ATLAS-CAMPASPE MINERAL SANDS PROJECT

OPTIMISATION MODIFICATION

APPENDIX B

AIR QUALITY REVIEW

TRONOX

katestone
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16 July 2019

Attn: Haakon Nielssen

Tronox Limited
PO Box 4032
MILDURA VIC 3502

Re: Air Quality Review for the Atlas-Campaspe Mineral Sands Project Optimisation Modification

Dear Haakon,

Katestone has prepared an Air Quality Review for the proposed Atlas-Campaspe Mineral Sands Project Optimisation Modification. The Air Quality Review of the potential air quality impacts associated with the Modification is based on:

- A review of the existing air quality monitoring in the vicinity of the Atlas-Campaspe Mine
- A comparison of dust emissions for the modified Project with the information presented in the existing Air Quality and Greenhouse Gas Assessment (Katestone Environmental, 2013) for the approved Project.

The Air Quality Review found that the Modification is unlikely to alter the outcomes of the Air Quality and Greenhouse Gas Assessment (Katestone Environmental, 2013) for the approved Project and the modified Project would not contribute to any additional exceedances of the relevant air quality criteria at any sensitive receptors in the vicinity of the Project.

Please contact the undersigned on (07) 3369 3699 if you would like to discuss the review.

Yours sincerely,

Tania Haigh – Senior Air Quality Consultant

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1. INTRODUCTION

The Atlas-Campaspe Mineral Sands Project (the Project) is being developed by Tronox Mining Australia Limited (Tronox). Development Consent (SSD_5012) for the Project was issued under the New South Wales (NSW) *Environmental Planning and Assessment Act 1979* in 2014.

The Project includes the development of a mineral sands mining operation (herein referred to as the Atlas-Campaspe Mine), together with the construction and operation of a rail loadout facility located near the township of Ivanhoe (herein referred to as the Ivanhoe Rail Facility).

The Atlas-Campaspe Mine is located approximately 80 kilometres (km) north of Balranald, NSW and 270 km south-east of Broken Hill, NSW (Figure 1). The Ivanhoe Rail Facility is located approximately 135 km north-east of the Atlas-Campaspe Mine, and is approximately 4.5 km to the south-west of the township of Ivanhoe (Figure 1).

Product (mineral concentrates) generated as a result of operations at the Atlas-Campaspe Mine will be trucked to the Ivanhoe Rail Facility for transfer to train wagons, which will then be railed to the existing Broken Hill Mineral Separation Plant (the MSP) (Figure 1).

The Project will integrate with currently existing/approved Tronox operations in western NSW, including (Figure 1):

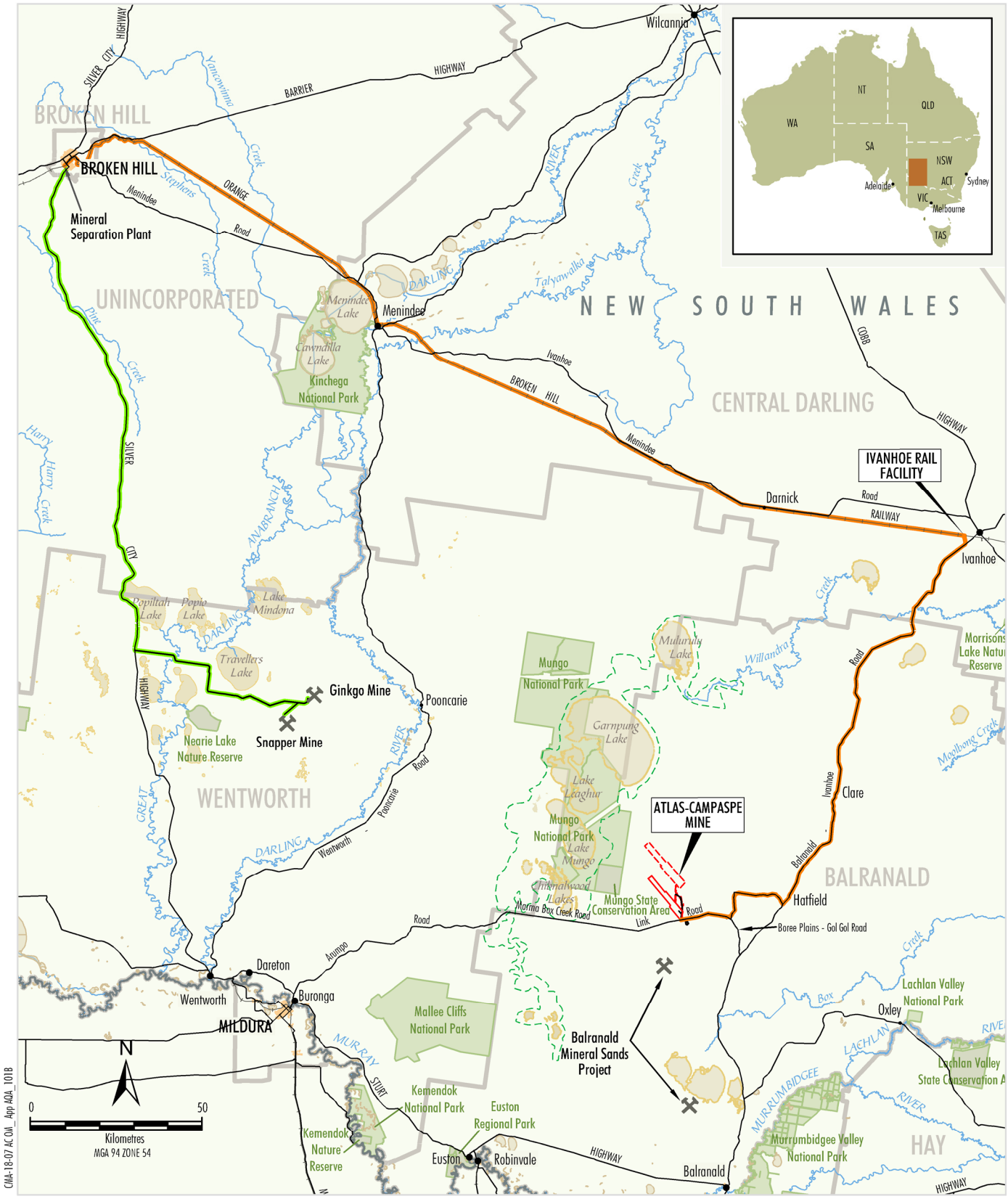
- the MSP – located in Broken Hill approximately 270 km north-west of the Atlas-Campaspe Mine
- Snapper Mine – located approximately 105 km to the west of the Atlas-Campaspe Mine
- Ginkgo Mine – located approximately 100 km to the west of the Atlas-Campaspe Mine.

This Air Quality Review has been prepared to support the application to modify Development Consent (SSD 5012) for the Project.

