Specialist Study 1

Air Quality Impact Assessment

uMN014-08

QUALITATIVE AIR QUALITY IMPACT FOR THE UPGRADE OF THE TRANSNET RAILWAY LINE FROM HOTAZEL TO ASSESSMENT

Version 2

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LIST OF ABBREVIATONS

ASTDR	Agency for Toxic Substances and Disease Control
BMDL	Lower level of the Benchmark Dose, i.e. the lowest amount of a chemical at which an effect may occur.
DEAT	The Department of Environmental Affairs and Tourism
mtpa	Million tons per annum
NOAEL	No observed adverse effects level
PM_{10}	Particulate matter with a diameter of 10 μm or less
TSP	Total suspended particulates, i.e. a diameter of 100 μm or less
μm	Micrometer, 1 μm = 0.0000001 m
WHO	World Health Organisation

ANNEX B:

AIR QUALITY

Section 1: Introduction

The scope and objectives of the quantitative air quality specialist study are to:

i. Describe the baseline condition of the study area in terms of ambient air quality;
ii. Describe the legislation, policies and guidelines that are applicable to air quality;
iii. Assess of potential air quality impacts associated with construction and operational activities;
iv. Describe relevant and implementable mitigation measures to reduce, avoid, or minimise the negative impacts and enhance positive impacts;
v. Identify information gaps, uncertainties, study limitations and the underlying assumptions; and
vi. Recommend possible monitoring studies.

Section 2: Approach and methodology

Description of the baseline

The description of the baseline air quality status along the route uses available ambient air quality information contained in the Initial State of the Air Report for South Africa (DEAT, 2006) as well as information on significant emission sources. The baseline description is also informed by the results of a short ambient air monitoring campaign at Rosmead. The monitoring campaign is designed to test the hypothesis that manganese dust is liberated from the moving freight trains and is present in the ambient air near the freight line, and is deposited in the soil adjacent to the line.

The current capacity of the railway line between Hotazel, the Port of Ngqura and Port Elizabeth for manganese is 4.2 mtpa (2 trains) and 3 trains per day per direction for containers. The proposed upgrade will facilitate an increase to approximately 6 mtpa (3 trains) of manganese ore in 2009 and thereafter to 8 mtpa (4 trains), 10 mtpa (5 trains) and 12 mtpa (6 trains) at different stages in the future. The container trains will increase to 9 trains per day per direction.

An active air quality sampler was located at Rosmead from 25 August 2008 to 8 September 2008, sampling for 24-hours every second day. Rosmead was selected as the monitoring site for two reasons. Firstly, the manganese ore is sprayed when on the freight cars prior to departure to dampen dust. By the time the freight train reaches Rosmead the ore will have dried somewhat thereby increasing the likelihood of dust being blown from the cars. Secondly, Rosmede provided a monitoring location close to the railway line within the station area that provided security, electricity and personnel on site to change

sampler filters. Monitoring was conducted at one station only to obtain an indication of whether dust from the freight cars presented a potential risk.

In active sampling ambient air is pumped through the sampler and particulate matter in the air is collected on a filter. The filter is analysed for manganese. The concentration of manganese in the air is then derived with knowledge of the volume of air passing through the filter. Total suspended particulates (TSP) were sampled rather than PM_{10} as coarse particulates are expected to be emitted from the freight cars as a result of the movement of the ore. Soil samples were collected from the immediate vicinity of the freight line and at increasing distances from the line to establish firstly whether that manganese is blown from the freight cars and is deposited next to the line, and secondly to establish a deposition gradient.

Legislation, policies and guidelines

South African ambient air quality standards (DEAT, 2007) for particulate matter and the World Health Organisation ambient air quality guidelines for manganese (WHO, 2000) are used as benchmarks to assess whether ambient concentrations of particulates and manganese pose a risk to human health. Information on background concentrations of manganese in soil (ASTDR, 2000) are also used are used to inform the assessment of any deviation from typical conditions.

Impact assessment

An impact on human health from inhalation of air pollutants occurs where individuals are exposed to concentrations that exceed health guidelines or standards. Information on the proximity of human settlements (or social receptors) to the freight line was gathered during a field survey in August 2008 and during the high level screening exercise (ERM, 2008). This information provides information on community areas that are potentially exposed to manganese and particulates from the freight line construction and operational activities.

The nature of the construction activity and the resultant emissions are considered in assessing the nature and significance of impacts from particulate emissions. Baseline ambient concentrations of manganese from the monitoring campaign are compared with guidelines to assess the nature and significance of any impacts.

