| srk consulting | TRONOX EOFS DISPOSAL PROJECT<br>Groot Goeraap River in its reaches through the site | Project No.<br>548215 |
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**Figure 4-16: Groot Goeraap River in its reaches through the site**

*Source: Day, 2020*

| srk consulting | TRONOX EOFS DISPOSAL PROJECT<br>View north to the Sout River from the site | Project No.<br>548215 |
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**Figure 4-17: View north to the Sout River from the site**

*Source: Day, 2020*

PES of the Sout River upstream of its estuary is Category B – largely natural (Day, 2020). This reflects a river that is relatively unimpacted, with low levels of alien plant or animal invasion; (assumed) relatively intact species diversity; low levels of erosion; assumed low levels of abstraction (due to the high natural salinity of the system and the low frequency of flows); and an apparently natural geomorphology, with low levels of geomorphological change.

The Sout River has a High EIS, with high sensitivity to physical disturbance (as it may be many years before a flood passes through that can potentially re-set damage done to the riverbed). The system is also considered highly sensitive to changes in hydroperiod and, if linked to changes in hydroperiod, water quality (Day, 2020). Ecological importance derives primarily from the role of the river as a corridor through the landscape, but also the pronounced river corridor, and bare sandy bed is a unique feature in the landscape, which adds to its importance.

**Sout River Estuary**

The Sout River Estuary lies outside of the Namakwa Sands Mine area (see Figure 4-9). A salt processing works has been established in the estuary, with the result that there has been considerable disturbance to the estuary bed and banks with multiple berms being created to contain water and promote its evaporation (to produce salt). Roads cross the watercourse, often with small single culverts, resulting in downstream constriction of flows and associated narrowing of wetland extent, downstream of the saltworks (Day, 2020).

As surface water flow in the Sout River rare, the saltworks use saline groundwater rather than river flows to derive their salts. This means that the lower estuary is the only part of the Sout River system that is perennially wet. Standing water in the lower estuary promotes algal growth (*Cladophora* sp.) and provides an artificial wetland habitat that supports wading birds such as Flamingos.

Physical disturbance of the estuary and changes in its natural flow dynamics are significant. The estuary is not included in the Cape Estuaries Conservation Plan, which extends as far as the Olifants River Estuary, some 65km south. An Estuary Management Plan has however been compiled for the estuary (Western Cape Government, 2019). This document accords the estuary a PES Category E, with a recommended Category D. Physical disturbance (particularly the salt works but also 4x4 activities), groundwater abstraction, nutrient enrichment and salinisation of the estuary are among the issues highlighted to be addressed if rehabilitation of the estuary is to be achieved, and a buffer area of 100m from the estuary edge is recommended.

**Perched Wetland Pans**

Two ephemeral pans (identified during previous specialist assessment at the Mine – Helme, 2014) occur in the study area: one east of the RSF and the other in the Kom; and topographical analysis has identified three depressions within the non-draining sub-catchments in the study area: the Northern Depression, Central Depression and Southern Depression (see Figure 4-9).

Previous specialist ecological surveys of the Northern Depression did not identify any floral / habitat incongruities in this area (which would have suggested water retention), confirming the extremely ephemeral nature of these systems (Helme N. , 2014), and the Central and Southern Depressions are within mined-out areas.

The three depressions do not support wetland plants and augered lowpoints showed no indications of soil wetness (no mottling, gleying or presence of impervious layers within 0.5 mbgl) (Day, 2020). In other words, these features do not retain sufficient moisture to support wetland habitat and are not considered to be wetlands (or watercourses).

The pan east of the RSF is a largely terrestrial “hardpan” of High botanical sensitivity (the “Hardpan”), and a rare feature in the landscape which supports threatened *Lachenalia barkeriana* plant species, and which could not be recreated once the underlying hardpan or calcrete is damaged or removed

(Helme N. , 2014). The sparse vegetation in the Hardpan includes *Ruschia fugitans, Antimima* sp. and *Drosanthemum* sp.

Two areas where the depth of soil on the Hardpan was greater within the broader area were found to display wetland characteristics, transitioning into terrestrial areas – see Figure 4-19 (Day, 2020). It is likely that these wetlands are inundated for only short periods during and shortly after wet conditions. Nevertheless, in some arid areas, such temporary pans can be important in supporting aquatic invertebrate fauna, some of which have high conservation value. Prolonged drying out of the pans between wet cycles is an important part of maintenance of conditions suitable for such life, and increased salinities as the pools dry up can act as cues for diapause or egg laying (Day, 2020).

Sout River Estuary showing extensive physical disturbance at the saltworks

Sout River Estuary downstream of the saltworks

| srk consulting | TRONOX EOFS DISPOSAL PROJECT<br>Sout River Estuary | Project No.<br>548215 |
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**Figure 4-18: Sout River Estuary**

*Source: Day, 2020*

The wetland pans were disturbed by vehicle tracks and possible excavations. The pans were assigned a PES of Category C on this basis. Their EIS is High, as they are rare features in this landscape and changes in water availability (particularly increases) could result in substantial changes in biodiversity (assuming that they do support temporary pool invertebrate fauna). They are also considered vulnerable to physical disturbance, particularly loss of topsoil and compaction.

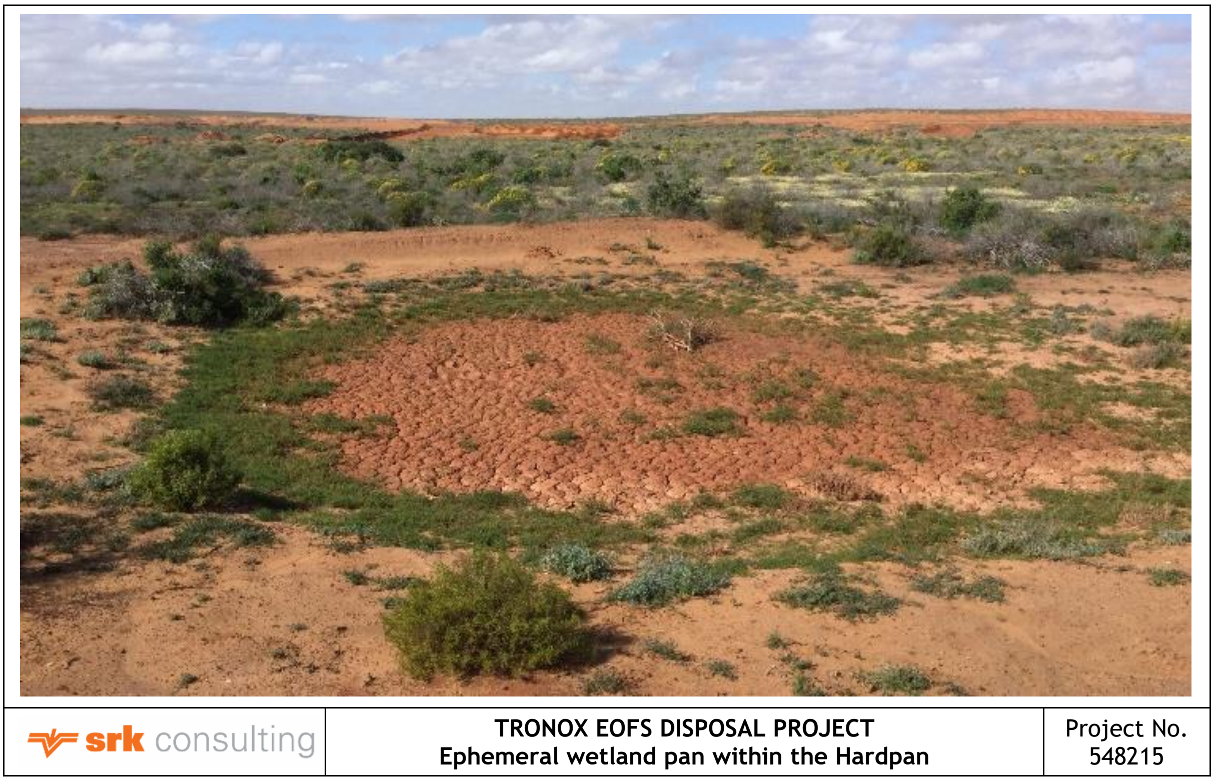



**Figure 4-19: Ephemeral wetland pan within Hardpan east of proposed RSF**

*Source: Day, 2020*

**The Kom Pan**

The De Kom pan lies to the south of the site. It has high biodiversity importance but would not be affected by the proposed East OFS project. It is not considered further in this report.

## 4.2 Socio-economic Environment, Cultural and Aesthetic Environment

### 4.2.1 Socio-economic Setting

The WCDM is located on the west coast of the Western Cape Province, with a coastline on the Atlantic Ocean which stretches over 400 km. The WCDM borders the Northern Cape Province in the north and the Cape Metro and Cape Winelands District Municipalities of the Western Cape Province in the south and south-east (see Figure 4-20).

The West Coast road (R27) is an important regional economic driver and links Cape Town to coastal towns such as Saldanha Bay and Paternoster. An equally significant economic corridor is the national road (N7) which bisects the WCDM and links Cape Town to towns such as Malmesbury, Moorreesburg, Piketberg, Clanwilliam, Vanrhynsdorp and Bitterfontein.

The Saldanha Bay export harbour falls within the WCDM, and the export market (including product from Namakwa Sands) forms an important aspect of the regional economy, and opportunities for future economic development. Tourism in the district is also viewed as an important growth sector.

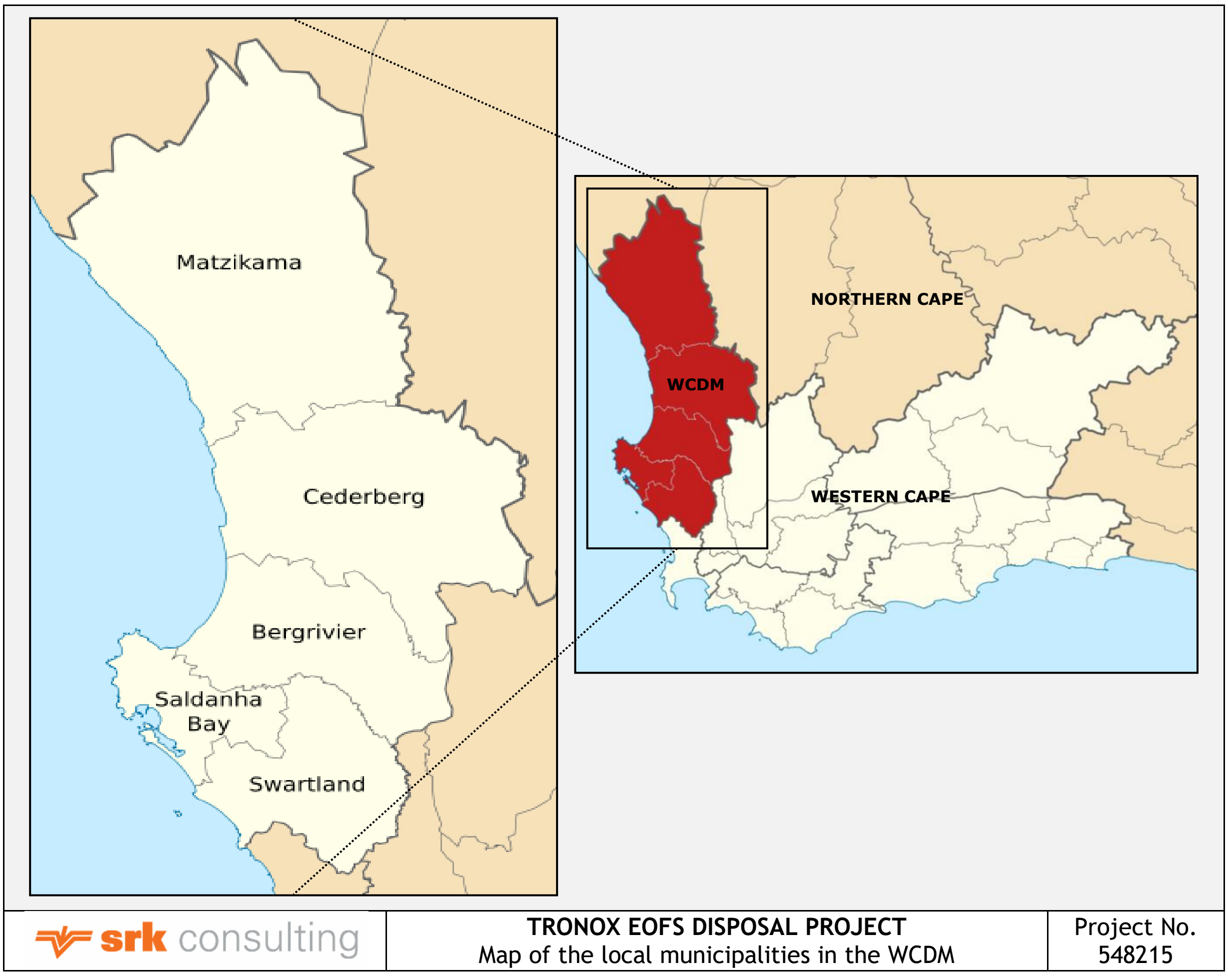



**Figure 4-20: Map of the local municipalities in the WCDM and the Western Cape Province**

Residents closest to the Mine comprise farmers and farmworkers, with the nearest formal communities located more than 50 km to the south-east of the Mine site, near the MSP[28]. The three main settlements of Vredendal, Lutzville and Koekenaap (see Figure 1-1 and Figure 4-21) are described in more detail below due to their size and regional importance, as well as the large number of Tronox employees that reside in these towns (together these three settlements accommodate more than 80% of Tronox employees):