2. OVERVIEW OF THE MODIFICATION

Tronox proposes to modify Development Consent (SSD 5012) for the Project to allow for changes to optimise the Project (herein referred to the Optimisation Modification or Modification). The Modification would include:

- The option to use an overland conveyor to transfer overburden in addition to haul trucks;
- Increased mineral concentrate production from 546,000 tonnes per annum (tpa) to 665,000 tpa;
- Increased mineral concentrate transport from 450,000 tpa to 665,000 tpa;
- Increased mineral concentrate transport truck trips from 24 per day to 35 per day;
- Increased MSP process waste disposal from 50,000 tpa to 65,000 tpa;
- Use of local roads other than the road haulage route by Project-related light vehicles to access site (Figure 1);
- The option to develop on-site solar power generation infrastructure at the Atlas-Campaspe Mine to supplement diesel generator sets (Figure 2);
- Development of an emergency airstrip at the Atlas-Campaspe Mine (Figure 2);
- Relocation of the accommodation camp (inside the approved surface development area) (Figure 2);
- Construction and operation of a telecommunications tower at the Atlas-Campaspe Mine;
- Increased mineral concentrate transport train length (from 600 metres [m] to 920 m) and frequency (from six to eight train movements per week [i.e. four arrivals, four departures]);
- Extension to the Ivanhoe Rail Facility hardstand area (Figure 3);
- Extension of the Ivanhoe Rail Facility rail siding and addition of a passing siding;
- Revised alignment of the Ivanhoe Rail Facility access road and access road intersection (Figure 3); and
- A groundwater supply for the Ivanhoe Rail Facility (Figure 3).



LEGEND

- National Park, Regional Park or State Conservation Area
- Willandra Lakes Region World Heritage Area
- Local Government Area Boundary
- Mining Lease Boundary (ML 1767)
- Mining Lease Application Boundary (MLA)
- Existing Mineral Concentrate Transport Route and MSP Process Waste Transport Route
- Approved Mineral Concentrate Transport Route*

Source: © NSW Department of Finance, Services & Innovation (2018); Cristal Mining Australia (2012)

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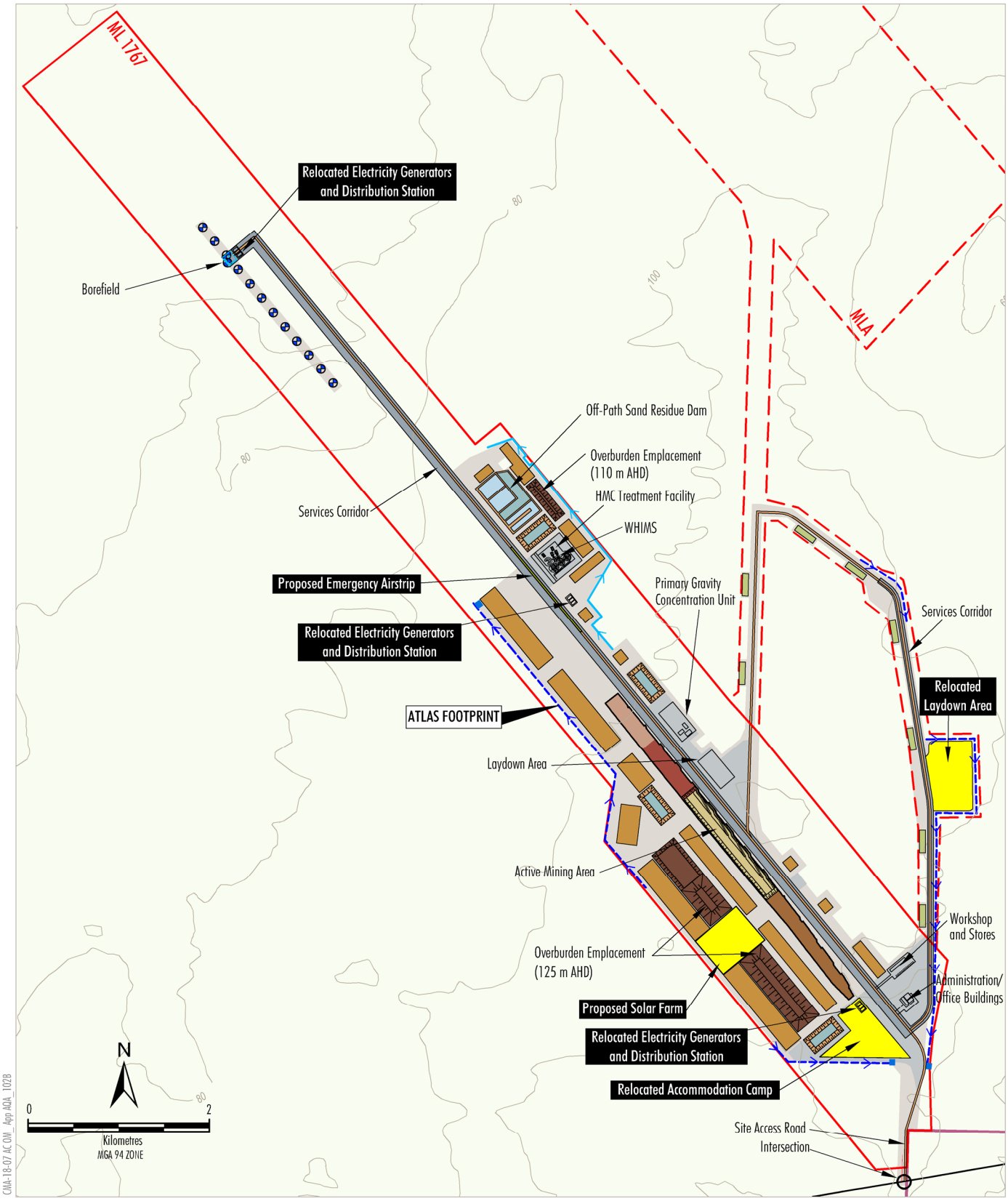
OPTIMISATION MODIFICATION

Regional Location

* MSP Process Waste Transport Route following cessation of operations at the Ginkgo and Snapper Mines.

Figure 1



Source: © NSW Department of Finance, Services & Innovation (2018); Cristal Mining Australia (2012) and Tronox (2019)

LEGEND

- Mining Lease Boundary (ML)
- Mining Lease Application Boundary (MLA)
- Exploration Licence Boundary (EL)
- Up-catchment Diversions
- Collection Drains
- Bore
- Approximate Extent of Surface Development - Year 2
- Fixed Infrastructure Areas
- Soil Stockpile
- Process Water Storage
- Overburden Emplacement
- Stage 1 Rehabilitation - Stabilised Landform with Seed/Cover Crop Application

Active Mining Area

- Vegetation Clearance/Soil Stripping
- Overburden Removal
- Ore Zone/Extraction Area
- Overburden Replacement/Process Waste Emplacement/Soil Replacement
- Sediment Basin

