bq/g the waste is blended with inert silica sands produced from the non-mags circuit until the level is below 100Bq/g (Section 20).	No further action required.	
• a conceptual decommissioning plan	Partial	Section 21 states that Conceptual decommissioning plans are included in the approved Mining Operation Plans for Ginkgo-Crayfish, Snapper and Atlas sites (**note: these were not sighted**).		

Plan name: **Murray Basin Mineral Sands Radiation Management Plan**
Reviewer: Paul Freeman paul.freeman@planning.nsw.gov.au
Date: 08/08/2019

General comments:				
• None				
Atlas-Campaspe (SSD_5012) ***Radiation Management Plan (RMP), condition 29 and schedule 3***	**Satisfactory (Yes/No/Partial)**	**Comment**	**Action Required**	**Company response**
Radiation Management Plan The Applicant shall prepare and implement a Radioactive Waste Management Plan for the development to the satisfaction of the Secretary. This plan must:				
(a) be prepared in consultation with the EPA by a suitably qualified expert/s whose appointment has been approved by the Secretary;	No	**Not satisfied** Consultation with the EPA is referenced, however no details are provided. No details provided that a suitably qualified expert prepared the plan and no evidence of Secretary endorsement.	Include details of consultation with the EPA, comments received and how they have been addressed. Include professional details of the person preparing the Plan, and the date of endorsement.	
(b) be submitted for approval 6 months prior to the commencement of the transport of MSP process waste to the site for disposal;		Not able to determine.	Include details of RMP approvals over time within the context of the mine approvals.	
(c) generally meet the environmental goals listed in *Environmental Guidelines: Solid Waste Landfills* (DEC, 1996 or its latest version);	No	**Not satisfied** The RMP does not reference the application of Guidelines, or what goals would be met and how. This review could not determine if the implementation of the RMP would ensure that the goals would be 'generally' met.	Specify the environmental goals listed in Environmental Guidelines: *Solid Waste Landfills.*	
(d) be consistent with the Code of Practice and Safety Guide for Radiation Protection and Radioactive Waste Management in Mining and Mineral Processing (ARPANSA, 2005);	No	**Not satisfied** The ARPANSA *Code of Practice and Safety Guide for Radiation Protection and Radioactive Waste Management in Mining and Mineral Processing* has not been referenced in the RMP.	Clarify how the ARPANSA *Code of Practice* has been applied in the development of the RMP and associated procedures and processes.	

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(e) include:	Partial	**See for Ginkgo DA condition 28 (e)**		
• a description of potential sources of dose delivery pathways and potential doses;	Yes	• Satisfied: Sources are covered in Section 10, while possible pathways for delivery of radiation doses are covered in Section 11.		
• a description of operation and control measures;	No	**Not satisfied:** • Operation and control measures are discussed in brief in Sections 12 (Personal Hygiene Control), 13 (Controlled and Supervised Areas) and 14 (Storage and Signage). • Section 13 refers to procedures for control of access and of radiation doses, however these are not discussed. • No reference to design controls.	Provide further detail regarding procedures for control of access and of radiation doses in Controlled and Supervised Areas. details of any design controls.	
• design and operation details of waste disposal areas;	Partial	**Partial:** there is a brief description in Section 21 of waste disposal processes. The design of the areas is not detailed and there is no reference to Standards/ Guidelines being applied/ met in the design and operation of the waste disposal areas.	Include details of the design of the waste disposal areas, including conformance details with any relevant Standards/ Codes/ Guidelines.	
• a management program for backloaded MSP process waste	Yes	**Satisfied:** Section 20 Stockpiled "pugged" MSP Rejects are subsequently back-loaded into mineral concentrate trucks for disposal at the Ginkgo Mine and Snapper Void, or Campaspe Mine on completion of the Ginkgo pit.	No further action required.	
• a system to monitor the movement of backloaded MSP waste	Yes	**Satisfied**: waste tracking to monitor the movement of back loaded MSP waste is covered in Section 23.	No further action required.	
• a description of waste generating processes and waste;	Yes	**Satisfied:** waste generating processes and waste are covered in Sections 8, 10 and 19.	No further action required.	
• demonstration of access to professional expertise in radiation protection;	Yes	**Satisfied**: Section 28 discusses the role and responsibilities of the Radiation Safety Officer. Suitably qualified personnel are listed in Section 25.	No further action required.	