- *Vredendal* is the largest town in the MLM with an approximate population of 20 400 in 2014 (Matzikama Municipality, 2014). The town serves as the commercial and administrative centre for the region and is the seat of the MLM. The town's economy relies mainly on the agricultural sector, primarily wine production and, to a lesser extent, vegetable and fruit production. The town has well-developed infrastructure, including an airfield, shopping centres and has good road access. Vredendal also serves as a base from where trips to Namaqualand, coastal towns on the West Coast and the Cederberg mountains can be undertaken and as such has an active tourism industry with many guesthouses and a number of restaurants (SRK, 2014a). There are currently 4 359 people on the waiting list for housing in Vredendal (Matzikama Municipality, 2016). The vast majority of land allocated for new housing (85%) will be required for subsidised housing units.
- The small town of *Lutzville* experienced rapid population growth between 1991 and 2001 with the opening of the Namakwa Sands Mine and the construction of new houses to accommodate mine employees, but the annual growth rate reduced to around 1.43% per year in 2011 and the current

[28] Lepelsfontein is located ~25 km to the north of Brand se Baai, but falls in the Northern Cape and is therefore considered to be outside the area of influence of the Namakwa Sands operations in the Matzikama Local Municipality.

population is estimated at 8 000 (Matzikama Municipality, 2014). The town's population is employed mainly in the mining and agricultural sectors, the latter entailing largely viniculture and tomatoes (SRK, 2014a). The rural population in Lutzville is declining, indicative of increasing urbanisation within the area (Matzikama Municipality, 2016).

- The settlement of *Koekenaap* had an estimated population of 1 330 in 2014 (Matzikama Municipality, 2014). Although small entrepreneurial businesses have been established within the area, Koekenaap's most viable long-term function is as an agricultural service centre for the surrounding farms. Economic challenges for the settlement include very weak local demand thresholds and competition from nearby settlements such as Lutzville and Vredendal, which offer a higher level of goods (Matzikama Municipality, 2014). On account of a small population size, Koekenaap does not reach the thresholds necessary to warrant most public facilities. Lack of economic growth over the past few years and close proximity to settlements with much greater economic potential have led to high unemployment and poverty levels, with most of the employed population working elsewhere (SRK, 2014a). As such, Koekenaap does not occupy a high priority in terms of spending scarce public funds on fixed infrastructure that could create wider benefits elsewhere (Matzikama Municipality, 2014).

Other smaller communities located in the MLM include:

- Ebenhaeser – a mission settlement on the lower Olifants River;
- Strandfontein – a coastal town popular as a holiday destination;
- Doringbaai – a small coastal town south of Strandfontein with an active lobster fishing industry;
- Klawer – a small agricultural town on the Olifants River; and
- Vanrhynsdorp – a mid-size agricultural town located further inland on the banks of an Olifants River tributary.

Tronox, including the Mine, MSP and Smelter, sustains approximately 1200 direct and many more indirect employment opportunities as at May 2019[29]. A number of companies in surrounding towns, and in the district, rely on and are indirectly supported by the Mine. Tronox therefore plays an important function as a regional economic driver.

[29] According to the previous Matzikama SDF (2010), in 2010 the Namakwa Sands mine was estimated to employ, either directly or indirectly, up to 60% of people employed in the local municipality (Headland, 2014).

*Vredendal (Church Street) as seen from the north-west*

*Lutzville as seen from the north-west*

*Koekenaap shops and post office*

| | | |
|---|---|---|
| srk consulting | **TRONOX EOFS DISPOSAL PROJECT**<br>Main settlements near the project area | Project No.<br>548215 |

**Figure 4-21: Main settlements near the project area**

## 4.2.2 Economic and Social Indicators for the WCDM and MLM

### 4.2.2.1 Population Size

In 2016 the WCDM had an estimated population of approximately 436 000 (see Figure 4-22). The population growth rate between the years of 2015 and 2020 is projected to be 6.8% per annum (WCG, 2016). This represents an increase from 4.9% in 2001, indicating that the population of the region is growing at an increasing rate. The district covers an area 31 099 km$^2$ and the population density is 14 people / km$^2$.

The population of the MLM was approximately 71 000 in 2016. In 2015, the population growth rate was projected to be 5.4% (WCG, 2016). The population density was estimated at ~5.4 people / km$^2$ in 2015, lower than the district average of 14 people per km$^2$.

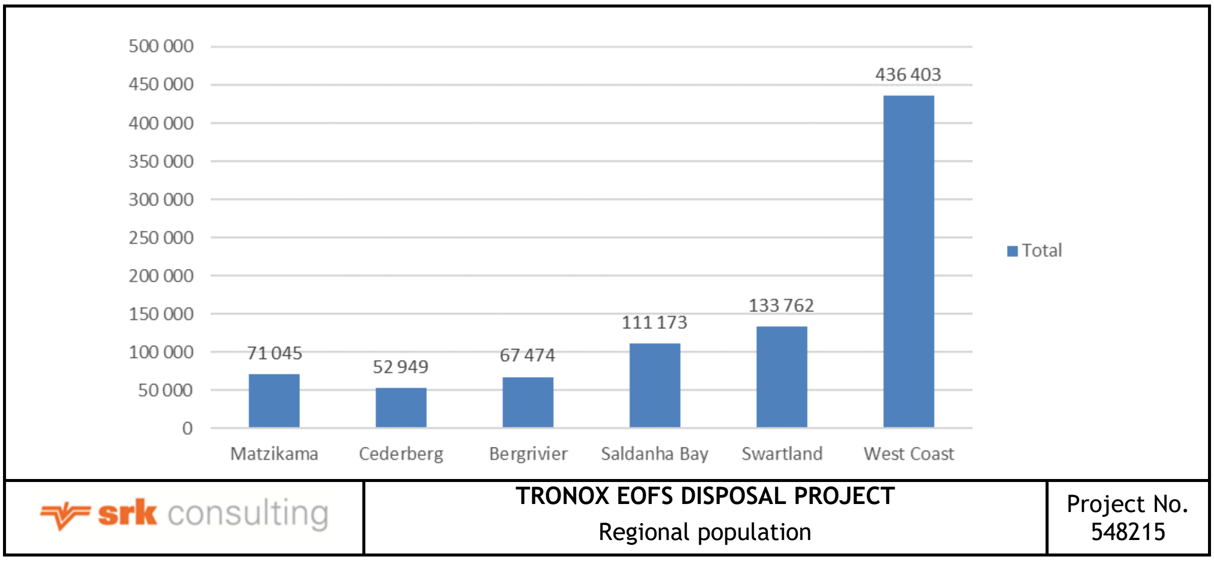



**Figure 4-22: Regional population**

*Source:* (StatsSA, 2016)

### 4.2.2.2 Age and Gender Distribution

Figure 4-23 shows the age and gender distributions of MLM and the WCDM's population in 2016 (StatsSA, 2016). Population pyramids are a visual representation of a society's age and sex distribution, providing valuable insight into dependency (and associated fertility, mortality and immigration) rates. The shape of both pyramids above suggests high levels of dependency on the economically active population.

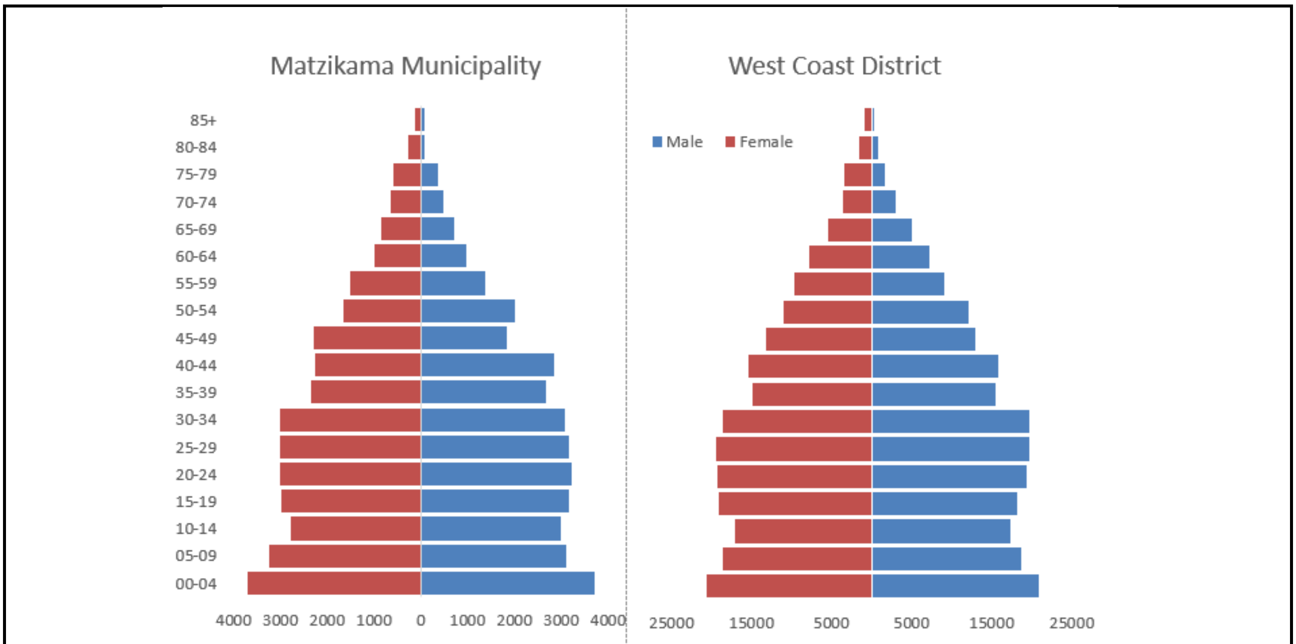
For both the MLM and WCDM, a large proportion of the population fall within 0 to 19 years, as well as with in the working age group between 20 and 34 years. This will have particular implications for the provision of educational facilities as well as a greater need for employment opportunities (WCG, 2015).

Both MLM and WCDM follow a similar pattern for population age distribution.

### 4.2.2.3 Population Groups

The Coloured population group (68.2% of total population in WCDM) was by far the most populous group in the WCDM (see Figure 4-24). The White population group comprised 15.3 % of the total population in 2016, while Africans represented 16.3%. Between 2007 and 2016, the proportion of Africans in the population doubled (9% - 2007; 16.3% - 2016) (StatsSA, 2016).