ACMSP Modification

- Modification Surface Development Area

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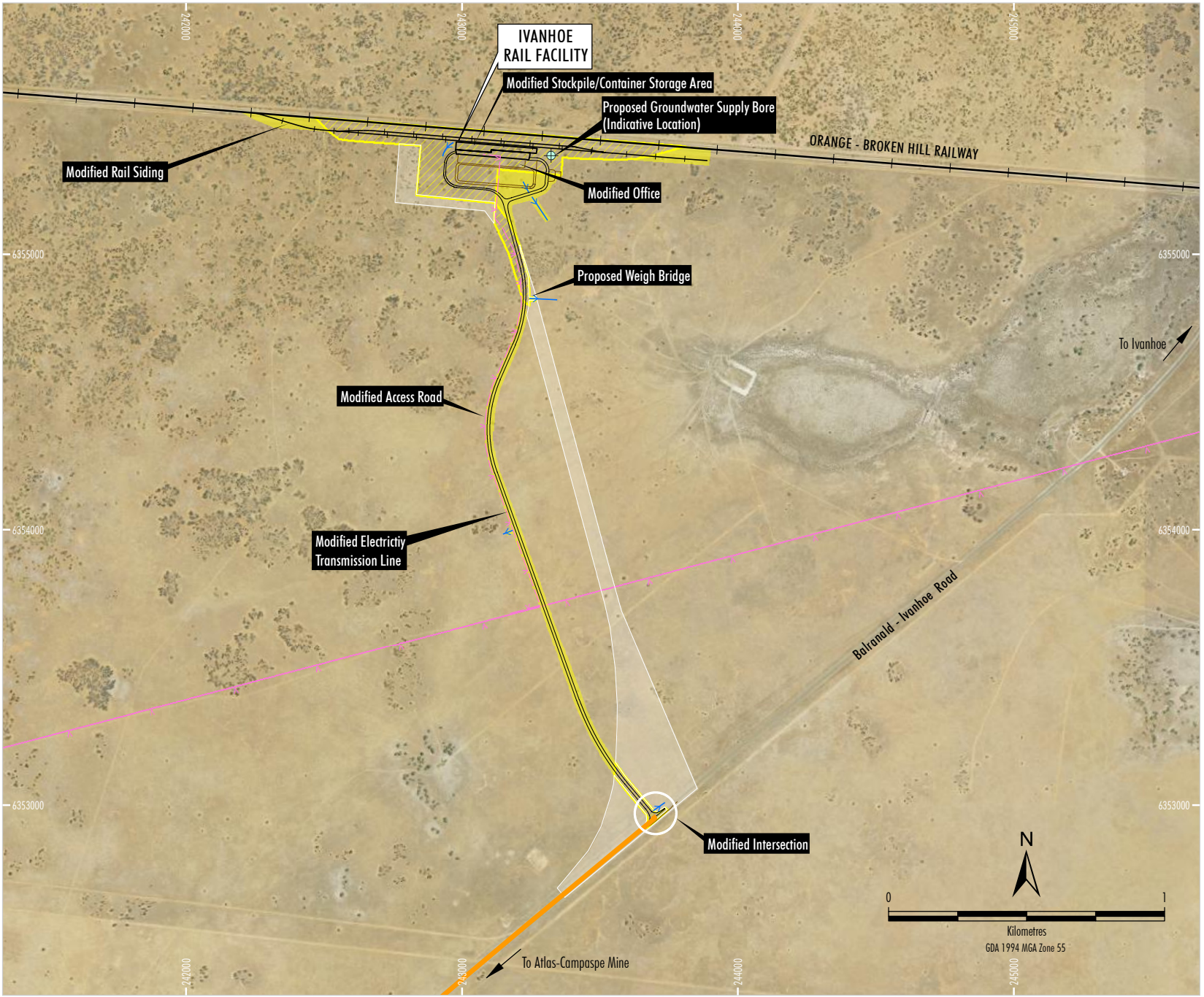
OPTIMISATION MODIFICATION

Modified Atlas-Campaspe Mine
General Arrangement - Year 2

Figure 2



LEGEND

- Approved Surface Development Area Required
- Additional Surface Development Area
- Approved Surface Development Area not Required
- Approved Mineral Concentrate Transport Route*
- Existing Electricity Transmission Line

* MSP Process Waste Transport Route following cessation of operations at the Ginkgo and Snapper Mines

Source: Cristal Mining Australia (2012); Tronox (2019)
Orthophoto: © NSW Department of Finance, Services & Innovation (2017)

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OPTIMISATION MODIFICATION

Modified Ivanhoe Rail Facility
General Arrangement

Figure 3

CMA-18-07 AC OM_ App AQA_201C

The Modification would not change the following components of the Project:

- Mine path or mine life;
- Mining method;
- Mineral concentration methods;
- Overburden and ore extraction rate;
- Sand residue, coarse reject and process waste placement management;
- Annual maximum water supply/demand;
- Rehabilitation works;
- Biodiversity offset area; or
- Workforce.

3. RELEVANT AIR QUALITY CRITERIA AND PERFORMANCE MEASURES

3.1 RELEVANT AIR QUALITY GUIDELINES

The Air Quality and Greenhouse Gas Assessment for the approved Project (Katestone Environmental, 2013) was prepared in accordance with the (now) superseded *Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales* (NSW Department of Environment and Conservation [DEC], 2005) (Section 6).

Subsequent to the grant of Development Consent (SSD_5012), the *Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales* (Environment Protection Authority [EPA], 2017) (Approved Methods) were introduced, which lists the statutory methods and air quality criteria that are to be used to model and assess emissions and impacts of air pollutants from stationary sources in NSW. The Approved Methods (EPA, 2017) introduced criteria for $PM_{2.5}$, and a reduced annual average PM_{10} criterion of 25 µg/m^3.

Ambient air quality in each state in Australia must be monitored and reported against the standards and goals defined in the *National Environment Protection (Ambient Air Quality) Measure 1998* (Air NEPM) (National Environment Protection Council [NEPC], 2016). Whilst these standards exist to evaluate ambient air quality, rather than the potential impact of an individual Project, they have been considered here for completeness.

3.2 DEVELOPMENT CONSENT (SSD 5012)

Air quality criteria are provided in Condition 19, Schedule 3 of Development Consent (SSD_5012). These conditions are reproduced below.

Air Quality Criteria

The Applicant shall ensure that all reasonable and feasible avoidance and mitigation measures are employed to ensure particulate matter emissions generated by the development do not exceed the criteria in Table 5, 6 and 7 at any residence on privately-owned land.

Table 5: Long term impact assessment criteria for particulate matter

Pollutant	***Averaging Period***	***[d]Criterion***
Total suspended particulate (TSP) matter	*Annual*	*[a] 90 µg/m^3*
Particulate matter < 10 µm (PM_{10})	*Annual*	*[a] 30 µg/m^3*

Table 6: Short term impact assessment criterion for particulate matter

Pollutant	***Averaging Period***	***[d]Criterion***
Particulate matter < 10 µm (PM_{10})	*24 hour*	*[a] 50 µg/m^3*

Table 7: Long term impact assessment criteria for deposited dust

Pollutant	Averaging Period	Maximum increase in deposited dust level	[d]Criterion
[c]Deposited Dust	Annual	[b] 2 g/m^2/month	[a] 4 g/m^2/month

Notes to Tables 5-7:

a Total impact (i.e. incremental increase in concentrations due to the development plus background concentrations due to all other sources);

b Incremental impact (i.e. incremental increase in concentrations due to the development on its own);

c. Deposited dust is to be assessed as insoluble solids as defined by Standards Australia, AS/NZS 3580.10.1:2003: Methods for Sampling and Analysis of Ambient Air - Determination of Particulate Matter - Deposited Matter - Gravimetric Method; and

d. Excludes extraordinary events such as bushfires, prescribed burning, dust storms, fire incidents or any other activity agreed by the Secretary.

The air quality related operating conditions are detailed in Condition 20, Schedule 3 of Development Consent (SSD_5012) and reproduced below.

Operating Conditions

The Applicant shall:

a) implement all reasonable and feasible measures to minimise off-site odour, fume, dust and greenhouse gas emissions of the development;
b) minimise any visible off-site air pollution generated by the development;
c) minimise the surface disturbance of the site;
d) operate an air quality management system that uses dust deposition gauges to monitor the performance of the development and implement air quality mitigation measures to ensure compliance with the relevant condition of this consent; and
e) minimise the air quality impacts of the development during adverse meteorological conditions and extraordinary events (see note d under Table 7),

to the satisfaction of the Secretary.

