# Interested and Affected Party Register

| LAST NAME | FIRST NAME | ORGANISATION | FARM NAME | FARM PORTION | DATE OF NOTIFICATION | NOTIFICATION TYPE | DATE OF REMINDER NOTIFICATION |
|---|---|---|---|---|---|---|---|
| **Landowners (Within the Mining Rights Area Boundary)** | | | | | | | |
| Jordaan | Koos | BAADTJIESBULT BOERDERY PTY LTD | KRANSPAN 49 | RE | 07-Dec-18 | E-mail | 07-Jan-19 |
| Prinsloo | Attie | AJB Boerdery | KRANSPAN 49 | 1 | 07-Dec-18 | | 07-Jan-19 |
| Prinsloo | Rudi | ROODEBLOEM TRUST | KRANSPAN 49 | 2 | 07-Dec-18 | | 07-Jan-19 |
| Papenfus | Jaco | CMJ PAPENFUS TRUST | KRANSPAN 49 | 3 | 07-Dec-18 | | 07-Jan-19 |
| Klein | Gysbert Samuel | PRIVATE LANDOWNER | KRANSPAN 49 | 4 | 07-Dec-18 | SMS / Post | 07-Jan-19 |
| Prinsloo | Rudi | ROODEBLOEM TRUST | KRANSPAN 49 | 5 | 07-Dec-18 | | 07-Jan-19 |
| Papenfus | Kobus | CMJ PAPENFUS TRUST | KRANSPAN 49 | 6 | 07-Dec-18 | | 07-Jan-19 |
| Papenfus | Kobus | CMJ PAPENFUS TRUST | KRANSPAN 49 | 7 | 07-Dec-18 | | 07-Jan-19 |
| Jordaan | Koos | BAADTJIESBULT BOERDERY PTY LTD | KRANSPAN 49 | 8 | 07-Dec-18 | | 07-Jan-19 |
| | | | | | | | |
| **Occupiers of the Site (Within the Mining Rights Area Boundary)** | | | | | | | |
| Marais | Frans | Private - Lessee | KRANSPAN 49 | 4 | 07-Dec-18 | E-mail | 07-Jan-19 |
| Prinsloo | Rudi | ROODEBLOEM TRUST | KRANSPAN 49 | 8 | 07-Dec-18 | E-mail | 07-Jan-19 |
| Jordaan | Koos | BAADTJIESBULT BOERDERY PTY LTD | KRANSPAN 49 | 1 | 07-Dec-18 | E-mail | 07-Jan-19 |
| | | | | | | | 07-Jan-19 |
| **Adjacent Landowners (Landowners Surrounding the MRA Boundary)** | | | | | | | |
| Swart | Dirk | NORTHERN COAL PTY LTD | ROETZ 210 | RE | 07-Dec-18 | E-mail | 07-Jan-19 |
| Swart | Dirk | NORTHERN COAL PTY LTD | JAGTLUST 47 | 1 | 07-Dec-18 | E-mail | 07-Jan-19 |
| Swart | Dirk | NORTHERN COAL PTY LTD | JAGTLUST 47 | RE | 07-Dec-18 | E-mail | 07-Jan-19 |
| Gangazhe | Mashudu | MSOBO COAL PTY LTD | VERKEERDEPAN 50 | 1 | 07-Dec-18 | E-mail | 07-Jan-19 |
| Gangazhe | Mashudu | MSOBO COAL PTY LTD | VERKEERDEPAN 50 | RE | 07-Dec-18 | E-mail | 07-Jan-19 |
| Gangazhe | Mashudu | MSOBO COAL PTY LTD | VERKEERDEPAN 50 | 2 | 07-Dec-18 | E-mail | 07-Jan-19 |
| Gangazhe | Mashudu | MSOBO COAL PTY LTD | VERKEERDEPAN 50 | 6 | 07-Dec-18 | E-mail | 07-Jan-19 |
| Gangazhe | Mashudu | MSOBO COAL PTY LTD | VERKEERDEPAN 50 | 7 | 07-Dec-18 | E-mail | 07-Jan-19 |
| Nkosi | Job | PRIVATE LANDOWNER | WITRAND 52 | 4 | 07-Dec-18 | SMS / Post | 07-Jan-19 |
| Nkosi | Rosina Mango | PRIVATE LANDOWNER | WITRAND 52 | 4 | 07-Dec-18 | SMS / Post | 07-Jan-19 |
| Booi | Sibongile | INGWE SURFACE HOLDINGS LTD (SOUTH32) | ROODEBLOEM 51 | 1 | 07-Dec-18 | E-mail | 07-Jan-19 |
| Jordaan | Koos | NAVIDU INV 10 CC | VAALBANK 212 | 1 | 07-Dec-18 | E-mail | 07-Jan-19 |
| Lukele | Christina | SIYATHUTHUKA CPA | VAALBANK 212 | RE | 07-Dec-18 | SMS | 07-Jan-19 |
| Prinsloo | Rudi | ROODEBLOEM TRUST | VAALBANK 212 | 8 | 07-Dec-18 | E-mail | 07-Jan-19 |
| Papenfus Trust | Jacobus | CMJ PAPENFUS TRUST | WITBANK 209 | RE | 07-Dec-18 | E-mail | 07-Jan-19 |
| Klein | Gysbert Samuel | NOVA TRUST | NAUDESBANK 172 | 14 | 07-Dec-18 | SMS / Post | 07-Jan-19 |
| Klein | Gysbert Samuel | NOVA TRUST | NAUDESBANK 172 | 6 | 07-Dec-18 | SMS / Post | 07-Jan-19 |
| | | | | | | | |
| **Municipal Councillors** | | | | | | | |
| Nkosi | Velepi | Ward Councillor: Ward 21 | | | 07-Dec-18 | E-mail | 07-Jan-19 |
| | | | | | | | |
| | | | | | | | |
| **Local and District Municipality** | | | | | | | |
| Nkosi | Paulos | Albert Luthuli Local Municipality | | | 07-Dec-18 | E-mail | 07-Jan-19 |
| Mavumbela | Lovedale | Albert Luthuli Local Municipality | | | 07-Dec-18 | E-mail | 07-Jan-19 |
| - | Molly | Albert Luthuli Local Municipality: Electricity | | | 07-Dec-18 | E-mail | 07-Jan-19 |
| Nkosi | D | Albert Luthuli Local Municipality: Mayor | | | 07-Dec-18 | E-mail | 07-Jan-19 |
| - | Mbuso | Albert Luthuli Local Municipality: Roads | | | 07-Dec-18 | E-mail | 07-Jan-19 |
| DM | Modimogale | Albert Luthuli Local Municipality: Service Delivery | | | 07-Dec-18 | E-mail | 07-Jan-19 |
| Gumede | ME | Albert Luthuli Local Municipality: Water | | | 07-Dec-18 | E-mail | 07-Jan-19 |
| Chirwa | MG | Gert Sibande District Municipality: Mayor | | | 07-Dec-18 | E-mail | 07-Jan-19 |
| B | Phiwe | Gert Sibande District Municipality: Roads | | | 07-Dec-18 | E-mail | 07-Jan-19 |
| T | Ephraim | Gert Sibande District Municipality: Service Delivery | | | 07-Dec-18 | E-mail | 07-Jan-19 |
| P | Tshidi | Gert Sibande District Municipality: Water | | | 07-Dec-18 | E-mail | 07-Jan-19 |

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| **Organs of State with Jurisdiction** | | | | | | | |
| Venter | Jan | Department of Agriculture: Land Use and Soil Management | | | 07-Dec-18 | E-mail | 07-Jan-19 |
| Sekgetho | Seapei | Department of Mineral Resources DDMLA | | | 07-Dec-18 | E-mail | 07-Jan-19 |
| Tshivhandekano | Aubrey | Department of Mineral Resources: Regional Manager | | | 07-Dec-18 | E-mail | 07-Jan-19 |
| Netshikweta | Herbert | Department of Mineral Resources Senior Inspector | | | 07-Dec-18 | E-mail | 07-Jan-19 |
| Mokonyane | Martha | Department of Mineral Resources: Emalahleni | | | 07-Dec-18 | E-mail | 07-Jan-19 |
| Mutengwe | Mashudu | Department of Mineral Resources: Emalahleni | | | 07-Dec-18 | E-mail | 07-Jan-19 |
| Ratsela | Matshilele | Department of Mineral Resources: Emalahleni | | | 07-Dec-18 | E-mail | 07-Jan-19 |
| Mathavhela | Sam | Department of Mineral Resources: Pretoria - Environment Authorisations: Mpumalanga | | | 07-Dec-18 | E-mail | 07-Jan-19 |
| Mfeka | Nonqubeko | Department of Rural Development and Land Reform | | | 07-Dec-18 | E-mail | 07-Jan-19 |
| Masuku | Lazarus | Department of Rural Development and Land Reform | | | 07-Dec-18 | E-mail | 07-Jan-19 |
| Mlomo | Bongani | Department of Rural Development and Land Reform | | | 07-Dec-18 | E-mail | 07-Jan-19 |
| Ratlhagane Simon | Mabuse | Department of Rural Development and Land Reform | | | 07-Dec-18 | E-mail | 07-Jan-19 |
| Ledwaba Christa | Mokgaetji | Department of Rural Development and Land Reform | | | 07-Dec-18 | E-mail | 07-Jan-19 |
| Mathabe | Thato | Department of Rural Development and Land Reform | | | 07-Dec-18 | E-mail | 07-Jan-19 |
| Makeke | Theledi | Department of Rural Development and Land Reform (Mpumalanga) | | | 07-Dec-18 | E-mail | 07-Jan-19 |
| Mushwana | Rose | Department of Rural Development and Land Reform (Mpumalanga) | | | 07-Dec-18 | E-mail | 07-Jan-19 |
| Khoza | Vusi | Department of Rural Development and Land Reform (Mpumalanga) | | | 07-Dec-18 | E-mail | 07-Jan-19 |
| Mulaudzi | Masala | Department of Water and Sanitation | | | 07-Dec-18 | E-mail | 07-Jan-19 |
| van Aswegen | Johan | Department of Water and Sanitation | | | 07-Dec-18 | E-mail | 07-Jan-19 |
| Maliaga | Simon | Department of Water and Sanitation (Bronkhorstspruit) | | | 07-Dec-18 | E-mail | 07-Jan-19 |
| Mare | Charmaine | Eskom Holdings SOC LTD | | | 07-Dec-18 | E-mail | 07-Jan-19 |
| Muswubi | Mpho | Eskom Transmission Land and Rights Mpumalanga | | | 07-Dec-18 | E-mail | 07-Jan-19 |
| Rasiuba | Thabo | Inkomati Usuthu Catchment Management Agency (IUCMA) | | | 07-Dec-18 | E-mail | 07-Jan-19 |
| Dzhangi | Thandi | Inkomati Usuthu Catchment Management Agency (IUCMA) | | | 07-Dec-18 | E-mail | 07-Jan-19 |
| Marebane | S | Mpumalanga Department of Agriculture, Rural Development, Land and Environmental Affairs | | | 07-Dec-18 | E-mail | 07-Jan-19 |
| Nyathikazi | Bheki | Mpumalanga Department of Agriculture, Rural Development, Land and Environmental Affairs | | | 07-Dec-18 | E-mail | 07-Jan-19 |
| de Lange | A | Mpumalanga Department of Agriculture, Rural Development, Land and Environmental Affairs | | | 07-Dec-18 | E-mail | 07-Jan-19 |
| Nkambule | Ntokozo | Mpumalanga Department of Agriculture, Rural Development, Land and Environmental Affairs | | | 07-Dec-18 | E-mail | 07-Jan-19 |
| Xulu | SP | Mpumalanga Department of Agriculture, Rural Development, Land and Environmental Affairs: HoD | | | 07-Dec-18 | E-mail | 07-Jan-19 |
| Mthombothi | W | Mpumalanga Department of Community Safety, Security and Liason: HoD | | | 07-Dec-18 | E-mail | 07-Jan-19 |
| Chunda | C | Mpumalanga Department of Co-Operative Governance and Traditional Affairs: HoD | | | 07-Dec-18 | E-mail | 07-Jan-19 |
| Mnisi | SW | Mpumalanga Department of Culture, Sports and Recreation: HoD | | | 07-Dec-18 | E-mail | 07-Jan-19 |
| Nxumalo | Tinyiko | Mpumalanga Department of Economic Development and Tourism | | | | | |
| Nkosi | Prudence | Mpumalanga Department of Economic Development and Tourism | | | | | |
| Mkhize | MW | Mpumalanga Department of Economic Development and Tourism | | | 07-Dec-18 | E-mail | 07-Jan-19 |
| Sebitso | N | Mpumalanga Department of Economic Development and Tourism | | | 07-Dec-18 | E-mail | 07-Jan-19 |
| Thobela | M | Mpumalanga Department of Economic Development and Tourism | | | 07-Dec-18 | E-mail | 07-Jan-19 |
| Mdluli | JD | Mpumalanga Department of Economic Development and Tourism | | | 07-Dec-18 | E-mail | 07-Jan-19 |
| Mnisi | JM | Mpumalanga Department of Economic Development and Tourism | | | 07-Dec-18 | E-mail | 07-Jan-19 |
| Makwetla | TI | Mpumalanga Department of Economic Development and Tourism | | | 07-Dec-18 | E-mail | 07-Jan-19 |
| Mdluli | LM | Mpumalanga Department of Economic Development and Tourism | | | 07-Dec-18 | E-mail | 07-Jan-19 |
| Mhlabane | M | Mpumalanga Department of Education: HoD | | | 07-Dec-18 | E-mail | 07-Jan-19 |
| | Josephine | Mpumalanga Department of Health: HoD | | | 07-Dec-18 | E-mail | 07-Jan-19 |
| Matshebula | SEB | Mpumalanga Department of Human Settlements: HoD | | | 07-Dec-18 | E-mail | 07-Jan-19 |
| Mohlaseedi | K | Mpumalanga Department of Public Works, Roads and Transport: HoD | | | 07-Dec-18 | E-mail | 07-Jan-19 |
| Mahlalela | X | Mpumalanga Department of Social Development: HoD | | | 07-Dec-18 | E-mail | 07-Jan-19 |
| Sithole | XGS | Mpumalanga Economic Growth Agency | | | 07-Dec-18 | E-mail | 07-Jan-19 |
| Johnson | U | Mpumalanga Economic Growth Agency | | | 07-Dec-18 | E-mail | 07-Jan-19 |
| Moduka | Benjamin | Mpumalanga Heritage Resources Authority | | | 07-Dec-18 | E-mail | 07-Jan-19 |
| Mokoena | Lineth | Mpumalanga Heritage Resources Authority | | | 07-Dec-18 | E-mail | 07-Jan-19 |
| Mtshweni | R | Mpumalanga Premier | | | 07-Dec-18 | E-mail | 07-Jan-19 |
| Sibiya | A | Mpumalanga Tourism and Parks Agency | | | 07-Dec-18 | E-mail | 07-Jan-19 |
| de Jesus | C | Mpumalanga Tourism and Parks Agency | | | 07-Dec-18 | E-mail | 07-Jan-19 |

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|---|---|---|---|---|---|---|---|
| de Kock | Rene | SANRAL SOC LTD. | | | 07-Dec-18 | E-mail | 07-Jan-19 |
| Khumalo | N | South African Heritage Resource Agency | | | 07-Dec-18 | E-mail | 07-Jan-19 |
| Ndou | Livhuwani | Transnet SOC LTD. | | | 07-Dec-18 | E-mail | 07-Jan-19 |
| Monyamane | Ezekiel | Transnet SOC LTD. | | | 07-Dec-18 | E-mail | 07-Jan-19 |
| Reddy | Krishna | Transnet SOC LTD. | | | 07-Dec-18 | E-mail | 07-Jan-19 |
| Papenfus | Norman | Transnet SOC LTD. | | | 07-Dec-18 | E-mail | 07-Jan-19 |
| Tshivhandekano | Aubrey | Department of Mineral Resources | | | 07-Dec-18 | E-mail | 07-Jan-19 |
| Nkosi | Sam | Department of Rural Development and Land Reform | | | 07-Dec-18 | E-mail | 07-Jan-19 |
| | | | | | | | |
| **Other** | | | | | | | |
| Stols | Nico | Mine Manager Msobo | | | 07-Dec-18 | E-mail | 07-Jan-19 |
| Mukwevho | Livhuwani | Environmental Manager: Ilima | | | 07-Dec-18 | E-mail | 07-Jan-19 |
| Davel | Robert | Mpumalanga Agriculture | | | 07-Dec-18 | E-mail | 07-Jan-19 |
| Rathbone | David | Chrissiesmeer Lake District | | | 07-Dec-18 | E-mail | 07-Jan-19 |
| | | | | | | | |

| LAST NAME | FIRST NAME | ORGANISATION | FARM NAME | FARM PORTION | DATE OF NOTIFICATION | NOTIFICATION TYPE | DATE OF REMINDER NOTIFICATION |
|---|---|---|---|---|---|---|---|
| **Landowners (Within the Mining Rights Area Boundary)** | | | | | | | |
| Jordaan | Koos | BAADTJIESBULT BOERDERY PTY LTD | KRANSPAN 49 | RE | 07-Dec-18 | E-mail | 07-Jan-19 |
| Prinsloo | Attie | AJB Boerdery | KRANSPAN 49 | 1 | 07-Dec-18 | E-mail | 07-Jan-19 |
| Prinsloo | Rudi | ROODEBLOEM TRUST | KRANSPAN 49 | 2 | 07-Dec-18 | E-mail | 07-Jan-19 |
| Papenfus | Jaco | CMJ PAPENFUS TRUST | KRANSPAN 49 | 3 | 07-Dec-18 | E-mail | 07-Jan-19 |
| Klein | Gysbert Samuel | PRIVATE LANDOWNER | KRANSPAN 49 | 4 | 07-Dec-18 | SMS / Post | 07-Jan-19 |
| Prinsloo | Rudi | ROODEBLOEM TRUST | KRANSPAN 49 | 5 | 07-Dec-18 | E-mail | 07-Jan-19 |
| Papenfus | Kobus | CMJ PAPENFUS TRUST | KRANSPAN 49 | 6 | 07-Dec-18 | E-mail | 07-Jan-19 |
| Papenfus | Kobus | CMJ PAPENFUS TRUST | KRANSPAN 49 | 7 | 07-Dec-18 | E-mail | 07-Jan-19 |
| Jordaan | Koos | BAADTJIESBULT BOERDERY PTY LTD | KRANSPAN 49 | 8 | 07-Dec-18 | E-mail | 07-Jan-19 |
| | | | | | | | |
| **Occupiers of the Site (Within the Mining Rights Area Boundary)** | | | | | | | |
| Marais | Frans | Private - Lessee | KRANSPAN 49 | 4 | 07-Dec-18 | E-mail | 07-Jan-19 |
| Prinsloo | Rudi | ROODEBLOEM TRUST | KRANSPAN 49 | 8 | 07-Dec-18 | E-mail | 07-Jan-19 |
| Jordaan | Koos | BAADTJIESBULT BOERDERY PTY LTD | KRANSPAN 49 | 1 | 07-Dec-18 | E-mail | 07-Jan-19 |
| | | | | | | | 07-Jan-19 |
| **Adjacent Landowners (Landowners Surrounding the MRA Boundary)** | | | | | | | |
| Swart | Dirk | NORTHERN COAL PTY LTD | ROETZ 210 | RE | 07-Dec-18 | E-mail | 07-Jan-19 |
| Swart | Dirk | NORTHERN COAL PTY LTD | JAGTLUST 47 | 1 | 07-Dec-18 | E-mail | 07-Jan-19 |
| Swart | Dirk | NORTHERN COAL PTY LTD | JAGTLUST 47 | RE | 07-Dec-18 | E-mail | 07-Jan-19 |
| Gangazhe | Mashudu | MSOBO COAL PTY LTD | VERKEERDEPAN 50 | 1 | 07-Dec-18 | E-mail | 07-Jan-19 |
| Gangazhe | Mashudu | MSOBO COAL PTY LTD | VERKEERDEPAN 50 | RE | 07-Dec-18 | E-mail | 07-Jan-19 |
| Gangazhe | Mashudu | MSOBO COAL PTY LTD | VERKEERDEPAN 50 | 2 | 07-Dec-18 | E-mail | 07-Jan-19 |
| Gangazhe | Mashudu | MSOBO COAL PTY LTD | VERKEERDEPAN 50 | 6 | 07-Dec-18 | E-mail | 07-Jan-19 |
| Gangazhe | Mashudu | MSOBO COAL PTY LTD | VERKEERDEPAN 50 | 7 | 07-Dec-18 | E-mail | 07-Jan-19 |
| Nkosi | Job | PRIVATE LANDOWNER | WITRAND 52 | 4 | 07-Dec-18 | SMS / Post | 07-Jan-19 |
| Nkosi | Rosina Mango | PRIVATE LANDOWNER | WITRAND 52 | 4 | 07-Dec-18 | SMS / Post | 07-Jan-19 |
| Booi | Sibongile | INGWE SURFACE HOLDINGS LTD (SOUTH32) | ROODEBLOEM 51 | 1 | 07-Dec-18 | E-mail | 07-Jan-19 |
| Jordaan | Koos | NAVIDU INV 10 CC | VAALBANK 212 | 1 | 07-Dec-18 | E-mail | 07-Jan-19 |
| Lukele | Christina | SIYATHUTHUKA CPA | VAALBANK 212 | RE | 07-Dec-18 | SMS | 07-Jan-19 |
| Prinsloo | Rudi | ROODEBLOEM TRUST | VAALBANK 212 | 8 | 07-Dec-18 | E-mail | 07-Jan-19 |
| Papenfus Trust | Jacobus | CMJ PAPENFUS TRUST | WITBANK 209 | RE | 07-Dec-18 | E-mail | 07-Jan-19 |
| Klein | Gysbert Samuel | NOVA TRUST | NAUDESBANK 172 | 14 | 07-Dec-18 | SMS / Post | 07-Jan-19 |
| Klein | Gysbert Samuel | NOVA TRUST | NAUDESBANK 172 | 6 | 07-Dec-18 | SMS / Post | 07-Jan-19 |
| | | | | | | | |
| **Municipal Councillors** | | | | | | | |
| Nkosi | Velepi | Ward Councillor: Ward 21 | | | 07-Dec-18 | E-mail | 07-Jan-19 |
| | | | | | | | |
| | | | | | | | |
| **Local and District Municipality** | | | | | | | |
| Nkosi | Paulos | Albert Luthuli Local Municipality | | | 07-Dec-18 | E-mail | 07-Jan-19 |
| Mavumbela | Lovedale | Albert Luthuli Local Municipality | | | 07-Dec-18 | E-mail | 07-Jan-19 |
| - | Molly | Albert Luthuli Local Municipality: Electricity | | | 07-Dec-18 | E-mail | 07-Jan-19 |
| Nkosi | D | Albert Luthuli Local Municipality: Mayor | | | 07-Dec-18 | E-mail | 07-Jan-19 |
| - | Mbuso | Albert Luthuli Local Municipality: Roads | | | 07-Dec-18 | E-mail | 07-Jan-19 |
| DM | Modimogale | Albert Luthuli Local Municipality: Service Delivery | | | 07-Dec-18 | E-mail | 07-Jan-19 |
| Gumede | ME | Albert Luthuli Local Municipality: Water | | | 07-Dec-18 | E-mail | 07-Jan-19 |
| Chirwa | MG | Gert Sibande District Municipality: Mayor | | | 07-Dec-18 | E-mail | 07-Jan-19 |
| B | Phiwe | Gert Sibande District Municipality: Roads | | | 07-Dec-18 | E-mail | 07-Jan-19 |
| T | Ephraim | Gert Sibande District Municipality: Service Delivery | | | 07-Dec-18 | E-mail | 07-Jan-19 |
| P | Tshidi | Gert Sibande District Municipality: Water | | | 07-Dec-18 | E-mail | 07-Jan-19 |

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| **Organs of State with Jurisdiction** | | | | | | | |
| Venter | Jan | Department of Agriculture: Land Use and Soil Management | | | 07-Dec-18 | E-mail | 07-Jan-19 |
| Sekgetho | Seapei | Department of Mineral Resources DDMLA | | | 07-Dec-18 | E-mail | 07-Jan-19 |
| Tshivhandekano | Aubrey | Department of Mineral Resources: Regional Manager | | | 07-Dec-18 | E-mail | 07-Jan-19 |
| Netshikweta | Herbert | Department of Mineral Resources Senior Inspector | | | 07-Dec-18 | E-mail | 07-Jan-19 |
| Mokonyane | Martha | Department of Mineral Resources: Emalahleni | | | 07-Dec-18 | E-mail | 07-Jan-19 |
| Mutengwe | Mashudu | Department of Mineral Resources: Emalahleni | | | 07-Dec-18 | E-mail | 07-Jan-19 |
| Ratsela | Matshilele | Department of Mineral Resources: Emalahleni | | | 07-Dec-18 | E-mail | 07-Jan-19 |
| Mathavhela | Sam | Department of Mineral Resources: Pretoria - Environment Authorisations: Mpumalanga | | | 07-Dec-18 | E-mail | 07-Jan-19 |
| Mfeka | Nonqubeko | Department of Rural Development and Land Reform | | | 07-Dec-18 | E-mail | 07-Jan-19 |
| Masuku | Lazarus | Department of Rural Development and Land Reform | | | 07-Dec-18 | E-mail | 07-Jan-19 |
| Mlomo | Bongani | Department of Rural Development and Land Reform | | | 07-Dec-18 | E-mail | 07-Jan-19 |
| Ratlhagane Simon | Mabuse | Department of Rural Development and Land Reform | | | 07-Dec-18 | E-mail | 07-Jan-19 |
| Ledwaba Christa | Mokgaetji | Department of Rural Development and Land Reform | | | 07-Dec-18 | E-mail | 07-Jan-19 |
| Mathabe | Thato | Department of Rural Development and Land Reform | | | 07-Dec-18 | E-mail | 07-Jan-19 |
| Makeke | Theledi | Department of Rural Development and Land Reform (Mpumalanga) | | | 07-Dec-18 | E-mail | 07-Jan-19 |
| Mushwana | Rose | Department of Rural Development and Land Reform (Mpumalanga) | | | 07-Dec-18 | E-mail | 07-Jan-19 |
| Khoza | Vusi | Department of Rural Development and Land Reform (Mpumalanga) | | | 07-Dec-18 | E-mail | 07-Jan-19 |
| Mulaudzi | Masala | Department of Water and Sanitation | | | 07-Dec-18 | E-mail | 07-Jan-19 |
| van Aswegen | Johan | Department of Water and Sanitation | | | 07-Dec-18 | E-mail | 07-Jan-19 |
| Maliaga | Simon | Department of Water and Sanitation (Bronkhorstspruit) | | | 07-Dec-18 | E-mail | 07-Jan-19 |
| Mare | Charmaine | Eskom Holdings SOC LTD | | | 07-Dec-18 | E-mail | 07-Jan-19 |
| Muswubi | Mpho | Eskom Transmission Land and Rights Mpumalanga | | | 07-Dec-18 | E-mail | 07-Jan-19 |
| Rasiuba | Thabo | Inkomati Usuthu Catchment Management Agency (IUCMA) | | | 07-Dec-18 | E-mail | 07-Jan-19 |
| Dzhangi | Thandi | Inkomati Usuthu Catchment Management Agency (IUCMA) | | | 07-Dec-18 | E-mail | 07-Jan-19 |
| Marebane | S | Mpumalanga Department of Agriculture, Rural Development, Land and Environmental Affairs | | | 07-Dec-18 | E-mail | 07-Jan-19 |
| Nyathikazi | Bheki | Mpumalanga Department of Agriculture, Rural Development, Land and Environmental Affairs | | | 07-Dec-18 | E-mail | 07-Jan-19 |
| de Lange | A | Mpumalanga Department of Agriculture, Rural Development, Land and Environmental Affairs | | | 07-Dec-18 | E-mail | 07-Jan-19 |
| Nkambule | Ntokozo | Mpumalanga Department of Agriculture, Rural Development, Land and Environmental Affairs | | | 07-Dec-18 | E-mail | 07-Jan-19 |
| Xulu | SP | Mpumalanga Department of Agriculture, Rural Development, Land and Environmental Affairs: HoD | | | 07-Dec-18 | E-mail | 07-Jan-19 |
| Mthombothi | W | Mpumalanga Department of Community Safety, Security and Liason: HoD | | | 07-Dec-18 | E-mail | 07-Jan-19 |
| Chunda | C | Mpumalanga Department of Co-Operative Governance and Traditional Affairs: HoD | | | 07-Dec-18 | E-mail | 07-Jan-19 |
| Mnisi | SW | Mpumalanga Department of Culture, Sports and Recreation: HoD | | | 07-Dec-18 | E-mail | 07-Jan-19 |
| Nxumalo | Tinyiko | Mpumalanga Department of Economic Development and Tourism | | | | | |
| Nkosi | Prudence | Mpumalanga Department of Economic Development and Tourism | | | | | |
| Mkhize | MW | Mpumalanga Department of Economic Development and Tourism | | | 07-Dec-18 | E-mail | 07-Jan-19 |
| Sebitso | N | Mpumalanga Department of Economic Development and Tourism | | | 07-Dec-18 | E-mail | 07-Jan-19 |
| Thobela | M | Mpumalanga Department of Economic Development and Tourism | | | 07-Dec-18 | E-mail | 07-Jan-19 |
| Mdluli | JD | Mpumalanga Department of Economic Development and Tourism | | | 07-Dec-18 | E-mail | 07-Jan-19 |
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|---|---|---|---|---|---|---|---|
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| | | | | | | | |
| **Other** | | | | | | | |
| Stols | Nico | Mine Manager Msobo | | | 07-Dec-18 | E-mail | 07-Jan-19 |
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| | | | | | | | |