In 2016 the MLM had the highest proportion of Coloureds (81.8%) and consequently the second lowest proportion of Whites (12.3%) after Saldanha (12.2%) and the second lowest proportion of Africans (5.9%) compared to other local municipalities in the district.




| srk consulting | TRONOX EOFS DISPOSAL PROJECT<br>Population age distribution | Project No.<br>548215 |
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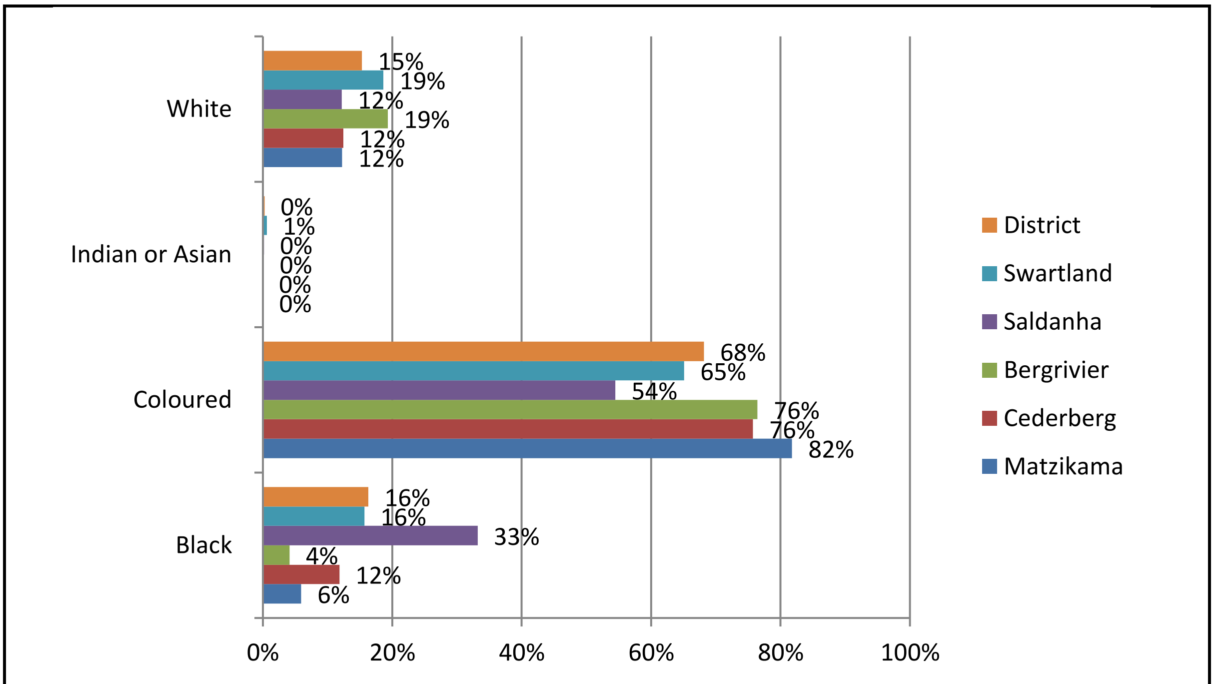
**Figure 4-23: Population age distribution**

*Source:* (StatsSA, 2016)




| srk consulting | TRONOX EOFS DISPOSAL PROJECT<br>Breakdown of district population by race | Project No.<br>548215 |
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**Figure 4-24: Breakdown of district population by race**

*Source:* (StatsSA, 2016)

#### 4.2.2.4 Size and Structure of the District and Local Economy

Figure 4-25 shows the Regional Gross Value Added[30] (GVA-R) for the WCDM (including local municipalities) and indicates that the value of production in the WCDM economy was R21 billion in 2015.

GVA-R and GVA-R per capita for the MLM were R3.17 billion and R44 600 respectively (~15% of district GVA-R from an area covering ~42% of the total district area). The low population density for the local municipality is indicative of this predominantly low carrying capacity, arid agricultural region with limited urbanisation. This inference is supported by the high contribution of the agricultural sector to the local economy (29.7% of GVA-R) (see Figure 4-26). The Olifants River and its associated canal systems underpin the agricultural sector, which is dominated by orchards and viticulture.

Figure 4-26 indicates the sectoral contribution to the GVA-R of WCDM and local municipalities. In 2015, at district level, agriculture (29,7%), trade (15.3%) and manufacturing (12.5%) contributed most to GVA-R.

A noteworthy feature of the local economy is the importance of the mining sector in the MLM compared to its profile in the district economy (2.9% and 0.5% respectively). Diamonds, heavy mineral (both of which are along the coast) and gypsum are mined in MLM. Mining makes by far the largest contribution to the MLM compared to other WCDM local municipalities and is therefore considered to be an important socio-economic driver locally.

Vredendal is a well-developed town and functions as MLM's administrative centre. The strength of the financial sector locally is largely accounted for by economic activities in this town (see Figure 4-26).

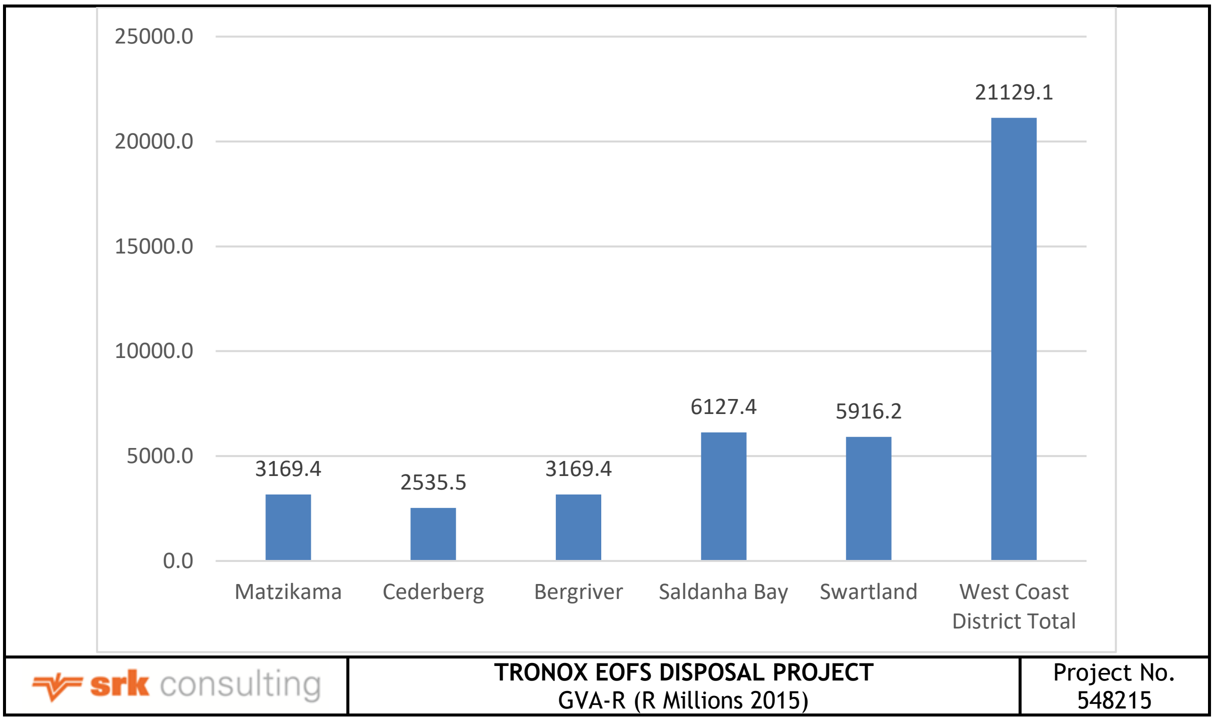
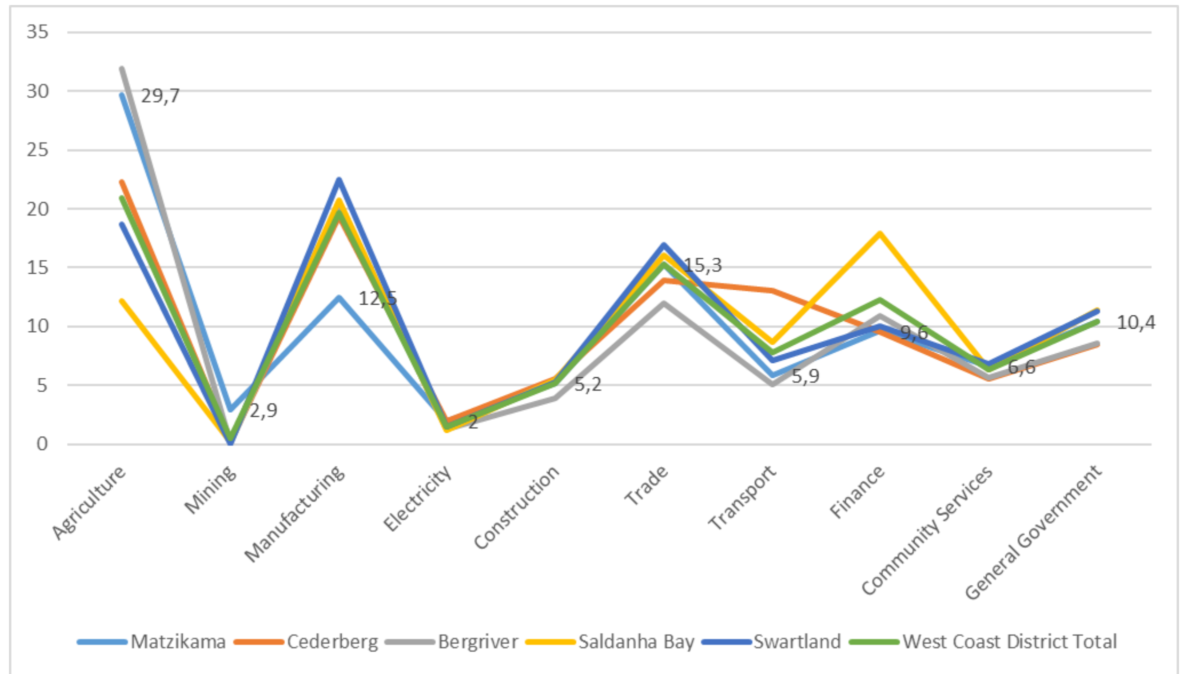



**Figure 4-25: 2015 GVA-R for the West Coast District at 2015 prices (R 000's)**

*Source:* (StatsSA, 2016)

[30] GVA measures the contribution to the economy of each individual producer, industry or sector. The link between GVA and GDP can be defined as: GVA (at current basic prices; available by industry only) plus taxes on products (available at economy level only) less subsidies on products (available at economy level only) equals GDP (at current market prices; available at whole economy level only).

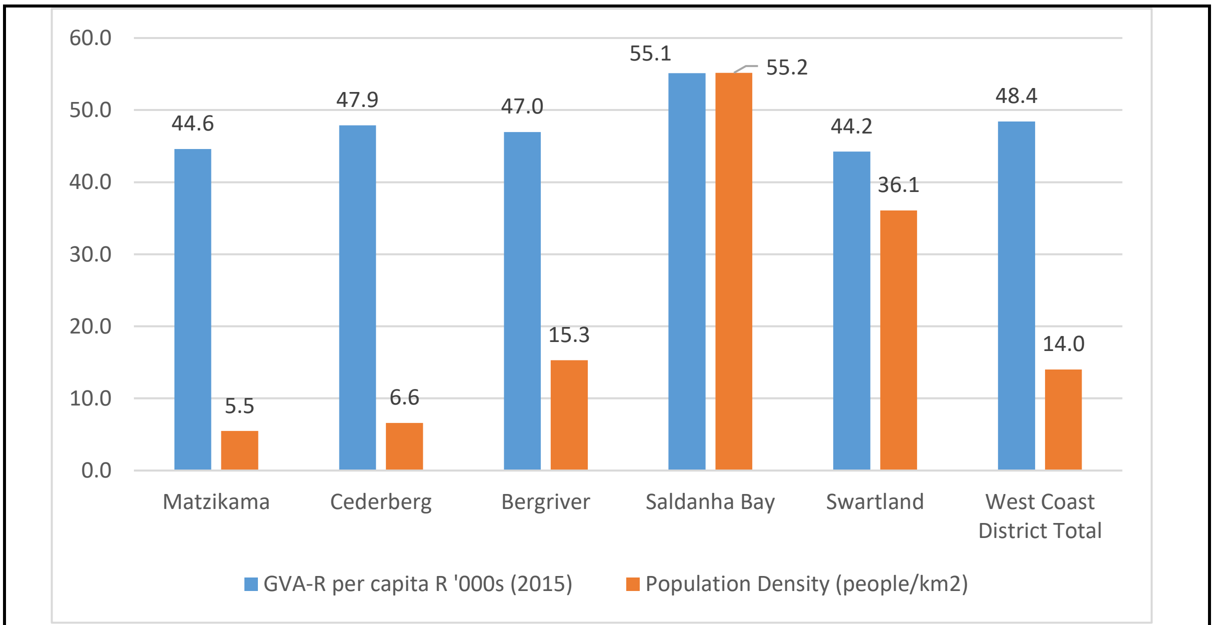



srk consulting | TRONOX EOFS DISPOSAL PROJECT Sector Contribution to GVA-R (%) | Project No. 548215

**Figure 4-26: Contribution to West Coast District Municipality GVA-R by sector (2015)**

*Source:* (StatsSA, 2016)

WCDM GVA-R per capita in 2015 was estimated at ~R48 400 per annum and population density at 14 people per km$^2$ in 2015 (see Figure 4-27). The low population density is indicative of the low carrying capacity of this water scarce region. The GVA-R per capita for the MLM is estimated to have been ~R44 600 and that the population density is only 5.5 people per km$^2$ in 2015.




srk consulting | TRONOX EOFS DISPOSAL PROJECT Population density and GVA-R per capita | Project No. 548215

**Figure 4-27: Population density and GVA-R for the WCDM (2009)**

### 4.2.2.5 Education, Employment and Income

Approximately 62% of WCDM's population over the age of 20 years either has no education (4%) or has not achieved Grade 12 (58%) in 2016 (see Figure 4-28), indicative of very low education levels in the district. According to the IDP, low levels of education in the region are attributed to challenges such as poor-quality infrastructure, high drop-out rates (e.g. due to teen pregnancies), language challenges and lack of access to transport.