Key assumptions

- Information on ambient air quality at places along the freight line is representative of the entire freight line;
- The ambient concentrations of manganese measured during the monitoring campaign represent typical conditions;

- Normal freight operating conditions occurred during the monitoring campaign.

Limitations and uncertainties

- A dearth ambient air quality data along the freight line is a limitation to this assessment, i.e. the limited existing data and data from a short monitoring campaign are assumed to represent air quality along the entire line at all times. The line generally passes through rural or sparsely populated areas and the potential emission of manganese dust from the train is therefore small. The data limitation does not impact dramatically on the outcomes of this assessment.

Section 3: Aspects of the project within the scope of the study

Two aspects of the project that could potentially be the root cause of impacts to the surrounding communities are:

- Dust generated by the construction activities and resulting in potential nuisance impacts, and
- Manganese dust blown from the ore on the moving freight cars resulting in ambient concentrations of manganese in adjacent communities that poses a risk to human health.

Section 4: Description of the affected environment

The current manganese ore railway line extends from Coega in the Eastern Cape to Sishen, near Hotazel, in the Northern Cape Province. It covers a distance of approximately 1 100km. The proposed upgrades and expansions of the current rail infrastructure lie between Coega and De Aar, covering a distance of approximately 500 km.

The passenger railway service on the freight line no longer serves the small agricultural communities between Coega and De Aar so most of the stations are no longer in use. As a result only a few households remain in some cases otherwise the associated communities have disappeared. The high-level screening study (ERM, 2008) and observations made by University of Pretoria (Pers. comm., Johan Nel, Archaic Heritage Project Management) identified inhabited settlements in relative close proximity to the stations selected for upgrade, expansion and development at Barkly Bridge, Golden Valley, Visrivier, Rosmead and Bletterman, comprising two or three households. None were however directly adjacent to any of the proposed upgrades, expansions and developments. Further details on the social receptors are contained in Appendix A of the high-level screening study (ERM, 2008).

Generally ambient air quality monitoring stations are located to monitor exposure in populated areas, or to measure background ambient concentrations. Ambient air quality monitoring in the Eastern Cape has is therefore been concentrated in the Nelson Mandela Metropolitan Municipality in Port Elizabeth and Coega (DEAT, 2006). The only ambient monitoring in the Northern Cape occurs in the mining area near Kuruman.

An ambient monitoring campaign was therefore conducted at Rosmead to provide some measure of existing ambient air quality for this study. This monitoring campaign was unfortunately interrupted due technical difficulties and a continuous record was not obtained. The available data is however reliable and the results confirm that ambient concentrations of manganese are very low compared with the WHO guideline at Rosmead and less than 0.0001 $\mu g/m^3$, which is the detection limit of the analytical instrumentation.

Manganese is a natural component of the environment and natural levels of manganese in soils range between 40 and 900 ppm (ATSDR, 2000). Analysis of soil samples collected at increasing distances from the railway at Rosmead indicates a gradient away from the freight line. The relatively high Mn concentrations in the soil at the interchange are attributed to Mn dust either falling through the cars as a result of vibrations at the interchange, or dust blowing from the cars and depositing close to the railway line.

Manganese concentrations are within the natural range, except at the interchange where they just exceed the upper limit (Table 5.1).

Table 5.1 Manganese concentration in soil near Rosmead at increasing distance from the line

Site	Description	Concentration (ppm)
1	At the interchange, about 2m away from the railway line	980
2	1m from the main freight line after the interchange	160 to 180
3	10 m from the main freight line after the interchange	430
4	50 m from the main freight line after the interchange	370
4	100 m from the main freight line after the interchange	220

There are no major sources of air pollution such as industrial stacks, large numbers of motor vehicles or large communities along the route. The only source of air pollution along the route is dust from agricultural activities such as ploughing or naturally wind blown dust from denuded surfaces. Despite there being no monitoring along the route, the air quality is therefore classed as good.

Section 5: Identification of applicable policies, legislation, standards and guidelines

Particulate matter

Dust fallout refers to the deposition of dust in the ambient environment and different standards apply in residential and industrial areas. Target, action and alert thresholds are presented in Tables 5.2 and 5.3.

Total suspended particulates (TSP) refer to relatively coarse particles with a diameter of less than 100 µm. TSP is mostly associated with nuisance effects such deposition and soiling. These particulates are either exhaled or trapped in the upper areas of the respiratory system and expelled. The South African Ambient Air Quality Standard for TSP is shown in Table 5.4.