## APPENDIX 7: IMPACT ASSESSMENT MATRIX

| GEOLOGY | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Project Activity | Geology | | Likelihood | | Consequence | | | Significance Rating |
| Clearing of Areas for Site Access, Infrastructure Siting, Mining of Open Pit | Phase of Project | Operational | Frequency of Activity | Frequency of Impact | Severity | Spatial Scope | Duration | |
| | Impact Classification | Negative - Direct Impact | Significance Pre-Mitigation | | | | | |
| | Resulting Impact from Activity | Sterilisation of mineral resources | 5 | 4 | 4 | 3 | 4 | 99 |
| | | | Significance Post- Mitigation | | | | | |
| | | | 2 | 1 | 1 | 2 | 5 | 24 |

| TOPOGRAPHY | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Project Activity | Topography | | Likelihood | | Consequence | | | Significance Rating |
| Clearing of Areas for Site Access, Infrastructure Siting, Mining of Open Pit and Development Surface Discard Stockpile | Phase of Project | Operational to Post Closure Phases | Frequency of Activity | Frequency of Impact | Severity | Spatial Scope | Duration | |
| | Impact Classification | Negative - Direct impact & residual | Significance Pre-Mitigation | | | | | |
| | Resulting Impact from Activity | Permanent, localised change in topography due to the development of the open pit and mine residue deposits | 5 | 5 | 2 | 1 | 4 | 70 |
| | | | Significance Post- Mitigation | | | | | |
| | | | 5 | 2 | 2 | 1 | 4 | 49 |

| SOILS | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Project Activity | Soils | | Likelihood | | Consequence | | | Significance Rating |
| All construction phase activities | Phase of Project | Construction Phase | Frequency of Activity | Frequency of Impact | Severity | Spatial Scope | Duration | |
| | Impact Classification | Negative - Direct Impact | Significance Pre-Mitigation | | | | | |
| | Resulting Impact from Activity | Loss of Soil Utilisation - removal from system | 4 | 5 | 5 | 3 | 4 | 108 |
| | | | Significance Post-Mitigation | | | | | |
| | | | 4 | 4 | 3 | 1 | 4 | 64 |
| Project Activity | Soils | | Likelihood | | Consequence | | | |
| All construction phase activities | Phase of Project | Construction Phase | Frequency of Activity | Frequency of Impact | Severity | Spatial Scope | Duration | Significance Rating |
| | Impact Classification | Negative - Direct Impact | Significance Pre-Mitigation | | | | | |
| | Resulting Impact from Activity | Loss of Soil Utilisation - Erosion and Compaction | 4 | 4 | 3 | 2 | 4 | 72 |
| | | | Significance Post-Mitigation | | | | | |
| | | | 4 | 3 | 3 | 1 | 4 | 56 |
| Project Activity | | Soils | Likelihood | | Consequence | | | |
| All construction phase activities | Phase of Project | Construction Phase | Frequency of Activity | Frequency of Impact | Severity | Spatial Scope | Duration | Significance Rating |
| | Impact Classification | Negative - Cumulative Impact | Significance Pre-Mitigation | | | | | |
| | Resulting Impact from Activity | Loss of Soil Utilisation - Product and Hydrocarbon Spills | 4 | 4 | 4 | 3 | 4 | 88 |
| | | | Significance Post-Mitigation | | | | | |
| | | | 4 | 3 | 3 | 1 | 4 | 56 |

| Project Activity | Soils | | Likelihood | | Consequence | | | Significance Rating |
|---|---|---|---|---|---|---|---|---|
| Ineffective Housekeeping and Management of Stockpiles and Exposed Soils | Phase of Project | Operational Phases | Frequency of Activity | Frequency of Impact | Severity | Spatial Scope | Duration | |
| | Impact Classification | Negative - Direct Impact | Significance Pre-Mitigation | | | | | |
| | Resulting Impact from Activity | Loss of Soil Utilisation - Open cast Mining | 4 | 5 | 5 | 3 | 4 | 108 |
| | | | Significance Post-Mitigation | | | | | |
| | | | 4 | 4 | 3 | 2 | 4 | 72 |
| Project Activity | Soils | | Likelihood | | Consequence | | | |
| Ineffective Housekeeping and Management of Stockpiles and Exposed Soils | Phase of Project | Operational Phases | Frequency of Activity | Frequency of Impact | Severity | Spatial Scope | Duration | Significance Rating |
| | Impact Classification | Negative - Direct Impact | Significance Pre-Mitigation | | | | | |
| | Resulting Impact from Activity | Contamination due to Product and Hydrocarbon Spills | 4 | 4 | 4 | 3 | 4 | 88 |
| | | | Significance Post-Mitigation | | | | | |
| | | | 3 | 3 | 3 | 2 | 2 | 42 |

| Project Activity | | Soils | Likelihood | | Consequence | | | |
|---|---|---|---|---|---|---|---|---|
| Ineffective Housekeeping and Management of Stockpiles and Exposed Soils | Phase of Project | Operational Phases | Frequency of Activity | Frequency of Impact | Severity | Spatial Scope | Duration | Significance Rating |
| | Impact Classification | Negative - Direct Impact | Significance Pre-Mitigation | | | | | |
| | Resulting Impact from Activity | Loss of soil Utilisation due to Infrastructure - Dumps, stockpiles etc. | 5 | 5 | 5 | 3 | 4 | 120 |
| | | | Significance Post-Mitigation | | | | | |
| | | | 5 | 4 | 3 | 2 | 3 | 72 |
| Project Activity | Soils | | Likelihood | | Consequence | | | |
| Continued Activities including Mining and Transportation | Phase of Project | Operational Phases | Frequency of Activity | Frequency of Impact | Severity | Spatial Scope | Duration | Significance Rating |
| | Impact Classification | Negative - Direct Impact | Significance Pre-Mitigation | | | | | |
| | Resulting Impact from Activity | Erosion and Compaction - wind, water and vehicle movement | 4 | 5 | 3 | 3 | 3 | 81 |
| | | | Significance Post-Mitigation | | | | | |
| | | | 4 | 3 | 3 | 2 | 3 | 56 |
| Project Activity | | Soils | Likelihood | | Consequence | | | |
| Continued Activities including Concurrent Rehabilitation and Closure | Phase of Project | Decommissioning & Closure | Frequency of Activity | Frequency of Impact | Severity | Spatial Scope | Duration | Significance Rating |
| | Impact Classification | Negative - Cumulative Impact | Significance Pre-Mitigation | | | | | |
| | Resulting Impact from Activity | Loss of soil Nutrient Pool | 4 | 5 | 4 | 3 | 4 | 99 |
| | | | Significance Post-Mitigation | | | | | |
| | | | 4 | 3 | 3 | 2 | 3 | 56 |

| Project Activity | Soils | | Likelihood | | Consequence | | | |
|---|---|---|---|---|---|---|---|---|
| Continued Activities including Concurrent Rehabilitation and Closure | Phase of Project | Decommissioning & Closure | Frequency of Activity | Frequency of Impact | Severity | Spatial Scope | Duration | Significance Rating |
| | Impact Classification | Negative - Cumulative Impact | Significance Pre-Mitigation | | | | | |
| | Resulting Impact from Activity | Compaction from vehicle movement during material replacement | 4 | 5 | 3 | 3 | 4 | 90 |
| | | | Significance Post-Mitigation | | | | | |
| | | | 4 | 3 | 3 | 2 | 3 | 56 |
| Project Activity | | Soils | Likelihood | | Consequence | | | |
| Continued Activities including Concurrent Rehabilitation and Closure | Phase of Project | Decommissioning & Closure | Frequency of Activity | Frequency of Impact | Severity | Spatial Scope | Duration | Significance Rating |
| | Impact Classification | Negative - Cumulative Impact | Significance Pre-Mitigation | | | | | |
| | Resulting Impact from Activity | Contamination by dirty water and hydrocarbon spills | 4 | 4 | 4 | 2 | 3 | 72 |
| | | | Significance Post-Mitigation | | | | | |
| | | | 4 | 3 | 3 | 1 | 3 | 49 |
| Project Activity | | Soils | Likelihood | | Consequence | | | |
| Continued Activities including Concurrent Rehabilitation and Closure | Phase of Project | Decommissioning & Closure | Frequency of Activity | Frequency of Impact | Severity | Spatial Scope | Duration | Significance Rating |
| | Impact Classification | Positive - Cumulative Impact | Significance Pre-Mitigation | | | | | |
| | Resulting Impact from Activity | Reduction in area of impact and return of soil utilisation potential | 2 | 3 | 3 | 3 | 3 | 45 |
| | | | Significance Post-Mitigation | | | | | |
| | | | 4 | 3 | 3 | 2 | 3 | 56 |

<table>
<tr><th colspan="9"><u>LAND CAPABILITY AND LAND USE</u></th></tr>
<tr><td>Project Activity</td><td colspan="2">Land Capability & Land Use</td><td colspan="2">Likelihood</td><td colspan="3">Consequence</td><td rowspan="2">Significance Rating</td></tr>
<tr><td rowspan="5">Stripping of Soils, Clearing of Vegetation and Stockpiling of Materials</td><td>Phase of Project</td><td>Preparation, Construction and Operational Phases</td><td>Frequency of Activity</td><td>Frequency of Impact</td><td>Severity</td><td>Spatial Scope</td><td>Duration</td></tr>
<tr><td>Impact Classification</td><td>Negative - Secondary Impact</td><td colspan="6">Significance Pre-Mitigation</td></tr>
<tr><td rowspan="3">Resulting Impact from Activity</td><td rowspan="3">Disturbance/Loss/Sterilisation of Inherent Land Capability and Land Use</td><td>4</td><td>5</td><td>3</td><td>3</td><td>4</td><td>90</td></tr>
<tr><td colspan="6">Significance Post-Mitigation</td></tr>
<tr><td>4</td><td>4</td><td>3</td><td>3</td><td>4</td><td>44</td></tr>
<tr><td>Project Activity</td><td colspan="2">Land Capability & Land Use</td><td colspan="2">Likelihood</td><td colspan="3">Consequence</td><td rowspan="2">Significance Rating</td></tr>
<tr><td rowspan="5">Continuous Clearing, Disturbance, Laydown, Stockpiling and Transportation</td><td>Phase of Project</td><td>Preparation - Post-Closure Phases</td><td>Frequency of Activity</td><td>Frequency of Impact</td><td>Severity</td><td>Spatial Scope</td><td>Duration</td></tr>
<tr><td>Impact Classification</td><td>Negative - Cumulative Impact</td><td colspan="6">Significance Pre-Mitigation</td></tr>
<tr><td rowspan="3">Resulting Impact from Activity</td><td rowspan="3">Loss of Land Services, Ecosystem Support and Services</td><td>4</td><td>5</td><td>3</td><td>3</td><td>3</td><td>81</td></tr>
<tr><td colspan="6">Significance Post-Mitigation</td></tr>
<tr><td>4</td><td>3</td><td>2</td><td>2</td><td>3</td><td>49</td></tr>
</table>

<table>
<tr><td colspan="9"><u>AIR QUALITY</u></td></tr>
<tr><td>Project Activity</td><td colspan="2">Air Quality</td><td colspan="2">Likelihood</td><td colspan="3">Consequence</td><td rowspan="2">Significance Rating</td></tr>
<tr><td rowspan="5">Elevated PM10 and PM2.5 Concentrations as a Result of mining Activities</td><td>Phase of Project</td><td>Operational Phase-Scenario 1,2,3 and 4</td><td>Frequency of Activity</td><td>Frequency of Impact</td><td>Severity</td><td>Spatial Scope</td><td>Duration</td></tr>
<tr><td>Impact Classification</td><td>Negative -Direct Impact</td><td colspan="6">Significance Pre-Mitigation</td></tr>
<tr><td rowspan="3">Resulting Impact from Activity</td><td rowspan="3">Elevated PM10 and PM2.5 Concentrations</td><td>4</td><td>5</td><td>4</td><td>3</td><td>3</td><td>90</td></tr>
<tr><td colspan="6">Significance Post- Mitigation</td></tr>
<tr><td>4</td><td>4</td><td>3</td><td>3</td><td>3</td><td>72</td></tr>
<tr><td>Project Activity</td><td colspan="2">Air Quality</td><td colspan="2">Likelihood</td><td colspan="3">Consequence</td><td rowspan="2">Significance Rating</td></tr>
<tr><td rowspan="5">Dust Fall due to Mining and transportation</td><td>Phase of Project</td><td>Operational Phase-Scenario 1,2,3 and 4</td><td>Frequency of Activity</td><td>Frequency of Impact</td><td>Severity</td><td>Spatial Scope</td><td>Duration</td></tr>
<tr><td>Impact Classification</td><td>Negative- Direct Impact</td><td colspan="6">Significance Pre-Mitigation</td></tr>
<tr><td rowspan="3">Resulting Impact from Activity</td><td rowspan="3">Elevated Dust Fall Levels</td><td>4</td><td>5</td><td>3</td><td>2</td><td>3</td><td>72</td></tr>
<tr><td colspan="6">Significance Post- Mitigation</td></tr>
<tr><td>4</td><td>4</td><td>2</td><td>2</td><td>3</td><td>56</td></tr>
</table>

NOISE

| Project Activity | Noise | | Likelihood | | Consequence | | | Significance Rating |
|---|---|---|---|---|---|---|---|---|
| All construction activities | Phase of Project | Construction | Frequency of Activity | Frequency of Impact | Severity | Spatial Scope | Duration | |
| | Impact Classification | Negative - Direct Impact | Significance Pre-Mitigation | | | | | |
| | Resulting Impact from Activity | Elevated Noise Levels | 4 | 4 | 3 | 3 | 3 | 72 |
| | | | Significance Post- Mitigation | | | | | |
| | | | 4 | 3 | 3 | 2 | 3 | 56 |
| Project Activity | Noise | | Likelihood | | Consequence | | | Significance Rating |
| Blasting, mining operations, construction of surface infrastructure, haulage | Phase of Project | Operational | Frequency of Activity | Frequency of Impact | Severity | Spatial Scope | Duration | |
| | Impact Classification | Negative - Direct Impact | Significance Pre-Mitigation | | | | | |
| | Resulting Impact from Activity | Elevated Noise Levels | 4 | 4 | 3 | 3 | 4 | 80 |
| | | | Significance Post- Mitigation | | | | | |
| | | | 4 | 3 | 3 | 2 | 4 | 63 |

| Project Activity | Noise | | Likelihood | | Consequence | | | Significance Rating |
|---|---|---|---|---|---|---|---|---|
| All closure activities | Phase of Project | Decommissioning & Post-Closure | Frequency of Activity | Frequency of Impact | Severity | Spatial Scope | Duration | |
| | Impact Classification | Negative - Direct Impact | Significance Pre-Mitigation | | | | | |
| | Resulting Impact from Activity | Elevated Noise Levels | 4 | 4 | 3 | 3 | 3 | 72 |
| | | | Significance Post- Mitigation | | | | | |
| | | | 4 | 3 | 3 | 2 | 3 | 56 |
| GROUNDWATER | | | | | | | | |
| Project Activity | Geohydrology | | Likelihood | | Consequence | | | Significance Rating |
| Lowering of groundwater levels as a result of mine dewatering | Phase of Project | Operational | Frequency of Activity | Frequency of Impact | Severity | Spatial Scope | Duration | |
| | Impact Classification | Negative - Direct Impact | Significance Pre-Mitigation | | | | | |
| | Resulting Impact from Activity | Lowering of groundwater levels in private boreholes, thus affecting the performance of the boreholes that fall within the dewatering cone | 4 | 4 | 3 | 3 | 4 | 80 |
| | | | Significance Post- Mitigation | | | | | |
| | | | 4 | 4 | 2 | 2 | 4 | 64 |
| Project Activity | Geohydrology | | Likelihood | | Consequence | | | Significance Rating |
| Spread of contamination from underground and opencast mining areas | Phase of Project | Operational | Frequency of Activity | Frequency of Impact | Severity | Spatial Scope | Duration | |
| | Impact Classification | Negative - Direct Impact | Significance Pre-Mitigation | | | | | |
| | Resulting Impact from Activity | Contamination of groundwater in private boreholes, making the groundwater unfit for use | 4 | 4 | 3 | 3 | 5 | 88 |
| | | | Significance Post- Mitigation | | | | | |
| | | | 4 | 4 | 2 | 2 | 5 | 72 |

| Project Activity | Geohydrology | | Likelihood | | Consequence | | | Significance Rating |
|---|---|---|---|---|---|---|---|---|
| Spread of contamination from the surface discard stockpile | Phase of Project | Operational | Frequency of Activity | Frequency of Impact | Severity | Spatial Scope | Duration | |
| | Impact Classification | Negative - Direct Impact | Significance Pre-Mitigation | | | | | |
| | Resulting Impact from Activity | Contamination of groundwater in private boreholes, making the groundwater unfit for use | 4 | 4 | 4 | 2 | 5 | 88 |
| | | | Significance Post- Mitigation | | | | | |
| | | | 4 | 2 | 3 | 2 | 5 | 60 |

| Project Activity | Geohydrology | | Likelihood | | Consequence | | | Significance Rating |
|---|---|---|---|---|---|---|---|---|
| Spread of contamination from the pit backfilled with discard | Phase of Project | Decommissioning & Closure | Frequency of Activity | Frequency of Impact | Severity | Spatial Scope | Duration | |
| | Impact Classification | Negative - Direct Impact | Significance Pre-Mitigation | | | | | |
| | Resulting Impact from Activity | Contamination of groundwater in private boreholes, making the groundwater unfit for use | 4 | 4 | 4 | 2 | 5 | 88 |
| | | | Significance Post- Mitigation | | | | | |
| | | | 4 | 2 | 2 | 2 | 5 | 54 |

<table>
<tr><th colspan="9"><u>FLORA</u></th></tr>
<tr><td>Project Activity</td><td colspan="2">Flora</td><td colspan="2">Likelihood</td><td colspan="3">Consequence</td><td rowspan="2">Significance Rating</td></tr>
<tr><td rowspan="5">Clearing of Vegetation for Site Access, Infrastructure Siting and Mining of Open Pit</td><td>Phase of Project</td><td>Preparation, Construction and Operational Phases</td><td>Frequency of Activity</td><td>Frequency of Impact</td><td>Severity</td><td>Spatial Scope</td><td>Duration</td></tr>
<tr><td>Impact Classification</td><td>Negative- Direct Impact</td><td colspan="6">Significance Pre-Mitigation</td></tr>
<tr><td rowspan="3">Resulting Impact from Activity</td><td rowspan="3">Loss of Natural Habitat of High or Medium-High Ecological Sensitivity</td><td>5</td><td>5</td><td>5</td><td>2</td><td>5</td><td>120</td></tr>
<tr><td colspan="6">Significance Post-Mitigation</td></tr>
<tr><td>5</td><td>5</td><td>2</td><td>2</td><td>5</td><td>90</td></tr>
<tr><td>Project Activity</td><td colspan="2">Flora</td><td colspan="2">Likelihood</td><td colspan="3">Consequence</td><td rowspan="2">Significance Rating</td></tr>
<tr><td rowspan="5">Clearing of Vegetation for Site Access and Infrastructure, Vehicle Activity along Haul Roads</td><td>Phase of Project</td><td>Preparation, Construction and Operational Phases</td><td>Frequency of Activity</td><td>Frequency of Impact</td><td>Severity</td><td>Spatial Scope</td><td>Duration</td></tr>
<tr><td>Impact Classification</td><td>Negative- Direct Impact</td><td colspan="6">Significance Pre-Mitigation</td></tr>
<tr><td rowspan="3">Resulting Impact from Activity</td><td rowspan="3">Introduction/proliferation of alien invasive species</td><td>4</td><td>4</td><td>4</td><td>4</td><td>5</td><td>104</td></tr>
<tr><td colspan="6">Significance Post-Mitigation</td></tr>
<tr><td>4</td><td>4</td><td>2</td><td>2</td><td>5</td><td>72</td></tr>
<tr><td>Project Activity</td><td colspan="2">Flora</td><td colspan="2">Likelihood</td><td colspan="3">Consequence</td><td rowspan="2">Significance Rating</td></tr>
<tr><td rowspan="5">All staff activities that take place outdoors</td><td>Phase of Project</td><td>Preparation, Construction and Operational Phases</td><td>Frequency of Activity</td><td>Frequency of Impact</td><td>Severity</td><td>Spatial Scope</td><td>Duration</td></tr>
<tr><td>Impact Classification</td><td>Negative- Direct Impact</td><td colspan="6">Significance Pre-Mitigation</td></tr>
<tr><td rowspan="3">Resulting Impact from Activity</td><td rowspan="3">Increased utilisation of plant resources as a result of an influx of people into the study area</td><td>3</td><td>3</td><td>2</td><td>3</td><td>5</td><td>60</td></tr>
<tr><td colspan="6">Significance Post-Mitigation</td></tr>
<tr><td>2</td><td>2</td><td>1</td><td>2</td><td>4</td><td>28</td></tr>
</table>

<u>FAUNA</u>

| Project Activity | Fauna | | Likelihood | | Consequence | | | Significance Rating |
|---|---|---|---|---|---|---|---|---|
| Clearing of Vegetation for Site Access, Infrastructure Siting and Mining of Open Pit | Phase of Project | Preparation - Closure Phase | Frequency of Activity | Frequency of Impact | Severity | Spatial Scope | Duration | |
| | Impact Classification | Negative - Direct Impact | Significance Pre-Mitigation | | | | | |
| | Resulting Impact from Activity | Disturbance/loss of threatened faunal habitat and associated Species of Conservation Concern | 5 | 5 | 5 | 2 | 5 | 120 |
| | | | Significance Post-Mitigation | | | | | |
| | | | 5 | 5 | 2 | 2 | 5 | 90 |
| Project Activity | Fauna | | Likelihood | | Consequence | | | Significance Rating |
| All staff activities that take place outdoors | Phase of Project | Preparation - Closure Phases | Frequency of Activity | Frequency of Impact | Severity | Spatial Scope | Duration | |
| | Impact Classification | Negative - Secondary Impact | Significance Pre-Mitigation | | | | | |
| | Resulting Impact from Activity | Illegal utilisation of animal resources as a result of an influx of people into the study area | 3 | 3 | 4 | 3 | 5 | 72 |
| | | | Significance Post-Mitigation | | | | | |
| | | | 2 | 2 | 2 | 3 | 5 | 40 |

| CULTURAL HERITAGE | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Project Activity | Cultural Heritage (Archaeology and Palaeontology) | | Likelihood | | Consequence | | | Significance Rating |
| Construction & Operation (Clearing, Mining, Stockpiling, Transportation) | Phase of Project | Preparation - Closure Phase | Frequency of Activity | Frequency of Impact | Severity | Spatial Scope | Duration | |
| | Impact Classification | Negative - Direct Impact | Significance Pre-Mitigation | | | | | |
| | Resulting Impact from Activity | Disturbance/Loss of Significant Archaeological or Cultural Heritage Sites | 2 | 2 | 4 | 2 | 5 | 44 |
| | | | Significance Post-Mitigation | | | | | |
| | | | 2 | 1 | 2 | 1 | 5 | 24 |

| SOCIO-ECONOMIC | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Project Activity | Socio-Economic | | Likelihood | | Consequence | | | Significance Rating |
| All activities involving employment and procurement of goods and services | Phase of Project | All | Frequency of Activity | Frequency of Impact | Severity | Spatial Scope | Duration | |
| | Impact Classification | Positive - Direct and indirect | Significance Pre-Mitigation | | | | | |
| | Resulting Impact from Activity | Local employment | 4 | 4 | 4 | 3 | 4 | 88 |
| | | | Significance Post- Mitigation | | | | | |
| | | | 4 | 5 | 5 | 3 | 4 | 108 |

| Project Activity | Socio-Economic | | Likelihood | | Consequence | | | Significance Rating |
|---|---|---|---|---|---|---|---|---|
| All activities involving employment and procurement of goods and services | Phase of Project | All | Frequency of Activity | Frequency of Impact | Severity | Spatial Scope | Duration | |
| | Impact Classification | Positive - Direct and indirect | Significance Pre-Mitigation | | | | | |
| | Resulting Impact from Activity | Local economic development | 3 | 4 | 4 | 3 | 4 | 77 |
| | | | Significance Post- Mitigation | | | | | |
| | | | 3 | 5 | 5 | 3 | 4 | 96 |

| Project Activity | Socio-Economic | | Likelihood | | Consequence | | | Significance Rating |
|---|---|---|---|---|---|---|---|---|
| All activities involving employment and procurement of goods and services | Phase of Project | All | Frequency of Activity | Frequency of Impact | Severity | Spatial Scope | Duration | |
| | Impact Classification | Positive - Direct and indirect | Significance Pre-Mitigation | | | | | |
| | Resulting Impact from Activity | Training and development | 5 | 4 | 3 | 3 | 5 | 99 |
| | | | Significance Post- Mitigation | | | | | |
| | | | 5 | 5 | 4 | 3 | 5 | 120 |

| Project Activity | Socio-Economic | | Likelihood | | Consequence | | | Significance Rating |
|---|---|---|---|---|---|---|---|---|
| All activities involving employment and procurement of goods and services | Phase of Project | All | Frequency of Activity | Frequency of Impact | Severity | Spatial Scope | Duration | |
| | Impact Classification | Negative - Direct and indirect | Significance Pre-Mitigation | | | | | |
| | Resulting Impact from Activity | Influx of job seekers - demand on municipal services | 3 | 5 | 3 | 3 | 3 | 72 |
| | | | Significance Post- Mitigation | | | | | |
| | | | 3 | 4 | 3 | 3 | 2 | 56 |

<table>
<tr><td>Project Activity</td><td colspan="2">Socio-Economic</td><td colspan="2">Likelihood</td><td colspan="3">Consequence</td><td rowspan="2">Significance Rating</td></tr>
<tr><td rowspan="5">All activities involving employment and procurement of goods and services</td><td>Phase of Project</td><td>All</td><td>Frequency of Activity</td><td>Frequency of Impact</td><td>Severity</td><td>Spatial Scope</td><td>Duration</td></tr>
<tr><td>Impact Classification</td><td>Negative - Direct and indirect</td><td colspan="6">Significance Pre-Mitigation</td></tr>
<tr><td rowspan="3">Resulting Impact from Activity</td><td rowspan="3">Influx of job seekers - disruption in community dynamics</td><td>3</td><td>5</td><td>4</td><td>3</td><td>3</td><td>80</td></tr>
<tr><td colspan="6">Significance Post- Mitigation</td></tr>
<tr><td>3</td><td>4</td><td>3</td><td>3</td><td>2</td><td>56</td></tr>
<tr><td>Project Activity</td><td colspan="2">Socio-economic</td><td colspan="2">Likelihood</td><td colspan="3">Consequence</td><td rowspan="2">Significance Rating</td></tr>
<tr><td rowspan="5">All mine-related activities</td><td>Phase of Project</td><td>All</td><td>Frequency of Activity</td><td>Frequency of Impact</td><td>Severity</td><td>Spatial Scope</td><td>Duration</td></tr>
<tr><td>Impact Classification</td><td>Negative - Direct</td><td colspan="6">Significance Pre-Mitigation</td></tr>
<tr><td rowspan="3">Resulting Impact from Activity</td><td rowspan="3">Mine health and safety</td><td>4</td><td>5</td><td>5</td><td>3</td><td>4</td><td>108</td></tr>
<tr><td colspan="6">Significance Post- Mitigation</td></tr>
<tr><td>3</td><td>3</td><td>5</td><td>3</td><td>4</td><td>72</td></tr>
</table>

| Project Activity | Socio-Economic | | Likelihood | | Consequence | | | Significance Rating |
|---|---|---|---|---|---|---|---|---|
| | Phase of Project | All | Frequency of Activity | Frequency of Impact | Severity | Spatial Scope | Duration | |
| All mine-related activities | Impact Classification | Negative - Direct | Significance Pre-Mitigation | | | | | |
| | Resulting Impact from Activity | Security risk | 4 | 4 | 5 | 2 | 4 | 88 |
| | | | Significance Post- Mitigation | | | | | |
| | | | 2 | 3 | 5 | 2 | 4 | 55 |

| Project Activity | Socio-Economic | | Likelihood | | Consequence | | | Significance Rating |
|---|---|---|---|---|---|---|---|---|
| | Phase of Project | All | Frequency of Activity | Frequency of Impact | Severity | Spatial Scope | Duration | |
| All mining activities | Impact Classification | Negative - Direct and indirect | Significance Pre-Mitigation | | | | | |
| | Resulting Impact from Activity | Loss of common property | 4 | 5 | 1 | 3 | 5 | 81 |
| | | | Significance Post- Mitigation | | | | | |
| | | | 4 | 4 | 1 | 2 | 4 | 56 |

| Project Activity | Socio-Economic | | Likelihood | | Consequence | | | Significance Rating |
|---|---|---|---|---|---|---|---|---|
| | Phase of Project | Construction and Operational | Frequency of Activity | Frequency of Impact | Severity | Spatial Scope | Duration | |
| All mine-related activities | Impact Classification | Positive - Direct and indirect | Significance Pre-Mitigation | | | | | |
| | Resulting Impact from Activity | Contribution of royalties, rates and taxes | 3 | 4 | 3 | 3 | 4 | 70 |
| | | | Significance Post- Mitigation | | | | | |
| | | | 3 | 4 | 3 | 3 | 4 | 70 |

| Project Activity | Socio-Economic | | Likelihood | | Consequence | | | Significance Rating |
|---|---|---|---|---|---|---|---|---|
| All mine-related activities | Phase of Project | All | Frequency of Activity | Frequency of Impact | Severity | Spatial Scope | Duration | |
| | Impact Classification | Negative - Direct and indirect | Significance Pre-Mitigation | | | | | |
| | Resulting Impact from Activity | Community health and safety | 4 | 5 | 5 | 3 | 4 | 108 |
| | | | Significance Post- Mitigation | | | | | |
| | | | 2 | 2 | 5 | 3 | 4 | 48 |

| Project Activity | Socio-Economic | | Likelihood | | Consequence | | | Significance Rating |
|---|---|---|---|---|---|---|---|---|
| All mine-related activities | Phase of Project | Decommissioning and Closure | Frequency of Activity | Frequency of Impact | Severity | Spatial Scope | Duration | |
| | Impact Classification | Negative - Direct and indirect | Significance Pre-Mitigation | | | | | |
| | Resulting Impact from Activity | Mine closure and associated effects on the local economy | 1 | 5 | 5 | 3 | 5 | 78 |
| | | | Significance Post- Mitigation | | | | | |
| | | | 1 | 5 | 3 | 3 | 5 | 66 |

| TRAFFIC AND ROAD SAFETY | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Project Activity | Traffic and Road Safety | | Likelihood | | Consequence | | | Significance Rating |
| Movement of man and materials | Phase of project | Construction, Operational and Closure | Frequency of Activity | Frequency of Impact | Severity | Spatial Scope | Duration | |
| | Impact Classification | Negative - Direct and Indirect | Significance Pre-Mitigation | | | | | |
| | Resulting Impact from Activity | Heavy vehicles may cause damage to the road surface | 5 | 4 | 4 | 4 | 5 | 117 |
| | | | Significance Post-Mitigation | | | | | |
| | | | 4 | 4 | 2 | 4 | 5 | 88 |
| Project Activity | Traffic and Road Safety | | Likelihood | | Consequence | | | Significance Rating |
| Movement of man and materials | Phase of project | Construction, Operational and Closure | Frequency of Activity | Frequency of Impact | Severity | Spatial Scope | Duration | |
| | Impact Classification | Negative - Direct and Indirect | Significance Pre-Mitigation | | | | | |
| | Resulting Impact from Activity | Loading and offloading of workers along roads at the mine access intersection may reduce road safety | 4 | 5 | 4 | 2 | 4 | 90 |
| | | | Significance Post-Mitigation | | | | | |
| | | | 4 | 2 | 2 | 2 | 4 | 48 |
| Project Activity | Traffic and Road Safety | | Likelihood | | Consequence | | | Significance Rating |
| Movement of man and materials | Phase of project | Construction, Operational and Closure | Frequency of Activity | Frequency of Impact | Severity | Spatial Scope | Duration | |
| | Impact Classification | Negative - Direct and Indirect | Significance Pre-Mitigation | | | | | |
| | Resulting Impact from Activity | Vehicles may reduce road safety due to reduced speed of the heavy vehicles entering fast flowing traffic | 4 | 4 | 4 | 3 | 4 | 88 |
| | | | Significance Post-Mitigation | | | | | |
| | | | 4 | 2 | 1 | 3 | 4 | 48 |

| SURFACE WATER ECOSYSTEMS | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Project Activity | Sensitive habitat | | Likelihood | | Consequence | | | Significance Rating |
| All construction phase activities | Phase of Project | Construction Phase | Frequency of Activity | Frequency of Impact | Severity | Spatial Scope | Duration | |
| | Impact Classification | Negative - Direct and Indirect | Significance Pre-Mitigation | | | | | |
| | Resulting Impact from Activity | Destruction of wetland habitat during construction phase if buffer zones are not taken into consideration | 4 | 4 | 4 | 3 | 5 | 96 |
| | | | Significance Post-Mitigation | | | | | |
| | | | 1 | 1 | 2 | 2 | 1 | 10 |
| Project Activity | Sensitive habitat | | Likelihood | | Consequence | | | Significance Rating |
| Operational phase activities | Phase of Project | Construction and Operational Phase | Frequency of Activity | Frequency of Impact | Severity | Spatial Scope | Duration | |
| | Impact Classification | Negative - Direct Impact | Significance Pre-Mitigation | | | | | |
| | Resulting Impact from Activity | impact on wetland habitat integrity. | 4 | 4 | 4 | 4 | 5 | 104 |
| | | | Significance Post-Mitigation | | | | | |
| | | | 3 | 3 | 3 | 2 | 4 | 54 |

| Project Activity | Sensitive habitat | | Likelihood | | Consequence | | | Significance Rating |
|---|---|---|---|---|---|---|---|---|
| Mining activities | Phase of Project | All phases of project | Frequency of Activity | Frequency of Impact | Severity | Spatial Scope | Duration | |
| | Impact Classification | Negative - Secondary & Cumulative Impact | Significance Pre-Mitigation | | | | | |
| | Resulting Impact from Activity | Fragmentation of interconnected habitat | 5 | 5 | 3 | 3 | 4 | 100 |
| | | | Significance Post-Mitigation | | | | | |
| | | | 2 | 2 | 2 | 1 | 1 | 16 |

| Project Activity | Sensitive habitat | | Likelihood | | Consequence | | | Significance Rating |
|---|---|---|---|---|---|---|---|---|
| Mining activities | Phase of Project | All phases of project | Frequency of Activity | Frequency of Impact | Severity | Spatial Scope | Duration | |
| | Impact Classification | Negative - Secondary & Cumulative Impact | Significance Pre-Mitigation | | | | | |
| | Resulting Impact from Activity | Disturbances that induce invasion of exotic flora | 5 | 5 | 3 | 2 | 5 | 100 |
| | | | Significance Post-Mitigation | | | | | |
| | | | 1 | 1 | 2 | 1 | 1 | 8 |

| Project Activity | Soil erosion | | Likelihood | | Consequence | | | Significance Rating |
|---|---|---|---|---|---|---|---|---|
| All construction phase activities | Phase of Project | All Phases | Frequency of Activity | Frequency of Impact | Severity | Spatial Scope | Duration | |
| | Impact Classification | Negative - Secondary & Cumulative Impact | Significance Pre-Mitigation | | | | | |
| | Resulting Impact from Activity | Soil erosion will impact watercourses both locally as well as downstream within more established habitat. | 4 | 4 | 4 | 4 | 5 | 104 |
| | | | Significance Post-Mitigation | | | | | |
| | | | 2 | 2 | 2 | 1 | 1 | 16 |

| Project Activity | Water quality | | Likelihood | | Consequence | | | Significance Rating |
|---|---|---|---|---|---|---|---|---|
| All construction phase and operations phase activities | Phase of Project | All Phases | Frequency of Activity | Frequency of Impact | Severity | Spatial Scope | Duration | |
| | Impact Classification | Negative - Direct, Secondary & Cumulative Impact | Significance Pre-Mitigation | | | | | |
| | Resulting Impact from Activity | Contamination of surface water will impact integrity of all surface water resources. | 4 | 4 | 4 | 4 | 5 | 104 |
| | | | Significance Post-Mitigation | | | | | |
| | | | 3 | 3 | 3 | 2 | 4 | 54 |