Education levels in the MLM are in line with the district average: 4% of the local population over the age of 20 years has no schooling (4% for WCDM) and 51% of those with an education did not achieve Grade 12 (see Figure 4-28). Only 35% of the MLM population over 20 years old achieved a matric pass or better.

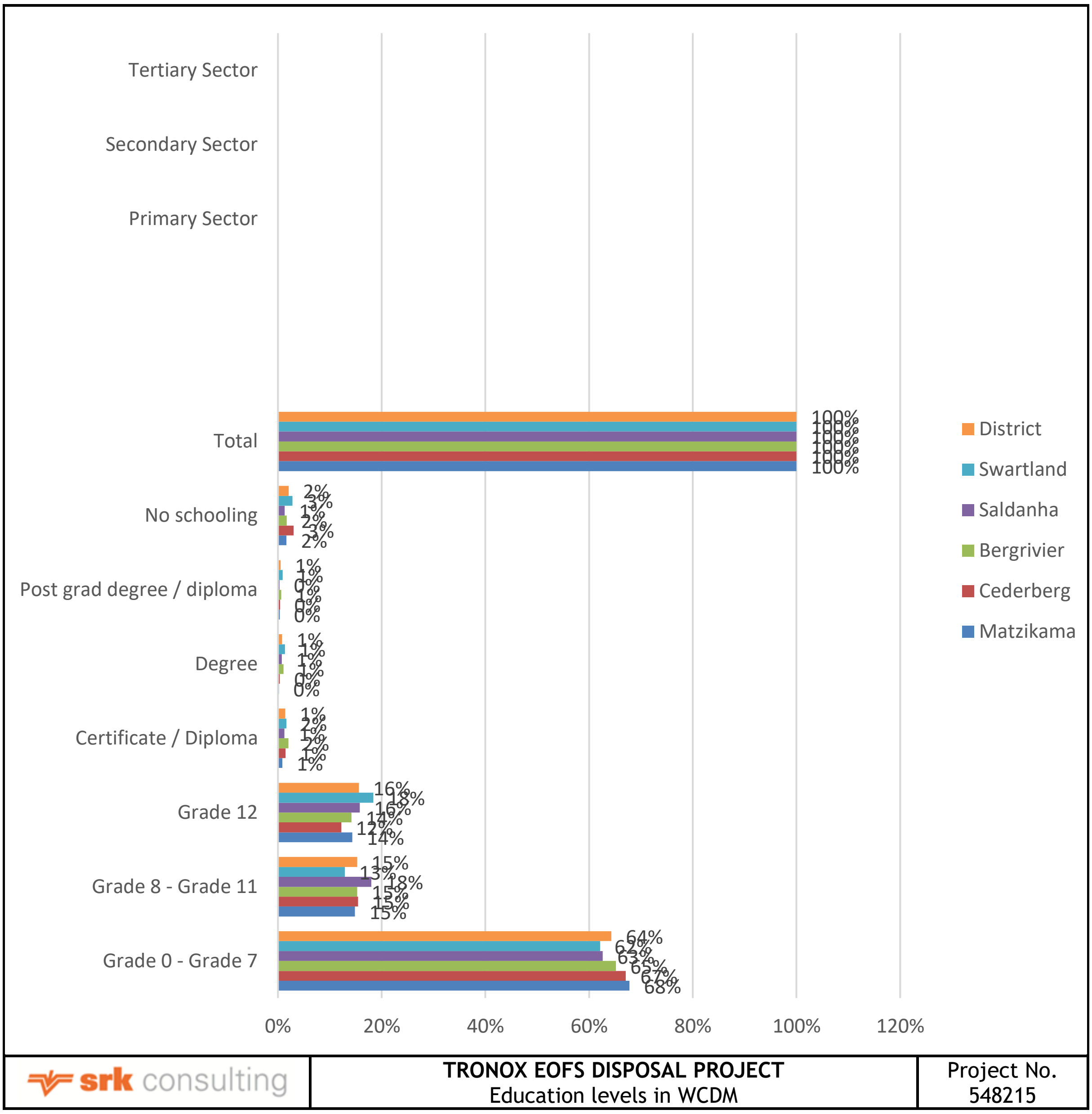
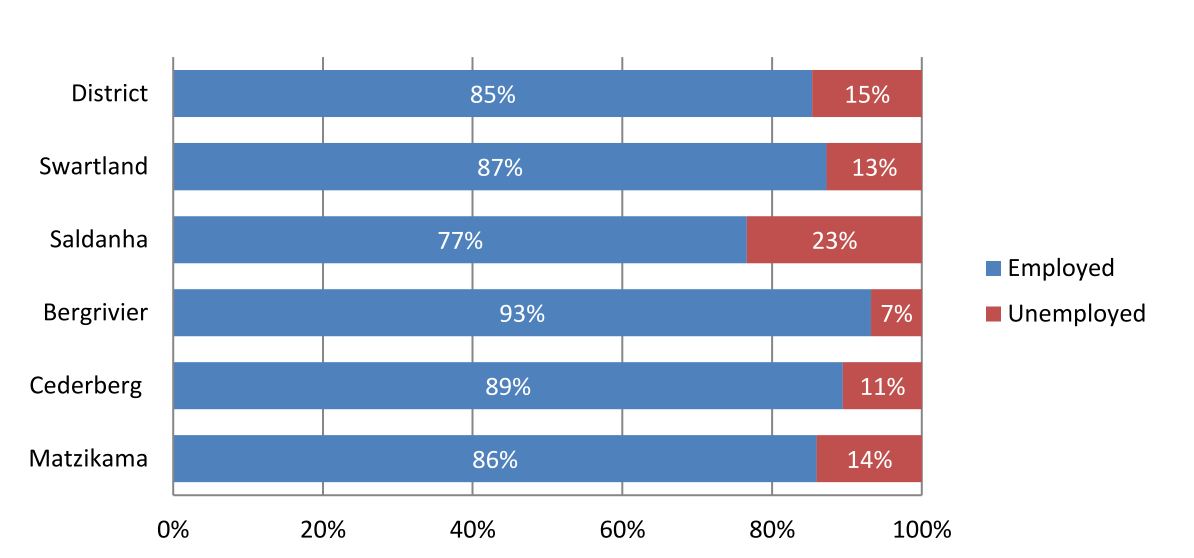



**Figure 4-28: Education levels in WCDM (over the age of 20 years)**

*Source:* (StatsSA, 2016)

The WCDM had an unemployment rate of 15% in 2016 (i.e. 15% of the economically active population who are actively seeking jobs are unemployed), while 85% of those seeking employment are employed (see Figure 4-29).

Approximately 23 806 people are employed in MLM (in 2016), while 3 889 are unemployed. The MLM has a relatively high unemployment rate (14%) (see Figure 4-29), corresponding with poor levels of education.




| srk consulting | **TRONOX EOFS DISPOSAL PROJECT**<br>Employment in the WCDM | Project No.<br>548215 |
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**Figure 4-29: Employment in the WCDM**

*Source:* (StatsSA, 2016)

Figure 4-30 indicates the sectoral contribution to employment in the WCDM for 2015[31] (WCG, 2016). The majority of district employment was in the tertiary sector (35%), while the contributions to employment were 21%, 26% and 17% for primary, secondary and quaternary sectors respectively. Figure 4-25 and Figure 4-30 show that the primary sector contributes proportionately more to employment than other sectors, although wages are expected to be correspondingly low.

The majority of employment opportunities in the MLM are in the primary sector (33%), reinforcing the importance of the agricultural and mining sectors to the local economy; although there is also a relatively high level of employment in the tertiary sector in the MLM (31%) (see Figure 4-30).

[31] The division of labour refers to proportions of the labour force employed in the primary, secondary tertiary, and quaternary sectors. The primary sector includes people employed in agriculture, forestry, fishery and mining. The secondary sector refers to manufacturing, construction, and energy production (electricity). The tertiary sector includes commerce, transport, and the financial institutions. The quaternary sector refers to public and private services.

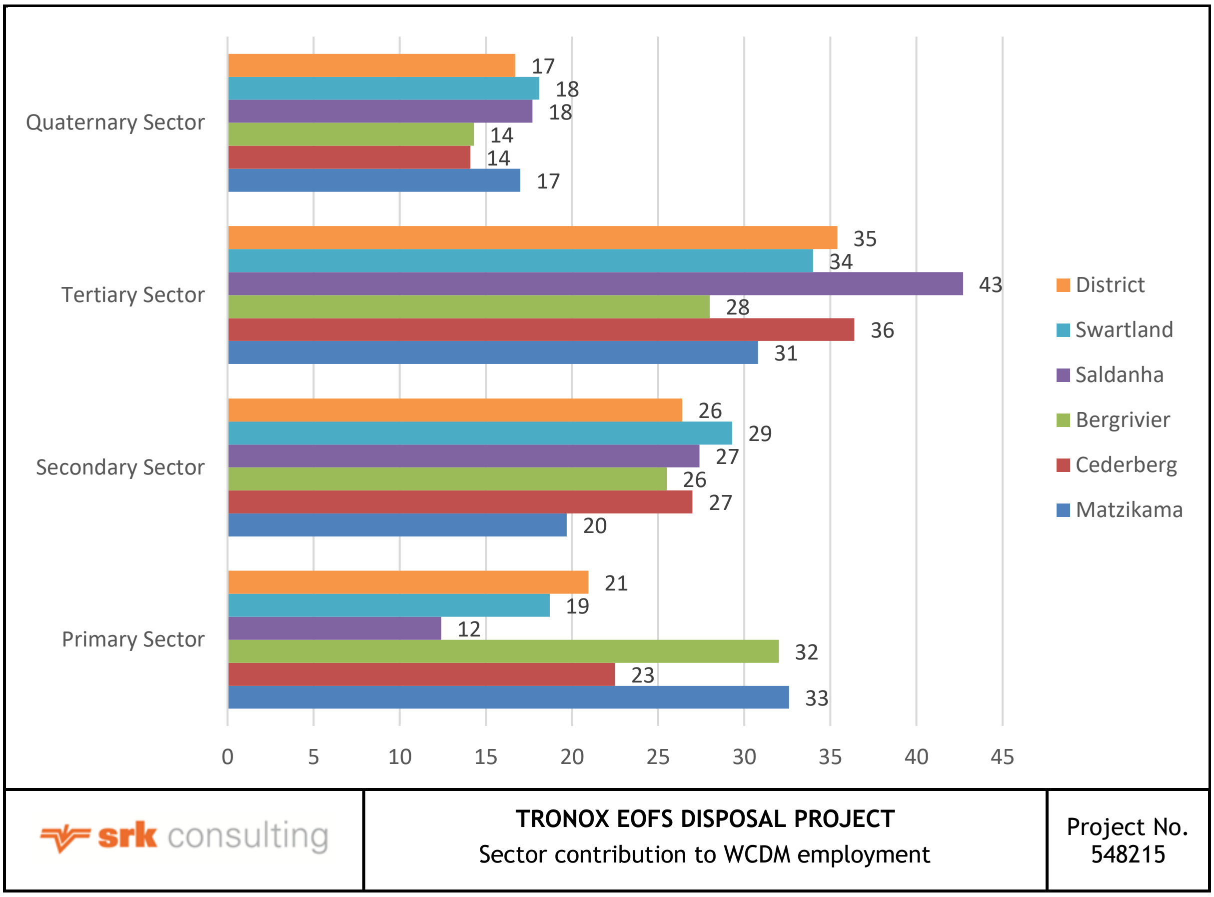


**Figure 4-30 Sectoral contribution (% of total people employed) to WCDM employment (2015)**

*Source: StatsSA: Community Survey, 2016*

The majority (52%) of WCDM households earned less than R4 218 per month (R50 616 per annum) and fell within the low income bracket (R 0 – R 4 218 per month) in 2016. More than half of the MLM households earned low income (55%), indicating a scope for human development within the MLM (see Figure 4-31).

The GVA-R per capita for the WCDM in 2015 was ~R48 400 (see Figure 4-27), compared to R74 274 for the Western Cape in 2015. This indicates that the personal income of the WCDM is lower than in the Western Cape and the national situation.

#### 4.2.2.6 Poverty

The Intensity of Poverty and Headcount Ratio are two different methods of measuring and reporting poverty. The Intensity of Poverty is measured by calculating the Poverty Gap Index[32], while the Headcount Ratio is the proportion of people within a population group that is living below a certain predetermined poverty level or line (a threshold level of income below which people are considered to live in a condition of poverty). The Headcount Ratio is slightly more restrictive tool in that it counts all the people below a poverty line, in a given population, and considers them equally. Both indices are shown in Figure 4-32 and Figure 4-33.