3.3 ENVIRONMENT PROTECTION LICENCE 21007

Tronox holds Environment Protection Licence (EPL) 21007 issued under the NSW *Protection of the Environment (Operations) Act 1997* (POEO Act) for the Project. Although EPL 21007 does not include air quality criteria, Condition M2.2 of EPL 21007 does identify six locations in the vicinity of the Atlas-Campaspe Mine site where dust deposition monitoring must be conducted on a monthly basis, and one location in the vicinity of the Atlas-Campaspe Mine site where a high-volume air sampler is to be operated to monitor PM_{10} and TSP every six days.

Operating conditions relevant to air quality are provided in Conditions O3 and O4 of EPL 21007:

O3 Dust

O3.1 All operations and activities occurring at the premises must be carried out in a manner that will minimise the emission of dust from the premises.

O3.2 Trucks entering and leaving the premises that are carrying loads must be covered at all times, except during loading and unloading.

O3.3 The premises must be maintained in a condition which minimises or prevents the emission of dust from the premises.

3.4 SUMMARY OF AIR QUALITY CRITERIA

Air quality criteria relevant to the Project are reproduced in Table 1.

Table 1 Particulate and dust deposition monitoring criteria for the Project

Pollutant	Averaging Period	Criterion	Source
TSP	Annual	90 µg/m^3	Development Consent, Approved Methods
PM_{10}	24-hour	50 µg/m^3	Development Consent, Approved Methods, Air NEPM
	Annual	30 µg/m^3	Development Consent
	Annual	25 µg/m^3	Approved Methods, Air NEPM
$PM_{2.5}$	24-hour	25 µg/m^3	Approved Methods, Air NEPM
	Annual	8 µg/m^3	Approved Methods, Air NEPM
Deposited dust	Annual	2 g/m^2/month (incremental)	Development Consent, Approved Methods
	Annual	4 g/m^2/month (total)	Development Consent, Approved Methods

4. EXISTING AIR QUALITY MANAGEMENT

Air quality management at the Project is undertaken in accordance with the Air Quality Management Plan (AQMP) (Cristal Mining Australia [CMA], 2018). The AQMP was prepared in accordance with Condition 21, Schedule 3 of Development Consent (SSD 5012) and includes:

- A description of the key sources of emissions
- Relevant air quality criteria applicable to the Project
- Air quality management measures for the Project
- Air quality monitoring program components
- A contingency plan to manage any unpredicted impacts and their consequences.

Table 2 provides a summary of the air quality management measures and controls included in the AQMP.

Tronox have advised that no air quality-related complaints have been received to date.

Table 2 Air Quality Management Measures and Controls

Project Phase	Management Measure
Construction	• Regular watering of roads and exposed areas to reduce wheel-generated dust and restricting vehicle speeds. • Dust-generating activities such as earthworks will not be carried out during high wind conditions (greater than 10 m/s). • Establishment of vegetation on stockpiled materiel material to prevent wind erosion. • Minimisation of haul trips and trip distances, where practicable. • Erecting physical barriers such as bunds and/or wind breaks around stockpiles or areas where earth moving is required, where practicable. • Earth moving activities will be avoided during unfavourable meteorological conditions, where practicable. • Minimising speed (speed limit of 40 kilometres per hour) of on-site traffic, where applicable, to minimise wheel generated dust.
Operational (Atlas-Campaspe Mine site)	• Watering of exposed haul roads within the active mining area. • Watering during topsoil removal. • Progressive rehabilitation of exposed areas. • Control of truck speeds. • Minimisation of travel speed and distance travelled for bulldozing.
Operational (mineral concentrate transport route)	• All vehicles transporting mineral concentrate from the Atlas-Campaspe Mine site will be covered to minimise potential losses. • All rail wagons transporting mineral concentrate along the Orange-Broken Hill Railway will be covered to minimise potential losses. • All MSP process waste transport will be undertaken in sealed containers.

Source: CMA (2018).

5. EXISTING AIR QUALITY ENVIRONMENT

5.1 SENSITIVE RECEIVERS

The Boree Plains residence (Tronox owned) is the closest residence to the Atlas-Campaspe Mine footprint and is located approximately 7 km away from the Campaspe deposit and approximately 18 km away from the Atlas deposit (where Project activities are occurring) (Figure 4). Other rural residences (e.g. Marona, Glen Tilt, Magenta and Langleydale) are located at least 14 km away from the Atlas-Campaspe Mine footprint (Figure 4).

The nearest receptors to the mineral concentrate transport route are located approximately 800 m (Magenta) and 1,300 m (Langleydale) from the unsealed sections of the haul road (Figure 4).

The township of Ivanhoe is representative of the closest residential area to the Ivanhoe Rail Facility. The Ivanhoe Rail Facility is located approximately 4.5 km from Ivanhoe (Figure 3).