BLASTING

| Project Activity | Blast-induced ground vibration damage to buildings closer than 1000 m from blasting | | Likelihood | | Consequence | | | |
|---|---|---|---|---|---|---|---|---|
| Overburden and midburden blasting with blasting hole depths between 20 and 30 m | Phase of Project | Operational Phase | Frequency of Activity | Frequency of Impact | Severity | Spatial Scope | Duration | Significance Rating |
| | Impact Classification | Direct Impact | Significance Pre-Mitigation | | | | | |
| | Resulting Impact from Activity | Minor damage to buildings (real or perceived by building owners) in the form of cracks in walls. Complaints from homeowners | 4 | 4 | 3 | 3 | 4 | 80 |
| | | | Significance Post-Mitigation | | | | | |
| | | | 4 | 3 | 2 | 2 | 4 | 56 |

| Project Activity | Blast-induced ground vibration damage to buildings farther than 1000 m from blasting | | Likelihood | | Consequence | | | |
|---|---|---|---|---|---|---|---|---|
| Overburden and midburden blasting with blasting hole depths between 20 and 30 m | Phase of Project | Operational Phase | Frequency of Activity | Frequency of Impact | Severity | Spatial Scope | Duration | Significance Rating |
| | Impact Classification | Direct Impact | Significance Pre-Mitigation | | | | | |
| | Resulting Impact from Activity | Minor damage to buildings (real or perceived by building owners). Possible complaints from homeowners. | 4 | 2 | 1 | 3 | 4 | 48 |
| | | | Significance Post-Mitigation | | | | | |
| | | | 4 | 2 | 1 | 1 | 4 | 36 |
| Project Activity | Blast-induced ground vibration damage to buildings closer than 500 m from blasting | | Likelihood | | Consequence | | | |
| Overburden and midburden blasting with blasting depths between 5 and 11 m | Phase of Project | Operational Phase | Frequency of Activity | Frequency of Impact | Severity | Spatial Scope | Duration | Significance Rating |
| | Impact Classification | Direct Impact | Significance Pre-Mitigation | | | | | |
| | Resulting Impact from Activity | Minor damage to buildings (real or perceived by building owners) in the form of cracks in walls. Complaints from homeowners | 4 | 4 | 3 | 3 | 4 | 80 |
| | | | Significance Post-Mitigation | | | | | |
| | | | 4 | 3 | 2 | 2 | 4 | 56 |

| Project Activity | Blast-induced <u>ground vibration</u> damage to buildings <u>farther than 500 m</u> from blasting | | Likelihood | | Consequence | | | |
|---|---|---|---|---|---|---|---|---|
| Overburden and midburden blasting with blasting hole depths between 5 and 11 m | Phase of Project | Operational Phase | Frequency of Activity | Frequency of Impact | Severity | Spatial Scope | Duration | Significance Rating |
| | Impact Classification | Direct Impact | Significance Pre-Mitigation | | | | | |
| | Resulting Impact from Activity | Minor damage to buildings (real or perceived by building owners). Possible complaints from homeowners. | 4 | 2 | 1 | 3 | 4 | 48 |
| | | | Significance Post-Mitigation | | | | | |
| | | | 4 | 2 | 1 | 1 | 4 | 36 |

| Project Activity | Blast Induced Damage to Wells | | Likelihood | | Consequence | | | Significance Rating |
|---|---|---|---|---|---|---|---|---|
| Overburden and midburden blasting with blasting depths between 20 and 30 m | Phase of Project | Operational Phase | Frequency of Activity | Frequency of Impact | Severity | Spatial Scope | Duration | |
| | Impact Classification | Direct Impact | Significance Pre-Mitigation | | | | | |
| | Resulting Impact from Activity | Loss of water perceived to be caused by blasting induced vibration | 4 | 2 | 1 | 2 | 4 | 42 |
| | | | Significance Post-Mitigation | | | | | |
| | | | 4 | 2 | 1 | 2 | 4 | 42 |

| Project Activity | Blast Induced Damage to road surfaces and earth dams | | Likelihood | | Consequence | | | Significance Rating |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Overburden and midburden blasting with blasting hole depths between 20 and 30 m | Phase of Project | Operational Phase | Frequency of Activity | Frequency of Impact | Severity | Spatial Scope | Duration | |
| | Impact Classification | Direct Impact | Significance Pre-Mitigation | | | | | |
| | Resulting Impact from Activity | Road substrate and compacted earth dams may suffer desegregation from high ground vibration radiated by blasting. | 4 | 4 | 3 | 2 | 4 | 72 |
| | | | Significance Post-Mitigation | | | | | |
| | | | 4 | 2 | 1 | 2 | 4 | 42 |
| Project Activity | Damage to structures or injury to people closer than 1000 m from fly rock | | Likelihood | | Consequence | | | |
| All blasting | Phase of Project | Operational Phase | Frequency of Activity | Frequency of Impact | Severity | Spatial Scope | Duration | Significance Rating |
| | Impact Classification | Direct Impact | Significance Pre-Mitigation | | | | | |
| | Resulting Impact from Activity | Serious to fatal injury or damage to property and infrastructure caused by uncontrolled fly rock | 4 | 4 | 5 | 3 | 4 | 96 |
| | | | | | | | | |
| | | | 4 | 2 | 2 | 1 | 4 | 42 |
| Project Activity | Damage to structures or complaints from neighbours caused by high air blast | | Likelihood | | Consequence | | | |
| All blasting, but particularly presplit and coal blasting | Phase of Project | Operational Phase | Frequency of Activity | Frequency of Impact | Severity | Spatial Scope | Duration | Significance Rating |
| | Impact Classification | Direct Impact | Significance Pre-Mitigation | | | | | |
| | Resulting Impact from Activity | Complaints or minor damage to buildings caused by high air blast levels. | 4 | 4 | 5 | 4 | 4 | 104 |
| | | | Significance Post- Mitigation | | | | | |
| | | | 4 | 3 | 2 | 1 | 4 | 49 |

| Project Activity | Water Pollution from Dissolved Nitrates | | Likelihood | | Consequence | | | |
|---|---|---|---|---|---|---|---|---|
| All blasting | Phase of Project | Operational Phase | Frequency of Activity | Frequency of Impact | Severity | Spatial Scope | Duration | Significance Rating |
| | Impact Classification | Cumulative | Significance Pre-Mitigation | | | | | |
| | Resulting Impact from Activity | Accumulation of dissolved nitrates in the water system causing an increase in algal and weed growth in waterways | 5 | 4 | 4 | 4 | 5 | 117 |
| | | | Significance Pre-Mitigation | | | | | |
| | | | | | | | | |
| | | | 1 | 2 | 1 | 1 | 4 | 18 |

| Project Activity | Dust and fumes generated by blasting affecting health and wellbeing of surrounding neighbours | | Likelihood | | Consequence | | | |
|---|---|---|---|---|---|---|---|---|
| All blasting | Phase of Project | Operational Phase | Frequency of Activity | Frequency of Impact | Severity | Spatial Scope | Duration | Significance Rating |
| | Impact Classification | Cumulative | Significance Pre-Mitigation | | | | | |
| | Resulting Impact from Activity | Dust and fumes are a risk to health of people within a zone of 2 to 3 km from blasting | 4 | 4 | 4 | 3 | 5 | 96 |
| | | | Significance Post- Mitigation | | | | | |
| | | | 4 | 2 | 2 | 2 | 4 | 48 |

<table>
<tr><td>Project Activity</td><td colspan="2">Damage to ruins, graves and heritage sites caused by vibration</td><td colspan="2">Likelihood</td><td colspan="3">Consequence</td><td></td></tr>
<tr><td rowspan="5">All blasting</td><td>Phase of Project</td><td>Operational Phase</td><td>Frequency of Activity</td><td>Frequency of Impact</td><td>Severity</td><td>Spatial Scope</td><td>Duration</td><td>Significance Rating</td></tr>
<tr><td>Impact Classification</td><td>Cumulative</td><td colspan="6">Significance Pre-Mitigation</td></tr>
<tr><td rowspan="3">Resulting Impact from Activity</td><td rowspan="3">Vibration may cause damage to structures and graves.</td><td>4</td><td>4</td><td>3</td><td>3</td><td>4</td><td>80</td></tr>
<tr><td colspan="6">Significance Post- Mitigation</td></tr>
<tr><td>4</td><td>2</td><td>1</td><td>2</td><td>4</td><td>42</td></tr>
<tr><td>Project Activity</td><td colspan="2">Damage to ruins, graves and heritage sites caused by fly rock</td><td colspan="2">Likelihood</td><td colspan="3">Consequence</td><td></td></tr>
<tr><td rowspan="5">All blasting</td><td>Phase of Project</td><td>Operational Phase</td><td>Frequency of Activity</td><td>Frequency of Impact</td><td>Severity</td><td>Spatial Scope</td><td>Duration</td><td>Significance Rating</td></tr>
<tr><td>Impact Classification</td><td>Cumulative</td><td colspan="6">Significance Pre-Mitigation</td></tr>
<tr><td rowspan="3">Resulting Impact from Activity</td><td rowspan="3">Fly rock impact will cause damage to structures and graves.</td><td>4</td><td>4</td><td>4</td><td>4</td><td>4</td><td>96</td></tr>
<tr><td colspan="6">Significance Post- Mitigation</td></tr>
<tr><td>4</td><td>2</td><td>2</td><td>2</td><td>4</td><td>48</td></tr>
</table>

| SPONTANEOUS COMBUSTION | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Project Activity | Spontaneous combustion of coal seams during surface and underground mining | | Likelihood | | Consequence | | | |
| Surface and underground mining | Phase of Project | Operational Phase | Frequency of Activity | Frequency of Impact | Severity | Spatial Scope | Duration | Significance Rating |
| | Impact Classification | Direct, Indirect, Cumulative | Significance Pre-Mitigation | | | | | |
| | Resulting Impact from Activity | Damage to infrastructure, sterilisation of resources, and possible impacts to employee health and safety | 4 | 4 | 5 | 3 | 4 | 96 |
| | | | Significance Post- Mitigation | | | | | |
| | | | 4 | 3 | 3 | 2 | 2 | 49 |

## APPENDIX 8: SPECIALIST REPORTS

# Air Quality Impact Assessment for the Ilima Coal Company Kranspan Project

Project done for ABS Africa

Report compiled by:
Rochelle Bornman

Project Manager:
Hanlie Liebenberg-Enslin

Report No: 18ABS07 | Date: March 2019

Address: 480 Smuts Drive, Halfway Gardens | Postal: P O Box 5260, Halfway House, 1685
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www.airshed.co.za

# Report Details

| | |
|---|---|
| Report Title | Air Quality Impact Assessment for the Ilima Coal Company Kranspan Project |
| Client | ABS Africa |
| Report Number | 18ABS07 |
| Report Version | Draft |
| Date | March 2019 |
| Prepared by | Rochelle Bornman, MPhil. GIS and Remote Sensing (University of Cambridge) |
| Reviewed by | Hanlie Liebenberg-Enslin, PhD (University of Johannesburg) |
| Notice | Airshed Planning Professionals (Pty) Ltd is a consulting company located in Midrand, South Africa, specialising in all aspects of air quality, ranging from nearby neighbourhood concerns to regional air pollution impacts as well as noise impact assessments. The company originated in 1990 as Environmental Management Services, which amalgamated with its sister company, Matrix Environmental Consultants, in 2003. |
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# Revision Record

| Version | Date | Comments |
|---|---|---|
| Draft | March 2019 | For client review |

# Competency Profiles

Report author: R Bornman (M.Phil in GIS and Remote Sensing, University of Cambridge)

Rochelle Bornman started her professional career in Air Quality in 2008 when she joined Airshed Planning Professionals (Pty) Ltd after having worked in malaria research at the Medical Research Council in Durban. Rochelle has worked on several air quality specialist studies between 2008 and 2018. She has experience on the various components including emissions quantification for a range of source types, simulations using a range of dispersion models, impacts assessment and health risk screening assessments. Her project experience range over various countries in Africa, providing her with an inclusive knowledge base of international legislation and requirements pertaining to air quality. Whilst most of his working experience has been in South Africa, a number of investigations were made in countries elsewhere, including Mozambique, Namibia, Saudi Arabia and Mali.

## NEMA Regulation (2014), Appendix 6

| NEMA Regulations (2014) - Appendix 6 | Relevant section in report |
|---|---|
| Details of the specialist who prepared the report. | Report details (page ii) |
| The expertise of that person to compile a specialist report including curriculum vitae. | Report details (page ii)<br>Appendix A |
| A declaration that the person is independent in a form as may be specified by the competent authority. | Report details (page i) |
| An indication of the scope of, and the purpose for which, the report was prepared. | Introduction and background (Executive Summary)<br>Section 1.2: Scope of Work<br>Section 1.4: Project Approach and Methodology |
| The date and season of the site investigation and the relevance of the season to the outcome of the assessment. | Section 3.2: Atmospheric Dispersion Potential<br>Section 3.4.2: Monitored ambient concentrations |
| A description of the methodology adopted in preparing the report or carrying out the specialised process. | Introduction and background (Executive Summary)<br>Section 1.4: Project Approach and Methodology<br>Section 4.2: Atmospheric Dispersion Modelling |
| The specific identified sensitivity of the site related to the activity and its associated structures and infrastructure. | Section 3.1: Receiving Environment |
| An identification of any areas to be avoided, including buffers. | Not applicable |
| A map superimposing the activity including the associated structures and infrastructure on the environmental sensitivities of the site including areas to be avoided, including buffers. | Section 3.1: Receiving Environment |
| A description of any assumptions made and any uncertainties or gaps in knowledge. | Section 1.5: Assumptions and Limitations |
| A description of the findings and potential implications of such findings on the impact of the proposed activity, including identified alternatives, on the environment. | Section 4: Impact Assessment This assessment investigates the impacts of the Operational Phase, with two options for discard disposal |
| Any mitigation measures for inclusion in the environmental management programme report | Section 6: Air Quality Management Measures |
| Any conditions for inclusion in the environmental authorisation | Section 6: Air Quality Management Measures |
| Any monitoring requirements for inclusion in the environmental management programme report or environmental authorisation. | Section 6: Air Quality Management Measures |
| A reasoned opinion as to whether the proposed activity or portions thereof should be authorised. | Section 8.2: Conclusion |
| If the opinion is that the proposed activity or portions thereof should be authorised, any avoidance, management and mitigation measures that should be included in the environmental management programme report, and where applicable, the closure plan. | Section 6: Air Quality Management Measures<br>Section 8.3: Recommendations |
| A description of any consultation process that was undertaken during the course of carrying out the study. | Not applicable |
| A summary and copies if any comments that were received during any consultation process. | Not applicable. |
| Any other information requested by the competent authority. | Not applicable. |

# Abbreviations

| | |
|---|---|
| Airshed | Airshed Planning Professionals (Pty) Ltd |
| APPA | Air Pollution Prevention Act |
| AQSR | Air Quality Sensitive Receptors |
| ASTM | American Standard Testing Method |
| DEA | Department of Environmental Affairs |
| EHS | Environmental, Health, and Safety (IFC) |
| EIA | Environmental Impact Assessment |
| GHG | Greenhouse gas |
| GLC | Ground Level Concentration |
| I&APs | Interested and Affected Parties |
| IFC | International Finance Corporation |
| Ltd | Limited |
| NEMAQA | National Environment Management Air Quality Act |
| NPI | National Pollutant Inventory (Australia) |
| Pty | Proprietary |
| ROM | Run-of-mine |
| SABS | South African Bureau of Standards |
| SANS | South African National Standards |
| SA NAAQS | South African National Ambient Air Quality Standards |
| SA NDCR | South African National Dust Control Regulations |
| SoW | Scope of Work |
| US EPA | United States Environmental Protection Agency |
| WBG | World Bank Group |
| WHO | World Health Organisation |

## Symbols and Units

| | |
|---|---|
| °C | Degrees Celsius |
| µg | Microgram(s) |
| $\mu g/m^3$ | Micrograms per cubic meter |
| $L_{MO}$ | Monin-Obukhov Length |
| m/s | Meters per second |
| $m^2$ | Metres squared |
| masl | Meters above sea level |
| mg | Milligram(s) |
| $mg/m^2/day$ | Milligram per metre squared per day |
| mm | Millimeters |
| mtpa | million tons per annum |
| PM | Particulate Matter |
| $PM_{10}$ | Thoracic particulate matter |
| $PM_{2.5}$ | Respirable particulate matter |
| TSP | Total Suspended Particulate |
| % | Percentage |

# Glossary

| | |
|---|---|
| Air pollution | This means any change in the composition of the air caused by smoke, soot, dust (including fly ash), cinders, solid particles of any kind, gases, fumes, aerosols and odorous substances |
| Ambient Air | This is defined as any area not regulated by Occupational Health and Safety regulations |
| Atmospheric emission or emission | Any emission or entrainment process emanating from a point, non-point or mobile source that results in air pollution |
| Averaging period | This implies a period of time over which an average value is determined |
| Dispersion | The spreading of atmospheric constituents, such as air pollutants |
| Dust | Solid materials suspended in the atmosphere in the form of small irregular particles, many of which are microscopic in size |
| Frequency of Exceedance | A frequency (number/time) related to a limit value representing the tolerated exceedance of that limit value, i.e. if exceedances of limit value are within the tolerances, then there is still compliance with the standard |
| Mechanical mixing | Any mixing process that utilizes the kinetic energy of relative fluid motion |
| Particulate Matter (PM) | These comprise a mixture of organic and inorganic substances, ranging in size and shape. These can be divided into coarse and fine particulate matter. The former is called Total Suspended Particulates (TSP), whilst $PM_{10}$ and $PM_{2.5}$ fall in the finer fraction. |
| $PM_{10}$ | Particulate Matter with an aerodynamic diameter less than or equal to 10 µm. it is also referred to as thoracic particulates and is associated with health impacts due to its tendency to be deposited in, and damaging to, the lower airways and gas-exchanging portions of the lung |
| $PM_{2.5}$ | Particulate Matter with an aerodynamic diameter less than or equal to 2.5 µm. it is also referred to as respirable particulates. It is associated with health impacts due to its high tendency to be deposited in, and damaging to, the lower airways and gas-exchanging portions of the lung |
| Vehicle Entrainment | This is the lifting and dropping of particles by the rolling wheels leaving the road surface exposed to strong air current in turbulent shear with the surface. The turbulent wake behind the vehicle continues to act on the road surface after the vehicle has passed |

## Executive Summary

The Kranspan Project is located approximately 13 km south-west of the town of Carolina in Albert Luthuli Local Municipality, Mpumalanga Province. Ilima Coal Company is the holder of a Prospecting Right for the project area, which comprises nine portions of the farm Kranspan 49-IT and is 3 382 hectares in size. The company is now applying for a Mining Right for the planned surface and underground mining operations. The proposed mine will also include associated infrastructure (haul roads, discard stockpile etc.) and a beneficiation plant.

The proposed mining and coal handling/processing activities will result in air quality impacts in the study area. Airshed Planning Professionals (Pty) Ltd (Airshed) was commissioned by ABS Africa to conduct an air quality impact assessment for the Project.

To meet the above objective, the following tasks were included in the Scope of Work (SoW):

- A desktop air quality impact study, including:
    - A review and identification of legal requirements pertaining to air quality;
    - A desktop study of the receiving atmospheric environment (baseline) incl.:
        - the identification of air quality sensitive receptors;
        - an analysis of regional climate and site-specific atmospheric dispersion taking into account local meteorology, land-use and topography; and
        - analysis and assessment of existing (baseline) ambient air quality data (if available).
    - The establishment of the Project operations' emissions inventory;
    - Atmospheric dispersion simulations for Project operations (pre- and post-mitigation);
    - A human health risk and nuisance impact screening assessment based on dispersion simulation results;
    - The identification of air quality management measures based on the findings of the compliance and impact assessment;
    - An Air Quality Impact Assessment (AQIA) Report in the prescribed specialist report format;
    - The development of an air quality monitoring programme to be included in the Environmental Management Plan (EMP).

Air quality impacts are associated with three distinct phases namely: The construction phase, the operational phase, and the closure and post-closure phase.

Construction phase: Opencast areas, haul roads to access the mining areas, ROM stockpile areas, underground mining infrastructure, crushing and screening plant, dense medium beneficiation plant, product stockpiles and loading area, discard stockpile, onsite laboratory, parking areas, diesel tanks, weighbridge and overland conveyor will be constructed; this will involve land clearing and metal and concrete works for the establishment of infrastructure.

Operational phase: The impacts as a result of operations during Year 5 and Year 9 were assessed. The two mining years were selected to determine the maximum impacts at the receptors closest to the proposed opencast areas.

The dispersion modelling scenarios for the operational phase may be described as follows:

- Scenario 1: YEAR 5 – Opencast and underground mining activities, with subsequent processing in the form of primary crushing and beneficiation at the wash plant and hauling and tipping of discard to a dedicated discard stockpile.
- Scenario 2: YEAR 5 – Opencast and underground mining activities, with subsequent processing in the form of primary crushing and beneficiation at the wash plant and hauling and backfilling of discard in the open void.
- Scenario 3: YEAR 9 – Opencast and underground mining activities, with subsequent processing in the form of primary crushing and beneficiation at the wash plant and hauling and tipping of discard to a dedicated discard stockpile.
- Scenario 4: YEAR 9 – Opencast and underground mining activities, with subsequent processing in the form of primary crushing and beneficiation at the wash plant and hauling and backfilling of discard in the open void.

Closure and post-closure phase: During closure, bulk earthworks and demolishing activities are expected. Very little information regarding the decommissioning phase was available for consideration, from an air quality perspective it is however likely to be similar in character and impact to the construction phase.

Due to the lack of detailed information and the relatively short duration of most of the activities associated with the construction, closure and post-closure phases, the assessment of impacts for these phases was done qualitatively.

A quantitative assessment was done for the operational phase scenarios as described above. Emissions were quantified for both (a) unmitigated and (b) design mitigated scenarios, with design mitigation including 75% control efficiency on unpaved roads via water sprays, 97% control efficiency on drilling for dust suppression fitted on drill rigs, 50% control efficiency on materials handling and crushing activities through water sprays and 50% control efficiency on windblown dust from the overland conveyor through enclosed side and roof.

The assessment included an estimation of atmospheric emissions, the simulation of pollutant levels and determination of the significance of impacts.

### Main Findings

The findings from the baseline assessment can be summarised as follows:

- The prevailing wind field in the area consists of west-north-westerly and north-easterly winds, with infrequent winds from the north and south. During the day, winds occurred more frequently from the north-westerly sector, with 4.75% calm conditions. Night-time airflow showed increased wind speeds which occurred most frequently from the north-easterly sector. Wind speeds higher than 6 m/s occurred approximately 16% of the time.

- The climate of the area may be described as warm and temperate with an average annual rainfall of 613 mm.
- The Project is located outside the Highveld Priority Area.
- Power generation, mining activities, farming and residential land-uses occur in the region. These land-uses contribute to baseline pollutant concentrations via vehicle tailpipe emissions, household fuel combustion, biomass burning and various fugitive dust sources.
- AQSRs around the project site include two schools, Silobela residential area, informal settlements, and surrounding farmsteads.
- Dust fallout data for one month was made available to the study. The dust fallout network was established to determine baseline dust fallout levels. Both off-site and on-site values were very low and did not exceed the residential or non-residential limits of 600 mg/m$^2$/day and 1200 mg/m$^2$/day respectively.
- Monitoring data from the DEA Hendrina site (approximately 24 km west of the project site) for the 1-year period of 1 February 2018 to 31 January 2019 was analysed. The daily 99$^{th}$ percentiles for $PM_{10}$ exceed the limit value (75 µg/m$^3$) at Hendrina station, with non-compliance occurring 6% of the time. The daily 99$^{th}$ percentiles for $PM_{2.5}$ exceed the limit value (40 µg/m$^3$) for 3% of the time.
- Time variation plots (mean with 95% confidence interval) of ambient particulate matter ($PM_{10}$ and $PM_{2.5}$) concentrations measured at Hendrina station were created to show the variation of these pollutants over a daily, weekly and annual cycle. Monthly variation of particulate matter shows elevated concentrations during winter months due to the larger contribution from domestic fuel burning, dust from uncovered soil and the lack of the settling influence of rainfall.

The impacts as a result of operations during Year 5 (Scenario 1 and 2) and Year 9 (Scenario 3 and 4) were assessed, with Year 5 opencast areas located to the west and further away from the plant, and Year 9 opencast areas concentrated more to the east and closer to the plant. The impact of the proposed Project can be summarized as follows:

Construction phase:

- Likely activities to result in dust impacts during construction are: Topsoil removal, material loading and hauling, stockpiling, grading, bulldozing, as well as metal and concrete works for the establishment of infrastructure.
- Construction: the impacts are expected to be Low to Medium.

Operational phase (Scenario 1 – Year 5, Surface Discard Stockpile):

- The primary and secondary sources of impact at AQSRs during Scenario 1a (unmitigated activities) are: for $PM_{10}$, roads followed by in-pit operations; in-pit operations and roads are the main sources for $PM_{2.5}$; and roads is the main source followed by in-pit operations for daily dustfall rates.

- The primary and secondary sources of impact at AQSRs during Scenario 1b (design mitigated activities) are: for $PM_{10}$, in-pit operations followed by roads; for $PM_{2.5}$, in-pit operations followed by crushing; and for daily dustfall rates, roads followed by in-pit operations.
- Simulated $PM_{10}$ daily GLCs for Scenario 1, with no mitigation in place, are likely to be in non-compliance with the NAAQS for distances of between 1.8 km and 4 km from the project site border. Eight (8) exceedances of the daily $PM_{10}$ NAAQS are expected at AQSR #1, 4 to 6, 8 to 9 and 13 to 14. With mitigation in place, exceedances of the $PM_{10}$ daily NAAQS is largely confined to the site and exceedance of the daily $PM_{10}$ NAAQS is expected at two (2) AQSRs, viz. #5 (nearby school) and #13 (on-site farmstead). Over an annual average the GLCs for unmitigated operations exceed the standard at AQSR#13, but for mitigated operations the GLCs are low and well within the standard.
- Simulated $PM_{2.5}$ daily GLCs for Scenario 1, with no mitigation in place, are likely to be in non-compliance with the NAAQS for distances up to 650 m and 1.4 km from the south-western border, for current and future NAAQS's respectively. Exceedances of the future $PM_{2.5}$ NAAQS are expected at five (5) AQSRs, viz. #1, 5, 6, 13 and 14. With mitigation in place, exceedances of the future $PM_{2.5}$ daily NAAQS is largely confined to the site and exceedances are expected at two (2) AQSRs, viz. #5 and 13. Over an annual average the GLCs for unmitigated activities are within the future $PM_{2.5}$ NAAQS at all receptors except AQSR#13; for mitigated activities the annual GLCs are low and well within the future standard.
- Simulated maximum daily dustfall rates for Scenario 1, for both unmitigated and design mitigated operations, are likely to be in compliance with the NDCR residential limit (600 mg/m²/day). No exceedances are expected at any of the AQSRs.
- The impact significance for Scenario 1 operations is *Medium to High* for unmitigated activities and *Low to Medium* for design mitigated activities. This applies to $PM_{2.5}$ and $PM_{10}$ concentrations. For dustfall rates the impacts are Low to Medium for both unmitigated and mitigated activities.

Operational phase (Scenario 2 – Year 5, In-Pit Discard Disposal):

- The main contributing sources to ground level impacts due to Scenario 2a and 2b emissions remain the same as those listed for Scenario 1a and 1b.
- Simulated $PM_{10}$ daily GLCs for Scenario 2, with no mitigation in place, are likely to be in non-compliance with the NAAQS for distances of between 2 km and 4.1 km from the project site border. The number of AQSRs where exceedances of the daily and annual $PM_{10}$ NAAQS due to unmitigated and mitigated activities were simulated is expected to stay the same as for Scenario 1a and 1b.
- Simulated $PM_{2.5}$ daily GLCs for Scenario 2, show similar impacting areas as for Scenario 1a and 1b. The number of AQSRs where exceedances of the daily and annual $PM_{2.5}$ NAAQS due to unmitigated and mitigated activities were simulated is expected to stay the same as for Scenario 1a and 1b.
- Simulated maximum daily dustfall rates for Scenario 2, for unmitigated operations, are likely to be in non-compliance with the NDCR residential limit (600 mg/m²/day) at one AQSR viz. AQSR#13. No exceedances are expected at any of the AQSRs for mitigated operations.
- The impact significance for Scenario 2 operations remains the same as for Scenario 1.