The Headcount Ratio[33] of the WCDM population below the South African poverty line was 2.9 in 2016, 0.9 higher than in 2011 (see Figure 4-32).

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[32] The Poverty Gap Index is the average poverty gap in the population as a proportion of the poverty line. It estimates the depth of poverty by considering how far, on the average, the poor are from that poverty line.

[33] Note that the Headcount Ratio in this instance measures those within the geographically defined areas who earned less than R498 per month in 2016.

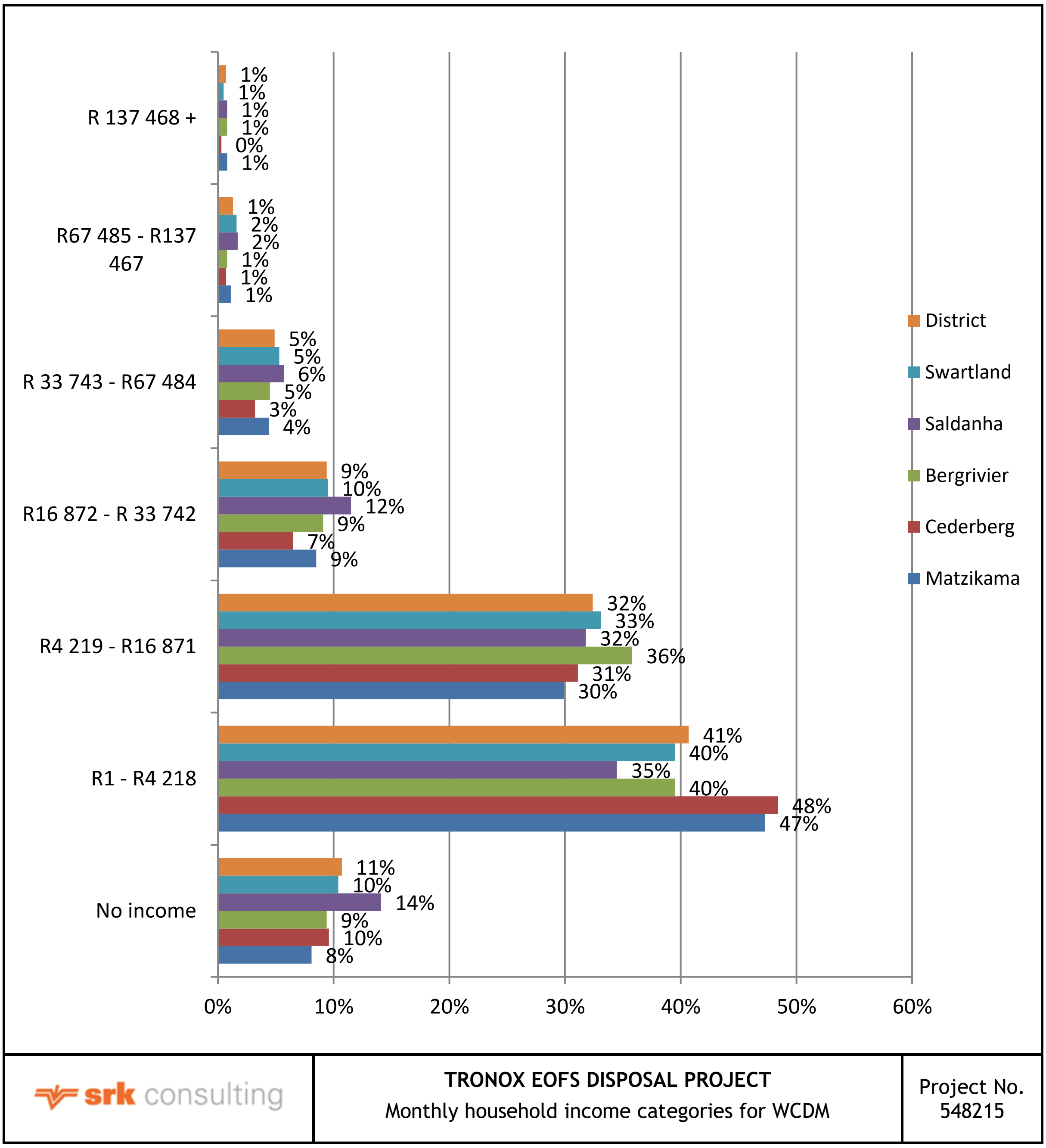
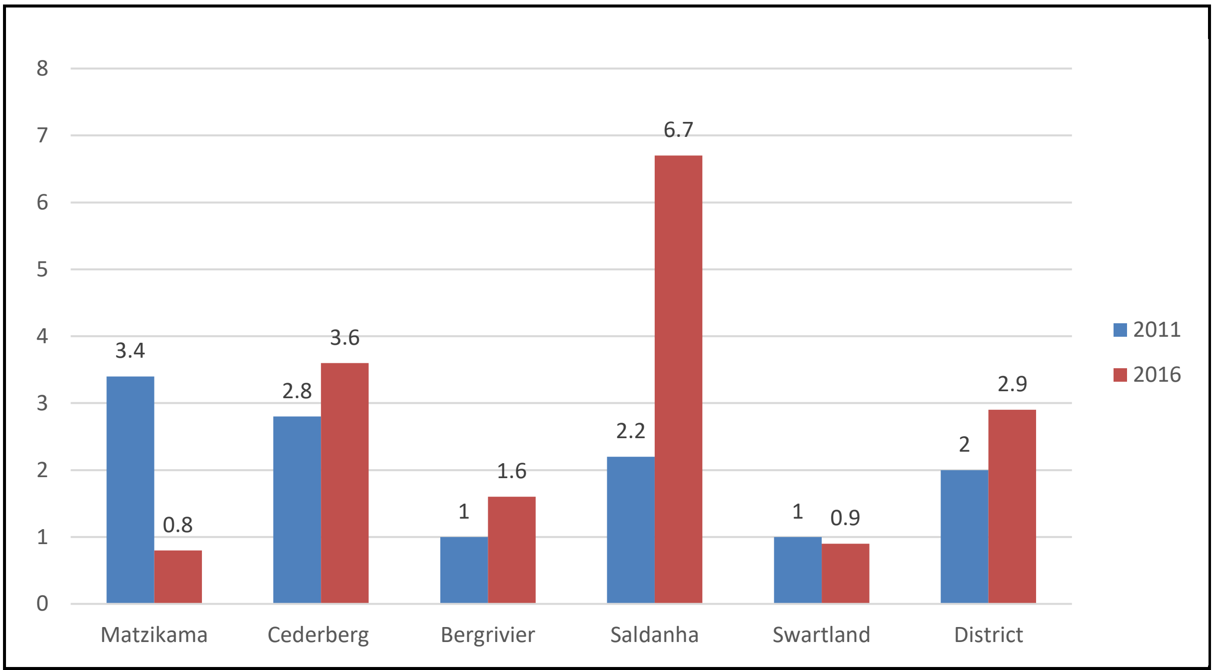



**Figure 4-31: Monthly household income categories for WCDM (2016)**

Source: (WCG, 2016)

Although income levels are comparatively low in the MLM (8% of households earned no income in 2016, while only 45% earn more than R4 218 per month) the Headcount Ratio indicates a significant decrease in population below the poverty line (0.8) since 2011 (3.4) (see Figure 4-32).

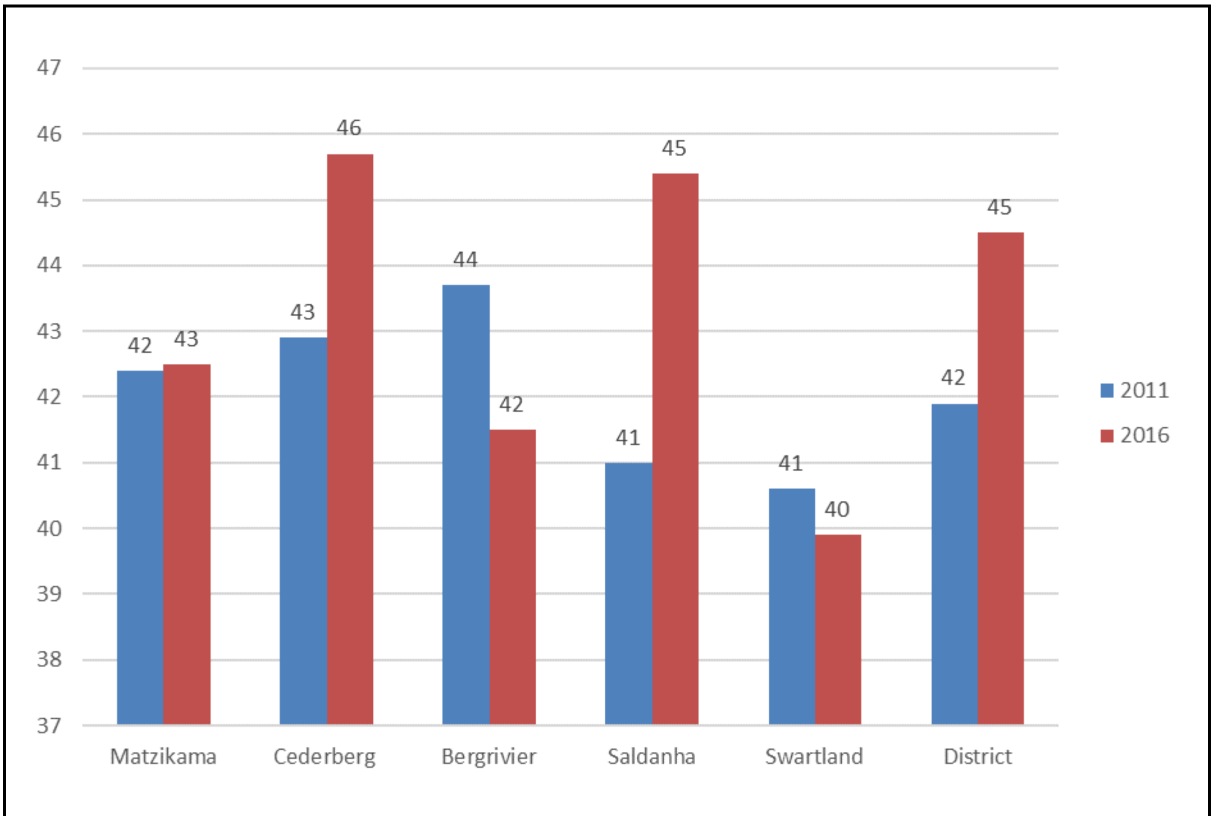
MLM poverty intensity marginally increased by 1% between 2011 and 2016. Of the three local municipalities which experienced increases in poverty intensity between 2011 and 2016 (MLM, Cederberg and Saldanha), MLM had the smallest increase (1%). The intensity of poverty within the WCDM increased from 42% in 2011 to 45% in 2016 (see Figure 4-33).




srk consulting | TRONOX EOFS DISPOSAL PROJECT<br>Headcount ratio of poverty in the WCDM | Project No.<br>548215

**Figure 4-32: Headcount ratio of poverty in the WCDM (2016)**

*Source:* (WCG, 2016)




srk consulting | TRONOX EOFS DISPOSAL PROJECT<br>Poverty intensity in the WCDM | Project No.<br>548215

**Figure 4-33: Poverty intensity in the WCDM (2016)**

*Source: Provincial Treasury, 2016*

#### 4.2.2.7 Health

Table 4-2 indicates that there are a total of 74 and 19 health care facilities in the WCDM and MLM respectively. The table also shows that that there are more health care facilities per person in the WCDM than in the MLM, suggesting a slightly lower level of health service provision in the local municipality compared to the district.

**Table 4-2: Access to health care facilities**

| Health Care Facility | WCDM | Persons per Facility - WCDM | MLM | Persons per Facility - MLM |
|---|---|---|---|---|
| Community Day Centres | 1 | 409 929 | 0 | 0 |
| Clinics | 26 | 15 767 | 5 | 14 179 |
| Satellite Clinics | 15 | 27 329 | 4 | 17 723 |
| Mobile Clinics | 25 | 16 398 | 9 | 7 877 |
| District Hospitals | 7 | 58 561 | 1 | 70 891 |
| Regional Hospitals | 0 | 0 | 0 | 0 |
| **Total** | **74** | **5 540** | **19** | **3 731** |

*Source:* (WCG, 2015)

Immunisation protects both adults and children against preventable infectious diseases. The full coverage rate in MLM (78%) was above the WCDM average of 74% (WCG, 2015).

While regional HIV/Aids infection rates are expected to be somewhat higher, Table 4-3 indicates that 1.5% of the district and 1.2% of the local population are receiving antiretroviral treatment (WCG, 2015).