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• details of radiation monitoring;	Yes	**Satisfied**: details of radiation monitoring are provided in Section 17, 16 Mine Radiation Monitoring and 18 Worker Exposure to Radiation.	No further action required.	
• details of appropriate equipment, staff, facilities and operational procedures;	Yes	**Satisfied**: Radiation gauges (Section 27), Personal Hygiene Control (Section 12), Controlled and Supervised Areas (Section 13), Storage and Signage (Section 14), Radiation Safety Officer (Section 28), Radiation Safety Structure (Section 25).	No further action required.	
• a description of induction and training courses;	Yes	**Satisfied**: Radiation safety training Section 24. Responsibility of the Radiation Safety Officer (Section 28). All employees who work with ionising radiation or radioactive substances are to be provided with appropriate induction and continuing radiation safety training, and records maintained of this training.	No further action required.	
• reporting and periodic review procedures;	Partial	**Partial**: Section 22.4 Incident reporting requirements, Section 26 Periodic Review and Audit and Section 25 Record keeping and Reporting. Does not refer to Annual reporting against the EPL.	Include details of EPL reporting in Section 26.	
• emergency plans;	Yes	**Satisfied**: Emergency plans and response is covered in Section 26. The following have been prepared: Mine Site Emergency Response Plan and MSP Emergency Preparedness and Response (not reviewed).	No further action required.	
• baseline radiological information	Yes	• **Satisfied**: Background radiation levels, measured prior to operations, are presented in Section 15.	No further action required.	
• description of the waste management system	Yes	• **Satisfied**: the waste management system is described in Sections 19 – 23.	No further action required.	

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• radioactive waste monitoring; and	Yes	**Satisfied**: radioactive waste monitoring. The MSP laboratory monitors the activity (Bq) of the waste stockpiles using XRF analysis and communicates the results to production operations. If the activity exceeds 100Bq/g the waste is blended with inert silica sands produced from the non-mags circuit until the level is below 100Bq/g (Section 20).	No further action required.	
• a conceptual decommissioning plan; and	Yes	**Satisfied** Section 21 states that Conceptual decommissioning plans are included in the approved Mining Operation Plans for Ginkgo-Crayfish, Snapper and Atlas sites.	No further action required.	
(f) ensure wastes are landfilled in a manner to ensure:	Yes	**Satisfied** See for Ginkgo DA condition 27.	No further action required.	
• the average concentration of radioactive material in landfill at the site would not exceed the average concentration of radioactive material in the original orebody;	Yes	**Satisfied**: Background radiation levels, measured prior to operations, are presented in Section 15. Background radiation levels will be measured on areas post mining and rehabilitation to ensure levels are equal to or no greater than the original background radiation levels. Results of monitoring will be reported in the Annual Environmental Management Report (AEMR).	No further action required.	

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• the radiation level of any material deposited to land is no greater than 0.7 microGray per hour measures 1 metre vertically above the surface of the material being deposited; and	Partial	**Not satisfied** Section 21 states that waste is disposed of in a way that the radiation level of any material being deposited to land is no greater than 0.7µGy/h measured 1 m vertically above the surface of the material being deposited. The 2 options for disposing waste are described: • within the Ginkgo mine pit and covered under a minimum of 10 m (up to 35 m) of sand and clay overburden. No monitoring is described. • paddock dumped in a designated area within the mining void and blended with inert material sourced from the mining pit (tailings sand or overburden). The blended waste is covered under a minimum of 10 m of sand and clay overburden and rehabilitated. Radiation monitoring during the activity is conducted and recorded to ensure radiation levels of the material being deposited is less than 0.7µGy/h.	Clarify the monitoring process for waste being deposited in the Ginkgo mine pit (first option listed).	
• there is no detectable change from the original natural background radiation level measures at the ground surface.	Yes	**Satisfied** (see note) Section 21 states that rehabilitation areas are monitored to ensure there is no detectable change in original background radiation level measured 1 m above the ground surface. Reference is made to the conceptual decommissioning plans that were included in the approved Mining Operation Plans for Ginkgo-Crayfish, Snapper and Atlas sites. (note: these documents were not reviewed). There is no mention of the frequency that monitoring will be conducted, or the duration.	Clarify the frequency of monitoring and the duration, as required/ relevant.	

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Broken Hill MSP (DA 345-11-01) Radiation Management Plan (RMP), Schedule 2, Condition 3.12	**Satisfactory (Yes/No/Partial)**	**Comment**	**Action Required**	
Waste Management				
Classification of controlled waste (m) The Applicant must accurately identify the waste, in accordance with Condition 6.4(c)(viii), and determine if the waste is a controlled waste within the meaning of the NEPM.	No	**Not satisfied** Waste is classified in accordance with the *Waste Classification Guidelines Part 3: Waste containing radioactive material (2014)* (Section 19). 'Controlled waste' is not referenced in the RMP. Table 2 (compliance table) incorrectly references Section 16 Mine Radiation Monitoring.	Clearly specify whether waste is classified as controlled waste within the meaning of the NEPM. Review referencing in Table 2.	
Application for a consignment authorisation (n) If the waste is transported from the Premises to another participating State or Territory, the Applicant must comply with all Conditions attached to the consignment authorisation issued by an agency or a facility delegated by an agency in the destination State or Territory. *Note: The waste producer is required by the Protection of the Environment Operations (Waste) Regulation 2005 to obtain, prior to the waste being dispatched, a consignment authorisation from an agency, or a facility delegated by an agency, in the destination State or territory to allow the movement of controlled waste.*	No	**Not satisfied** The RMP does not mention transport of waste interstate.	Address requirements regarding interstate waste transport in the RMP.	