Operational phase (Scenario 3 – Year 9, Surface Discard Stockpile):

- The primary and secondary sources of impact at AQSRs during Scenario 3a (unmitigated activities) are: in-pit operations followed by roads for $PM_{10}$; in-pit operations and crushing are the main sources for $PM_{2.5}$; and in-pit operations followed by roads for daily dustfall rates.
- The primary and secondary sources of impact at AQSRs during Scenario 3b (design mitigated activities) are: in-pit operations followed by roads for $PM_{10}$; in-pit operations followed by crushing for $PM_{2.5}$; and in-pit operations followed by crushing for daily dustfall rates.
- Simulated $PM_{10}$ daily GLCs for Scenario 3, with no mitigation in place, are likely to be in non-compliance with the NAAQS for distances of between 950 m and 3.5 km from the project site border. Exceedances of the daily $PM_{10}$ NAAQS are expected at three (3) AQSRs, viz. #1 (on-site informal housing), and #13 and 14 (farmsteads), whereas exceedances of the annual $PM_{10}$ NAAQS are expected at two (2) AQSRs, viz. #1 and 13. With mitigation in place, exceedances of the $PM_{10}$ daily NAAQS extend for a distance of up to 1.2 km from the project site border and daily exceedances are still expected at AQSR #1 and 13. Over an annual average the mitigated GLCs are within the standard.
- Simulated $PM_{2.5}$ daily GLCs for Scenario 3, with no mitigation in place, are likely to be in non-compliance with the current and future NAAQS for distances up to 1.2 km and 2.2 km from the site border respectively. Exceedances of the future daily $PM_{2.5}$ NAAQS's are expected at three (3) AQSRs, viz. #1, 13 and 14. With mitigation in place, exceedances of the $PM_{2.5}$ future daily NAAQS extend for a distance of up to 1 km from the site border and exceedances are still expected at AQSR #1 and #13. Over an annual average the GLCs are within the standard for both unmitigated and mitigated activities.
- Simulated maximum daily dustfall rates for Scenario 3, for both unmitigated and design mitigated operations, are likely to be in compliance with the NDCR residential limit (600 mg/m²/day). No exceedances are expected at any of the AQSRs.
- The impact significance for Scenario 3 operations remains the same as for Scenarios 1 and 2.

Operational phase (Scenario 4 - Year 9, In-Pit Discard Disposal):

- The main contributing sources to ground level impacts due to Scenario 4a and 4b emissions remain the same as those listed for Scenario 3a and 3b.
- Simulated $PM_{10}$ daily GLCs for Scenario 4, with no mitigation in place, show similar impacting areas as for Scenario 3a. The number of AQSRs where exceedances of the daily and annual $PM_{10}$ NAAQS due to unmitigated and mitigated activities were simulated is expected to stay the same as for Scenario 3a and 3b.
- Simulated $PM_{2.5}$ daily GLCs for Scenario 2, show similar impacting areas as for Scenario 3a and 3b. The number of AQSRs where exceedances of the daily and annual $PM_{2.5}$ NAAQS due to unmitigated and mitigated activities were simulated is expected to stay the same as for Scenario 3a and 3b.

- Simulated maximum daily dustfall rates for Scenario 4, for unmitigated operations, are likely to be in non-compliance with the NDCR residential limit (600 mg/m²/day) at one AQSR viz. AQSR#13. No exceedances are expected at any of the AQSRs for mitigated operations.
- The impact significance for Scenario 4 operations remains the same as for Scenarios 1, 2 and 3.

Closure and post-closure phases:

- Likely activities to result in dust impacts during closure are: Infrastructure removal/demolition; topsoil recovered from stockpiles for rehabilitation and re-vegetation of surroundings; and vehicle entrainment on unpaved road surfaces during rehabilitation – once that is done, vehicle activity associated with the operations should cease.
- Closure and Post-closure: the impacts are expected to be Low to Medium.

GHG Emissions:

- The total $CO_2$-e emissions for Kranspan mining operations is not likely to be more than 118 414 tpa. The calculated $CO_2$-e emissions from the proposed mining operations contribute less than 0.02% to the total of the national inventory's GHG emissions (excluding land-use change and forestry) and 0.29% to the national inventory's "manufacturing industry and construction" sector GHG emissions.
- A Pollution Prevention Plan is not required for the proposed Project since the scope 1 GHG contribution due to the proposed mining operations is below 100 000 tons.
- The GHG emissions from the proposed Kranspan Project are not likely to result in a noteworthy contribution to climate change on its own.
- The project and the community are likely to be negatively impacted by climate change, the project less than the community due to the short time operations are planned to occur for.
- The following is recommended to reduce the impacts of climate change on the project:
    - Additional support infrastructure can reduce the climate change impact on the staff and project, for example the addition/upgrading of an on-site clinic, ensuring adequate water supply for staff and reducing on-site water usage as much as possible.
- The following is recommended to reduce the GHG emissions from the project:
    - Ensuring the vehicles and equipment is maintained through an effective inspection and maintenance program.
    - Limiting the removal or vegetation and ensuring adequate re-vegetation or addition of vegetation surrounding the project. Vegetation acts as a carbon sink.

## Conclusions

The impacts due to the proposed Project were assessed with respect to location of the opencast areas relative to the closest receptors. Two options were assessed for the disposal of discard from the beneficiation plant, namely disposal via surface discard stockpile or via backfilling.

No significant differences were found with respect to the options for discard disposal. However, the proposed Project operations are projected to result in exceedances at the closest receptors (AQSRs #1, #5, #13 and #14, viz. informal housing located on-site, a nearby school and two farmsteads – the latter located within the project site boundary) even with design mitigation measures in place (water suppression on roads, dust suppression fitted on drill rigs, roofing and one side covering of the overland conveyor, and water sprays at materials handling points and crushers).

It is recommended that the two on-site farmsteads not be used for residential purposes at the time of commencement of Kranspan mining operations. It is also recommended that continuous $PM_{10}$ and $PM_{2.5}$ monitoring be conducted at the school and informal community from Year 3 onwards, to start an investigation into the impacts on these receptors well before nearby opencast mining occurs from Year 5 through Year 12. Should exceedances of the daily $PM_{10}$ and/or $PM_{2.5}$ NAAQS occur, the relocation of the school and/or informal community must be considered.

The proposed Project operations should not result in significant ground level concentrations or dustfall levels at the nearby receptors provided the design mitigation measures are applied effectively. From an air quality perspective, the proposed project can be authorised permitted the recommended mitigation and monitoring measures are applied.[1]

## Recommendations

A summary of the recommendations and management measures is given below:

- Construction and closure phases:
  - Air quality impacts during construction would be reduced through basic control measures such as limiting the speed of haul trucks; limit unnecessary travelling of vehicles on untreated roads; and to apply water sprays on regularly travelled, unpaved sections.
  - When haul trucks need to use public roads, the vehicles need to be cleaned of all mud and the material transported must be covered to minimise windblown dust.
  - The access road to the Project also needs to be kept clean to minimise carry-through of mud on to public roads.
- Operational phases:
  - In controlling dust due to drilling operations, dust suppression must be fitted on drill rigs to achieve an emission reduction efficiency of 97%.
  - For the control of vehicle entrained dust it is recommended that water (at an application rate >2 litre/m$^2$/hour), be applied. Literature reports an emissions reduction efficiency of 75%.

[1] A new site layout was introduced after the completion of the current study. The new position of the plant and co-disposal stockpile is now closer to the on-site farmstead located in the centre of the mining property, but further away from the other on-site receptors, viz. a second on-site farmstead and informal community respectively. As the farmstead closest to the mining activities has now been bought by the mine, the change in position of the plant is not expected to result in higher air quality impacts than what was simulated in the impact assessment and the conclusions and recommendations are still valid.

- o In controlling dust from crushing and screening operations, it is recommended that water sprays be applied to keep the ore wet, to achieve a control efficiency of up to 50%.
- o Mitigation of materials transfer points should be done using water sprays at the tip points. This should result in a 50% control efficiency. Regular clean-up at loading points is recommended.
- o In minimizing windblown dust from stockpile areas, water sprays should be used to keep surface material moist. A mitigation efficiency of 50 % is anticipated.
- o In minimizing windblown dust from the overland conveyor, roofing and covering of one side of the conveyor should be installed to achieve a mitigation efficiency of 50 %.

- ▪ Given the high impacts that are expected at the on-site informal community, nearby school and two on-site farmsteads it is recommended that the two farmsteads not be used for residential purposes at the time that opencast mining commences and that continuous $PM_{10}$ and $PM_{2.5}$ monitoring be conducted at the school and informal community starting two years before opencast mining occurs near the two receptors. This will give time to track the impacts as opencast activities occur closer to these two receptors and to decide on additional mitigation measures or whether to relocate either or both of these receptors should exceedances of the NAAQS occur.
- ▪ Continuous monitoring of dustfall must be conducted as part of the Project's air quality management plan.

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# 1 Introduction

The Kranspan Project is located approximately 13 km south-west of the town of Carolina in Albert Luthuli Local Municipality, Mpumalanga Province. Ilima Coal Company is the holder of a Prospecting Right for the project area, which comprises nine portions of the farm Kranspan 49-IT and is 3382 hectares in size. The company is now applying for a Mining Right for the planned surface and underground mining operations. The proposed mine will also include associated infrastructure (haul roads, discard stockpile etc.) and a beneficiation plant.

The proposed mining and coal handling/processing activities will result in air quality impacts in the study area. Airshed Planning Professionals (Pty) Ltd (Airshed) was commissioned by ABS Africa to conduct an air quality impact assessment for the Project.

## 1.1 Study Objective

The main objective of the investigation is to quantify the potential impacts resulting from the proposed activities on the surrounding environment and human health. As part of the air quality assessment, a good understanding of the regional climate and local dispersion potential of the site is necessary and subsequently an understanding of existing sources of air pollution in the region and the current and potential future air quality. The layout of the project site is provided in Figure 2.

## 1.2 Scope of Work

Based on the required scope, the following tasks have been identified:

- A desktop air quality impact study, including:
    - A review and identification of legal requirements pertaining to air quality;
    - A desktop study of the receiving atmospheric environment (baseline) incl.:
        - the identification of air quality sensitive receptors;
        - an analysis of regional climate and site-specific atmospheric dispersion taking into account local meteorology, land-use and topography; and
        - assessment of the results from ambient air quality sampling to date ($PM_{10}$, $PM_{2.5}$ and dustfall) if available).
    - The establishment of the Project operations' emissions inventory;
    - Atmospheric dispersion simulations for Project operations (pre- and post-mitigation);
    - A human health risk and nuisance impact screening assessment based on dispersion simulation results;
    - The identification of air quality management measures based on the findings of the compliance and impact assessment;
    - An Air Quality Impact Assessment (AQIA) Report in the prescribed specialist report format;
    - The development of an air quality monitoring programme to be included in the Environmental Management Plan (EMP).

- A Tier 1 (if required Tier 2) greenhouse gas inventory and qualitative discussion on climate change impacts.

## 1.3 Description of Plant Activities from an Air Quality Perspective

A conventional strip mining (roll-over) method will be employed for each of the opencast pits. Material from the boxcut phase will be stored per overburden classification, with the bulk of the material placed in a position alongside the final strip, to facilitate filling of the final void. Rehabilitation of the opencast mining area will be done concurrently with the opencast mining according to a stated mining sequence. The mining process is shown in Figure 1 below.

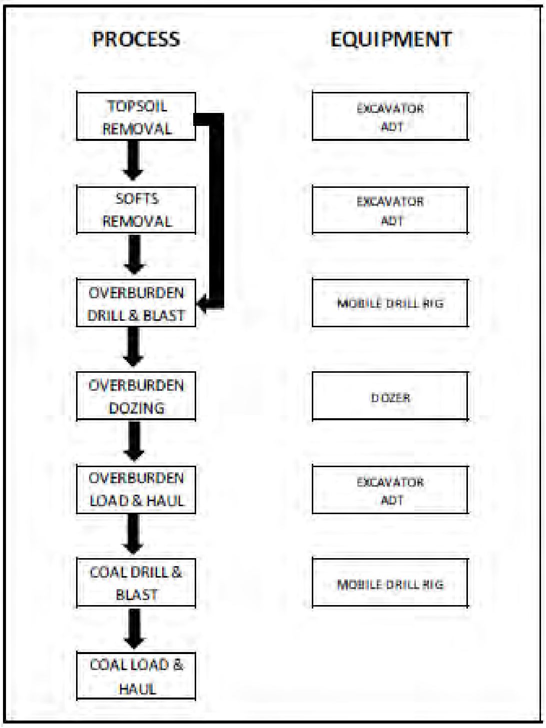


*Figure 1: Opencast mining process*

Underground mining will be done concurrently with opencast mining and will be a conventional bord and pillar mining operation deploying continuous miners with shuttle cars, supported by roof bolters for roof support and load haul dumpers for sweeping. The mine will be designed for the maximum extraction on the advance with no pillar extraction on retreat. Ore will be pre-crushed before being discharged onto a conveyor feeding into the shaft loading facility. Material skips will hoist the ore to surface and discharge into loading bins on surface. The surface reef conveyor will transfer the run-of-mine (ROM) ore to the secondary crushing circuit.

The raw coal handling facilities, coal preparation plant and product out-loading facilities are designed to receive and process coal from both opencast and underground mining operations. Seventy percent (70%) of the total ROM will go through the beneficiation process, and 30% of the total ROM will be crushed only (primary crusher) and exported via road to Eskom. The yield from the wash plant is estimated at 70%, and the rest discard. Two options are considered for disposal of discard, namely tipping of discard to a discard stockpile located close to the plant or hauling and backfilling of the discard at the open void. Beneficiated product will be out-loaded to rail for export.

Air quality impacts are associated with three distinct phases namely: The construction phase, the operational phase, and the closure and post-closure phase.

Construction phase: Opencast areas, haul roads to access the mining areas, ROM stockpile areas, underground mining infrastructure, crushing and screening plant, dense medium beneficiation plant, product stockpiles and loading area, discard stockpile, onsite laboratory, parking areas, diesel tanks, weighbridge and overland conveyor will be constructed; this will involve land clearing and metal and concrete works for the establishment of infrastructure.

Operational phase: The impacts as a result of operations during Year 5 and Year 9 will be assessed. The two mining years were selected to determine the maximum impacts at the receptors closest to the proposed opencast areas.

The scenarios that are included in the assessment may be described as follows:

- Scenario 1: YEAR 5 – Opencast and underground mining activities, with subsequent processing in the form of primary crushing and beneficiation at the wash plant and hauling and tipping of discard to a dedicated discard stockpile.
- Scenario 2: YEAR 5 – Opencast and underground mining activities, with subsequent processing in the form of primary crushing and beneficiation at the wash plant and hauling and backfilling of discard in the open void.
- Scenario 3: YEAR 9 – Opencast and underground mining activities, with subsequent processing in the form of primary crushing and beneficiation at the wash plant and hauling and tipping of discard to a dedicated discard stockpile.
- Scenario 4: YEAR 9 – Opencast and underground mining activities, with subsequent processing in the form of primary crushing and beneficiation at the wash plant and hauling and backfilling of discard in the open void.

Closure and post-closure phase: During closure, bulk earthworks and demolishing activities are expected. Very little information regarding the decommissioning phase was available for consideration, from an air quality perspective it is however likely to be similar in character and impact to the construction phase.

Due to the lack of detailed information and the relatively short duration of most of the activities associated with the construction, closure and post-closure phases, the assessment of impacts for these phases will be done qualitatively.

A quantitative assessment was done for the operational phase scenarios as described above. Emissions were quantified for both unmitigated and design mitigated scenarios, with design mitigation including 75% control efficiency (CE) on unpaved roads via water sprays, 97% CE on drilling for dust suppression fitted on drill rigs, 50%

CE on materials handling and crushing activities through water sprays and 50% CE on windblown dust from the overland conveyor (for underground mining) through enclosed side and roof.

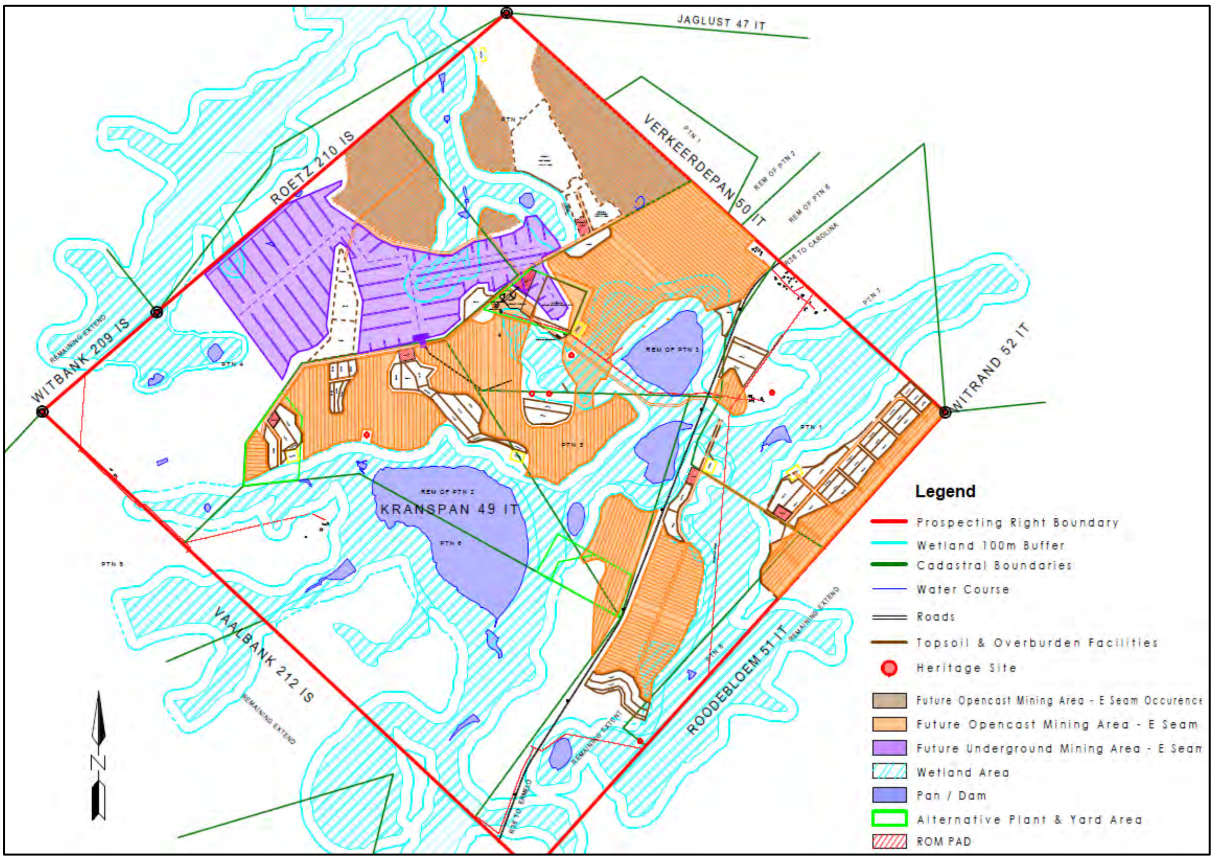


*Figure 2: Site layout*

From Figure 2, the alternative positions for the plant area are indicated (in green), with the preferred plant area and associated discard dump located in the top centre, directly adjacent to the underground mining area. It must be noted that this layout was provided after the dispersion modelling study was concluded, and that dispersion modelling was conducted based on the site layout in Appendix D.

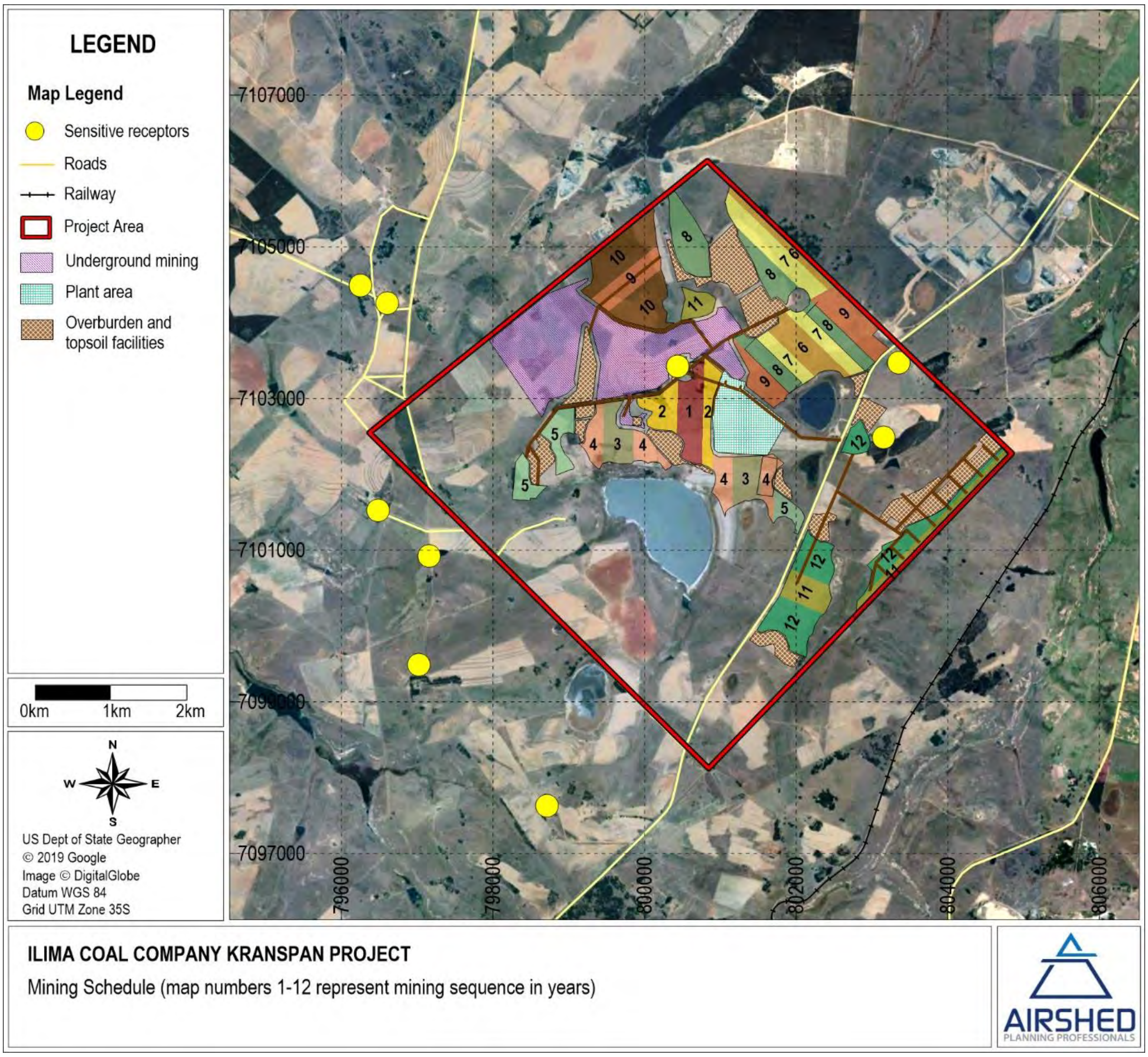


*Figure 3: Mining schedule*

## 1.4 Project Approach and Methodology

The project methodology followed in the completion of tasks as part of the SoW is provided in Table 1.

*Table 1: Project approach and methodology*

| Task | Activity | Description | Section of Report |
|---|---|---|---|
| Legal Review | A study of legal requirements pertaining to air quality – National Ambient Air Quality Standards (NAAQSs); National Dust Control Regulations (NDCR) and applicable international legal guidelines and limits, including:<br>Legislation pertaining to air quality impact assessments, such as Regulations on Dispersion Modelling, is also discussed. | International air quality criteria referenced, include:<br>• World Health Organisation (WHO);<br>• World Bank Group (WBG);<br>• International Finance Corporation (IFC); and<br>• US Environmental Protection Agency (EPA)<br>Limited information is available on the impact of dust on vegetation and grazing quality | Section 0 |
| Baseline Assessment | Desktop review of all available project and associated data, including meteorological data, previous air quality assessments, Environmental Impact Assessments (EIAs) and technical air quality data and models. | | Section 3 |
| | Physical environmental parameters that influence the dispersion of pollutants in the atmosphere include:<br>• terrain,<br>• land cover, and<br>• meteorology. | Modelled WRF meteorological data was obtained for the period 1 January 2016 to 31 December 2018 for dispersion modelling purposes and to describe the local dispersion potential. | Section 3.2 |
| | Identification of existing air pollution sources (other mines; power stations; industries; etc.). | The Highveld Priority Area (HPA) baseline assessment and site visit observations were used to describe nearby air pollution sources. | Section 3.3 |
| | Identification of air quality-sensitive receptors, including any nearby residential dwellings and proposed receptors (temporary or permanent workers accommodation site(s)) near the facility. | The locations of schools, residential areas and farmsteads near the study area were identified from Google Earth imagery and from information gathered during the site visit for the noise impact assessment. | Section 3.1 |
| | Analysis of available ambient air quality data for the area. Particulate Matter (PM) data from the nearest Department of Environmental Affairs (DEA) monitoring station at Hendrina is provided. | Ambient air quality data at the nearest DEA monitoring station at Hendrina was sourced from the most recently available data from the South African Air Quality Information System (SAAQIS) (1 February 2018 to 31 January 2019). | Section 3.4 |
| Impact Assessment | The compilation of an emissions inventory incl. the identification and quantification of all emissions associated with the existing and proposed operations. | Air quality impacts will be associated with four distinct phases namely: the construction phase, the operational phase (surface mining), the operational phase (underground mining) and the closure and post-closure phase. | Section 4.1 |

| Task | Activity | Description | Section of Report |
|---|---|---|---|
| | | Pollutants quantified include particulate matter (TSP, $PM_{10}$ and $PM_{2.5}$). Use was made of process description, throughput rates and infrastructure maps to quantify activity emissions through the application of emissions factors and emission equations as published by the United States Environmental Protection Agency (US EPA) and Australian National Pollutant Inventory (NPI). | |
| | Atmospheric dispersion simulations of all pollutants ($PM_{10}$, $PM_{2.5}$ and dust fallout) for the operations reflecting highest daily and annual average concentrations due to routine emissions from the mining operations were done using the US EPA approved AERMOD model. | As per the National Code of Practice for Air Dispersion Modelling use is made of the US EPA approved AERMOD atmospheric dispersion modelling suite for the simulation of ambient air pollutant concentrations and dustfall rates. AERMOD is a Gaussian plume model, which is best used for near-field applications where the steady-state meteorology assumption is most likely to apply. | Section 4.2 |
| | Dispersion modelling results and compliance evaluation for Operational phases, with two sub-scenarios (unmitigated and mitigated).<br>Closure and Decommissioning phases are assessed qualitatively. | Compliance is assessed by comparing modelled ambient PM ($PM_{2.5}$ and $PM_{10}$) concentrations and dustfall rates to the relevant National Ambient Air Quality Standards (NAAQSs) and National Dustfall Control Regulations (NDCR). | Section 4.3 |
| | AQIA | The impact significance is based on an impact significance rating methodology provided by ABS Africa. | Section 5 |
| | The identification of air quality management and mitigation measures based on the findings of the compliance and impact assessment. | Practical mitigation and optimisation measures that can be implemented effectively to reduce or enhance the significance of impacts were identified. | Section 6 |
| Greenhouse Gas Emissions Statement | A Tier 1 (if required Tier 2) greenhouse gas inventory and qualitative discussion on climate change impacts. | Scope 1 and Scope 2 carbon dioxide ($CO_2$), methane ($CH_4$) and nitrous oxide ($N_2O$) emissions were calculated for the operational phase. This includes diesel used for opencast and underground mining and infrastructure operations. Fugitive methane emissions were calculated for opencast and underground mining.<br>Scope 1 and Scope 2 emissions were converted to $CO_2$ equivalent ($CO_2$-e) emissions.<br>Modelling was not included in the scope of work. | Section 7 |

## 1.5 Limitations and Assumptions

The main assumptions, exclusions and limitations are summarized below:

- Meteorological data: no onsite meteorological data was available. Modelled WRF data for the study site was obtained for the period January 2016 – December 2018.
- Operational hours for the processing plant were provided as 24 hours per day, 7 days a week. Operational hours for mining activities were given as 24 hours per day, 6 days a week. It was assumed that this information is correct.
- Emissions:
  - The quantification of sources of emission was for Project activities only. Background sources were not included.
  - Information required for the calculation of emissions from fugitive dust sources for the facility's operations were provided in the form of ROM tonnages and overburden volumes. Bulk densities of overburden materials typical to the study area were used to calculate overburden tonnages.
  - Only routine emissions were estimated and modelled. This was done for the provided operational hours.
  - Gaseous emissions from vehicle exhaust and other auxiliary equipment were not quantified as the impacts from these sources are usually localized and unlikely to exceed health screening limits outside the project area. The main pollutant of concern from the operations at the study site is particulate matter and hence formed the focus of the study.
  - Particle size distribution for discard and product coal material was based on information from similar mining processes.
- Impact assessment:
  - Impacts due to two operational phases (Year 5 and Year 9) were assessed quantitatively, whilst the construction, closure and decommissioning phases were assessed qualitatively due to the limited information available.
  - The impact assessment was limited to airborne particulate (including TSP, $PM_{10}$ and $PM_{2.5}$).
  - There will always be some degree of uncertainty in any geophysical model, but it is desirable to structure the model in such a way to minimize the total error. A model represents the most likely outcome of an ensemble of experimental results. The total uncertainty can be thought of as the sum of three components: the uncertainty due to errors in the model physics; the uncertainty due to data errors; and the uncertainty due to stochastic processes (turbulence) in the atmosphere. Nevertheless, dispersion modelling is generally accepted as a necessary and valuable tool in air quality management and typically provides a conservative prediction of emission concentrations.
- Greenhouse gas (GHG):
  - Scope 1 and Scope 2 carbon dioxide ($CO_2$), methane ($CH_4$) and nitrous oxide ($N_2O$) emissions were calculated for the operational phase (using the annual fuel usage as calculated from equipment information contained in the Mine Working Plan, and the annual throughputs for opencast and underground coal mining to calculate fugitive methane emissions). The fuel usage includes diesel used for mining and infrastructure operations;
  - Modelling was not included in the scope of work.

# 2 Regulatory Requirements and Impact Assessment Criteria

Prior to assessing the impact of proposed activities on human health and the environment, reference needs to be made to the environmental regulations governing the impact of such operations i.e. air emission standards, ambient air quality standards and dust control regulations.

Air emission standards are generally provided for point sources and specify the amount of the pollutant acceptable in an emission stream and are often based on proven efficiencies of air pollution control equipment.

Air quality guidelines and standards are fundamental to effective air quality management, providing the link between the source of atmospheric emissions and the user of that air at the downstream receptor site. The ambient air quality standards indicate safe daily exposure levels for the majority of the population, including the very young and the elderly, throughout an individual's lifetime. Air quality guidelines and standards are normally given for specific averaging or exposure periods.

This section summarises legislation for particulate matter (PM) concentrations and dustfall. Discussions on regulations regarding dispersion modelling and emissions reporting are also provided.

## 2.1 Emission Standards

The NEMAQA (Act No. 39 of 2004 as amended) (DEA, 2005) mandates the Minister of Environment to publish a list of activities which result in atmospheric emissions and consequently cause significant detrimental effects on the environment, human health and social welfare. All scheduled processes as previously stipulated under the Air Pollution Prevention Act (APPA) (Dept of Labour, 1993) are included as listed activities with additional activities added to the list. The updated Listed Activities and Minimum National Emission Standards (MES) were published on the 22nd November 2013 (Government Gazette No. 37054). An amendment to this Act was published in June 2015.

According to the Project description, none of the Project activities trigger a listed activity and therefore there is no need for an AEL application.

### 2.1.1 Ambient Air Quality Standards for Criteria Pollutants

Criteria pollutants are considered those pollutants most commonly found in the atmosphere, that have proven detrimental health effects when inhaled and are regulated by ambient air quality criteria. These include carbon monoxide (CO), nitrogen dioxide ($NO_2$,), sulfur dioxide ($SO_2$), $PM_{2.5}$ and $PM_{10}$. The main pollutant of concern in this study is particulate matter.