Table 5.2 South African four band scale for dust deposition

Band	Band description	Dust fall rate (D) mg/m²/day, 30-day averaging period	Comment
1	Residential	D < 600	Permissible for residential and light commercial
2	Industrial	600 < D < 1200	Permissible for heavy commercial and industrial
3	Action	1200 < D < 2400	Requires investigation and remediation if 2 sequential months lie in this band, or more than 3 occur in a year
4	Alert	2400 < D	Immediate action and remediation required following the first incidence of dust fall rate being exceeded. Incidents reported to be submitted to the relevant authority

Table 5.3 South African target, action and alert threshold for dust deposition

Category	Dust Fallout Rate	Averaging Period	Permissible Frequency of Exceedance
Target	< 300 mg/m²/day	Annual	
Residential	< 600 mg/m²/day	30 days	3 within a year, no 2 sequential months
Industrial	600 – 1200mg/m²/day	30 days	3 within a year, no sequential months
Action	1200 – 2400 mg/m²/day	30 days	
Alert	> 2400 mg/m²/day	30 days	None

PM_{10} refers to particulate matter with a diameter of 10 µm or less is also referred to as inhalable particulates. PM_{10} is inhalable and either clings to protective mucous and is removed or lodges in the lung capillaries and alveoli and may result in health impacts. The South African Ambient Air Quality Standard for PM_{10} is shown in Table 5.4.

Table 5.4 South African ambient air quality standards for TSP and PM_{10}. The number of permitted exceedances is in brackets

	24-hour Average	Annual Average	Compliance date
TSP	300 µg/m³	100 µg/m³	Immediate
PM_{10}	180	60	Immediate
	127 (4)	50 (0)	2012
	100 (2)	45 (0)	2017
	75 (1)	40 (0)	2022

Manganese

In urban and rural areas without significant manganese pollution, annual averages are mainly in the range of 0.01–0.07 µg/m³; near foundries the level can rise to an annual average of 0.2–0.3 µg/m³ and, where ferro- and silico-

manganese industries are present, to more than 0.5 µg/m^3, with individual 24-hour concentrations sometimes exceeding 10 µg/m^3 (WHO, 2005).
The toxicity of manganese varies according to the route of exposure. By ingestion, manganese has relatively low toxicity at typical exposure levels and is considered a nutritionally essential trace element. By inhalation, however, manganese has been known to be toxic to workers (WHO, 2000). Manganism is characterised by various psychiatric and movement disorders, with some general resemblance to Parkinson's disease in terms of difficulties in the fine control of some movements, lack of facial expression, and involvement of underlying neuroanatomical (extrapyramidal) and neurochemical (dopaminergic) systems (Roels, 1992; Mergler, 1994). Respiratory effects such as pneumonitis and pneumonia and reproductive dysfunction such as reduced libido are also frequently reported features of occupational manganese intoxication. The available evidence is inadequate to determine whether or not manganese is carcinogenic; some reports suggest that it may even be protective against cancer. Based on this evidence, the US Environmental Protection Agency has concluded that manganese is not classifiable as to human carcinogenicity (IRIS, 1988)

Based on neurotoxic effects observed in occupationally exposed workers and using the benchmark approach, an estimated No Observed Adverse Effect Level (NOAEL) (the lower 95% confidence limit of the BMDL5) of 30 µg/m^3 is provided by the WHO (2000). The BMDL is the lowest amount of a chemical at which an effect may occur. BMDL5 is the 5% level.

No ambient air quality standards or guidelines exist for manganese. An ambient annual guideline value for manganese of 0.15 µg/m^3 is derived by dividing by a factor of 4.2 to adjust for continuous exposure and an uncertainty factor of 50 (WHO, 2000). The adjustment for continuous exposure is considered sufficient to account for long-term exposure based on knowledge of the half-time of manganese in the brain.

Table 5.5: ***World Health Organisation ambient air quality guideline for Mn (WHO, 2000)***

Averaging Period	Concentration (µg/m^3)
Annual average	0.15

Permitting and licensing

There are no permitting or licensing requirements for ambient air relating to the control of emissions of manganese dust from rail freight cars.

Section 6: Specification of relevant thresholds

The relevant threshold values for compliance with ambient air quality are the South African ambient air quality standards for TSP and PM_{10} (Table 5.4).