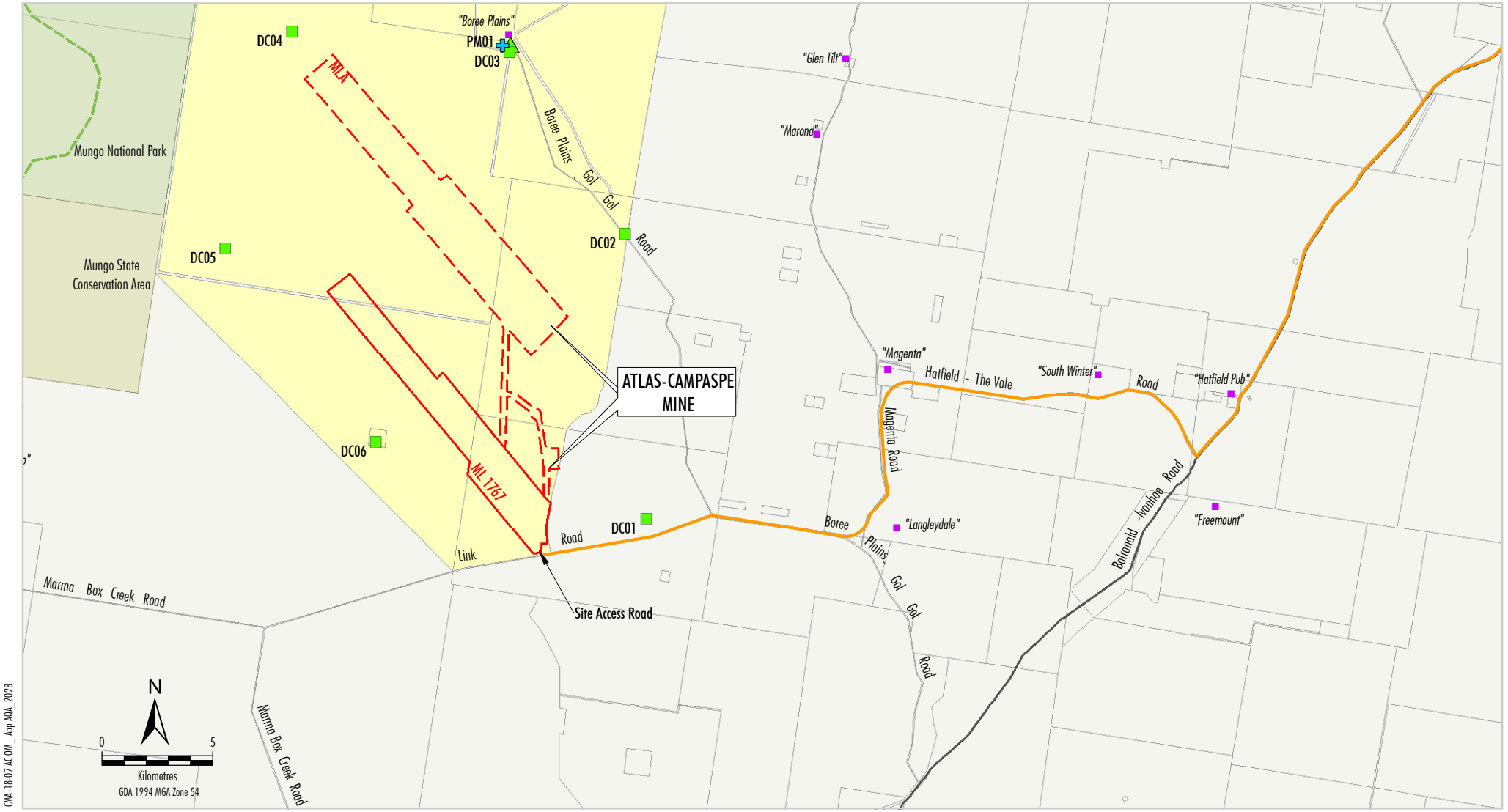
5.2 AIR QUALITY MONITORING

Tronox operates a network of dust deposition gauges (DC01 to DC06), as well as a high volume air sampler (HVAS) (PM01) (Figure 4) in accordance with the AQMP.

A summary of the air quality monitoring results is provided below.

Particulate Monitoring

PM_{10} and TSP are monitored using a high-volume sampler on a 1-in-6 day schedule. The high-volume sampler is located near the sensitive receptor (i.e. Boree Plains – Figure 4) with the highest predicted ground-level concentrations due to the Atlas-Campaspe Mine site operations in the Air Quality Assessment (Katestone Environmental, 2013). The TSP concentration is calculated based on the PM_{10} measurement applying a PM_{10}/TSP ratio of 0.67.



LEGEND

- Mining Lease Boundary (ML 1767)
- Mining Lease Application Boundary (MLA)
- Willandra Lakes Region World Heritage Area
- National Park
- State Conservation Area
- Tronox Owned Land
- Private Landholder
- Dwelling
- Approved Mineral Concentrate Transport Route
- Automatic Weather Station
- Dust Gauge Location
- PM_{10} /TSP Monitoring Site

Source: © NSW Department of Finance, Services & Innovation (2018)
Cristal Mining Australia (2012)

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OPTIMISATION MODIFICATION

Atlas-Campaspe Mine
- Air Quality Monitoring Sites

Figure 4

Table 3 summarises the PM_{10} monitoring data collected between 4 September 2018 and 8 February 2019. Figure 5 shows PM_{10} monitoring data over the same period. Measurements reported on 22 and 28 December 2018 and 3 January 2019 were identical, as were the two measurements reported on 15 and 25 January 2019. Tronox advised this was due to the filter paper not being changed during these periods and the single sample result has been reported for each sampling period.

Table 3 Summary of PM_{10} monitoring data from the Project site collected to date

Parameter	Number of samples*	Maximum 24-hour average (µg/m³)	Number of measurements > 50 µg/m³	Average (µg/m³)
PM_{10}	27	242.0	9	45.8
PM_{10} – excluding measurements known to have been recorded during periods with dust storms	25	89.3	7	33.8
Criterion	**-**	**50.0**	**-**	**25/30**

Table note:

* Measurements reported on 22 and 28 December 2018 and 3 January 2019 were identical, as were the two measurements reported on 15 and 25 January 2019. Tronox advised that this was due to the filter paper not being changed during these periods and a single sample result reported for each sampling period.

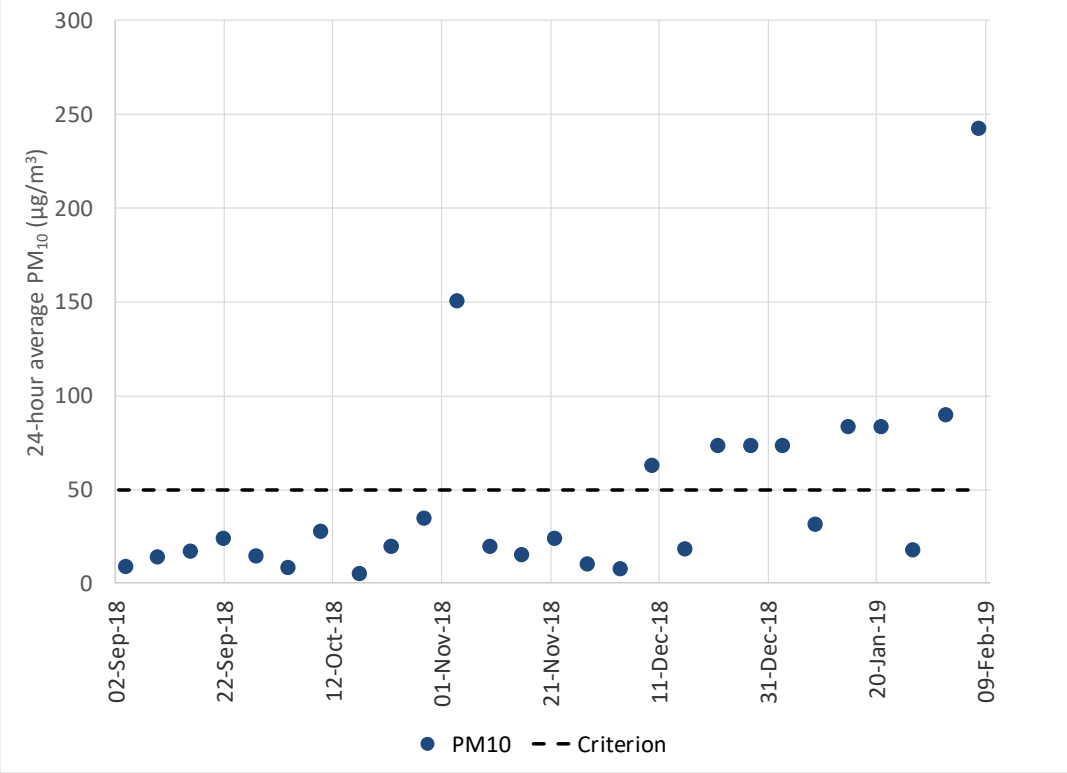


Figure 5 24-hour average PM_{10} concentrations measured at PM01

Twenty-four hour average PM_{10} measurements recorded at PM01 exceeded the Development Consent (SSD 5012) 24-hour PM_{10} criterion of 50 µg/m^3 on a total of nine days during this period (Table 3 and Figure 5).

It is expected that natural sources of wind-blown dust are likely to contribute to ambient concentrations in the region. This is particularly due to the location and proximity of the Project to nearby ephemeral lakes, which can be a considerable source of dust in dry periods. Significant amounts of silt can be deposited into these lakes as rain water drains into them, and after the surface dries this material becomes available to be swept up by the wind (Katestone Environmental, 2013). These conditions are expected to be currently present as 2018 was the sixth-driest year on record in New South Wales since 2002 (BoM, 2019a) and the warmest year on record. Whilst above average monthly rainfall was recorded for the state during October and November, overall rainfall measured in western New South Wales was below average for the year. Summer 2018-2019 was also a record warm summer with very dry conditions across the state, and a number of dust storms occurred during the period (BoM, 2019b). Meteorological monitoring stations in western New South Wales, including at Broken Hill Airport, measured higher than average maximum and minimum temperatures and low to average rainfall during summer. Dust storms were noted by Tronox at the site on 4 November 2018 and 8 February 2019.

In addition, as PM01 is located approximately 18 km north of current Project activities, it is expected that other closer sources in the region such as wind-blown dust are contributing to particulate matter levels at PM01.