The South African Bureau of Standards (SABS) assisted the DEA in the development of ambient air quality standards. NAAQS were determined based on international best practice for $PM_{10}$, $PM_{2.5}$, dustfall, $SO_2$, $NO_2$, $O_3$, CO, lead and benzene.

The final revised NAAQSs were published in the Government Gazette on 24 of December 2009 (DEA, 2009) and in some instances included a margin of tolerance and linked implementation timelines. NAAQSs for $PM_{2.5}$ were published on 29 June 2012 (DEA, 2012). NAAQSs for the criteria pollutants assessed in this study are listed in Table 2. Currently, only $PM_{2.5}$ has a margin of tolerance, which is applicable until 31 December 2029. Short-term standards (daily) are represented by a limit value based on the 99th percentile of the observation (or simulated concentration) for that averaging period.

*Table 2: Air quality standards for specific criteria pollutants (SA NAAQS)*

| Pollutant | Averaging Period | Limit Value (µg/m³) | Frequency of Exceedance | Compliance Date |
|---|---|---|---|---|
| $PM_{10}$ | 24-hour | 75 | 4 | 1 Jan 2015 |
| | 1 year | 40 | 0 | 1 Jan 2015 |
| $PM_{2.5}$ | 24-hour | 40 | 4 | 1 Jan 2016 – 31 Dec 2029 |
| | | 25 | 4 | 1 Jan 2030 |
| | 1 year | 20 | 0 | 1 Jan 2016 – 31 Dec 2029 |
| | | 15 | 0 | 1 Jan 2030 |

### 2.1.2 National Dust Control Regulations

The NDCR were published on the 1st of November 2013 (DEA, 2013). The purpose of the regulations is to prescribe general measures for the control of dust from areas operations identified by a local Air Quality Officer as potentially causing a nuisance. Acceptable dustfall rates for residential and non-residential areas according to the regulation is summarised in Table 3.

*Table 3: Acceptable dustfall rates*

| Restriction areas | Dustfall rate (D) in mg/m²-day over a 30 day average | Permitted frequency of exceedance |
|---|---|---|
| Residential areas | D < 600 | Two within a year, not sequential months. |
| Non-residential areas | 600 < D < 1 200 | Two within a year, not sequential months. |

The regulation also specifies that the method to be used for measuring dustfall and the guideline for locating sampling points shall be American Standard Testing Method (ASTM, 1970)[2], or equivalent method approved by any internationally recognized body. It is important to note that dustfall is assessed for nuisance impact and not inhalation health impact.

[2] ASTM 1739:70 is a previous version of ASTM 1739 which did not prescribe a wind shield around the opening of the bucket; the addition of a wind shield is intended to deflect wind away from the lip of the container, allowing for a more laminar flow across the top of the collecting container (Kornelius *et al*., 2015). SANS 1929-2004 does however refer to ASTM 1739-98 (ASTM, 1998), which has a wind shield.

## 2.2 International Conventions

International guidelines are referenced as part of this project to comply with the requirements of the International Finance Corporation (IFC) in cases where no national legislated standards exist (IFC, 2007). In South Africa, national air quality standards have been established which are in line with international criteria (Section 2.1).

The IFC Environmental Health and Safety (EHS) Guidelines provide a general approach to air quality management for a facility, including the following:

- Identifying possible risks and hazards associated with the project as early on as possible and understanding the magnitude of the risks, based on:
  - the nature of the project activities; and,
  - the potential consequences to workers, communities, or the environment if these hazards are not adequately managed or controlled.
- Preparing project- or activity-specific plans and procedures incorporating technical recommendations relevant to the project or facility;
- Prioritising the risk management strategies with the objective of achieving an overall reduction of risk to human health and the environment, focusing on the prevention of irreversible and / or significant impacts;
- When impact avoidance is not feasible, implementing engineering and management controls to reduce or minimise the possibility and magnitude of undesired consequence; and,
- Continuously improving performance through a combination of ongoing monitoring of facility performance and effective accountability.

Significant impacts to air quality should be prevented or minimised by ensuring that:

- Emissions to air do not result in pollutant concentrations exceeding the relevant ambient air quality standards. These standards can be national guidelines or standards (or in their absence WHO AQGs or any other international recognised sources).
- Emissions do not contribute significantly to the relevant ambient air quality standards. It is recommended that 25% of the applicable air quality standards are allowed to enable future development in a given airshed.
- The EHS recognises the use of dispersion models to assess potential ground level concentrations. The models used should be internationally recognised or comparable.

## 2.3 Screening criteria for animals and vegetation

Limited information is available on the impact of dust on vegetation and grazing quality. While there is little direct evidence of the impact of dustfall on vegetation in the South African context, a review of European studies has shown the potential for reduced growth and photosynthetic activity in sunflower and cotton plants exposed to dustfall rates greater than 400 mg/m²/day (Farmer, 1993). In addition, there is anecdotal evidence to indicate that over extended periods, high dustfall levels in grazing lands can soil vegetation and this can impact the teeth of livestock (Farmer, 1993).

## 2.4 Regulations regarding Air Dispersion Modelling

Air dispersion modelling provides a cost-effective means for assessing the impact of air emission sources, the major focus of which is to assess compliance with the relevant ambient air quality standards. Regulations regarding Air Dispersion Modelling were promulgated in Government Gazette No. 37804 vol. 589; 11 July 2014, (DEA, 2014) and recommend a suite of dispersion models to be applied for regulatory practices as well as guidance on modelling input requirements, protocols and procedures to be followed. The Regulations regarding Air Dispersion Modelling are applicable –

a) in the development of an air quality management plan, as contemplated in Chapter 3 of the NEMAQA;
b) in the development of a priority area air quality management plan, as contemplated in section 19 of the NEMAQA;
c) in the development of an atmospheric impact report, as contemplated in section 30 of the NEMAQA; and,
d) in the development of a specialist air quality impact assessment study, as contemplated in Chapter 5 of the NEMAQA.

The Regulations have been applied to the development of this report. The first step in the dispersion modelling exercise requires a clear objective of the modelling exercise and thereby gives clear direction to the choice of the dispersion model most suited for the purpose. Chapter 2 of the Regulations present the typical levels of assessments, technical summaries of the prescribed models (SCREEN3, AERSCREEN, AERMOD, SCIPUFF, and CALPUFF) and good practice steps to be taken for modelling applications. The project falls under a Level 2 assessment – which is described as follows:

- The distribution of pollutant concentrations and deposition are required in time and space.
- Pollutant dispersion can be reasonably treated by a straight-line, steady-state, Gaussian plume model with first order chemical transformation. The model specifically to be used in the air quality impact assessment of the proposed operation is AERMOD.
- Emissions are from sources where the greatest impacts are in the order of a few kilometers (less than 50 km) downwind)

Dispersion modelling provides a versatile means of assessing various emission options for the management of emissions from existing or proposed installations. Chapter 3 of the Regulation prescribe the source data input to be used in the model. Dispersion models are particularly useful under circumstances where the maximum ambient concentration approaches the ambient air quality limit value and provide a means for establishing the preferred combination of mitigation measures that may be required.

Chapter 4 of the Regulations prescribe meteorological data input from onsite observations to simulated meteorological data. The chapter also gives information on how missing data and calm conditions are to be treated in modelling applications. Meteorology is fundamental for the dispersion of pollutants because it is the primary factor determining the diluting effect of the atmosphere.

Topography is also an important geophysical parameter. The presence of terrain can lead to significantly higher ambient concentrations than would occur in the absence of the terrain feature. In particular, where there is a significant relative difference in elevation between the source and off-site receptors large ground level concentrations can result.

The modelling domain would normally be decided on the expected zone of influence; the extent being defined by simulated ground level concentrations from initial model runs. The modelling domain must include all areas where the ground level concentration is significant when compared to the air quality limit value (or other guideline). Air dispersion models require a receptor grid at which ground-level concentrations can be calculated. The receptor grid size should include the entire modelling domain to ensure that the maximum ground-level concentration is captured and the grid resolution (distance between grid points) sufficiently small to ensure that areas of maximum impact adequately covered. No receptors should however be located within the property line as health and safety legislation (rather than ambient air quality standards) is applicable within the site.

Chapter 5 provides general guidance on geophysical data, model domain and coordinates system requirements, whereas Chapter 6 elaborates more on these parameters as well as the inclusion of background air pollutant concentration data. Chapter 6 also provides guidance on the treatment of $NO_2$ formation from NOx emissions, chemical transformation of $SO_2$ into sulphates and deposition processes.

Chapter 7 of the Regulation outlines how the plan of study and modelling assessment reports are to be presented to authorities.

## 2.5 South African Climate Change Literature and Legislation

### 2.5.1 National Climate Change Response Policy 2011

South Africa ratified the United Nations Framework Convention on Climate Change (UNFCCC)[3] in August 1997 and acceded to the Kyoto protocol in 2002, with effect from 2005. However, since South Africa is a non-annex I country[4] it implies no binding commitment to cap or reduce GHG emissions.

[3] The UNFCCC is an international environmental treaty adopted on 9 May 1992 and entered into force on 21 March 1994, after a sufficient number of countries had ratified it. The framework sets non-binding limits on greenhouse gas emissions for individual countries and contains no enforcement mechanisms. Instead, the framework outlines how specific international treaties (called "protocols" or "Agreements") may be negotiated to specify further action towards the objective of the UNFCCC.

[4] Annex I and Annex B Countries/Parties are the signatory nations to the Kyoto Protocol that are subject to caps on their emissions of GHGs and committed to reduction targets–countries with developed economies. As a developing country (non-annex I country), South Africa is mandated to provide the prescribed data in the emission inventory and submit periodic national communications to the UNFCCC secretariat, although there are several other contributions that can be made which are essentially of a voluntary nature. Climate change response measures must be consistent with the national development needs and government priorities.

The National Climate Change Response White Paper stated that in responding to climate change, South Africa has two objectives: to manage the inevitable climate change impacts and to contribute to the global effort in stabilising GHG emissions at a level that avoids dangerous anthropogenic interference with the climate system. The White Paper proposes mitigation actions, especially a departure from coal-intensive electricity generation, be implemented in the short- and medium-term to match the GHG trajectory range. Peak GHG emissions are expected between 2020 and 2025 before a decade long plateau period and subsequent reductions in GHG emissions.

The White Paper also highlighted the co-benefit of reducing GHG emissions by improving air quality and reducing respiratory diseases by reducing ambient particulate matter, ozone and $SO_2$ concentrations to levels in compliance with NAAQS by 2020. In order to achieve these objectives, the DEA has appointed a service provider to establish a national GHG emissions inventory, which will report through SAAQIS.

### 2.5.2 Intended Nationally Determined Contribution

The South African Intended Nationally Determined Contribution (INDC) submission was completed in 2015. This was undertaken to comply with decision 1/CP.19 and 1/CP.20 of the Conference of the Parties to the UNFCCC. This document describes South Africa's INDC on adaptation, mitigation and finance and investment necessities to undertake the resolutions.

As part of the adaptation portion the following goals have been assembled:

1. Goal 1: Development and implementation a National Adaption Plan. The implementation of this will also result in the implementation of the National Climate Change Response Plan (NCCRP) as per the 2011 policy.
2. Goal 2: In the development of national, sub-national and sector strategy framework, climate concerns must be taken into consideration.
3. Goal 3: An official institutional function for climate change response planning and implementation needs to be assembled.
4. Goal 4: The creation of an early warning, vulnerability and adaptation monitoring system
5. Goal 5: Develop policy regarding vulnerability assessment and adaptation needs.
6. Goal 6: Disclosure of undertakings and costs with regards to past adaptation strategies.

As part of the mitigation portion the following have been or can be implemented:

- The approval of 79 (5 243 MW) renewable energy Independent Power Producer (IPP) projects as part of a Renewable Energy Independent Power Producer Procurement Programme (REI4P). An additional 6 300 MW is being deliberated.
- A "Green Fund" has been created to back green economy initiatives. This fund will be increased in the future to sustain and improve successful initiatives.
- It is intended that by 2050 electricity will be decarbonised.
- Carbon Capture and Sequestration (or Carbon Capture and Storage) (CCS) which is discussed in more detail in the mitigation section.
- To support the use of electric and hybrid electric vehicles.

- Reduction of emissions can be achieved through the use of energy efficient lighting; variable speed drives and efficient motors; energy efficient appliances; solar water heaters; electric and hybrid electric vehicles; solar PV; wind power; CCS; and advanced bio-energy.

### 2.5.3 Greenhouse Gas as a Priority Pollutant

Greenhouse gases – $CO_2$, $CH_4$, $N_2O$, HFCs, PFCs and $SF_6$ – have been declared priority pollutants under Section 29(1) of the Air Quality Act (Government Gazette 37421 of 14 March 2014). The declaration provides a list of sources and activities including (i) fuel combustion (both stationary and mobile), (ii) fugitive emission from fuels, (iii) industrial processes and other product use, (iv) agriculture; forestry and other land use and (v) waste management. GHG emitters in excess of 0.1 Megatons or more, measured as $CO_2$-e, are required to submit a pollution prevention plan to the Minister for approval.

### 2.5.4 Greenhouse Gas Inventories

#### *2.5.4.1 National Greenhouse Gas Emissions Inventory*

South Africa is perceived as a global climate change contributor and is undertaking steps to mitigate and adapt to the changing climate. DEA is categorised as the lead climate change institution and is required to coordinate and manage climate related information such as development of mitigation, monitoring, adaption and evaluation strategies (DEA, 2014a). This includes the establishment and updating of the National GHG Inventory. The National Greenhouse Gas Improvement Programme (GHGIP) has been initiated; it includes sector specific targets to improve methodology and emission factors used for the different sectors and improving the availability of data.

The 2000 to 2010 National GHG Inventory was prepared using the 2006 Intergovernmental Panel on Climate Change (IPCC) Guidelines (IPCC, 2006). According to the National GHG Inventory (DEA, 2014a) the 2010 total GHG emissions were estimated at approximately 544.314 million metric tonnes $CO_2$-e (excluding Forestry and Other Land Use (FOLU)). This was a 21.1% increase from the 2000 total GHG emissions (excluding FOLU). FOLU is estimated to be a net carbon sink which reduces the 2010 GHG emissions to 518.239 million metric tonnes $CO_2$-e. The assessment (excluding FOLU) showed the main sectors contributing to GHG emissions in 2010 to be the energy industries (solid fuels); road transport; manufacturing industry and construction (solid fuels); and energy industries (liquid fuels). In 2010 the energy industry contributed 78.7% to the total GHG emissions (excluding FOLU), this increased by 3.6% from 2000.

The DEA is working together with local sectors to develop country specific emissions factors in certain areas; however, in the interim the IPCC default emission figures may be used to populate the SAAQIS GHG emission factor database. These country specific emission factors will replace some of the default IPCC emission factors.

#### *2.5.4.2 Greenhouse Gas Emission Inventory for the Sector*

The proposed Kranspan mining operations would most likely fall under the category of “industry” for the global GHG inventory and “manufacturing industries and construction” for the national GHG inventory. According to the "mitigation of climate change" document as part of the IPCC fifth Assessment Report (AR5) (IPCC, 2014) the 2010 global GHG emissions were 49 (±4.5) Gt $CO_2$-e, 21% (10 Gt $CO_2$-e) of which is as a result of industry. This category contributes approximately 41.117 million metric tonnes $CO_2$-e (excluding FOLU). 4.6% (1.891 million metric tonnes $CO_2$-e) of this emission is as a result of liquid fuel use.

### 2.5.5 Greenhouse Gas Reporting

Regulations pertaining to GHG reporting using the National Atmospheric Emissions Inventory System (NAEIS) was published on 3 April 2017 (Government Gazette 40762, Notice 275 of 2017). The South African mandatory reporting guidelines focus on the reporting of Scope 1 emissions only. The NAEIS web-based monitoring and reporting system will also be used to collect GHG information in a standard format for comparison and analyses. The system forms part of the National Atmospheric Emission Inventory component of SAAELIP and SAAQIS.

#### *2.5.5.1 Greenhouse Gas Reporting Requirements*

Based on the new GHG reporting regulations (Department Environmental Affairs, 2017a), Kranspan is required to:

1. Register all facilities where activities exceed the thresholds (for coal mining there is no threshold, so therefore the data provider has to report activity data and greenhouse gas emissions irrespective of the size of greenhouse gas emissions and the scale of the operation of the activity) listed in Annexure 1 by providing the relevant information as listed in Annexure 2 to these Regulations, within 30 days after the commencement of these Regulations or within 30 days after commencing such an activity after the commencement of these Regulations.
2. Ensure that the registration details are complete and are an accurate reflection of the IPCC emission sources at each facility.
3. The registration contemplated in sub-regulation (1) must be done as follows:
    i. on the NAEIS;
    ii. in cases where the NAEIS is unable to meet the registration requirements, the registration must be done by submitting the information specified in Annexure 2 in an electronic format to the competent authority.

The reporting requirements are:

1. Submit the greenhouse gas emissions and activity data as set out in the Technical Guidelines for Monitoring, Reporting and Verification of Greenhouse Gas Emissions by Industry (Department Environmental Affairs, 2017c) for each of the relevant greenhouse gases and IPCC emission sources specified in Annexure 1 to these Regulations for all of its facilities and in accordance with the data and format requirements specified in Annexure 3 to these Regulations for the preceding calendar year, to the competent authority by 31 March of each year.
2. Where the 31 March falls on a Saturday, Sunday or public holiday, the submission deadline is the next working day.
3. The reporting contemplated in sub-regulations (1) and (2) must be done as follows:
    i. on the NAEIS;

ii. in cases where the NAEIS is unable to meet the reporting requirements, the reporting must be done by submitting the information specified in Annexure 3 in an electronic format to the competent authority.

The technical guidelines (Department Environmental Affairs, 2017c) referenced by the NGER will be used for quantifying GHG inventories. Coal mining (code 1B1a as specified in Annexure 1) needs to report applying a tier[5] 2 or tier 3 methodology after 5 years from the date of promulgation of the regulations. Tier 1 can be used in the first 5 years.

The anticipated carbon tax will be calculated based on the $CO_2$eq emissions.

### 2.5.6 Carbon Tax Legislation

A draft carbon tax bill was introduced for a further round of public consultation. The Carbon Tax Policy Paper (CTPP) (Department of Environmental Affairs, 2013) stated consideration will be given to sectors where the potential for emissions reduction is limited.

[5] "Tier" means a method used for determining greenhouse gas emissions as defined by the "IPCC Guidelines for National Greenhouse Gas Inventories (2006)" and include–

i. Tier 1 method: A method using readily available statistical data on the intensity of processes (activity data) and IPCC emission factors (specified in the Technical Guidelines for Monitoring, Reporting and Verification of Greenhouse Gas Emissions by Industry or available in 2006 IPCC);
ii. Tier 2 method: similar to Tier 1 but uses country-specific emission factors;
iii. Tier 3 method: Tier 3 is any methodology more detailed than Tier 2 and might include amongst others, process models and direct measurements as specified in the 2006 IPCC guidelines.

# 3 Description of the Receiving Environment

This chapter provides details of the receiving environment which is described in terms of:

- The identification of Air Quality Sensitive Receptors (AQSRs) from available maps and Google Earth imagery;
- A study of the atmospheric dispersion potential of the area taking into consideration local meteorology, land-use and topography;
- The identification of existing sources of emissions in the study area; and
- The analysis of all available ambient air quality information/data to determine pre-development ambient pollutant levels and dustfall rates.

## 3.1 Receiving Environment

AQSRs primarily refer to places where people reside; however, it may also refer to other sensitive environments that may adversely be affected by air pollutants. Ambient air quality guidelines and standards, as discussed under Section 2.1, have been developed to protect human health. Ambient air quality, in contrast to occupation exposure, pertains to areas outside of an industrial site/mine boundary where the public has access to and according to the NEMAQA, excludes areas regulated under the Occupational Health and Safety Act (Act No 85 of 1993) (Dept of Labour, 1993).

Prior to dispersion modelling, 14 receptors were identified in the vicinity of the Project (within the 20-by-20 km modelling domain). Sensitive receptors include schools, residential areas, informal housing and farmsteads (Figure 4 and Table 4). The adjacent Northern and Msobo Coal Mines are also indicated in Figure 4.

*Table 4: Air quality sensitive receptors included in dispersion modelling*

| AQSR | Description | Distance (km) | Direction from site |
|---|---|---|---|
| 1 | Informal housing | 0 | – |
| 2 | Farmstead | 1.8 | SW |
| 3 | Farmstead | 5.3 | SW |
| 4 | Farmstead | 1.7 | SW |
| 5 | School | 0.6 | SW |
| 6 | Farmstead | 0.7 | W |
| 7 | Informal housing | 4.2 | W |
| 8 | Informal settlement | 1.2 | NW |
| 9 | Kromkrans primary school | 1.6 | NW |
| 10 | Farmstead | 4.2 | N |
| 11 | Farmstead | 3.7 | N |
| 12 | Silobela residential area | 9.8 | NE |
| 13 | Farmstead | 0 | – |
| 14 | Farmstead | 0 | – |

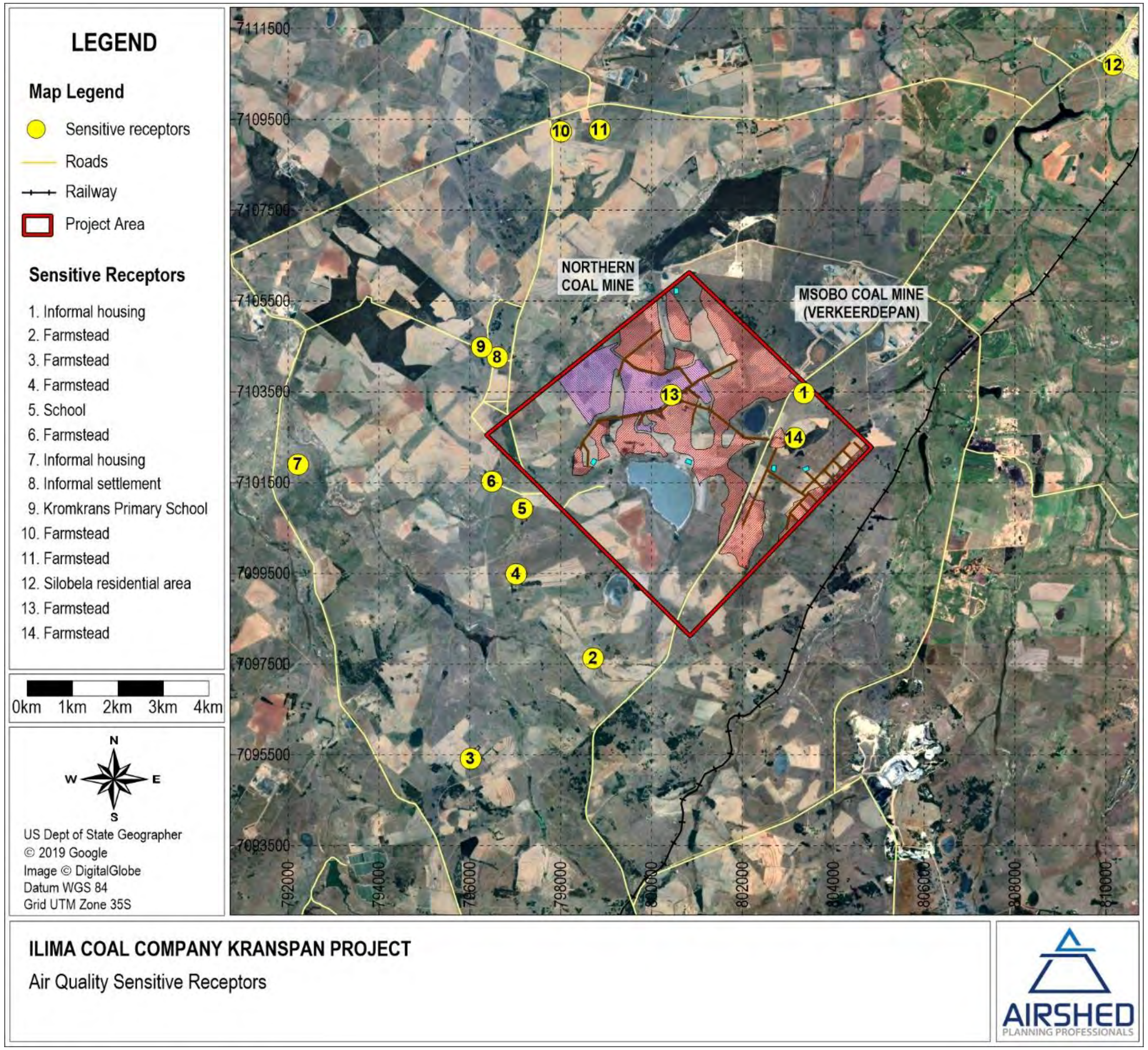


*Figure 4: Location of potential air quality sensitive receptors*

## 3.2 Atmospheric Dispersion Potential

Physical and meteorological mechanisms govern the dispersion, transformation, and eventual removal of pollutants from the atmosphere. The analysis of hourly average meteorological data is necessary to facilitate a comprehensive understanding of the dispersion potential of the site. Parameters useful in describing the dispersion and dilution potential of the site i.e. wind speed, wind direction, temperature and atmospheric stability, are subsequently discussed.

No weather station is located close to the proposed Project area, and use was made of WRF data to quantify the atmospheric dispersion potential. Data for the period January 2016 to December 2018 (3 years) was obtained as required by the regulations on Air Dispersion Modelling (DEA, 2014) (Section 2.4). The dataset is regarded as representative of the weather conditions at the project site.

### 3.2.1 Surface Wind Field

The wind field determines both the distance of downward transport and the rate of dilution of pollutants. The generation of mechanical turbulence is a function of the wind speed, in combination with the surface roughness. The wind field for the study area is described with the use of wind roses. Wind roses comprise 16 spokes, which represent the directions from which winds blew during a specific period. The colours used in the wind roses below, reflect the different categories of wind speeds; the yellow area, for example, representing winds in between 4 and 5 m/s. The dotted circles provide information regarding the frequency of occurrence of wind speed and direction categories. Calm conditions are periods when the wind speed was below 1 m/s. These low values can be due to "meteorological" calm conditions when there is no air movement; or, when there may be wind, but it is below the anemometer starting threshold.

The period wind field and diurnal variability in the wind field are shown in Figure 5. Seasonal variations in the wind field are provided in Figure 6. The wind field was predominantly from the west-northwest and north-east. Calm conditions occurred 4.70% of the time. There is a significant contrast between day-time and night-time wind fields. During the day, winds occurred more frequently from the north-westerly sector, with 4.75% calm conditions. Night-time airflow showed increased wind speeds which occurred most frequently from the north-easterly sector. The frequency of night-time calm conditions decreased to 4.65%. From Figure 6, autumn and winter show similar wind direction profiles to the period average, while summer shows more frequent winds from the east-northeast and a decrease in wind speeds from the north-west. There is an increased frequency of wind speeds of 3 m/s or more in spring.

According to the Beaufort wind force scale (https://www.metoffice.gov.uk/guide/weather/marine/beaufort-scale), wind speeds between 6-8 m/s equates to a moderate breeze, with wind speeds between 9-11 m/s referred to as a fresh breeze. Wind speeds between 11-14 m/s are described as a strong breeze with winds between 14-17 m/s near gale force winds and 17 - 21 m/s as gale force winds. Based on the three years of WRF data, wind speeds between 6 m/s and 8 m/s occurred 10.4% of the time; wind speeds between 9 m/s and 11 m/s occurred 5.4% of the time and wind speeds higher than11 m/s occurred 0.3% of the time.

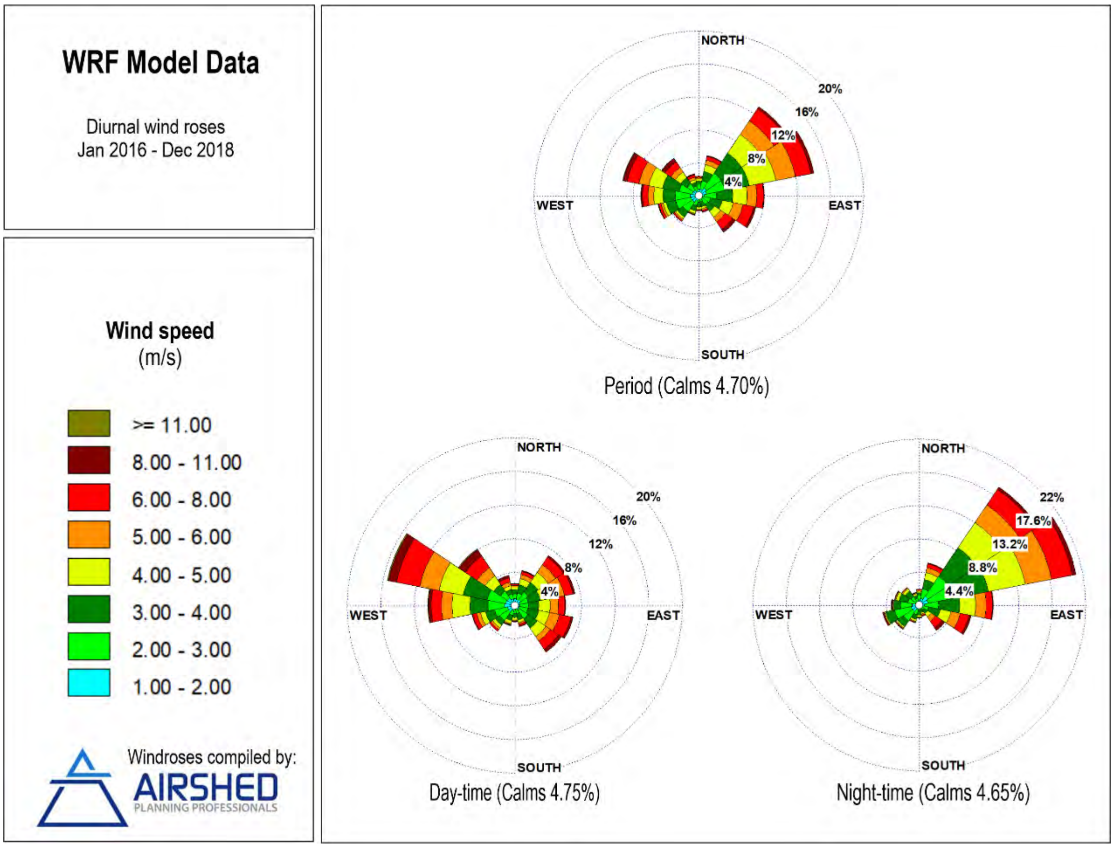


*Figure 5: Period, day- and night-time wind roses (WRF data; 2016-2018)*

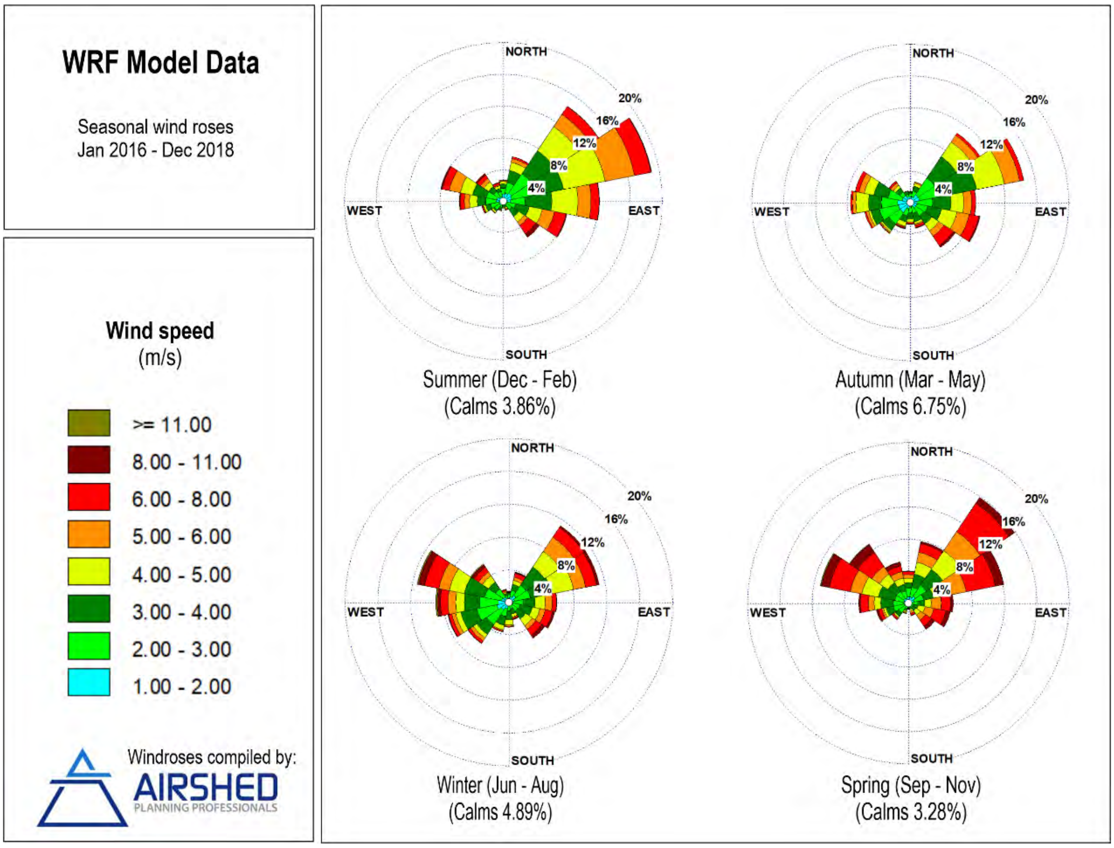


*Figure 6: Seasonal wind roses (WRF data; 2016-2018)*

### 3.2.2 Temperature

Air temperature is important, both for determining the effect of plume buoyancy (the larger the temperature difference between the plume and the ambient air, the higher a pollution plume is able to rise) and determining the development of the mixing and inversion layers. The monthly temperature pattern is shown in Figure 7. The area experienced mild temperatures during summer. Winter temperatures were relatively low especially in the month of July. Average maximum temperatures range from 33.3°C in December to 21.9°C in July, with minima ranging between -2.8°C in July and 7.8°C in December.