Without a standard for manganese the WHO ambient air quality guideline for manganese of 0.15 µg.m^3 (Table 5.5) is used .

Section 7: Key issues and impact pathways

Key issues and concerns associated with the proposed project are:

- An increase in dust deposition in the surrounding environment due to the construction activities; and
- Impacts on health in communities situated adjacent to the freight line associated with an increase in airborne manganese dust due to an increase in the amount of ore being freighted.

Section 8: Scenarios considered in the impact assessment

Construction

A number of activities in the construction of the approximately 28 loops between Port Elizabeth and De Aar are potential sources of dust and impacts in the ambient environment. These include:

- Land clearance for site facilities;
- Clearing of land and removal of topsoil inside the rail reserve where banks and cuttings are to be widened;
- Clearing of land and removal of topsoil outside the rail reserve where new roads and level crossings are to be constructed;
- Construction of new roads and level crossings ;
- Excavation of cuttings, placement and compaction of soil material where banks and cuttings are to be widened;
- Excavation of borrow pits on or outside the rail reserve;
- Blasting to widen cuttings;
- Operation of a crushing plant on site to crush available rock to be used in the construction; and
- Movement of vehicles on site and on unpaved surface off site.

Freight cars

Manganese ore is transported in open freight cars. The ore is sprayed with water before leaving the mine to suppress dust. As the ore dries on route and agitation between ore chunks occurs the potential exists for manganese dust to be generated and blown from the moving freight cars and result in potential impacts in the ambient environment.

Section 9: Impact assessment

Construction dust

Dust will be generated during the construction of the freight line and the loops as a result of the excavation activities, the handling of spoil and through entrainment by vehicle movement. This dust will subsequently be deposited

in the surrounding environment. Such dust is typically coarse (diameter > 10 μm). It therefore does not pose a health risk. The impacts associated with dust from construction are therefore likely to be of a nuisance nature only.

The area where dust is likely to be deposited will be limited to the area immediately surrounding the construction sites. The heaviest dust deposition will occur on the construction sites and be limited to a few hundred metres only. The impact will be of a short duration, i.e. only for the construction period. Generally the areas surrounding the construction sites are sparsely populate so the nuisance will be to a few people for a relatively short period. The significance of the impact associated with the construction activities is therefore considered to be low (Table 5.6). Management measures to control dust during construction will further reduce any potential impact.

Manganese dust from freight cars

Dust is likely to be blown from the manganese ore on the freight cars as they move along the freight line. Manganese dust is therefore likely to exist in the ambient air before being deposited. Dust that results from the agitation of larger ore pieces is typically coarse (diameter > 10 μm) and is therefore unlikely to pose a health risk.

The measured ambient concentration of respireable manganese (diameter < 10 μm) of 0.0001 $\mu m/m^3$ at Rosmead is well below the WHO ambient guideline value of 0.15 $\mu m/m^3$. The impacts associated with dust from the freight cars are therefore highly unlikely to have any health impact. Rather the potential impact will be nuisance only.

Measurements of manganese in the soil alongside the freight line indicted that the effect of manganese dust deposition is limited to the area immediately adjacent to the line only. Within 50 m of the freight line the concentrations of manganese in the soil are within natural limits. Generally the areas immediately alongside the freight line are uninhabited or very sparsely populated. Considering this and the localised nature of the deposition the significance of the impact associated with manganese dust being liberated from the freight cars is considered to be negligible (Table 5.6).

Section 10: Recommendations for management actions and alternatives not yet considered

Dust will be generated from a number of construction activities relating to the freight line and the loops. While the impact is expected to be low it will result in nuisance impacts near the construction sites. It is necessary therefore to implement dust control measured through the Environmental Management Plan (EMP) for the construction phase. These measures should include the following:

- The removal of vegetation must be limited to the construction areas only;
- Dust must be contained on the construction sites, stockpiles and spoil piles by the implementation of an ongoing spraying programme. Spraying must ensure that surfaces remain sufficiently wet to prevent dust entrainment by vehicle movement and wind erosion.
- Speed restrictions must be implemented on construction sites and access roads to limit dust entrainment by vehicles.
- Verges, cuttings, lay-down areas and construction camps must be re-vegetated as soon as the construction activity is completed at each of the respective site.

It is possible that some dust is generated in the freight cars with the agitation of ore pieces. It is necessary that the current practice of ore wetting continues once the freight cars are loaded continues.