**Table 4-3: Anti-Retroviral (ART) Treatment patient load**

| Municipality | ART Patient Load | ART Patient Load % of pop. | ART Treatment Sites |
|---|---|---|---|
| WCDM | 6 521 | 1.5 | 41 |
| MLM | 901 | 1.2 | 8 |

*Source:* (WCG, 2015)

The HIV epidemic has led to an increase in the number of Tuberculosis (TB) cases (Provincial Treasury, 2015). Individuals with HIV are far more susceptible to TB infection and are less able to fight it off.

The TB patient load in the WCDM was 0.8% of the district population in 2015. The MLM patient load decreased to 950 in 2015 from 1 015 previously recorded in 2014.

**Table 4-4: Tuberculosis (TB) prevalence and care (2015)**

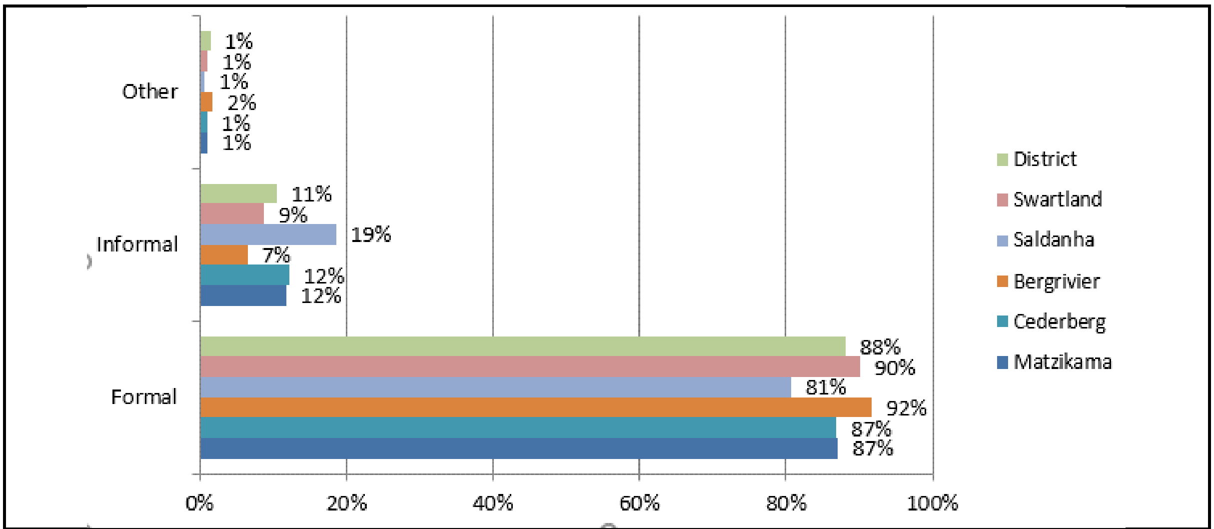
| Municipality | # of TB Patients | ART Patient Load % of pop. | # of TB Treatment Sites |
|---|---|---|---|
| WCDM | 3 593 | 0.8 | 73 |
| MLM | 950 | 2.7 | 21 |

*Source:* (WCG, 2015)

### 4.2.3 Service Provision

#### 4.2.3.1 Access to Housing

Figure 4-34 indicates that 88% of household structures in the WCDM are formal and 11% are informal, while no households in the district are traditional. Within the MLM, 87% of household structures are formal and 12% are informal (only 5% of households in the MLM were informal in 2007, indicating a decline in the proportion of formal to informal housing locally between 2007 and 2016).



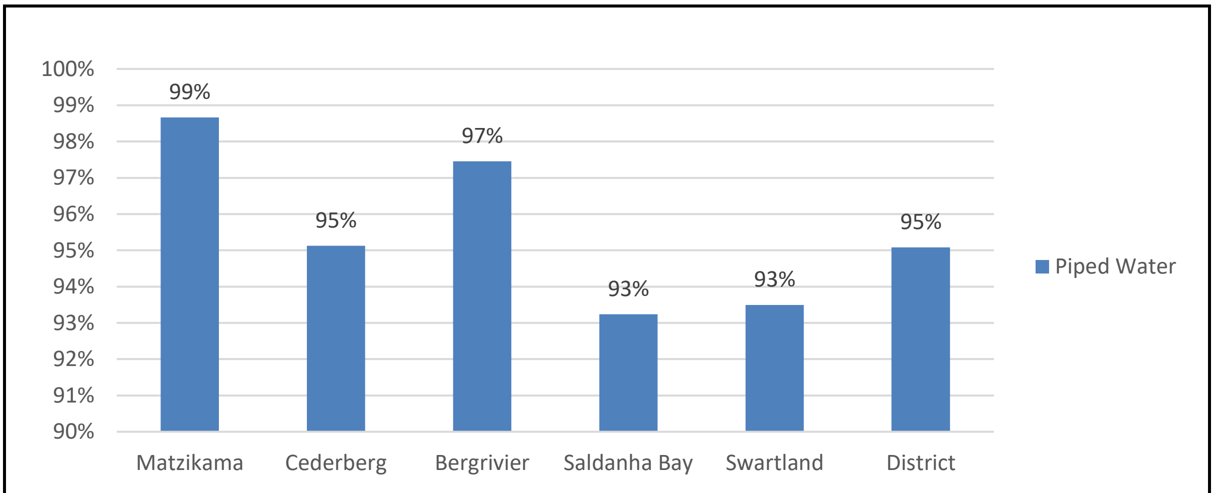

| srk consulting | TRONOX EOFS DISPOSAL PROJECT<br>Household types in the WCDM | Project No.<br>548215 |
|---|---|---|

**Figure 4-34: Household types in the WCDM (2016)**

*Source:* (WCG, 2016)

### 4.2.3.2 Water

Figure 4-35 indicates that ~95% of all households in the WCDM (~99% in the MLM) have access to piped water, although only about ~84% had access to water inside their dwelling.




| srk consulting | TRONOX EOFS DISPOSAL PROJECT<br>Household Access to Piped Water in the WCDM | Project No.<br>548215 |
|---|---|---|

**Figure 4-35: Household access to piped water in the WCDM (2007)**

*Source:* (StatsSA, 2016)

### 4.2.3.3 Electricity

Roughly 92% of households in the WCDM had access to electricity for cooking in 2016 (see Figure 4-36). The proportion of households with access to electricity in WCDM has increased from 89.71%

in 2007. About 95% of households in the MLM has access to electricity for cooking – the second highest of all local municipalities in the WCDM after Swartland (~97%).

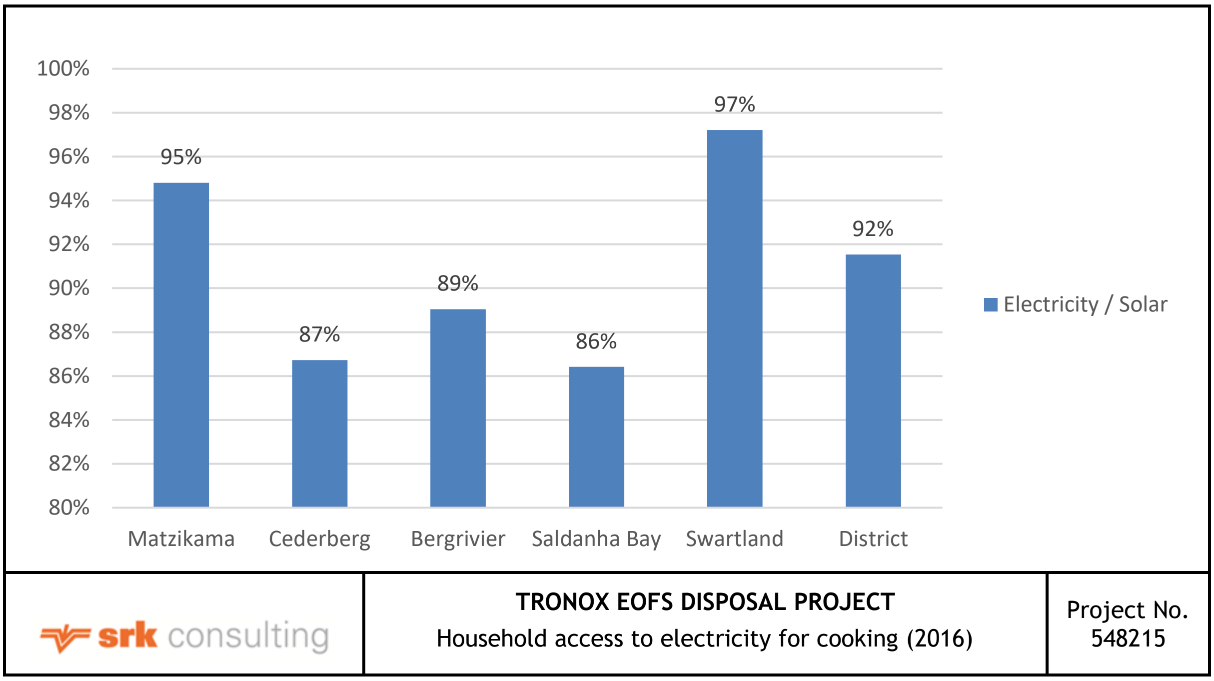



**Figure 4-36: Household access to electricity for cooking (2016)**

*Source:* (StatsSA, 2016)

### 4.2.3.4 Sanitation

Access to sanitation is a crucial basic service as it directly affects health and the dignity of human beings (Provincial Treasury, 2013). Figure 4-37 shows that ~94% of households in the WCDM had access to flush toilets in 2016. The proportion of households with access to sanitation in the WCDM has increased only slightly from 93 % in 2007.

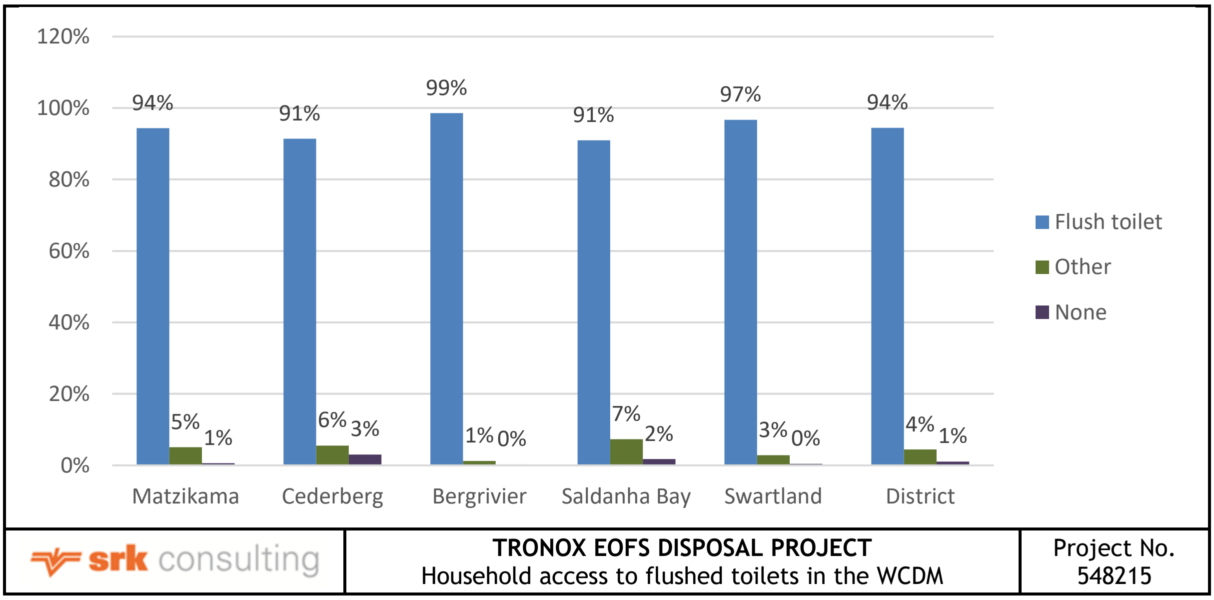



**Figure 4-37: Household access to flushed toilets in the WCDM (2016)**

*Source:* (StatsSA, 2016)

#### 4.2.3.5 Solid Waste Management

There are four categories of refuse removal, *viz*.: ‘removal by private company / local authority’, ‘communal refuse dump’, ‘own refuse dump’ and ‘other’ forms of refuse disposal (StatsSA, 2016). The category of refuse disposal available to households is considered indicative of general welfare.

Figure 4-38 indicates that 88% of households in the WCDM had their refuse removed by the local authority or private company in 2016 (the highest level of access in the WCDM). The proportion of households with access to refuse removal in the WCDM has increased from 84.5% in 2007.