Daily average meteorological data recorded at the on-site monitoring station indicates that the winds on most exceedance days were from southerly directions, which is the predominant wind direction at the Project site, particularly during summer. During southerly winds, the monitoring station would be downwind of the Atlas-Campaspe Mine site.

Whilst there is not a full year of data available to calculate an annual average, the average of the data collected to date shows that the average PM_{10} concentration recorded to date is 45.8 µg/m^3 based on all data (and 33.8 µg/m^3 excluding dates on which dust storms occurred). This is above the Development Consent (SSD 5012) annual average PM_{10} criterion of 30 µg/m^3 and the Approved Methods criterion of 25 µg/m^3 (Table 1).

The average TSP concentration calculated to date is 68.7 µg/m^3, which complies with the air quality criteria of 90 µg/m^3.

Given the elevated PM_{10} measurements recorded during the construction period, consideration could be given to additional PM_{10} monitoring to determine the contribution of activities at the Atlas-Campaspe Mine site to measured concentrations. For example, one additional PM_{10} monitoring station on the southwestern side of the Atlas-Campaspe Mine may assist in distinguishing the likely contribution of elevated ambient background concentrations and on-site activities to elevated PM_{10} measurements.

Dust Deposition Monitoring

Figure 6 presents the monthly dust deposition measurements from the six monitoring sites collected between January 2018 to February 2019. Also shown for comparison on Figure 6 is the guideline of 4 grams per square meter per month (g/m^2/month); however, it should be noted this applies to the annual average, not monthly dust deposition rates. Rolling annual averages for the available period are presented in Table 4, and these are well below the guideline of 4 g/m^2/month.

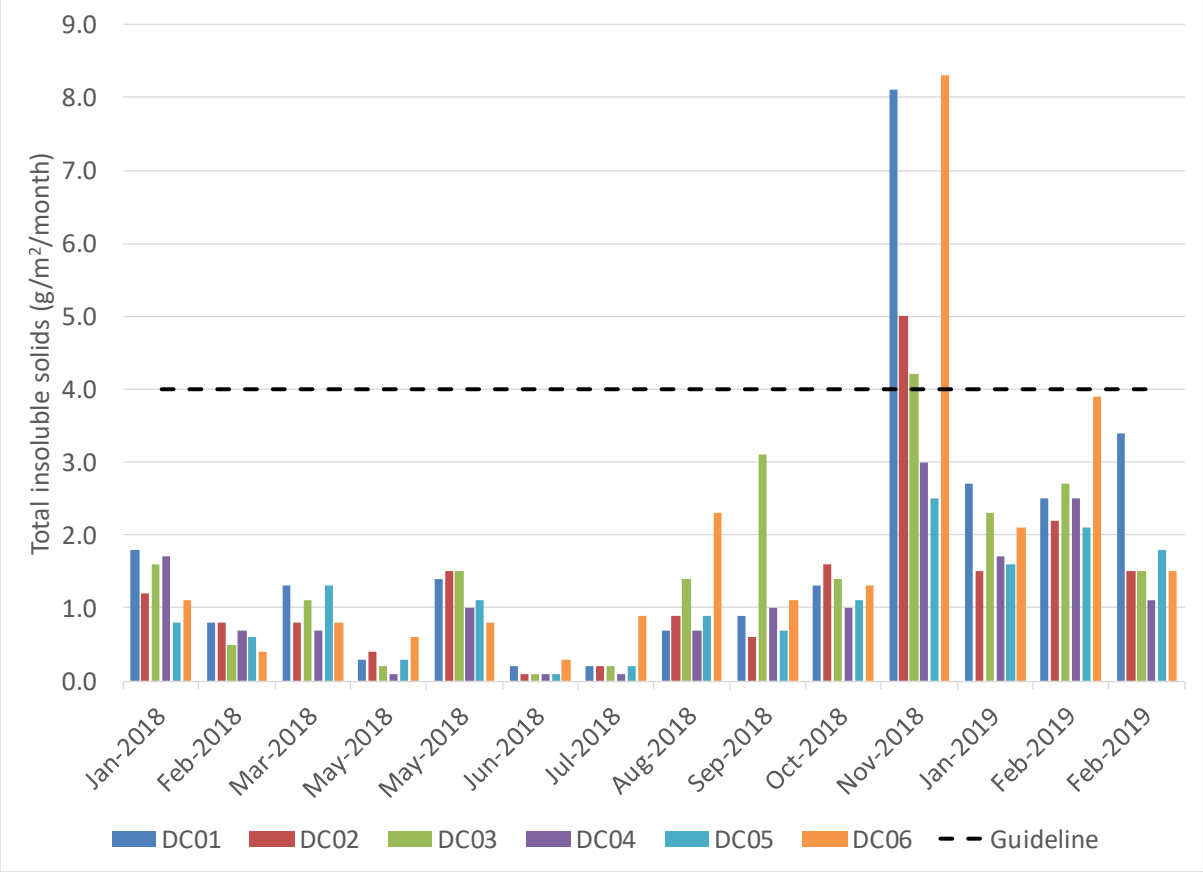


Figure 6 **Monthly dust deposition measurements**

Table 4 **Annual average dust deposition measurements**

Date	12-month average dust deposition (g/m²/month)					
	DC01	DC02	DC03	DC04	DC05	DC06
24-Jan-2018 – 9-Jan-2019	1.6	1.2	1.5	1.0	0.9	1.7
16-Feb-2018 – 5-Feb-2019	1.7	1.3	1.6	1.1	1.0	1.9
27-Mar-2018 – 26-Feb-2019	1.9	1.4	1.6	1.1	1.1	2.0
Objective	**4.0**					

6. OVERVIEW OF EXISTING AIR QUALITY ASSESSMENT

An Air Quality and Greenhouse Gas Assessment for the Project was undertaken for the Project by Katestone Environmental (2013). As described in Section 3.1, the assessment was conducted in accordance with the *Approved Methods for the Modelling and Assessment of Air Pollutants in NSW* (DEC, 2005) and included an assessment of the potential air quality impacts associated with the Atlas-Campaspe Mine, Ivanhoe Rail Facility and mineral concentrate transport between the Atlas-Campaspe Mine and Ivanhoe Rail Facility.

6.1 ATLAS-CAMPASPE MINE SITE

Potential air quality impacts at the Atlas-Campaspe Mine were modelled for Year 16 of the Project to assess the potential impact at sensitive receptors, including the nearest residence (Boree Plains – which is now Tronox owned) (Figure 4). The next nearest residence is approximately 14 km away from the Atlas-Campaspe Mine.

An emission inventory was prepared for Year 16 of the Atlas-Campaspe Mine operations in consideration of the anticipated mining activities for that year, including topsoil and overburden removal rates, haul road distances and routes, stockpile and pit areas and equipment operating hours. The major emission sources were associated with overburden removal; on-site haulage; and wind erosion from exposed areas (Katestone Environmental, 2013). The assessment of Year 16 operations accounted for the maximum overburden extraction rate from the Project life (notwithstanding that those maximum rates were scheduled to occur in Year 5) thereby providing a conservative estimate of potential air quality impacts (Katestone Environmental, 2013).

Consideration of the potential cumulative impacts associated with the construction and operation of the Balranald Mineral Sands Project were conservatively incorporated in the Air Quality and Greenhouse Gas Assessment (Katestone Environmental, 2013).