The diurnal temperature profile for the site is given in Figure 8. During the day, temperatures increase to reach maximum at around 12:00 in the afternoon. Ambient air temperature decreases to reach a minimum at around 05:00 i.e. just before sunrise.

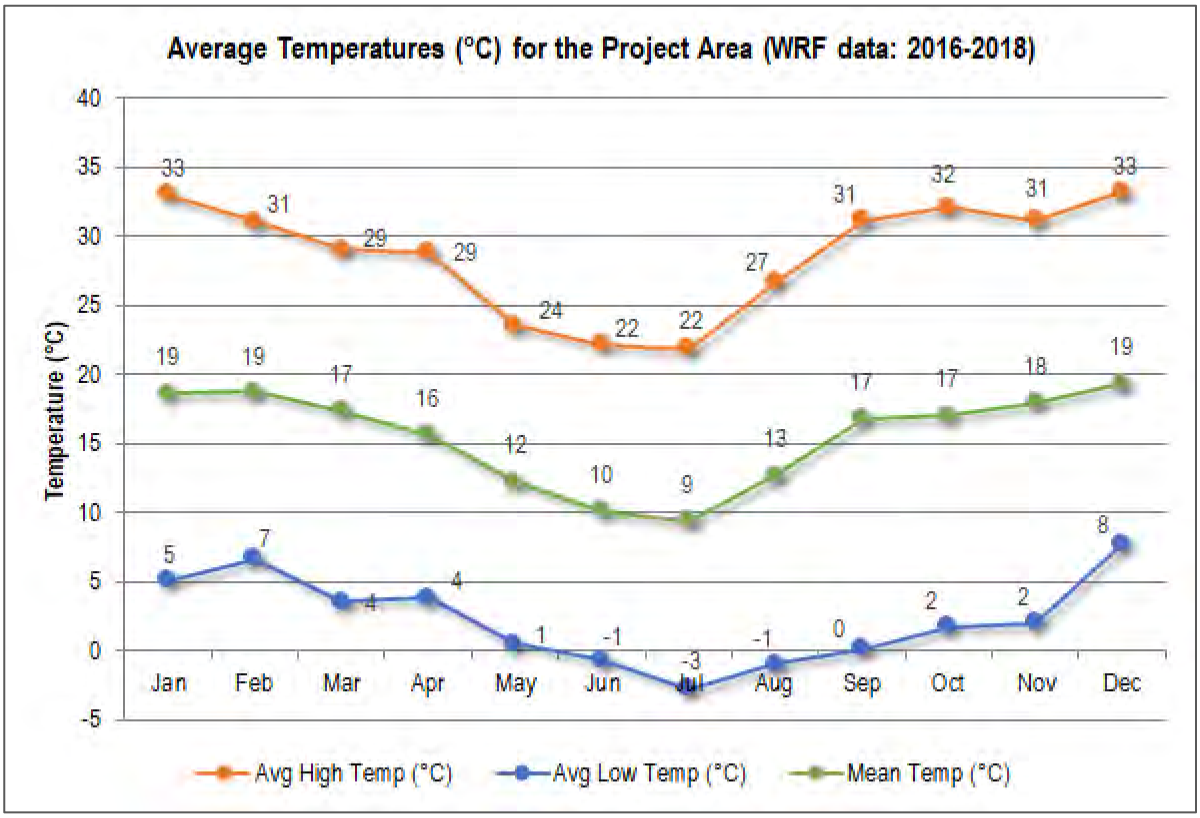


*Figure 7: Monthly temperature profile (WRF data; 2016-2018)*

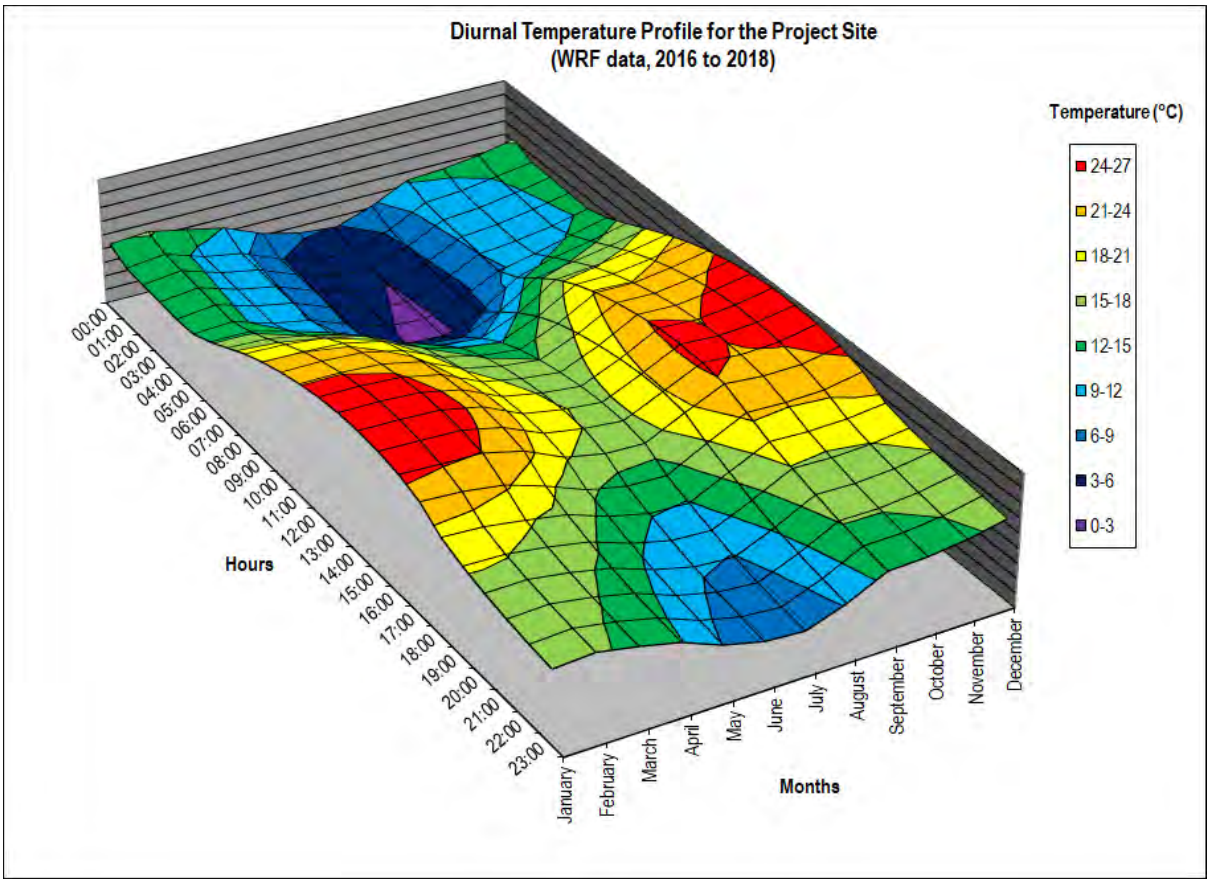


*Figure 8: Diurnal temperature profile (WRF data; 2016-2018)*

### 3.2.3 Precipitation

Precipitation is important to air pollution studies since it represents an effective removal mechanism for atmospheric pollutants and inhibits dust generation potentials. Monthly rainfall for the nearby town of Carolina, located 13km away, is given in Figure 9 (based on data obtained from http://www.saexplorer.co.za/south-africa/climate/carolina_climate.asp). Months wherein the most rain occur stretch from October to March. The average annual rainfall for Carolina is given as 613 mm.

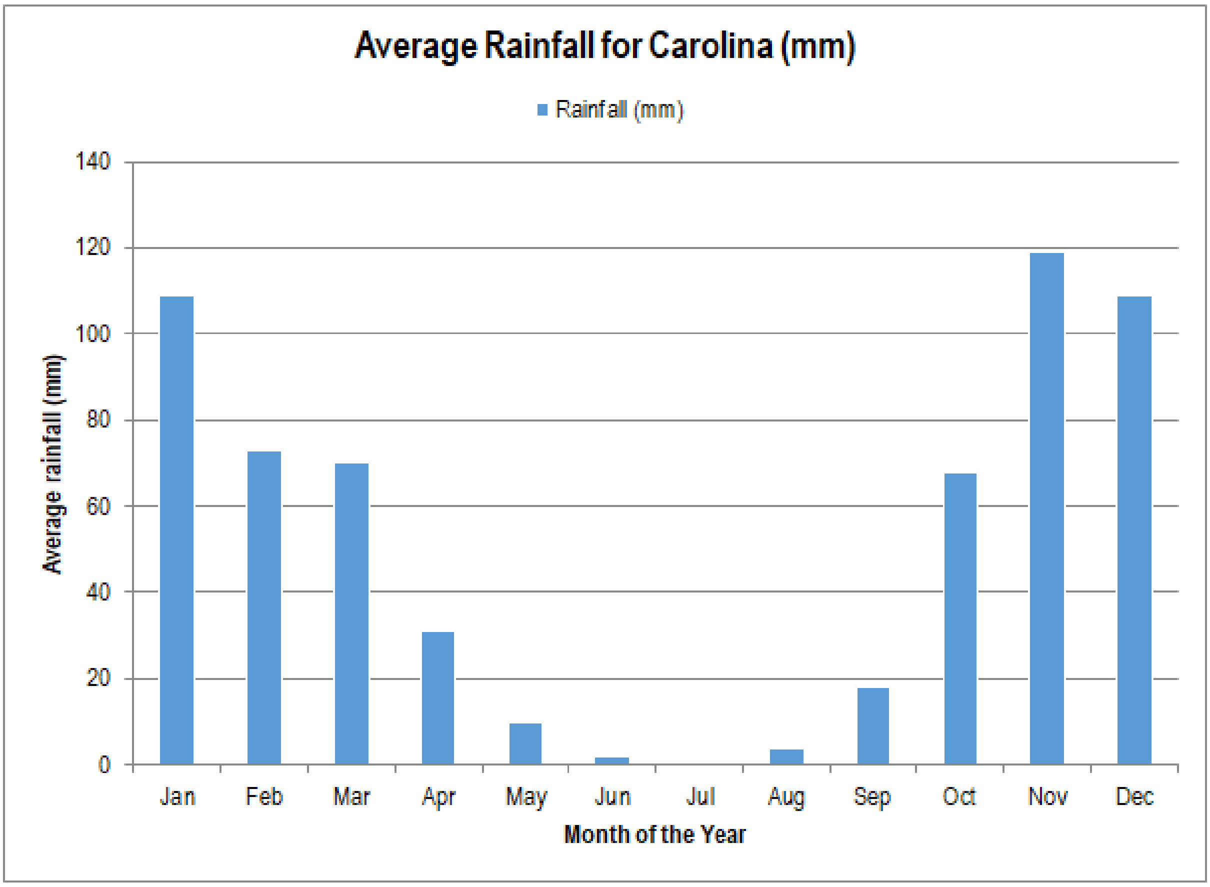


*Figure 9: Monthly precipitation (http://www.saexplorer.co.za/south-africa/climate/carolina_climate.asp)*

#### 3.2.4 Atmospheric Stability

The new generation air dispersion models differ from the models traditionally used in several aspects, the most important of which are the description of atmospheric stability as a continuum rather than discrete classes. The atmospheric boundary layer properties are therefore described by two parameters; the boundary layer depth and the Monin-Obukhov length, rather than in terms of the single parameter Pasquill Class. The Monin-Obukhov length ($L_{MO}$) provides a measure of the importance of buoyancy generated by the heating of the ground and mechanical mixing generated by the frictional effect of the earth's surface. Physically, it can be thought of as representing the depth of the boundary layer within which mechanical mixing is the dominant form of turbulence generation (CERC, 2004).

The atmospheric boundary layer constitutes the first few hundred metres of the atmosphere. During the daytime, the atmospheric boundary layer is characterised by thermal turbulence due to the heating of the earth's surface and the predominance of an unstable layer. In unstable conditions, ground level pollution is readily dispersed thereby reducing ground level concentrations (Figure 10). Night times are characterised by weak vertical mixing and the predominance of a stable layer. These conditions are normally associated with low wind speeds and less dilution potential (Figure 10). During windy and/or cloudy conditions, the atmosphere is normally neutral (which causes sound scattering in the presence of mechanical turbulence).

Atmospheric stability is frequently categorised into one of six stability classes – these are briefly described in Table 5 with the percentage time each class occurred at the study site. Diurnal variation in atmospheric stability described by the inverse Monin-Obukhov length and the mixing height is provided in Figure 11. For low level releases, such as activities associated with mining operations, the highest ground level concentrations would occur during weak wind speeds and stable (night-time) atmospheric conditions, which relates to 41% of the time at the study site. However, windblown dust is likely to occur under high winds (neutral conditions) which is for 25% of the time.

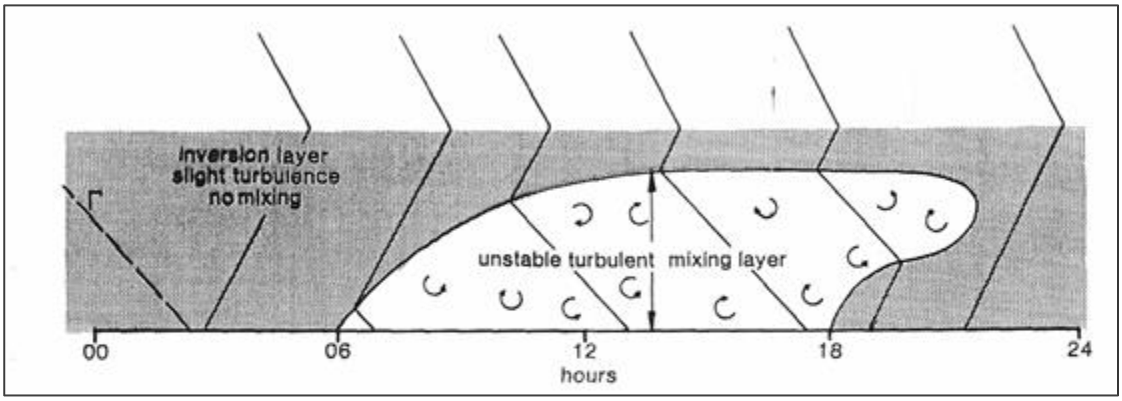


*Figure 10: Daytime development of a turbulent mixing layer (Preston-Whyte & Tyson, 1988)*

*Table 5: Atmospheric stability classes*

| Designation | Stability Class | Atmospheric Condition | Frequency of occurrence |
|---|---|---|---|
| A | Very unstable | calm wind, clear skies, hot daytime conditions | 5% |
| B | Moderately unstable | clear skies, daytime conditions | 7% |
| C | Unstable | moderate wind, slightly overcast daytime conditions | 22% |
| D | Neutral | high winds or cloudy days and nights | 25% |
| E | Stable | moderate wind, slightly overcast night-time conditions | 19% |
| F | Very stable | low winds, clear skies, cold night-time conditions | 22% |

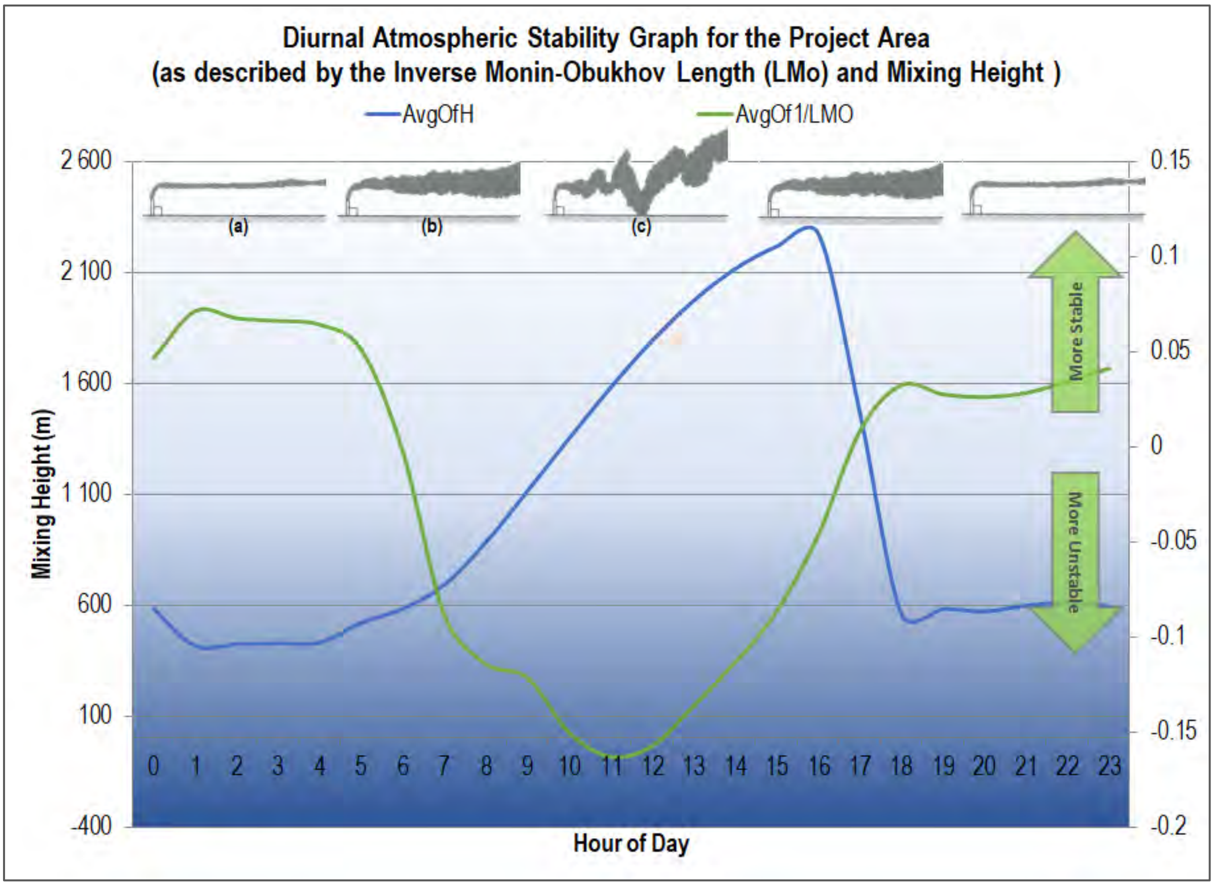


*Figure 11: Diurnal atmospheric stability graph for the Project area (based on WRF data: 2016-2018)*

## 3.3 Existing Sources of Emissions near the Project Site

Power generation, mining activities, farming and residential land-uses occur in the region. These land-uses contribute to baseline pollutant concentrations via vehicle tailpipe emissions, household fuel combustion, biomass burning and various fugitive dust sources. Long-range transport of particulates, emitted from remote tall stacks and from large-scale biomass burning in countries to the north of South Africa, has been found to contribute to background fine particulate concentrations within the South African boundary (Andreae, et al., 1996; Garstang, Tyson, Swap, & Edwards, 1996; Piketh, Annegarn, & Kneen, 1996).

### 3.3.1 Power Generation

Operational power stations are further west – Hendrina Power Station and Komati Power Station, at distances of 40km and 50km respectively; to the south (Camden Power Station, some 48km away); and to the northwest (Arnot Power Station, 30km away). The main emissions from such electricity generation operations are carbon dioxide ($CO_2$), $SO_2$, NOx and ash (PM). Fly-ash particles emitted comprise various trace elements such as arsenic, chromium, cadmium, lead, manganese, nickel, vanadium and zinc. Small quantities of volatile organic compounds are also released from such operations.

### 3.3.2 Mining Operations

Fugitive emissions from open cast and underground mining operations mainly comprise of land clearing operations (i.e. scraping, dozing and excavating), materials handling operations (i.e. tipping, off-loading and loading, conveyor transfer points), vehicle entrainment from haul roads, wind erosion from open areas, drilling and blasting. These activities mainly result in particulates and dust emissions, with small amounts of oxides of nitrogen ($NO_x$), carbon monoxide (CO), $SO_2$, methane and $CO_2$ being released during blasting operations. There are two known operational mines adjacent to the proposed Project, namely Northern Coal Mine and Msobo Coal Mine (previously known as Verkeerdepan Mine). Tselentis Colliery is located approximately 7.5km to the south.

### 3.3.3 Agricultural operations

Agriculture is a land-use within the area surrounding the site. Particulate matter is the main pollutant of concern from agricultural activities as particulate emissions are deriving from windblown dust, burning crop residue, and dust entrainment as a result of vehicles travelling along dirt roads. In addition, pollen grains, mould spores and plant and insect parts from agricultural activities all contribute to the particulate load. Should chemicals be used for crop spraying, they would typically result in odoriferous emissions. Crop residue burning is an additional source of particulate emissions and other toxins.

### 3.3.4 Miscellaneous Fugitive Dust Sources

Fugitive PM emissions are generated through entrainment from local paved and unpaved roads, and erosion of open or sparsely vegetated areas. The extent of particulate emissions from the main roads will depend on the number of vehicles using the roads and the silt loading on the roadways. Major paved roads in the area include the R36 main road to Carolina/Breyten. The extent, nature and duration of road-use activity and the moisture and silt content of soils are required to be known in order to quantify fugitive emissions from this source. The quantity of windblown dust is similarly a function of the wind speed, the extent of exposed areas and the moisture and silt content of such areas.

### 3.3.5 Vehicle Tailpipe Emissions

Air pollution from vehicle emissions may be grouped into primary and secondary pollutants. Primary pollutants are those emitted directly into the atmosphere, and secondary, those pollutants formed in the atmosphere as a result of chemical reactions, such as hydrolysis, oxidation, or photochemical reactions. Notable primary pollutants emitted by vehicles include $CO_2$, CO, hydrocarbons (HCs), $SO_2$, $NO_x$, DPM and Pb. Secondary pollutants include: $NO_2$, photochemical oxidants (e.g. ozone), HCs, sulphur acid, sulphates, nitric acid, nitric acid and nitrate aerosols. Hydrocarbons emitted include benzene, 1.2-butadiene, aldehydes and polycyclic aromatic hydrocarbons (PAH). Benzene represents an aromatic HC present in petrol, with 85% to 90% of benzene emissions emanating from the exhaust and the remainder from evaporative losses. Vehicle tailpipe emissions are localised sources and unlikely to impact far-field.

Both small and heavy private and industrial vehicles travelling along the R36 (public) road as well as unpaved public and private roads, are notable sources of vehicle tailpipe emissions.

### 3.3.6 Household Fuel Burning

Domestic households are known to have the potential to be one the most significant sources that contribute to poor air quality within residential areas. Individual households are low volume emitters, but their cumulative impact is significant. It is likely that households within the local communities or settlements utilize coal, paraffin and/or wood for cooking and/or space heating (mainly during winter) purposes. Pollutants arising from the combustion of wood include respirable particulates, CO and $SO_2$ with trace amounts of polycyclic aromatic hydrocarbons (PAHs), in particular benzo(a)pyrene and formaldehyde. Particulate emissions from wood burning have been found to contain about 50% elemental carbon and about 50% condensed hydrocarbons.

Coal is relatively inexpensive in the Mpumalanga region and is easily accessible due to the proximity of the region to coal mines and the well-developed coal merchant industry. Coal burning emits a large amount of gaseous and particulate pollutants including $SO_2$, heavy metals, PM including heavy metals and inorganic ash, CO, PAHs (recognized carcinogens), $NO_2$ and various toxins. The main pollutants emitted from the combustion of paraffin are $NO_2$, particulates, CO and PAHs.

## 3.4 Baseline Air Quality

Particulates represent the main pollutant of concern in the assessment of mining operations. The particulates in the atmosphere may contribute to visibility reduction, pose a threat to human health, or simply be a nuisance due to their soiling potential.

### 3.4.1 Modelled Ambient Air Pollutant Concentrations

The Project is located outside the Highveld Priority Area (Figure 12) and therefore the modelled $PM_{10}$ predictions and $PM_{10}$ hotspots, as provided in the Highveld Priority Area Management Plan, are not relevant to this study.

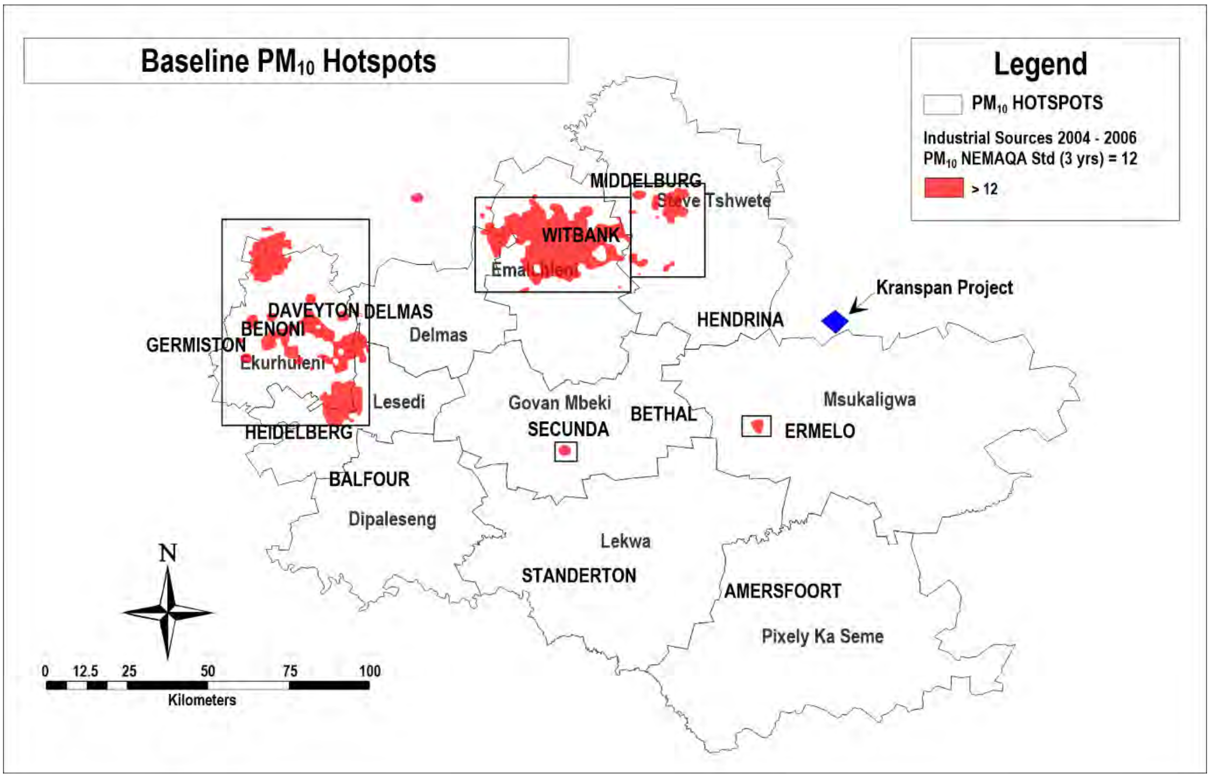


*Figure 12: Location of the Project (outside the Highveld Priority Area boundary)*

### 3.4.2 Monitored Ambient Concentrations

The DEA monitoring network has ambient monitoring stations to measure the ambient air quality within the Highveld Priority Area. The ambient monitoring stations are located at Ermelo, Hendrina, Middelburg, Secunda, and Witbank. The closest monitoring station to the Project is Hendrina (~24 km west) (see Figure 12).

The measured $PM_{10}$ and $PM_{2.5}$ daily ground level concentrations from the Hendrina monitoring station for the period February 2018 to January 2019 are provided in Figure 13 and Figure 14 respectively (data obtained from SAAQIS website (Department of Environmental Affairs, 2019)). No data was available for September to November 2018, and the data availability is only 68%.

The measured $PM_{10}$ and $PM_{2.5}$ concentrations exceed the respective daily NAAQS's mainly during the winter period. The annual average concentration was calculated from the monthly concentrations over the measuring period and was estimated to be 30 µg/m³ for $PM_{10}$ and 17 µg/m³ for $PM_{2.5}$ respectively.

It should be noted that the Hendrina monitoring station, which would be measuring local and far-afield emission sources, may not be representative of the background $PM_{10}$ and $PM_{2.5}$ concentrations at the Project site.