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Waste movements (o) If the waste is transported from the Premises to another participating State or Territory, the Applicant must ensure that the waste is transported to a place that can lawfully be used as a waste facility for that waste.	No	**Not satisfied** The RMP does not mention transport of waste interstate.	Address requirements regarding interstate waste transport in the RMP.	
(p) The Applicant must ensure that the waste transporter is licensed as required by the agency of each participating State or Territory through which the waste is transported.	No	**Not satisfied** The RMP does not mention transport of waste interstate.	Address requirements regarding interstate waste transport in the RMP.	
(q) The Applicant must: • retain a copy of the waste transport certificate for the waste for a period of not less than 4 years from the time the form was completed, and • make the copy of the waste transport certificate available for inspection by an authorised officer on request.	Yes	**Satisfied** Addressed in Section 23.	No further action.	

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Waste Management (s) The Applicant must not cause, permit or allow any waste generated outside the Premises to be received at the Premises for storage, treatment, processing, reprocessing or disposal or any waste generated at the Premises to be disposed of at the Premises, except as expressly permitted by a licence under the POEO Act 1997.	No	**Not satisfied** Waste Management addressed in Section 19. Does not include any limitation of waste allowed.	Include a statement regarding limitations on waste that can be received.	
(t) This Condition only applies to the storage, treatment, processing, reprocessing or disposal of waste at the Premises if it requires an environment protection licence under the POEO Act 1997.	No	**Not satisfied** Waste Management addressed in Section 19. Does not include any limitation of waste allowed.	Include a statement regarding limitations on waste that can be received.	
(u) Except as provided by any other Condition of this Consent, only the hazardous, industrial or group A waste listed below may be generated or stored at the Premises. *Note: Radioactive waste assessed as hazardous or industrial waste under Section 3.5 of the Wastes Guidelines.*	Yes	**Satisfied** Only radioactive waste will be generated or stored.	No further action .	

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Broken Hill MSP (DA 345-11-01) Radiation Management Plan, Schedule 2, Condition 3.16	**Satisfactory (Yes/No/Partial)**	**Comment**	**Action Required**	
Transport of Hazardous Materials				
(a) Material to be transported shall be classified and transported in accordance with the NSW Radiation Control Regulation 2003 and the Code of Practice for the Safe Transport of Radioactive Material published by the Australian Radiation Protection and Nuclear Safety Agency, 2001; and	Partial	**Not satisfied** Section 20 Waste transport does not specify the Regulations or Codes that the transport process is managed in accordance with. Section 23.4 Radiation Gauge Transport is in accordance with the Regulation.	Clearly identify throughout the document any legislation/ Codes/ Guidelines etc that are considered, addressed or complied with in the development of processes and procedures.	
(c) Process waste is to be transported by heavy vehicles otherwise transporting mineral and heavy mineral concentrates, as backloads on return trips, wherever practicable.	Yes	**Satisfied** Stockpiled "pugged" MSP Rejects are subsequently back-loaded into mineral concentrate trucks for disposal at the Ginkgo Mine or Campaspe Mine on completion of the Ginkgo pit.	No further action.	

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Broken Hill MSP (DA 345-11-01) Radiation Management Plan, Schedule 2, Condition 4.7	**Satisfactory (Yes/No/Partial)**	**Comment**	**Action Required**	
Requirement to monitor radiation				
The Applicant must monitor radiation levels in accordance with the requirements set out in the Environmental Protection Licence issued by the EPA. The Applicant must ensure that blended waste to be disposed of outside the premises is analysed to ensure characterisation in accordance with EPA waste disposal guidelines and is disposed of at a place licensed by the EPA to lawfully accept that class of waste.	Partial	**Not satisfied** Monitoring is covered in Section 16-18. There is no reference that monitoring will meet the requirements set out in the Environmental Protection Licence. The MSP Rejects are transported by a contractor who is licensed by the NSW EPA to transport this material. Each truckload of MSP Rejects is sampled with a gamma radiation meter at 1 m and the reading recorded on the Shippers Declaration Form.	Address this requirement in the RMP.	