The Air Quality and Greenhouse Gas Assessment concluded (Katestone Environmental, 2013):

- The operation of the Atlas-Campaspe Mine plus contemporaneous background concentrations is not predicted to result in any additional exceedances of the impact assessment criterion for 24-hour average PM_{10} of 50 µg/m^3 at any sensitive receptors.
- Annual average PM_{10} and TSP, $PM_{2.5}$ and dust deposition rates at the nearest sensitive receptors due to the Project and ambient background concentrations were not predicted to result in any additional exceedances compared to background concentrations.
- No cumulative air quality impacts are expected from the coincident construction and operation of the Project and the Balranald Mineral Sands Project.

6.2 IVANHOE RAIL FACILITY

Potential air quality impacts at the Ivanhoe Rail Facility were also assessed in the Air Quality and Greenhouse Gas Assessment (Katestone Environmental, 2013). As operations at the Ivanhoe Rail Facility would generally remain unchanged throughout the Project life, one scenario that would represent all years of operation was assessed. An emissions inventory was prepared for the Ivanhoe Rail Facility and the major emission source was determined to be wheel generated dust from unpaved haul road (Katestone Environmental, 2013).

The Air Quality and Greenhouse Gas Assessment concluded (Katestone Environmental, 2013):

- The operation of the Ivanhoe Rail Facility plus contemporaneous background concentrations is not predicted to result in any additional exceedances of the impact assessment criterion for 24-hour average PM_{10} of 50 µg/m^3 at any sensitive receptors.
- Annual average PM_{10} and TSP, $PM_{2.5}$ and dust deposition rates at the nearest sensitive receptors due to the Project and ambient background concentrations were not predicted to result in any additional exceedances compared to background concentrations.

6.3 MINERAL CONCENTRATE TRANSPORT

The Air Quality and Greenhouse Gas Assessment also addressed the potential air quality impacts associated with mineral concentrate transport on unsealed sections of the mineral concentrate transport route and concluded (Katestone Environmental, 2013):

- The maximum 1-hr average PM_{10} concentration at a distance of 25 m from the unsealed sections of the mineral concentrate transport route were predicted to range from 40.4 µg/m^3 to 25.6 µg/m^3 for vehicles travelling at 100 km/hr and 40 km/hr, respectively, which is below the 24-hour average air quality objective of 50 µg/m^3.

- At a distance of 500m from the road, the maximum 1-hour average PM_{10} concentration from the unsealed sections of the mineral concentrate transport route were predicted to range from 2.3 µg/m^3 to 1.5 µg/m^3 to for vehicles travelling at 100km/hr and 40 km/hr, respectively, which is well below the 24-hour average air quality objective of 50 µg/m^3.

7. POTENTIAL AIR QUALITY IMPACTS DUE TO THE MODIFICATION

7.1 ATLAS-CAMPASPE MINE SITE

The following components of the Modification have the potential to change the TSP, PM_{10} and $PM_{2.5}$ emissions at the Atlas-Campaspe Mine:

- Increased mineral concentrate production from 546,000 tpa to 665,000 tpa;Addition of conveyors to transfer overburden (haul trucks are currently approved).

Emission rates of TSP, PM_{10} and $PM_{2.5}$ due to Year 16 of operations for the approved Atlas-Campaspe Mine and modified Atlas-Campaspe Mine are presented in Table 5.

Table 5 Summary of emission rates due to Year 16 of the Approved and Modified Atlas-Campaspe Mine operations

Activity	Emission rate (g/s) due to the Approved Atlas-Campaspe Mine*			Emission rate (g/s) due to the Modified Atlas-Campaspe Mine			% increase
	TSP	PM_{10}	$PM_{2.5}$	TSP	PM_{10}	$PM_{2.5}$	
Topsoil removal	1.8	0.4	0.2	1.8	0.4	0.2	0%
Overburden removal	18.6	7.4	1.6	18.6	7.4	1.6	0%
Ore removal	0.7	0.3	0.1	0.7	0.3	0.1	0%
Ore processing – screening	2.9	1.0	0.1	2.9	1.0	0.1	0%
Product stacking	0.0018	0.0008	0.0001	0.0022	0.0010	0.0002	22%
Road train loading	0.004	0.002	0.0003	0.004	0.002	0.0003	22%
Overburden haulage	20.3	6.5	0.7	20.3	6.5	0.7	0%^
HMC/MSP on-site haulage	5.2	1.3	0.1	7.6	1.9	0.2	46%
Grading	0.9	0.3	0.03	0.9	0.3	0.03	0%
Wind erosion	7.7	4.3	0.7	7.7	4.3	0.7	0%
TOTAL	**58.0**	**21.5**	**3.4**	**60.4**	**22.1**	**3.4**	**4%**

Table notes:

* Katestone Environmental (2013)

^ Note that emissions would reduce if conveyors are adopted.

Emissions due to product stacking and road train loading are expected to increase by 22% and on-site haulage of mineral concentrate is also expected to increase by 46% due to increased production. Overall, emissions from the modified Atlas-Campaspe Mine site are expected to increase by 4% compared to emissions from the approved Atlas-Campaspe Mine.

The use of conveyors to transport some or all of the overburden rather than haul trucks would reduce emissions from the Atlas-Campaspe Mine. Overburden haulage accounts for 6.5 grams per second (g/s), or 30%, of the estimated Atlas-Campaspe Mine emissions of PM_{10}. Based on an estimated 95% reduction in dust emissions, the use of conveyors instead of haul trucks would reduce emissions from overburden transport from 6.5 g/s to 0.3 g/s. Given that PM_{10} emissions from the modified Atlas-Campaspe Mine are expected to increase by 0.6 g/s due to the higher mineral concentrate production rate, the transport of even a portion of overburden via conveyor instead of haul truck would result in overall PM_{10} emissions rates that are lower than those assessed for the approved Atlas-Campaspe Mine.

Given that the Modification would result in either a decrease or a relatively small increase in emissions (depending if the conveyor is adopted) (Table 5) and the significant distances to the nearest sensitive receptors (Figure 4), it is likely that the conclusions of the Air Quality and Greenhouse Gas Assessment (Katestone Environmental, 2013) for the approved Project (Section 6.1) would remain valid, and the modified Project would not contribute to any additional exceedances of the relevant air quality criteria at any sensitive receptors in the vicinity of the Atlas-Campaspe Mine site.

7.2 IVANHOE RAIL FACILITY

The following components of the Modification have the potential to change the TSP, PM_{10} and $PM_{2.5}$ emissions at the Ivanhoe Rail Facility:

- Increased mineral concentrate transport/handling from 450,000 tpa to 665,000 tpa
- Increased mineral concentrate transport truck trips from 24 per day to 35 per day
- Extension to the Ivanhoe Rail Facility hardstand area and rail siding to accommodate the longer trains
- Revised alignment of the Ivanhoe Rail Facility access road and access road intersection (i.e. increased distance from the nearest privately-owned receptors)
- Addition of a groundwater supply (i.e. water would be available for dust suppression resulting in less wheel-generated dust).

Table 6 presents the emission rates for the approved Ivanhoe Rail Facility and the modified Ivanhoe Rail Facility.