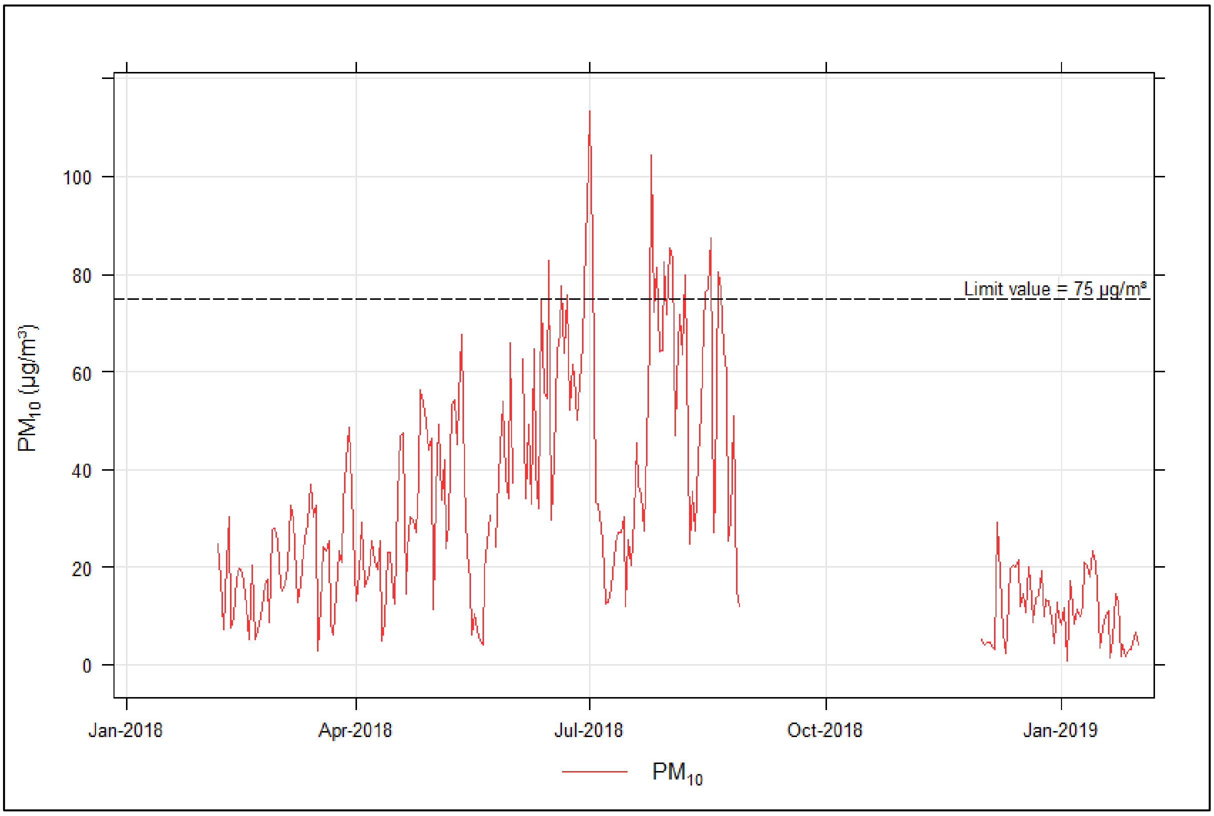


*Figure 13: Observed daily average $PM_{10}$ concentrations at Hendrina for the period Feb 2018 to Jan 2019*

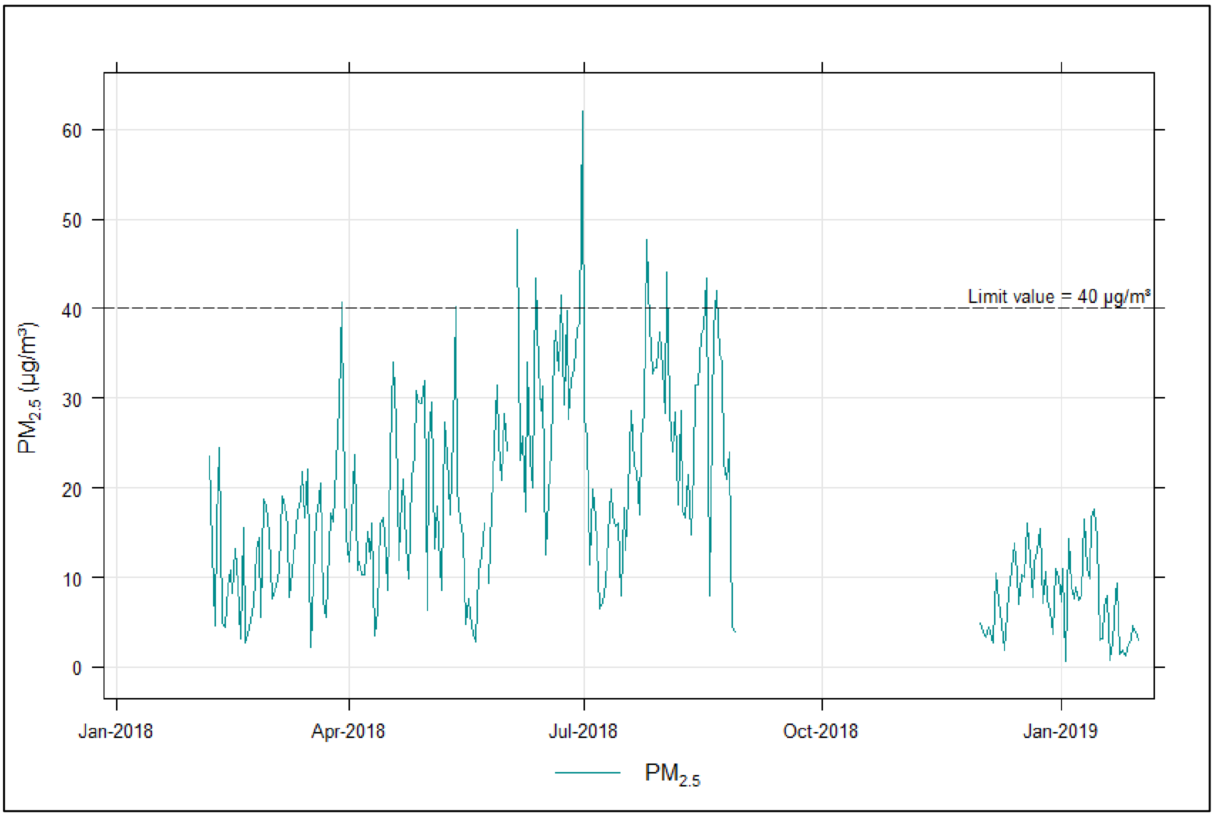


*Figure 14: Observed daily average $PM_{2.5}$ concentrations at Hendrina for the period Feb 2018 to Jan 2019*

The daily 99th percentiles for $PM_{10}$ exceed the limit value (75 µg/m³) at Hendrina station for 6% of the time during the 1-year period (Figure 15), whereas the daily 99th percentiles for $PM_{2.5}$ exceed the limit value (40 µg/m³) at Hendrina station for 3% of the time during the same period (Figure 16).

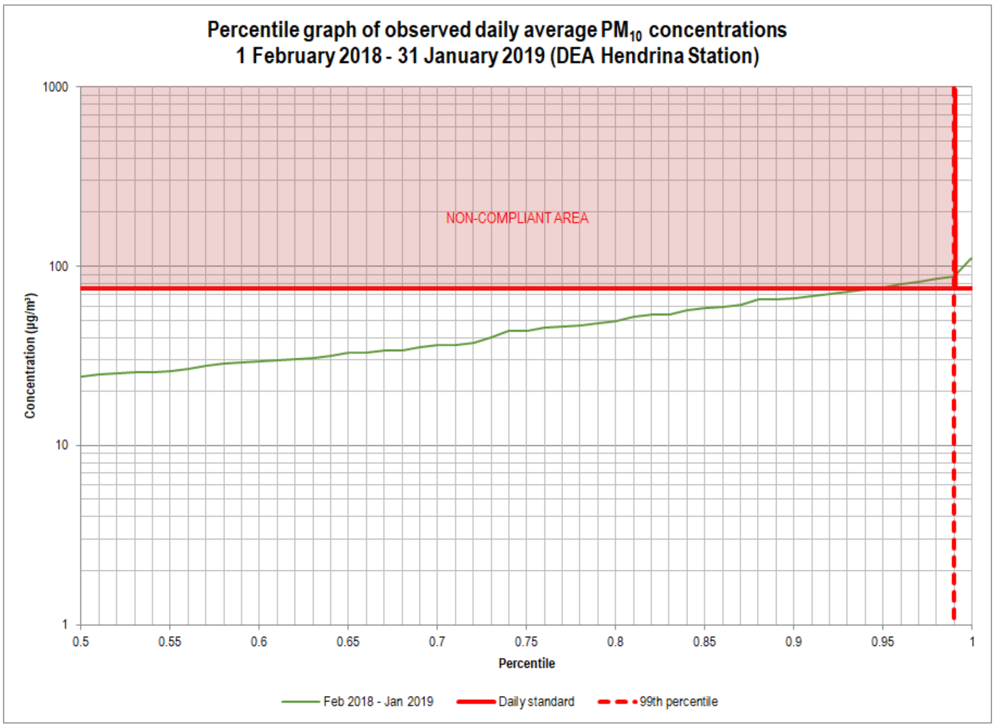


*Figure 15: Percentile graph of observed daily average $PM_{10}$ concentrations at Hendrina*

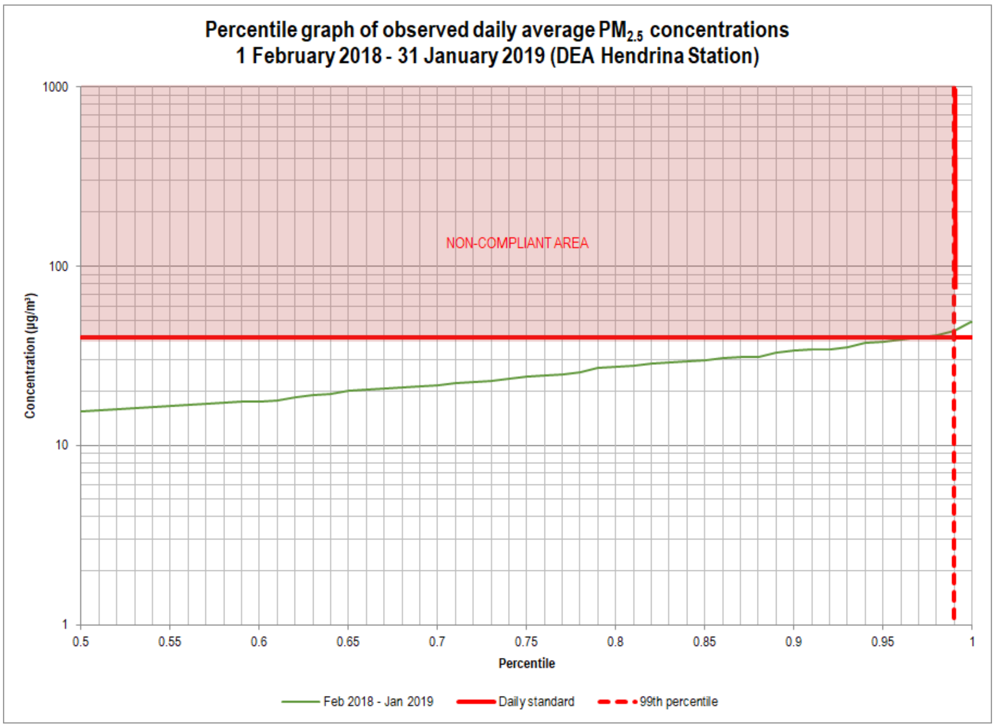


*Figure 16: Percentile graph of observed daily average $PM_{2.5}$ concentrations at Hendrina*

An analysis of the hourly observed $PM_{10}$ concentrations at Hendrina was completed, in which the concentration values were categorised into wind speed and direction bins for different concentrations, and visualised in the form of polar plots, where the centre of the polar plot refers to the location of the monitoring station. Polar plots provide an indication of the directional contribution as well as the dependence of concentrations on wind speed (Carslaw and Ropkins, 2012; Carslaw, 2013).

Whereas the directional display is fairly obvious, i.e. when higher concentrations are shown to occur in a certain sector, it is understood that most of the high concentrations occur when winds blow from that sector (i.e. east or south). When the high concentration pattern is more symmetrical around the centre of the plot, it is an indication that the contributions are near-equally distributed.

Particulate concentrations recorded at the DEA Hendrina monitoring station show high concentrations from nearby sources to the west-northwest and northwest (Komati and Hendrina Power Stations respectively) at low wind speeds (below 4 m/s) (Figure 17). Sources in the north-easterly and south-easterly sectors contribute the lowest concentrations, especially at higher wind speeds. Higher $PM_{10}$ concentrations (between 30 µg/m³ and 40 µg/m³) under high wind speed conditions (> 4 m/s) to the northeast indicate wind-dependent sources.


*Figure 17: Polar plot of hourly mean $PM_{10}$ concentration observations at Hendrina (February 2018 – January 2019)*

### 3.4.3 Dustfall Rates

The dustfall monitoring network, which consists of six buckets (shown in Figure 18), was established taking into consideration the position of the proposed plant, residential and non-residential areas in the vicinity of the premises, prevailing winds and areas where the most dust is visible, so as to determine baseline dust fallout levels. Dustfall rates as measured by the National Occupational Health and Safety (NOHS) Consultants Company during the period January 2019 are shown in Table 6 and Figure 19. The values were very low and did not exceed the residential or non-residential limits of 600 mg/m²/day and 1200 mg/m²/day respectively.


*Figure 18: NOHS dust monitoring points (NOHS Consultants, 27 February 2019)*

*Table 6: Dust fallout results for January 2019 (in mg/m²/day)*

| Sample # | Description | Coordinates (lat/lon) | Restriction Area (Future) | NDCR Limit Value (in mg/m²/day) | Measured fallout (in mg/m²/day) |
|---|---|---|---|---|---|
| 1 | Residence yard at REM OF PTN 3 | 26° 9'27.31"S 30° 0'32.12"E | Non-Residential | 1 200 | 10.69 |
| 2 | Residence yard at PTN 1 | 26° 9'56.86"S 30° 1'49.69"E | Non-Residential | 1 200 | 0.15 |
| 3 | Corner along R36 road | 26°11'2.00"S 30° 1'7.16"E | Non-Residential | 1 200 | 3.53 |
| 4 | East of Pan @ REM OF PTN 2 | 26°10'12.89"S 30° 0'24.89"E | Non-Residential | 1 200 | 1.55 |
| 5 | At the school | 26°10'49.87"S 29°58'22.75"E | Residential | 600 | 9.68 |
| 6 | REM OF PTN 2 | 26° 9'43.88"S 29°59'24.33"E | Non-Residential | 1 200 | 1.26 |

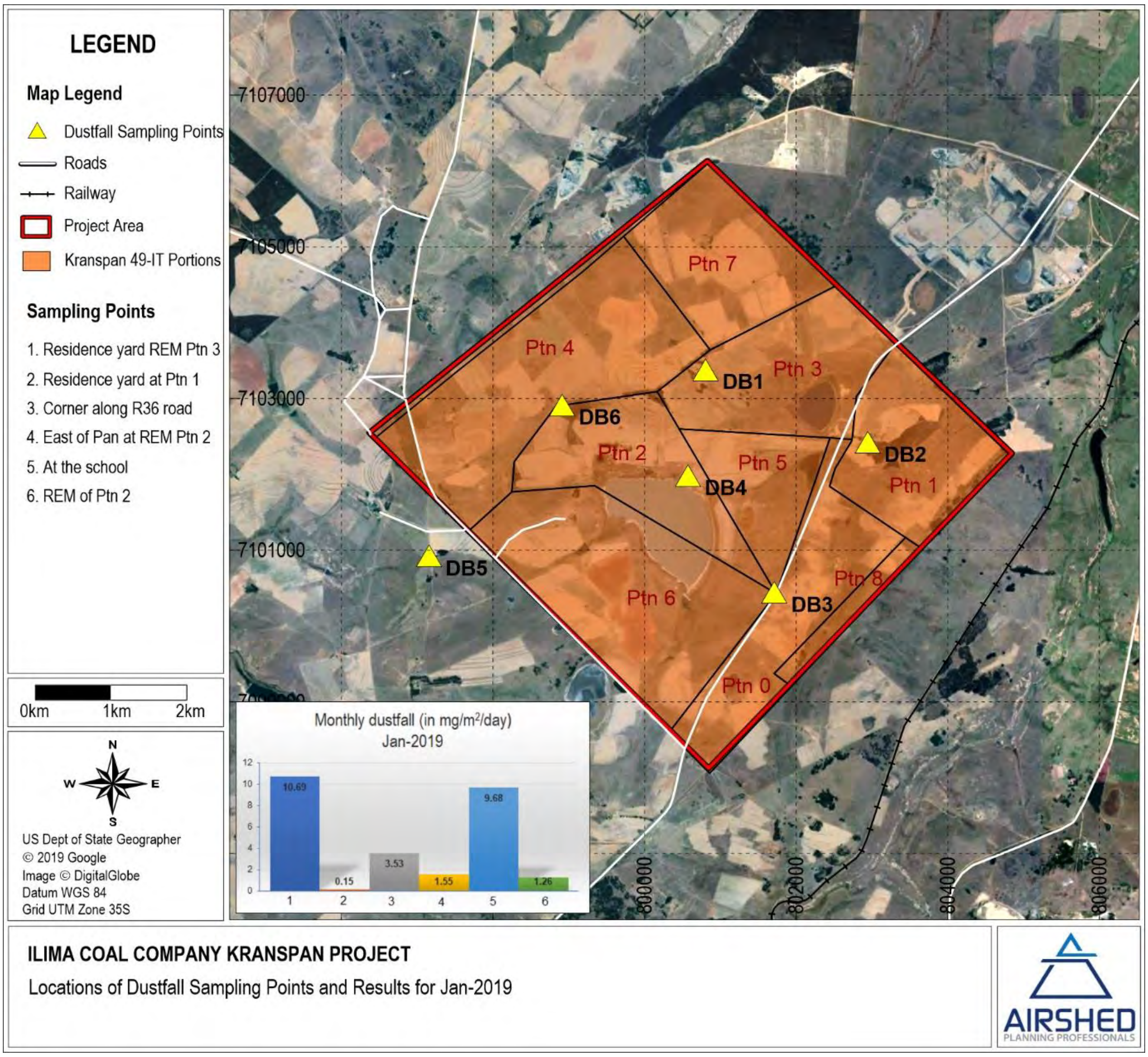


*Figure 19: NOHS dust monitoring points relative to the site boundary and first results for Jan-2019*

# 4 Impact Assessment

The emissions inventory, dispersion modelling and results are discussed in Section 4.1 and Section 4.2 respectively.

## 4.1 Atmospheric Emissions

### 4.1.1 Construction Phase

The mine infrastructure will be situated in the south-eastern portion of the farm Kranspan 49IT. The mine infrastructure will consist of the following:

- Opencast mining areas with contractors' camp.
- Haul roads to access the mining areas.
- Adits from opencast highwalls to provide access to the underground mining.
- ROM stockpile areas.
- Upcast ventilation shaft with the main fan situated on this shaft.
- Offices, stores, workshop, change house, and lamp room, all prefabricated structures that allows for easy removal and rehabilitation of the site.
- Parking area.
- Diesel Tanks
- Crushing and Screening Plant (Raw)
- Dense Medium beneficiation plant
- Product stockpiles and loading area.
- Discard/Tailings
- Onsite laboratory
- Weighbridges
- An access road to the shaft that will be constructed along the overland conveyor route and in the same servitude.

The main pollutant of concern from construction operations is particulate matter, including $PM_{10}$, $PM_{2.5}$ and TSP. $PM_{10}$ and $PM_{2.5}$ concentrations are associated with potential health impacts due to the size of the particulates being small enough to be inhaled. Nuisance effects are caused by the TSP fraction (20 µm to 75 µm in diameter) resulting in soiling of materials and visibility reductions. This could in effect also have financial implications due to the requirement for more cleaning materials.

Activities resulting in the release of these pollutants include topsoil removal, material loading and hauling, stockpiling, grading, bulldozing, as well as metal and concrete works for the establishment of infrastructure. Each of these operations has its own duration and potential for dust generation. It is anticipated that the extent of dust emissions would vary substantially from day to day depending on the level of activity, the specific operations, and the prevailing meteorological conditions. This contrasts with most other fugitive dust sources where emissions are either relatively steady or follow a discernible annual cycle. It is often necessary to estimate area wide construction emissions, without regard to the actual plans of any individual construction process.

Quantified construction emissions are usually lower than operational phase emissions and since the construction schedule was not available (and due to their temporary nature); and the likelihood that these activities will not occur concurrently at all portions of the site; dispersion simulation was not undertaken for construction emissions.

### 4.1.2 Operational Phase

To determine the significance of air pollution impacts from the proposed Project, the impacts as a result of unmitigated and mitigated operations during Year 5 and Year 9 were assessed, with Year 5 opencast areas located to the west and further away from the plant[6], and Year 9 opencast areas concentrated more to the east and closer to the plant (see site layout in Figure 2 and mining schedule in Figure 3).

The dispersion modelling scenarios may be described as follows:

- Scenario 1: YEAR 5 – Opencast and underground mining activities, with subsequent processing in the form of primary crushing and beneficiation at the wash plant and hauling and tipping of discard to a dedicated discard stockpile.
- Scenario 2: YEAR 5 – Opencast and underground mining activities, with subsequent processing in the form of primary crushing and beneficiation at the wash plant and hauling and backfilling of discard in the open void.
- Scenario 3: YEAR 9 – Opencast and underground mining activities, with subsequent processing in the form of primary crushing and beneficiation at the wash plant and hauling and tipping of discard to a dedicated discard stockpile.
- Scenario 4: YEAR 9 – Opencast and underground mining activities, with subsequent processing in the form of primary crushing and beneficiation at the wash plant and hauling and backfilling of discard in the open void.

For each scenario, the following two sub-scenarios were assessed:

- (a): Unmitigated activities; and
- (b): Design mitigated activities on roads, tipping points and crushers, drilling activities and overland conveyor. No mitigation of blasting activities, bulldozing activities or windblown dust from the coal stockpiles, overburden and topsoil stockpiles and discard stockpiles.

Aspects associated with the operational phase in terms of air quality are outlined in Table 7. The emission equations for each aspect are provided in Table 8. Particle size distributions for ROM coal, product coal and discard, and topsoil and overburden are shown in Table 9. The estimated control factors used in the calculation of mitigated emissions are shown in Table 10. The total emissions due to the operational phase are shown in Table 11 (for Scenario 1 operations) and Table 12 (for Scenario 2 operations).

[6] The assessment was done using the preferred location of the plant shown in Figure 2.

*Table 7: Environmental impacts and associated activities during the operational phase*

| Impact | Source | Activity |
|---|---|---|
| Particulates | UG ROM stockpile | Tipping at ROM stockpile, loading of overland conveyor to secondary crusher |
| | Opencast areas | Blasting and drilling of overburden and coal. Removal of ROM coal and 70% of hard overburden by the truck and shovel method, and 30% of overburden by bulldozing. Backfilling and rehabilitation of adjacent voids. |
| | Various points at the coal handling/ processing facility | Materials handling of coal at the ROM, product and discard stockpiles, out-loading export product to rail. |
| | Crushing plant | Primary crushing |
| | Washing plant | Secondary crushing |
| | Unpaved roads | Vehicle entrainment on unpaved road surfaces |
| | Paved road | Vehicle entrainment on paved road surfaces (R36) |
| | Wind erosion | Windblown dust from various stockpiles and discard stockpile |
| | Conveyor | Windblown dust from conveyor. |

*Table 8: Emission equations used to quantify fugitive dust emissions from the Project*

| Activity | Emission Equation | Source | Information assumed/provided |
|---|---|---|---|
| Materials handling | $$E = 0.0016\frac{(U/2.2)^{1.3}}{(M/2)^{1.4}}$$<br>Where,<br>E = Emission factor (kg dust / t transferred)<br>U = Mean wind speed (m/s)<br>M = Material moisture content (%)<br><br>The $PM_{2.5}$, $PM_{10}$ and TSP fraction of the emission factor is 5.3%, 35% and 74% respectively.<br><br>An average wind speed of 3.9 m/s was used based on the WRF data for the period 2016 – 2018. | US-EPA AP42 Section 13.2.4 | The moisture content of material is as follows:<br>ROM coal (opencast): 3.5% (from the mine working plan)<br>ROM coal (underground): 2% (from the mine working plan)<br>Discard coal: 5% (assumed)<br>Overburden: 7.9% (US EPA default mean moisture content, Table 11.9-3)<br>Topsoil: 3.4% (US EPA default mean moisture content, Table 11.9-3)<br><br>The throughput of materials was assumed as follows:<br>ROM coal (opencast): 1.29 mega ton per annum (Mtpa) (provided by client)<br>ROM coal (underground): 0.97 Mtpa (provided by client)<br>Overburden: Calculated from volumes in bank cubic metres (bcm) as provided by the client as 4.17 Mtpa soft overburden, 16.15 Mtpa hard overburden and 0.36 Mtpa topsoil. 30% of hard overburden will be removed by bulldozer and 70% by truck and shovel.<br>Product for export: 1.12 Mtpa (70% of coal undergoing beneficiation).<br>Product for Eskom: 0.68 Mtpa (30% of total ROM).<br>Discard coal: 0.46 Mtpa (30% of coal undergoing beneficiation).<br><br>Hours of operation were given as 24 hrs per day, 6 days per week. |
| Bulldozing | $$E = k \cdot (s)^{a}/(M)^{b}$$<br>Where,<br>E = Emission factor (kg dust / hr / vehicle)<br>s = Material silt content (%)<br>M = Material moisture content (%) | NPI Section: Mining | The particle size multiplier (k) is given as 2.6 for TSP, and 0.34 for $PM_{10}$<br>The empirical constant (a) is given as 1.2 for TSP, and 1.5 for $PM_{10}$<br>The empirical constant (b) is given as 1.3 for TSP, and 1.4 for $PM_{10}$<br>Fraction of $PM_{2.5}$ assumed to be 10% of $PM_{10}$<br><br>Hours of operation were assumed as 12 hrs per day, 6 days per week. Activities include the bulldozing of hard overburden, and the levelling of backfilled overburden and topsoil. |

| Activity | Emission Equation | Source | Information assumed/provided |
|---|---|---|---|
| Drilling | $E_{TSP} = 0.59\, kg/hole\ drilled$<br>$E_{PM_{10}} = 0.31\, kg/hole\ drilled$<br>$E_{PM_{2.5}} = 0.31\, kg/hole\ drilled$ | NPI Section: Mining | Number of drill holes per area was given as 150 (under the assumption of drilling areas of 7000 m² with horizontal distance of 200m and vertical distance of 35m). Number of drill holes per week was given as 300.<br><br>Hours of operation were given as 24 hours per day, 7 days a week. |
| Blasting | $E = 0.00022 \cdot (A)^{1.5}$<br><br>Where,<br>E = Emission factor (kg dust / t transferred)<br>A = Blast area (m²)<br><br>The $PM_{2.5}$, $PM_{10}$ and TSP fraction of the emission factor is 5.3%, 35% and 74% respectively. | NPI Section: Mining | The blast area was assumed as 7000 m² (for both waste rock and ore).<br><br>The number of blasts for waste rock were given as 2 blasts per week each, on alternate days and once a week for coal. |
| Vehicle entrainment on paved surfaces | $E = k(sL)^{0.91}(W)^{1.02}$<br>Where,<br>E = particulate emission factor in grams per vehicle km travelled (g/VKT)<br>k = basic emission factor for particle size range and units of interest<br>s = road surface silt loading (g/m²)<br>W = average weight (tonnes) of (all) the vehicles travelling the road<br><br>The particle size multiplier (k) is given as 0.15 for $PM_{2.5}$, 0.62 for $PM_{10}$, and 3.23 for TSP | US EPA AP42 Section 13.2.1 | In the absence of site-specific silt data, use was made of US EPA default mean silt loading for public roads, with average daily traffic (ADT) <500, of 0.6 g/m².<br><br>Operational transport activities on the paved R36 public road include the transport of ROM coal from mining strips located adjacent to the R36 to the plant, and the transport of Eskom product coal off-site.<br><br>It was assumed that the average weight of vehicles travelling on the paved road was the same as for Kranspan vehicles, viz. 45 t.<br><br>The layout of the roads was provided.<br><br>Hours of operation were given as 24 hrs per day, 6 days per week. |
| Vehicle entrainment on unpaved surfaces | $E = k\left(\frac{s}{12}\right)^{a}\left(\frac{W}{3}\right)^{b} \cdot 281.9$<br>Where,<br>E = particulate emission factor in grams per vehicle km travelled (g/VKT) | US-EPA AP42 Section 13.2.2 | In the absence of site-specific silt data, use was made of the US EPA default mean silt content for haul roads at coal mines of 8.4%.<br><br>Operational transport activities include the transport of ROM coal from the opencast areas to the plant, the discard from the plant to the discard |

| Activity | Emission Equation | Source | Information assumed/provided |
|---|---|---|---|
| | k = basic emission factor for particle size range and units of interest<br>s = road surface silt content (%)<br>W = average weight (tonnes) of the vehicles travelling the road = 25 t<br><br>The particle size multiplier (k) is given as 0.15 for $PM_{2.5}$ and 1.5 for $PM_{10}$, and as 4.9 for TSP<br><br>The empirical constant (a) is given as 0.9 for $PM_{2.5}$ and $PM_{10}$, and 4.9 for TSP<br><br>The empirical constant (b) is given as 0.45 for $PM_{2.5}$, $PM_{10}$ and TSP | | stockpile or back to the opencast area and the transport of overburden to dedicated stockpiles.<br><br>Hours of operation were given as 24 hrs per day, 6 days per week.<br><br>The capacity of the haul trucks to be used was given as 35 t.<br><br>The layout of the roads was provided.<br><br>The throughputs of material were provided are provided in the "materials handling" section of this table. |
| Crushing and screening | Primary:<br>$E_{TSP} = 0.2\ kg/t\ material\ processed$<br>$E_{PM10} = 0.02\ kg/t\ material\ processed$<br>$E_{PM2.5} = 0.01\ kg/t\ material\ processed$<br>Where,<br>E = Default emission factor for <u>low moisture</u> content ore<br><br>Fraction of $PM_{2.5}$ taken from US-EPA crushed stone emission factor ratio for tertiary crushing | NPI Section: Mining | The throughput of material to be crushed was calculated as:<br><br>Primary crusher: 1.29 Mtpa coal.<br>Secondary crusher + wash plant: 1.58 Mtpa coal.<br><br>Hours of operation were given as 24 hrs per day, 7 days per week. |
| Wind Erosion | $E(i) = G(i)10^{(0.134(\%clay)-6)}$<br><br>For<br>$G(i) = 0.261\left[\frac{P_a}{g}\right]u^{*3}(1+R)(1-R^2)$<br>And<br>$R = \frac{u_*{}^t}{u^*}$<br>where,<br>$E_{(i)}$ = emission rate (g/m²/s) for particle size class i | Marticorena & Bergametti, 1995 | ROM coal, product coal, discard coal, overburden and topsoil particle size distributions were obtained from similar projects (see Table 9).<br><br>The moisture content of ROM and discard coal were assumed as 0.001% and 0.5% respectively. Typical values for particle density and particle size were assumed.<br><br>Layout of ROM, product, discard, topsoil, hard overburden and soft overburden stockpiles was provided.<br><br>Hourly emission rate file was calculated and simulated. |

| Activity | Emission Equation | Source | Information assumed/provided |
|---|---|---|---|
| | $P_a$ = air density (g/cm³)<br>$G$ = gravitational acceleration (cm/s³)<br>$u_*^t$ = threshold friction velocity (m/s) for particle size i<br>$u^*$ = friction velocity (m/s) | | |
| Wind-blown dust from conveyor | $$E_{TSP} = c\,(u^* - u^t)\ \text{(in g/metre of conveyor)}$$<br>where the dust emission rate E is equivalent to a constant c multiplied by the difference between the friction velocity (u*) and the threshold friction velocity of the coal ($u^*_t$).<br><br>An estimate for the constant (*c*) has been made based on data reported by GHD/Oceanics (1975) for measured conveyor emissions at a wind speed of 10 m/s. The $PM_{10}$ fraction has been estimated as 45% of the TSP. The $PM_{2.5}$ fraction has been assumed as 50% of the $PM_{10}$.<br><br>The approach is conservative since it assumes emissions from a conventional conveyor and based on emission factors provided for coal dust. A control efficiency of 50% for roofing and one side covering of the conveyor was factored into the emissions calculation under the *mitigated* scenario. | GHD/Oceanics (1975) | The section of the conveyor belt that emerges from the underground area to the ROM stockpiles was modelled as an area source. The width of the conveyor belt was assumed as 1.35 m. The length of the conveyor belt (open to wind erosion) was determined through on-screen digitising as 1.7km.<br><br>Typical values for particle density and particle size were assumed. The wind speed profile was created from the WRF data for the period 2016-2018. |