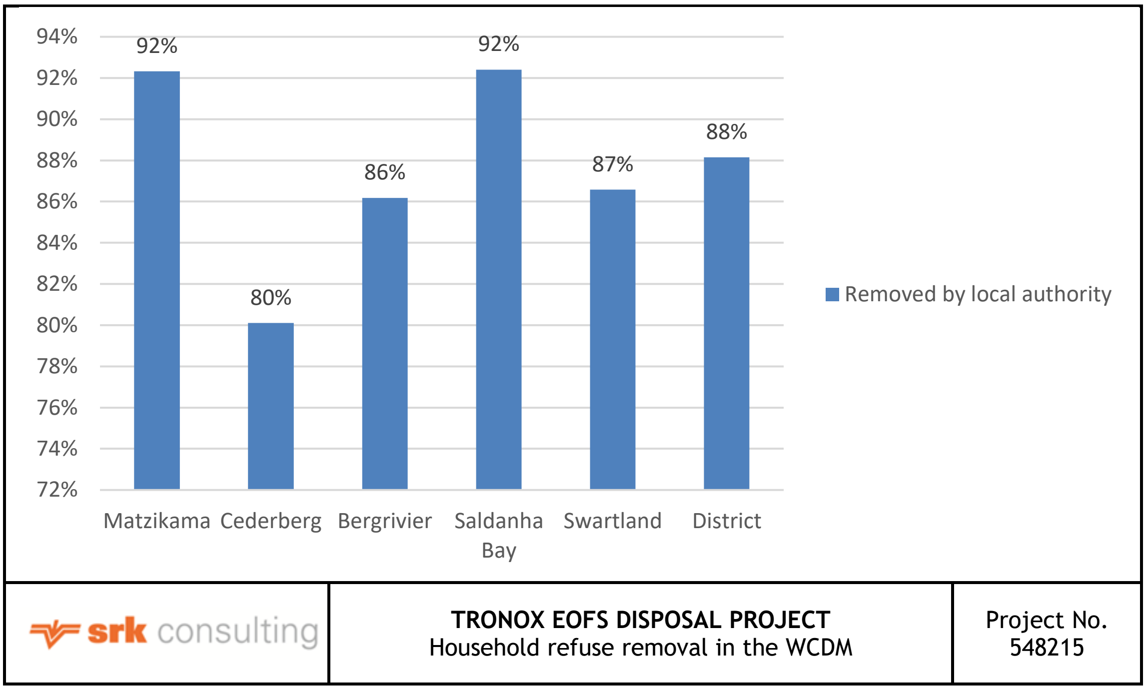



**Figure 4-38: Household refuse removal by private company or local authority in WCDM (2016)**

*Source:* (StatsSA, 2016)

### 4.2.4 Cultural and Historical Environment

The project will be restricted to mined out areas or areas approved for mining. A general description of the archaeological and palaeontological resources found at the site area are provided below.

#### 4.2.4.1 Archaeological Context

The arid areas of the Namaqualand coastline are considered to be archaeologically rich (Hart, 2006). The rocky and sandy coastal areas were attractive to early San hunter-gatherers due to the rich abundance marine foods, particularly shellfish. In excess of 1 500 archaeological sites, including shell middens and wind-deflation sites have been documented along the rocky shoreline and adjacent to dune ridges and sandy beaches of the Namaqua coast (ACRM, 2013).

Parts of the Namaqualand area were occupied by Early Stone Age (ESA) inhabitants more than one million years ago. It is also estimated that Middle Stone Age (MSA) inhabitants have been exploiting the Namaqua coastline for the past 120 000 years. However, the majority of archaeological sites discovered in the area relate to the history of the San hunter-gatherers and Khoenkhoen herders during the Late Stone Age (LSA) (ACRM, 2013) (Hart, 2006) (Webley & Halkett, 2010) (Webley 2012) (Van der Ryst & Küsel, 2012).

#### 4.2.4.2 Historic Structures

Two vacant farmhouses (HK12 and “East Mine House”) and a vacant outhouse (HK13) all older than 60 years and located on the East Mine are to be demolished. Two of those buildings (farmhouse HK12 and outhouse HK13 in Figure 4-39) are graded as Heritage sites on the Mine (Grade 3c – local low heritage significance) and were positively assessed for demolition in 2006 (ACO, 2020).

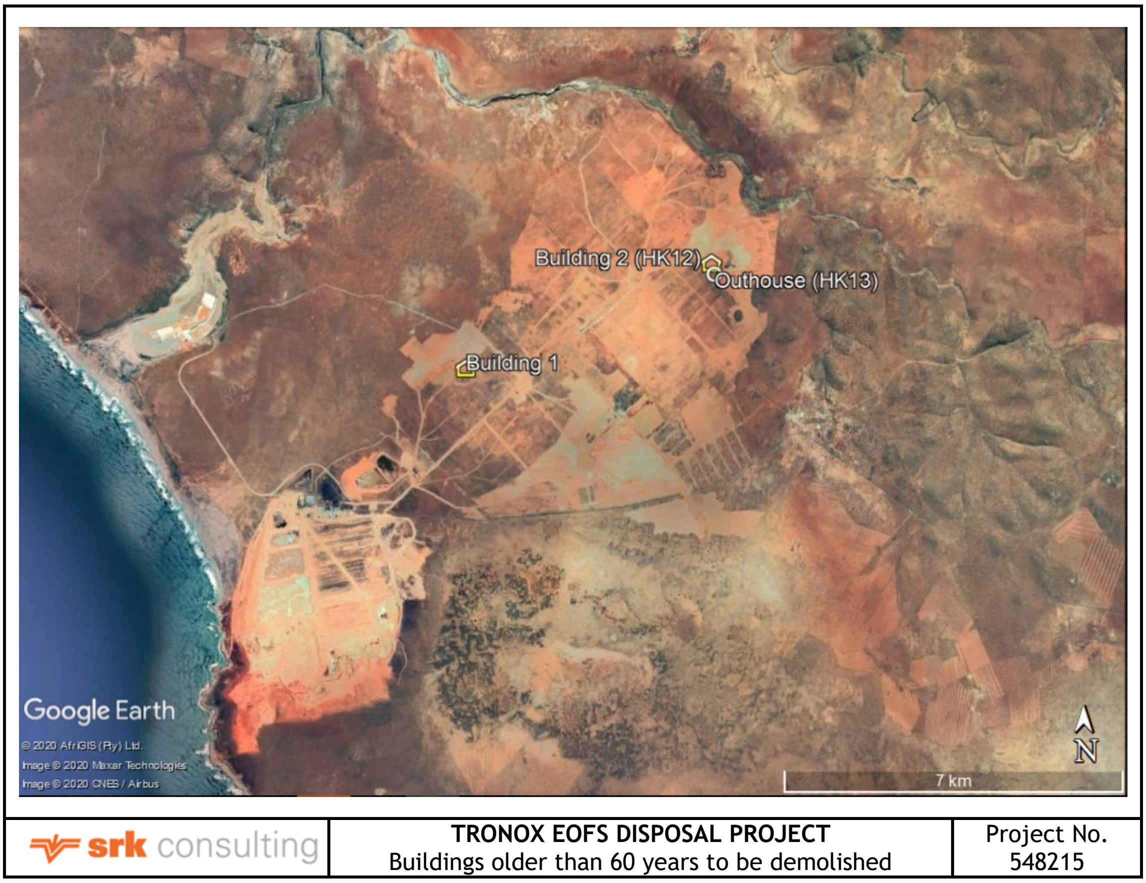



**Figure 4-39: Buildings older than 60 years to be demolished**

HK13 is a structure that probably dates from the $19^{th}$ century (ACO, 2020). It is a one-roomed structure made from mud bricks. The roof is missing, and the bricks are eroding rapidly (see Figure 4-40).

The structure is assumed to have been an outbuilding of the farm.

srk consulting | TRONOX EOFS DISPOSAL PROJECT<br>View of out building HK11 | Project No.<br>548215

**Figure 4-40: View of out building HK13**

HK12 is a cottage most likely dating to the 1930's (ACO, 2020). It is in relatively poor condition due to a lack of maintenance. The house was built in two stages with the rear rooms and *stoep* having been added to the front, pitched roof section (see Figure 4-41). The overall plan is roughly square with seven rooms, two stoeps and an external hearth. A tiny storeroom and separate water tank has been added to the left-hand side of the building. The presence of older, non-residential structures nearby suggests that an older house ruin may be present in the area (ACO, 2020).

Just in front of the house is a separate small ruin. All that remains of this is the stone foundation and cement floor at ground level.

The ruins of two other structures (HK13 & HK14) are located very nearby. Due to the poor condition of all structures the complex is not considered conservation worthy (ACO, 2020).

srk consulting | TRONOX EOFS DISPOSAL PROJECT<br>View of farmhouse HK12 | Project No.<br>548215

**Figure 4-41: View of farmhouse HK12**

"East Mine House" is an ungraded, single-story bungalow situated on Farm Rietfontein Extension, 151. The farm itself was first granted in 1880 and finally approved in 1926.

The use of concrete and standard brick and cement throughout the house, the fibre-board ceilings and steel framed windows suggests that it was constructed in the mid-20th century (ACO, 2020). The building, although at one time used as a temporary mine facility, has been abandoned for many years.

The structure is not considered conservation-worthy (ACO, 2020).


**Figure 4-42: View of "East Mine House"**

## 4.2.5 Visual and Aesthetic Environment

The Namakwa Sands Mine includes infrastructure that will be decommissioned and removed following mining (such as stockpiles, conveyors, roads and plant infrastructure) as well as infrastructure that will be left at the Mine site in perpetuity (such as RSFs). The transformation of the natural environment through mining (i.e. vegetation clearing) has a significant initial visual impact that is almost entirely reversed in the long term through rehabilitation.

### 4.2.5.1 Visual Character

The basis for the visual character of the area is provided by the geology, vegetation and land use.

The broader landscape has a predominantly undulating character with natural cover. There is significant influence from the ocean with limited rural and agricultural activities, and isolated farmsteads. Most of the area can therefore be defined as a *natural transition landscape* dominated by natural scenery, with rural elements visible in the landscape, but rural elements and artefacts are visible in the landscape (SRK, 2020a).

The Namakwa Sands Mine is a substantially modified landscape with high visual impact caused by earthmoving, scarring and associated infrastructure and activities e.g. water pipeline and powerline along the access road. This results in a *highly transformed landscape* visual character (SRK, 2020a).

### 4.2.5.2 Visual Quality

The visual quality of the broader landscape is largely defined by the open, stark character of the landscape with limited anthropogenic signature or disturbance. Views over the Atlantic Ocean contribute to this sense of 'expansive openness'. This landscape is disrupted by the operation at the Mine. In some ways the scale of the mining operations is strangely congruent with the vastness of the landscape, although the immense man-made landforms (e.g. existing fines dams) and mining infrastructure become incongruent when viewers are in close proximity to these elements (SRK, 2020a).

The Sout River, Klein Goeraap River and the Groot Goeraap River have created erosive landforms which provide interest in the landscape, thereby increasing the visual quality. The dynamic coastline of rocky outcrops and sandy beaches increases the visual quality of the coastal strip.

The low growing character of the vegetation does not add any visual interest although the predominantly natural state of the landscape and lack of human influence (beyond the influence of the Mine) creates a sense of 'starkness'.

Elements that detract from visual quality in the region include the electrical and water supply network to Namakwa Sands Mine, fines dams and other infrastructure, scarring from previous diggings and borrow pits, the concentration plants and conveyors and windbreaks.

#### 4.2.5.3 Sense of Place

The region has scenic value in terms of its open stark setting and sense of wilderness invoked when visiting, partly due to the relatively limited anthropogenic influence in the region (SRK, 2020a).

The landscape has a distinct and dramatic character. The region has high visual-spatial qualities related to the predominantly natural landscape, and the sense of place has value independent of sensitive visual receptors, of which there are few in the area. The region does not, however, have an immediately recognisable sense of place as there are few defining or unique features.

| srk consulting | TRONOX EOFS RSF SCREENING STUDY<br>Views towards proposed RSF location | Project No.<br>548215 |
|---|---|---|

**Figure 4-43: Views towards proposed RSF location**

*Source: S Reuther, 5 November 2019*

Within the existing mining area, the mining operations have had, and continue to have a significant influence on sense of place. The vast mining areas contains large mining infrastructure and facilities.

#### 4.2.5.4 Visual Receptors

Receptors are important inasmuch as they inform visual sensitivity. The sensitivity of viewers is determined by the number of viewers and the degree to which they are likely to be affected. The remoteness of the project area means that there is a very limited number of receptors. Potential viewers of the RSF and backfilled topography, including STFs, are briefly described below and linked to public viewpoints (VP) indicated in Figure 4-44.