Table 6 Summary of emission rates due to the Ivanhoe Rail Facility – as per the Air Quality Report, and due to the proposed amended Project

Activity	Emission rate (g/s) at the Approved Ivanhoe Rail Facility*			Emission rate (g/s) at the Modified Ivanhoe Rail Facility			% increase
	TSP	PM_{10}	$PM_{2.5}$	TSP	PM_{10}	$PM_{2.5}$	
Wheel generated dust from unpaved access road	4.17	1.04	0.11	3.39	0.84	0.1	-16%
Dumping of mineral concentrates onto stockpiles	0.0056	0.0026	0.0004	0.0083	0.0039	0.0006	48%
FEL transfer of mineral concentrates from stockpile to rail wagon	0.017	0.008	0.001	0.025	0.012	0.002	48%
Wind erosion of mineral concentrate stockpiles	0.007	0.004	0.001	0.011	0.006	0.001	50%
TOTAL	**4.20**	**1.06**	**0.12**	**3.44**	**0.86**	**0.10**	**-15%**

* Katestone Environmental (2013)

Overall the Modification would result in a 15% reduction in emissions from the Ivanhoe Rail Facility.

Whilst the proposed increase in mineral concentrate handling and associated increase in mineral concentrate transport truck trips would increase emissions at the Ivanhoe Rail Facility, the addition of a bore at the Ivanhoe Rail Facility will provide water for dust suppression on the access road that would reduce emissions associated with wheel generated dust from mineral concentrate transport trucks. The addition of dust suppression on the haul road results in a 16% decrease in emissions in from wheel generated dust from access road despite the increase in mineral concentrate truck numbers compared to the Air Quality and Greenhouse Gas Assessment, which did not account for dust suppression on the haul road.

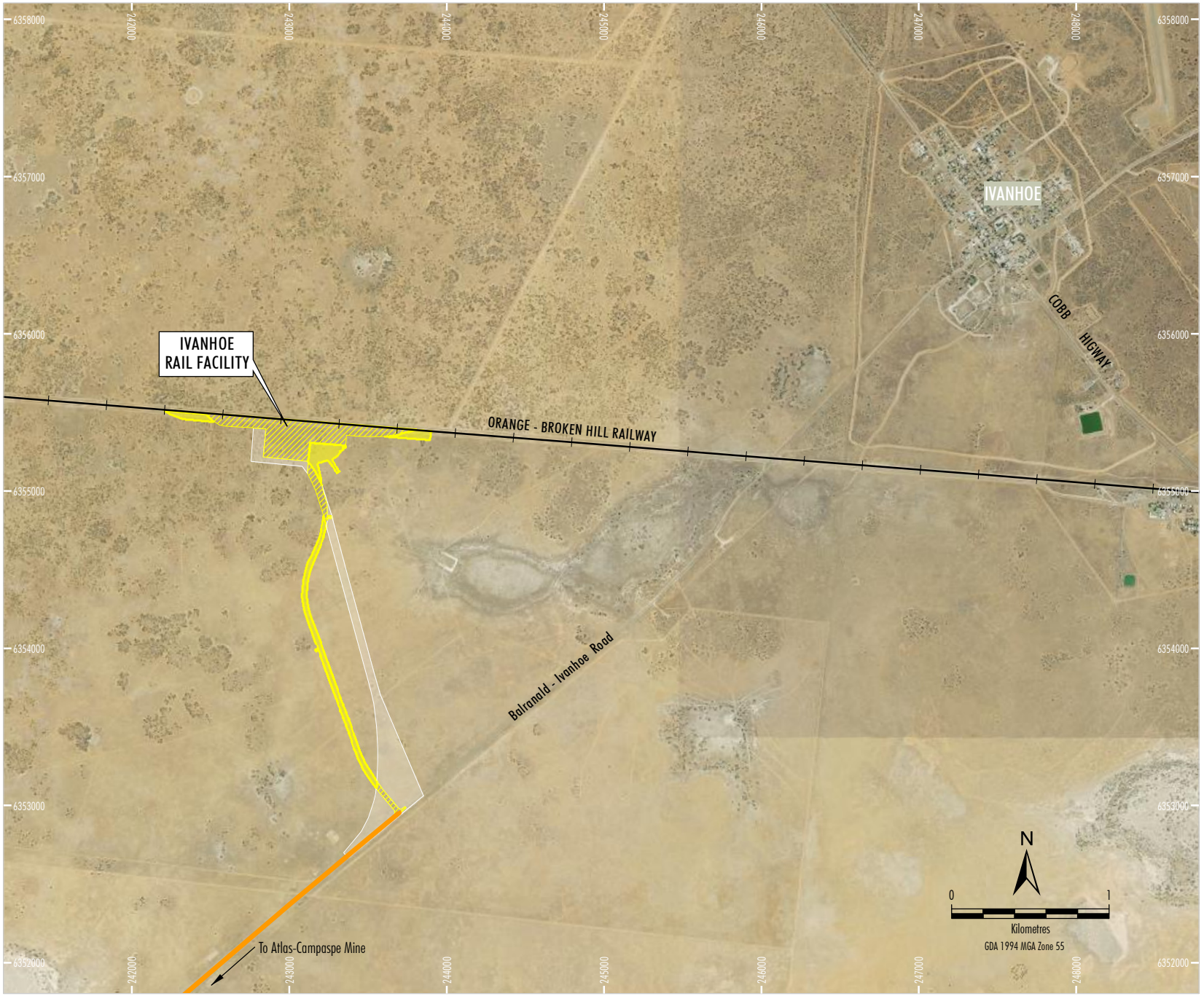
The modified Ivanhoe Rail Facility layout (e.g. minor changes to the site access road alignment and stockpile areas) also results in changes to emissions from wind erosion and wheel generated dust from the haul road.

Given that the Modification would result in reduction in emissions from the Ivanhoe Rail Facility (Table 6) and the distances to the nearest sensitive receptors (Figure 7), it is likely that the conclusions of the Air Quality and Greenhouse Gas Assessment (Katestone Environmental, 2013) for the approved Project (Section 6.1) would remain valid, and the modified Project would not contribute to any additional exceedances of the relevant air quality criteria at any sensitive receptors in the vicinity of the Ivanhoe Rail Facility.

7.3 MINERAL CONCENTRATE TRANSPORT

Emissions of dust due to product transport along unsealed sections of the mineral concentrate transport route are expected to increase by approximately 46% due to the increase in trips per day from 24 to 35.

An increase in trips per day from 24 to 35 along the mineral concentrate transport route is however unlikely to result in additional exceedances of the relevant air quality criteria given the relatively small contribution of the mineral concentrate transport route emissions to ground-level concentrations, the reduction in this contribution with increasing distance from the mineral concentrate transport route and the distance between the mineral concentrate transport route and sensitive receptors.



LEGEND

- Approved Surface Development Area Required
- Additional Surface Development Area
- Approved Surface Development Area not Required
- Approved Mineral Concentrate Transport Route*

* MSP Process Waste Transport Route following cessation of operations at the Ginkgo and Snapper Mines

Source: Cristal Mining Australia (2012); Tronox (2019)
Orthophoto: © NSW Department of Finance, Services & Innovation (2018)

TRONOX

OPTIMISATION MODIFICATION

Modified Ivanhoe Rail Facility and Surrounds

Figure 7

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8. CONCLUSIONS

This Air Quality Review of the potential air quality impacts associated with the Modification is based on:

- A review of the existing air quality monitoring in the vicinity of the Atlas-Campaspe Mine
- A comparison of dust emissions for the modified Project with the information presented in the existing Air Quality and Greenhouse Gas Assessment (Katestone Environmental, 2013) for the approved Project.

The Air Quality Review found that the Modification is unlikely to alter the outcomes of the Air Quality and Greenhouse Gas Assessment (Katestone Environmental, 2013) for the approved Project and the modified Project would not contribute to any additional exceedances of the relevant air quality criteria at any sensitive receptors in the vicinity of the Project.

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