*Table 9: Particle size distributions of materials (given as a fraction)*

| Product coal | | Discard coal | | ROM coal | | Overburden | | Topsoil | |
|---|---|---|---|---|---|---|---|---|---|
| Size µm | Mass Fraction | Size µm | Mass Fraction | Size µm | Mass Fraction | Size µm | Mass Fraction | Size µm | Mass Fraction |
| 75 | 0.91 | 1000 | 0.00 | 1019.52 | 0.00 | 2000 | 0.16 | 2000 | 0.06 |
| 45 | 0.06 | 75 | 0.91 | 890.12 | 0.00 | 1000 | 0.21 | 1000 | 0.07 |
| 30 | 0.00 | 45 | 0.06 | 394.24 | 0.05 | 425 | 0.45 | 425 | 0.39 |
| 15 | 0.00 | 30 | 0.00 | 229.08 | 0.20 | 75 | 0.08 | 75 | 0.19 |
| 10 | 0.00 | 15 | 0.00 | 101.46 | 0.14 | 40 | 0.03 | 40 | 0.03 |
| 5 | 0.03 | 10 | 0.00 | 67.52 | 0.30 | 30 | 0.05 | 30 | 0.07 |
| 2 | 0.00 | 5 | 0.03 | 22.8 | 0.23 | 10 | 0.03 | 10 | 0.07 |
| | | 2 | 0.00 | 10.10 | 0.07 | 4 | 0.00 | 4 | 0.04 |
| | | | | 5.12 | 0.01 | 2 | 0.00 | 2 | 0.09 |
| | | | | 2.27 | 0.00 | | | | |

*Table 10: Estimated control factors for various mining operations*

| Operation/Activity | Control method and emission reduction |
|---|---|
| Windblown dust from discard stockpile & coal stockpiles | No control |
| Bulldozing | No control |
| Blasting | No control |
| Drilling | 97% CE for dust suppression fitted on drill rigs |
| Haul roads | 75% CE for water sprays |
| Materials handling (loading and unloading) | 50% CE for water sprays |
| Crushing and screening of coal material | 50% CE for water sprays |
| Conveyor | 50% for roofing and one side covering of the conveyor |

Note: CE is Control Efficiency

*Table 11: Calculated emission rates due to unmitigated and mitigated YEAR 5 operations, for the two discard disposal options (Scenario 1 and 2)*

| Description | Emissions (tpa) – Discard tipped to stockpile | | | | | | Emissions (tpa) – Discard backfilled | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Scenario 1a[(c)] | | | Scenario 1b[(d)] | | | Scenario 2a[(e)] | | | Scenario 2b[(f)] | | |
| | $PM_{2.5}$ | $PM_{10}$ | TSP | $PM_{2.5}$ | $PM_{10}$ | TSP | $PM_{2.5}$ | $PM_{10}$ | TSP | $PM_{2.5}$ | $PM_{10}$ | TSP |
| In-pit operations[(a)] | 115.27 | 472.18 | 878.34 | 65.24 | 214.46 | 426.97 | 115.27 | 472.18 | 878.34 | 65.24 | 214.46 | 426.97 |
| In-pit operations (rollover)[(b)] | 8.03 | 19.22 | 40.25 | 8.03 | 19.22 | 40.25 | 8.03 | 19.22 | 40.25 | 8.03 | 19.22 | 40.25 |
| Blasting | 0.60 | 10.45 | 20.10 | 0.60 | 10.45 | 20.10 | 0.60 | 10.45 | 20.10 | 0.60 | 10.45 | 20.10 |
| Materials Handling | 2.94 | 19.43 | 41.08 | 1.47 | 9.71 | 20.54 | 2.94 | 19.43 | 41.08 | 1.47 | 9.71 | 20.54 |
| Conveyor | 13.25 | 26.50 | 58.88 | 6.62 | 13.25 | 29.44 | 13.25 | 26.50 | 58.88 | 6.62 | 13.25 | 29.44 |
| Crushing | 12.86 | 25.73 | 257.26 | 6.43 | 12.86 | 128.63 | 12.86 | 25.73 | 257.26 | 6.43 | 12.86 | 128.63 |
| Vehicle entrainment | 80.10 | 800.66 | 2 184.22 | 20.03 | 200.16 | 703.56 | 83.94 | 839.01 | 2 947.69 | 20.98 | 209.75 | 736.92 |
| Wind Erosion | 11.10 | 64.24 | 250.81 | 11.10 | 64.24 | 250.81 | 8.12 | 23.96 | 210.20 | 8.12 | 23.96 | 210.20 |
| Total | 244 | 1 438 | 4 361 | 120 | 544 | 1 620 | 245 | 1 436 | 4 454 | 117 | 514 | 1 613 |

Notes:

(a) Including drilling and bulldozing

(b) Including bulldozing

(c) Scenario 1 (Year 5 operations, discard tipped to stockpile) – unmitigated emissions.

(d) Scenario 1 (Year 5 operations, discard tipped to stockpile) – mitigated emissions. See Table 10 for estimated control factors for various mining operations.

(e) Scenario 2 (Year 5 operations, discard backfilled) – unmitigated emissions.

(f) Scenario 2 (Year 5 operations, discard backfilled) – mitigated emissions. See Table 10 for estimated control factors for various mining operations.

*Table 12: Calculated emission rates due to unmitigated and mitigated YEAR 9 operations, for the two discard disposal options (Scenario 3 and 4)*

| Description | Emissions (tpa) – Discard tipped to stockpile | | | | | | Emissions (tpa) – Discard backfilled | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Scenario 3a[(c)] | | | Scenario 3b[(d)] | | | Scenario 4a[(e)] | | | Scenario 4b[(f)] | | |
| | $PM_{2.5}$ | $PM_{10}$ | TSP | $PM_{2.5}$ | $PM_{10}$ | TSP | $PM_{2.5}$ | $PM_{10}$ | TSP | $PM_{2.5}$ | $PM_{10}$ | TSP |
| In-pit operations[(a)] | 113.99 | 570.32 | 1 050.90 | 53.99 | 212.84 | 415.32 | 113.99 | 570.32 | 1 050.90 | 53.99 | 212.84 | 415.32 |
| In-pit operations (rollover)[(b)] | 22.61 | 54.09 | 113.31 | 22.61 | 54.09 | 113.31 | 22.61 | 54.09 | 113.31 | 22.61 | 54.09 | 113.31 |
| Blasting | 0.60 | 10.45 | 20.10 | 0.60 | 10.45 | 20.10 | 0.60 | 10.45 | 20.10 | 0.60 | 10.45 | 20.10 |
| Materials Handling | 2.22 | 9.36 | 31.00 | 1.11 | 4.68 | 15.50 | 2.22 | 9.36 | 31.00 | 1.11 | 4.68 | 15.50 |
| Conveyor | 13.25 | 26.50 | 58.88 | 6.62 | 13.25 | 29.44 | 13.25 | 26.50 | 58.88 | 6.62 | 13.25 | 29.44 |
| Crushing | 12.86 | 25.73 | 257.26 | 6.43 | 12.86 | 128.63 | 12.86 | 25.73 | 257.26 | 6.43 | 12.86 | 128.63 |
| Vehicle entrainment | 35.05 | 349.10 | 1 231.31 | 8.76 | 87.28 | 307.83 | 37.95 | 378.17 | 1 332.20 | 9.49 | 94.54 | 333.05 |
| Wind Erosion | 17.72 | 74.54 | 262.31 | 17.72 | 74.54 | 262.31 | 14.74 | 34.25 | 221.70 | 14.74 | 34.25 | 221.70 |
| Total | 218 | 1 120 | 3 025 | 118 | 470 | 1 292 | 218 | 1 112 | 3 080 | 116 | 438 | 1 275 |

Notes:

(a) Including drilling and bulldozing.

(b) Including bulldozing.

(c) Scenario 3 (Year 9 operations, discard tipped to stockpile) – unmitigated emissions.

(d) Scenario 3 (Year 9 operations, discard tipped to stockpile) – mitigated emissions. See Table 10 for estimated control factors for various mining operations.

(e) Scenario 4 (Year 9 operations, discard backfilled) – unmitigated emissions.

(f) Scenario 4 (Year 9 operations, discard backfilled) – mitigated emissions. See Table 10 for estimated control factors for various mining operations.

### 4.1.3 Closure Phase

All operational activities will have ceased by the closure (decommissioning and post-closure) phase of the project. This will result in a positive impact on the surrounding environment and human health. The potential for impacts during the closure phase will therefore depend on the extent of rehabilitation efforts to be undertaken at the infrastructure area and existing discard stockpile area (if in-pit discard disposal is not practiced). Aspects and activities associated with the closure phase of the proposed project are listed in Table 13.

*Table 13: Activities and aspects identified for the closure phase*

| Aspects | Activities |
|---|---|
| Fugitive dust | Demolition and stripping away of structures and facilities |
| Fugitive dust | Wind-blown dust from stockpile and exposed areas |
| Fugitive dust | Degradation of roads resulting in exposed surface areas |

## 4.2 Atmospheric Dispersion Modelling

The impact assessment of the project's operations on the environment is discussed in this section. To assess impact on human health and the environment the following important aspects need to be considered:

- The criteria against which impacts are assessed (Section 2.1);
- The potential of the atmosphere to disperse and dilute pollutants emitted by the project (Section 3.2);
- The AQSRs in the vicinity of the proposed mine (Section 3.1); and
- The methodology followed in determining ambient pollutant concentrations and dustfall rates (Section 1.4).

The impact of proposed operations on the atmospheric environment was determined through the simulation of ambient pollutant concentrations. Dispersion models simulate ambient pollutant concentrations as a function of source configurations, emission strengths and meteorological characteristics, thus providing a useful tool to ascertain the spatial and temporal patterns in the ground level concentrations arising from the emissions of various sources. Increasing reliance has been placed on concentration estimates from models as the primary basis for environmental and health impact assessments, risk assessments and emission control requirements. It is therefore important to carefully select a dispersion model for the purpose.

### 4.2.1 Dispersion Model Selection

Gaussian-plume models are best used for near-field applications where the steady-state meteorology assumption is most likely to apply. One of the most widely used Gaussian plume model is the US EPA AERMOD model that was used in this study. AERMOD is a model developed with the support of AERMIC, whose objective has been to include state-of the-art science in regulatory models (Hanna, Egan, Purdum, & Wagler, 1999). AERMOD is a dispersion modelling system with three components, namely: AERMOD (AERMIC Dispersion Model), AERMAP (AERMOD terrain pre-processor), and AERMET (AERMOD meteorological pre-processor).

AERMOD is an advanced new-generation model. It is designed to predict pollution concentrations from continuous point, flare, area, line, and volume sources. AERMOD offers new and potentially improved algorithms for plume rise and buoyancy, and the computation of vertical profiles of wind, turbulence and temperature however retains the single straight-line trajectory limitation. AERMET is a meteorological pre-processor for AERMOD. Input data can come from hourly cloud cover observations, surface meteorological observations and twice-a-day upper air soundings. Output includes surface meteorological observations and parameters and vertical profiles of several atmospheric parameters. AERMAP is a terrain pre-processor designed to simplify and standardise the input of terrain data for AERMOD. Input data includes receptor terrain elevation data. The terrain data may be in the form of digital terrain data. The output includes, for each receptor, location and height scale, which are elevations used for the computation of air flow around hills.

A disadvantage of the model is that spatial varying wind fields, due to topography or other factors cannot be included. Input data types required for the AERMOD model include: Source data, meteorological data (supplied in the required format with the WRF data), terrain data, information on the nature of the receptor grid and pre-development or background pollutant concentrations or dustfall rates. The EPA_09292 executable was used in Version 7.2.5 of AERMOD for this study.

### 4.2.2 Meteorological Requirements

For the current study, use was made of modelled WRF data for the study site for the period 2016-2018 (Section 3.2).

### 4.2.3 Source Data Requirements

The AERMOD model can model point, jet, area, line and volume sources. Sources were modelled as follows:

- Opencast areas – modelled as inpit sources
- Materials handling – modelled as volume sources;
- Crushing and screening – modelled as volume sources;
- Unpaved and paved roads – modelled as area sources;
- Windblown dust from conveyor – modelled as area sources; and
- Windblown dust from discard and coal stockpiles – modelled as area sources.

### 4.2.4 Modelling Domain

The dispersion of pollutants expected to arise from proposed activities was modelled for an area covering 20 km (east-west) by 20 km (north-south). The area was divided into a grid matrix with a resolution of 160 m by 160 m, with the project located centrally. AERMOD calculates ground-level (1.5 m above ground level) concentrations and dustfall rates at each grid and discrete receptor points (AQSRs).

## 4.3 Dispersion Modelling Results

Dispersion modelling was undertaken to determine highest daily and annual average ground level concentrations (GLCs). Averaging periods were selected to facilitate the comparison of predicted pollutant concentrations to relevant ambient air quality and inhalation health criteria as well as dustfall regulations.

Pollutants with the potential to result in human health impacts which are assessed in this study include $PM_{2.5}$ and $PM_{10}$. Dustfall is assessed for its nuisance potential. Results are primarily provided in form of isopleths to present areas of exceedance of assessment criteria. Ground level concentration or dustfall isopleths presented in this section depict interpolated values from the concentrations simulated by AERMOD for each of the receptor grid points specified.

Isopleth plots reflect the incremental GLCs for $PM_{2.5}$ and $PM_{10}$ where exceedances of the relevant NAAQSs were simulated.

It should also be noted that ambient air quality criteria apply to areas where the Occupational Health and Safety regulations do not apply, normally outside the property or lease area. Ambient air quality criteria are therefore not occupational health indicators but applicable to areas where the general public has access, including some landowners still living within the Mining Right Area, including the informal community on Portion 1.

Mitigation measures assumed during mitigated operations are:

- water sprays on haul roads assuming 75% CE due to continuous water sprays;
- 97% CE for dust suppression fitted on drill rigs;
- materials handling (loading and unloading of waste rock, topsoil, ROM, product and discard) assuming 50% CE due to water sprays at tip points;
- control efficiency on wind erosion due to semi-enclosed conveyor belt (enclosed one side and roof) of 50%;
- 50% CE on crushing and screening due to continuous water sprays.

### 4.3.1 $PM_{10}$

The simulated highest daily and annual average $PM_{10}$ concentrations for Scenarios 1a and 1b, and Scenarios 2a and 2b (operational Year 5) are provided in Figure 20 to Figure 23 respectively, with the GLCs at each of the AQSRs provided in Table 14. The simulated highest daily and annual average $PM_{10}$ concentrations for Scenarios 3a and 3b, and Scenarios 4a and 4b (operational Year 9) are provided in Figure 24 to Figure 27 respectively, with the GLCs at each of the AQSRs provided in Table 15.

The main findings are:

- Scenario 1a: YEAR 5 – unmitigated, discard tipped at surface discard stockpile. *$PM_{10}$* daily GLCs, with no mitigation in place, are likely to be in non-compliance with the NAAQS for distances up to 3 km from the north-eastern border, 4 km from the south-western border and up to 1.8 km from the north-western border of the project site (Figure 20). From Table 14 eight (8) exceedances of the daily $PM_{10}$ NAAQS are expected at AQSR #1, 4 to 6, 8 to 9 and 13 to 14. Over an annual average the GLCs are within the standard at all receptors except AQSR#13 (Figure 20 and Table 14).

- Scenario 1b: YEAR 5 – mitigated, discard tipped at discard stockpile. With mitigation in place, exceedances of the $PM_{10}$ daily NAAQS is largely confined to the site (Figure 21) and exceedance of the daily $PM_{10}$ NAAQS is expected at two AQSRs, viz. #5 and 13 (Table 14). Over an annual average the GLCs are low and well within the standard (Figure 21 and Table 14).
- Scenario 2a: YEAR 5 – unmitigated, discard backfilled. *$PM_{10}$* daily GLCs, with no mitigation in place, show similar impacting areas as with Scenario 1a and are likely to be in non-compliance with the NAAQS for distances up to 3.3 km from the north-eastern border, 4.1 km from the south-western border and up to 2 km from the north-western border of the project site (Figure 22). From Table 14 eight (8) exceedances of the daily $PM_{10}$ NAAQS are expected at the same AQSRs as Scenario 1a, viz. AQSR #1, 4 to 6, 8 to 9 and 13 to 14. Over an annual average the GLCs exceed the standard only at AQSR#13 (Figure 22 and Table 14).
- Scenario 2b: YEAR 5 – mitigated, discard backfilled. With mitigation in place, exceedances of the $PM_{10}$ daily NAAQS extend slightly over the south-western site border to include AQSR#5 and AQSR#13 (Figure 23 and Table 14). Over an annual average the GLCs are low and well within the standard.
- Scenario 3a: YEAR 9 – unmitigated, discard tipped at discard stockpile. *$PM_{10}$* daily GLCs, with no mitigation in place, are likely to be in non-compliance with the NAAQS for distances up to 3.5 km from the north-eastern border, 1 km from the north-western border and 950 m from the south-eastern border of the project site (Figure 24). From Table 15 exceedances of the daily $PM_{10}$ NAAQS are expected at three (3) AQSRs, viz. #1, 13 and 14, and of the annual standard at two AQSRs, viz. #1 and 13.
- Scenario 3b: YEAR 9 – mitigated, discard tipped at discard stockpile. With mitigation in place, exceedances of the $PM_{10}$ daily NAAQS extend for a distance of up to 1.2 km from the north-eastern site border (Figure 25) and exceedances are still expected at AQSR#1 and 13 (Table 15). Over an annual average the GLCs are within the standard (Figure 25 and Table 15).
- Scenario 4a: YEAR 9 – unmitigated, discard backfilled. *$PM_{10}$* daily GLCs, with no mitigation in place, show similar impacting areas as with Scenario 3a with exceedances of the daily $PM_{10}$ NAAQS's expected at three (3) AQSRs, viz. #1, 13 and 14, and of the annual standard at two AQSRs, viz. #1 and 13 (Figure 26).
- Scenario 4b: YEAR 9 – mitigated, discard backfilled. With mitigation in place, the footprint of exceedance of the $PM_{10}$ daily NAAQS is similar as for Scenario 3b (Figure 27) with exceedances expected at AQSR #1 and 13 (Table 15). Over an annual average the GLCs are low and well within the standard (Figure 27 and Table 15).

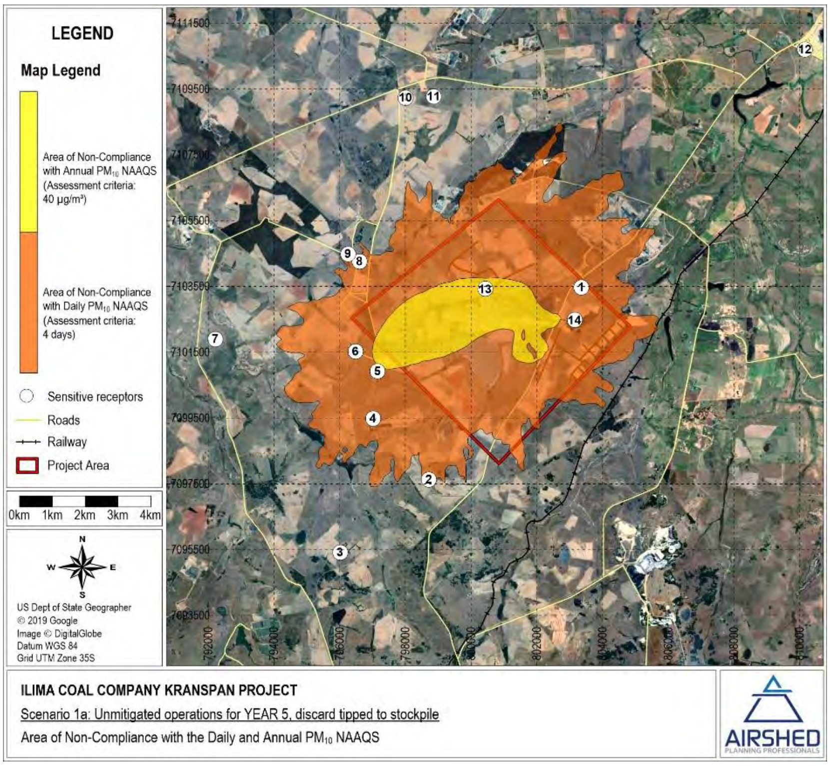


*Figure 20: Scenario 1a – Area of non-compliance of daily and annual $PM_{10}$ NAAQS for <u>unmitigated</u> YEAR 5 operations, discard tipped to stockpile*

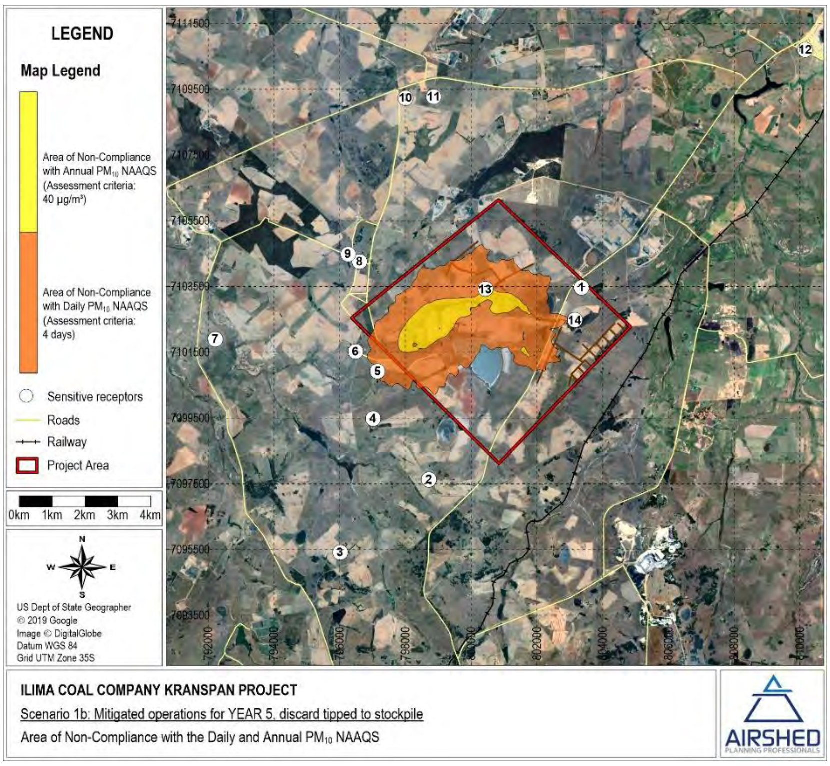


*Figure 21: Scenario 1b – Area of non-compliance of daily and annual $PM_{10}$ NAAQS for <u>mitigated</u> YEAR 5 operations, discard tipped to stockpile*

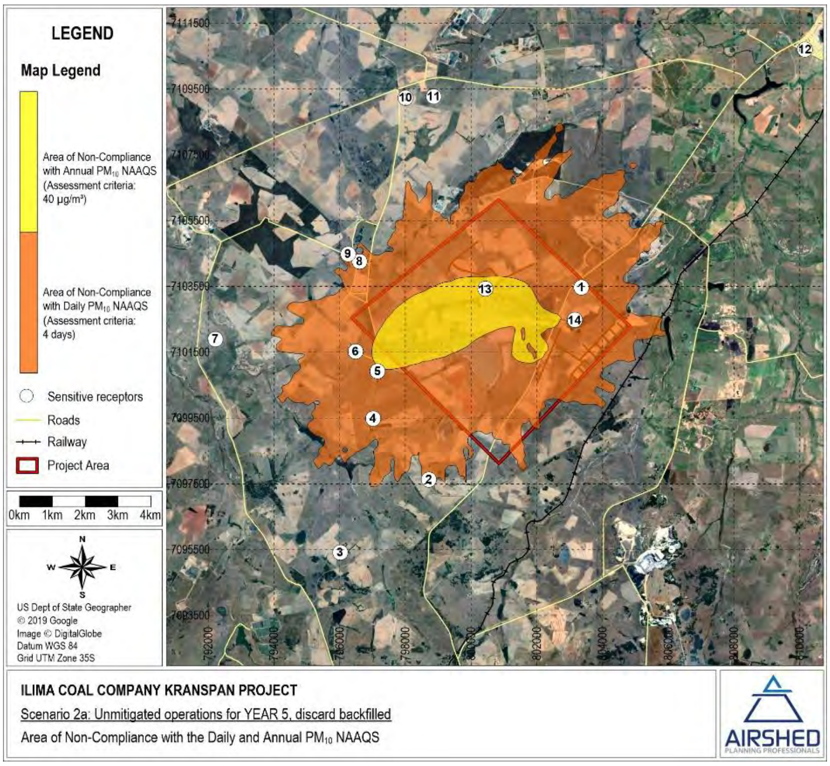


*Figure 22: Scenario 2a – Area of non-compliance of daily and annual $PM_{10}$ NAAQS for unmitigated YEAR 5 operations, discard backfilled*

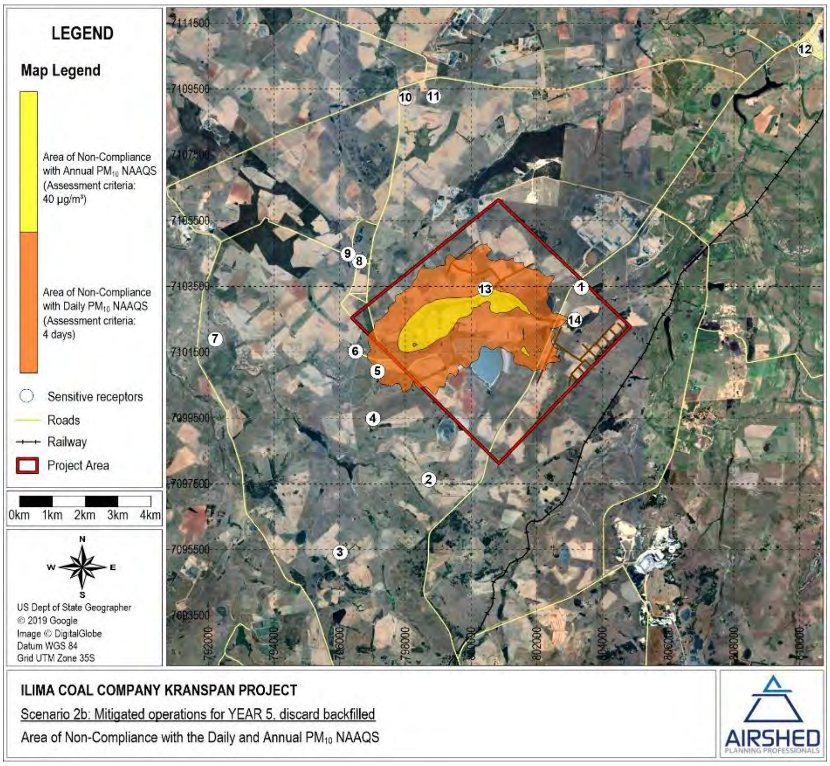


*Figure 23: Scenario 2b – Area of non-compliance of daily and annual $PM_{10}$ NAAQS for mitigated YEAR 5 operations, discard backfilled*

*Table 14: Simulated AQSR $PM_{10}$ concentrations (in µg/m³) due to unmitigated and mitigated YEAR 5 operations, for the two discard disposal options (Scenario 1 and 2)*

| AQ SR | $PM_{10}$ GLCs (µg/m³) – Discard tipped to stockpile | | | | | | | | $PM_{10}$ GLCs (µg/m³) – Discard backfilled | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Scenario 1a[(a)] | | | | Scenario 1b[(b)] | | | | Scenario 2a[(c)] | | | | Scenario 2b[(d)] | | | |
| | Highest Daily | Annual | No of Exceedances | Within Compliance (Yes/No) | Highest Daily | Annual | No of Exceedances | Within Compliance (Yes/No) | Highest Daily | Annual | No of Exceedances | Within Compliance (Yes/No) | Highest Daily | Annual | No of Exceedances | Within Compliance (Yes/No) |
| 1 | 203.5 | 14.8 | 16 | No | 63.7 | 5.3 | 0 | Yes | 213.2 | 15.3 | 17 | No | 65.8 | 5.4 | 0 | Yes |
| 2 | 134.2 | 4.2 | 4 | Yes | 42.3 | 1.5 | 0 | Yes | 134.2 | 4.3 | 4 | Yes | 42.3 | 1.5 | 0 | Yes |
| 3 | 73.9 | 2.9 | 0 | Yes | 25.4 | 1.0 | 0 | Yes | 74.4 | 2.9 | 0 | Yes | 25.5 | 1.0 | 0 | Yes |
| 4 | 197.1 | 10.9 | 9 | No | 66.2 | 3.9 | 0 | Yes | 197.2 | 11.1 | 9 | No | 66.2 | 4.0 | 0 | Yes |
| 5 | 483.1 | 34.8 | 57 | No | 168.9 | 12.5 | 9 | No | 485.8 | 35.2 | 57 | No | 169.6 | 12.6 | 9 | No |
| 6 | 317.9 | 25.9 | 41 | No | 113.2 | 8.9 | 4 | Yes | 319.9 | 26.3 | 43 | No | 113.8 | 9.0 | 4 | Yes |
| 7 | 65.8 | 3.4 | 0 | Yes | 23.6 | 1.2 | 0 | Yes | 65.9 | 3.5 | 0 | Yes | 24.1 | 1.2 | 0 | Yes |
| 8 | 176.1 | 7.1 | 6 | No | 54.1 | 2.4 | 0 | Yes | 176.3 | 7.3 | 6 | No | 54.2 | 2.5 | 0 | Yes |
| 9 | 134.7 | 5.8 | 5 | No | 47.1 | 2.0 | 0 | Yes | 134.9 | 5.9 | 5 | No | 47.2 | 2.0 | 0 | Yes |
| 10 | 96.8 | 1.7 | 2 | Yes | 33.3 | 0.6 | 0 | Yes | 97.3 | 1.8 | 2 | Yes | 33.5 | 0.6 | 0 | Yes |
| 11 | 71.6 | 1.8 | 0 | Yes | 23.6 | 0.6 | 0 | Yes | 72.5 | 1.9 | 0 | Yes | 23.6 | 0.6 | 0 | Yes |
| 12 | 49.3 | 1.7 | 0 | Yes | 17.9 | 0.6 | 0 | Yes | 52.3 | 1.8 | 0 | Yes | 18.7 | 0.6 | 0 | Yes |
| 13 | 525.9 | 80.0 | 142 | No | 172.8 | 26.6 | 32 | No | 640.6 | 92.3 | 158 | No | 201.4 | 29.5 | 43 | No |
| 14 | 249.3 | 18.3 | 29 | No | 76.7 | 6.7 | 3 | Yes | 249.4 | 18.5 | 28 | No | 76.7 | 6.7 | 3 | Yes |

Notes:

(a) Scenario 1 (Year 5 operations, discard tipped to stockpile) – unmitigated scenario.

(b) Scenario 1 (Year 5 operations, discard tipped to stockpile) – mitigated scenario. See Table 10 for estimated control factors for various mining operations.

(c) Scenario 2 (Year 5 operations, discard backfilled) – unmitigated scenario.

(d) Scenario 2 (Year 5 operations, discard backfilled) – mitigated scenario. See Table 10 for estimated control factors for various mining operations.