Section 11: Recommendations for monitoring

Monitoring of dust fallout during construction is not considered to be necessary. Similarly, it is not deemed to be necessary to monitor manganese dust anywhere along the freight line.

Table 5.6: Assessment of the air quality impacts associated with the construction and operations of the upgrade of the freight line from Hotazel to Coega.

Impact criteria	Construction dust	Dust from freight cars
Nature	Dust emissions from construction activities are likely to result in a direct negative impact of a nuisance nature only.	Mn dust emissions from the freight cars are likely to result in a direct negative impact of a nuisance nature only.
Extent	The extent of the impact is likely to be on-site or local as it is unlikely to impact beyond the construction sites.	The extent of the impact is likely to be limited to the immediate area along the length freight line, i.e. a local effect.
Duration	The duration of the construction activities is regarded as short-term as it would only occur for the construction period.	The duration of the impact will be for the operational life of the freight line.
Intensity	Dust from construction is unlikely to cause a major nuisance impact or impact on human health. As such the intensity will be low.	Mn dust from the freight cars is unlikely to cause a major nuisance impact or impact on human health. As such the intensity will be low.
Probability	There will be site clearing, earthworks and vehicle movement during construction. The probability of occurrence is definite.	Agitation of larger pieces of Mn in the freight cars will generate dust which can be blown from the moving freight cars. The probability of occurrence is probable.
Degree of confidence	Specialist familiarity with construction activities provides a moderate degree of confidence in the prediction.	Ambient monitoring data from alongside the freight line provides a moderate degree of confidence in the prediction.
Significance	Pre-mitigation: Low. Post-mitigation: Negligible.	Pre-mitigation: Low. Post mitigation: Negligible.

Nature: ***Positive/negative and direct/indirect***
Extent: ***Description of the scale of the impact, i.e. local (specific construction site), the district, national, international***
Duration: ***Prediction of the lifetime of the project, i.e., temporary are of short duration or intermittent; short term to last for the duration of construction; long-term for the life time of the project; permanent effects last beyond the life of the project***
Intensity: ***The magnitude or size of the impact, i.e. low or negligible if ambient air quality standards are not exceeded anywhere; medium if air quality standards are exceeded at times beyond the project sites; high if ambient air quality standards are continually exceeded outside the project sites.***
Probability of occurrence: ***Description of the probability of the impact occurring, i.e. improbable (low likelihood); probable (distinct possibility); highly probable (most likely)***
Degree of confidence in the predictions based on the availability of information and specialist knowledge.
Significance: Low for an impact for which no mitigation is necessary; medium for an impact that requires effective mitigation; high for an impact, which if not mitigated, could stop the project from proceeding.
Status: ***Positive (a benefit) or negative (a cost).***

Section 12: References

ATSDR, 2000. Agency for Toxic Substance and Disease Regisrty, Public Health Statement for Mananese, September 2000, Availale at http://www.atsdr.cdc.gov/toxprofiles/phs151.tml (visited 7 December 2007).

Department of Environmental Affairs and Tourism (DEAT), 2006. The National Air Quality Management Programe (NAQMP): Output C.4: Initial State of air Report, DEAT, Pretoria.

Department of Enviromental Affairs and Tourism (DEAT) , 2007. Proposed National Ambient Air Quality Standards in terms of Section 9(1)(a) and (b) of the National Environment Management: Air Quality Act 2004 (Act No. 39 of 2004), CD:AQM&CC D:APRP 12/11/2007, DEAT, Pretoria.

Environmental Resources Management (ERM), 2008. Internal Environmental Screening Report: Proposed Coega - De Aar Freight Line Upgrade, February 2008.

Integrated Risk Information System (IRIS). *Carcinogenicity assessment for lifetime exposure to manganese* (http://www.epa.gov/ngispgm3/iris/subst/0373.htm#II). Cincinnati, OH, US Environmental Protection Agency (accessed 25 May 1988).

Mergler, D., 1994. Nervous system dysfunction among workers with long-term exposure to manganese. *Environmental research*, **64**: 151–180.

Roels, H.A., 1992. Assessment of the permissible exposure level to manganese in orkers exposed to manganese dioxide dust. *British journal of industrial medicine*, **49**: 25–34.

South African Institute for Occupational Hygiene (SAIOH), 2006, Occupational Exposure Limits for Airborne Pollutants, http://www.saioh.org/OELs/oels.htm (visited 7 September 2008)

WHO, 2000. Air Quality Guidelines for Europe, 2nd Edition, World Health Organisation, ISBN 92 890 1358 3.