- **Motorists** (VP4, VP5, VP7): The district road (R363) leading into the mine is used sporadically by the local farming community, the occasional visitor from outside the area and daily by mine employees and contractors. This road is one of the few public roads providing vehicular access to the coast. This road bisects and terminates in the mine, and the receptors travelling through this area have a clear view of mining operations.
- **Farmers and farm labourers** (VP2, VP3, VP6): Some farmers and farm labourers in the region are currently exposed to portions of the existing mining operation, primarily during transit to farms and residences. Occupied homesteads are typically shielded by topography, e.g. ridgelines, and at considerable distance from the East Mine (more than 5 km).
- **Holiday makers and recreational users** (VP8): Holiday makers and occasional visitors come to the coast to fish or camp. The mine and its operations are not currently visible to holiday-makers visiting many of the bays along the coastline, especially those holiday-makers who approach the area from the south (as they do not have to travel through the mine, although the area to the south has been affected by other smaller scale mining and activities that have marked the environment).
- **Saltworks employees and residents** (VP1): The employees at the Cawood Saltworks use the district road through the mine to access the saltworks. These employees are currently exposed to the Namakwa Sands operation.

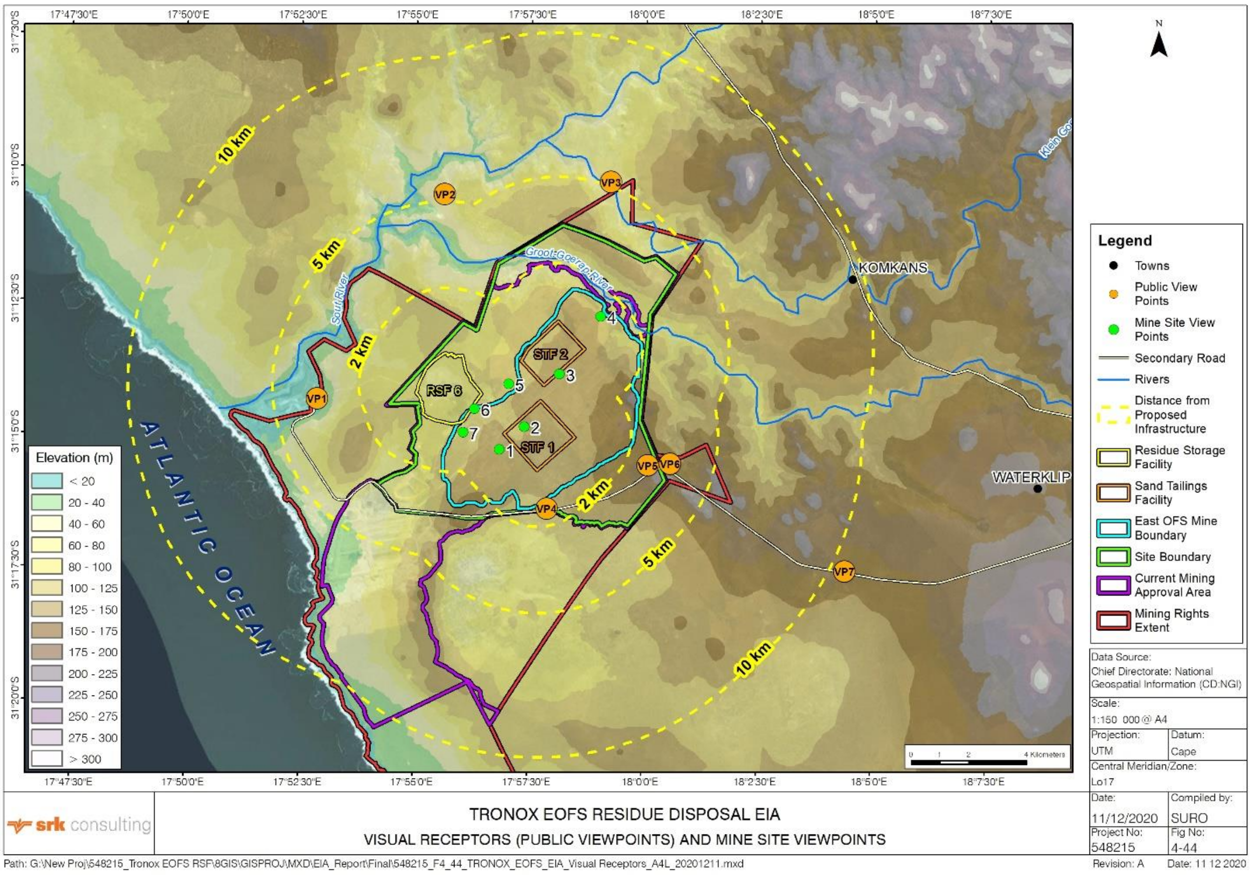



**Figure 4-44: Visual receptors (public viewpoints) and Mine site viewpoints**

# 5 Stakeholder Engagement

Stakeholder engagement forms a key component of the S&EIR process. The objectives of stakeholder engagement are outlined in this section, followed by a summary of the approach followed in compliance with Chapter 6 of the EIA Regulations, 2014 and issues raised by the public with regard to the proposed development during Pre-Application and Scoping Phases.

## 5.1 Objectives and Approach to Stakeholder Engagement

The overall aim of public consultation is to ensure that all stakeholders have adequate opportunity to provide input into the process and raise their comments and concerns. More specifically, the objectives of public consultation are to:

- Identify IAPs and inform them about the proposed development and S&EIR process;
- Provide the public with the opportunity to participate effectively in the process and identify relevant issues and concerns;
- Coordinate cooperation between organs of state in the consideration of the assessment; and
- Provide the public with the opportunity to review documentation and assist in identifying mitigation and management options to address potential environmental issues.

## 5.2 Stakeholder Engagement during the Scoping Phase

The key stakeholder engagement activities undertaken during the Scoping Phase are summarised in Table 5-1 below.

**Table 5-1: Stakeholder engagement activities undertaken during the Pre-Application and Scoping Phases**

| Task | Objectives | Reference | Dates |
|---|---|---|---|
| Public Participation Plan | To address, prevent and combat the spread of COVID-19 relating to National Environmental Management permits and licences | N/A | 18 June 2020 |
| Submit Application Forms to DMRE | Register the applications for EA, WML and EMPr amendments, and confirm authority requirements. | EA Application Form<br>WML Application Form<br>MPRDA Section 102 Application Form | 18 June 2020 (application submission)<br>7 July 2020 (application acceptance) |
| Initiate eWULAAS | Register the application for the WUL amendment and confirm authority requirements. | WU16841 | 6 March 2020 (application submission) |
| Place posters on-site | To notify stakeholders of the commencement of the EIA process and to provide a description of the proposed project and the affected environment, as well as a description of potential environmental issues, and the proposed approach to the Impact Assessment Phase. | SRK Report No. 548315/1 | 19 June 2020 |
| Advertise commencement of S&EIR process and release of Scoping Report for public comment period | | SRK Report No. 548215/1 | 18 June 2020 |

| Task | Objectives | Reference | Dates |
|---|---|---|---|
| Public comment period | To provide stakeholders with the opportunity to review and comment on the results of the Scoping Phase. | N/A | 19 June 2020 – 20 July 2020 |
| Conduct authorities meeting | To present the findings of the Scoping Report to the DMRE and DHSWS and provide an opportunity for questions and discussion. | Appendix F2 – notes of meeting | 30 July 2020 |
| Compile Issues and Responses Summary and finalise Scoping Report | To record and respond to all issues and concerns raised and collate these comments.<br>To provide an opportunity for stakeholders to review changes to the Scoping Report and make comments on these changes if necessary. | N/A | 21 July – 29 July 2020 |
| Submit Final Scoping Report (and Issues and Responses Summary) to DMRE | To provide authority with information for decision-making. | SRK Report No. 548215/2 | 30 July 2020 (report submission)<br>2 September 2020 (report accepted) |

Comments submitted during the public review period for the Scoping Report are provided in this report (see Appendix F*4*).

The key activities are described in further detail below.

### 5.2.1 Newspaper Advertisements and Posters

Newspaper advertisements announcing the commencement of the S&EIR process, the availability of the Scoping Report for stakeholder review and inviting IAPs to register on the project database were placed on 18 June 2020 in:

- One regional newspaper (in Afrikaans):
  - Die Burger; and
- One local paper (in Afrikaans and English):
  - Ons Kontrei.

English and Afrikaans posters with details of the project and EIA process and EAP contact details were placed at the Mine entrance notice board, at the notice board of OK Foods Koekenaap and the notice board at OK Foods Lutzville on 19 June 2020 *(see Appendix F1)*.

### 5.2.2 Identification of Key Stakeholders and IAPs

Relevant IAPs from local, provincial and national authorities, conservation bodies, Non-Governmental Organisations (NGO) groups, local businesses and forums and surrounding landowners were considered for inclusion as IAPs for the project.

Relevant authorities (Organs of State) were automatically registered as IAPs. As specified in the EIA Regulations, 2014, all persons who submit written comments, attend meetings or request in writing are to be placed on the register were (and will be) registered as IAPs.

The stakeholder database is attached as Appendix F*3* and was updated throughout the process.

### 5.2.3 Notification of Scoping Report for Public Comment

The release of the Scoping Report for public review was communicated to all automatically registered IAPs by post or email on or by 19 June 2020.

An electronic version of the report was made available on SRK's website **www.srk.co.za** (via the 'Library' and 'Public Documents' links).

Stakeholders were provided with a 30-day comment period until 20 July 2020.

Proof of notifications was provided to DMRE with the Final Scoping Report submitted on 30 July 2020 *and is appended in Appendix F1*.

### 5.2.4 Authority Meeting

A meeting was held with key decision making authorities (i.e. the DMRE and the DHSWS) on 30 July 2020. Meeting notes are attached as Appendix F*2*.

### 5.2.5 Issues and Concerns Raised by IAPs during Scoping

Comments received were incorporated into the Issues and Responses Summary and are appended to this report as Appendix F*4*. Stakeholders who submitted written comments during the Scoping Phase are listed in Table 5-2.

**Table 5-2: Stakeholders who submitted written comments during the Scoping Phase**

| No | Name | Affiliation | Comment date |
|---|---|---|---|
| **Authorities** | | | |
| 1 | R Nieuwoudt | DHSWS | 22 June 2020 |
| 2 | A La Meyer | DEA&DP | 20 July 2020 |
| 3 | N Tonjeni | DEA:O&C | 31 July 2020 (late) |

The main issues raised by stakeholders on the contents of the Scoping Report are:

1. The project must be designed to prevent impacts from **groundwater** contamination; and
2. **Air quality** and **noise** impacts must be managed.

Many of the comments received from stakeholders during the Scoping Phase could only be addressed in the Impact Assessment Phase of the project, as indicated in the responses provided in the Scoping Report Issues and Responses Summary (Appendix F*7*). These comments and recommendations have been considered in the assessment of impacts in Section 6 of this report.

### 5.2.6 Submission and Acceptance of Final Scoping Report

The Final Scoping Report, which was prepared in compliance with Section 21 of the EIA Regulations, 2014, was submitted to the DMRE on 30 July 2020, within 44 days of the submission of the application for EA.

The Final Scoping Report was accepted by the DMRE on 7 September 2020.

## 5.3 Stakeholder Engagement during the Impact Assessment Phase

Stakeholder engagement activities during the Impact Assessment Phase are aimed at ensuring that the specialist studies and assessment by the EIA project team adequately address the issues and concerns raised during the Scoping Phase. Opportunity to raise further issues is also provided.

The key public participation activities during the Impact Assessment Phase are summarised in Table 5-3 below.

**Table 5-3: Stakeholder engagement activities during the Impact Assessment Phase**

| Task | Objectives | Reference | Projected Dates |
|---|---|---|---|
| Public comment period including distribution of an Executive Summary to all registered stakeholders | To provide stakeholders with the opportunity to review and comment on the results of the Impact Assessment Phase, and to obtaining written comments from stakeholders and key stakeholders on the EIA Report. | SRK Report No. 548215/5 | 8 January – 8 February 2021 |
| Compile Issues and Responses Summary | To record and respond to all issues and concerns raised and collate these comments.<br>To provide an opportunity for stakeholders to review changes to the EIA Report, and make comments on these changes if necessary. | SRK Report No. 548215/7 Appendix F7 | February 2021 |
| Finalise EIA Report and submit to DMRE | To present the findings of the EIA process, incorporating stakeholder comment and submit the EIA Report to the authorities to facilitate their decisions. | SRK Report No. 548215/7 | February 2021 |

The key activities are described in further detail below.

### 5.3.1 Notification of Draft EIA Report for Public Comment

Registered stakeholders were notified of the release of the draft EIA Report for public review. Notifications, including copies of the Executive Summary, were posted or e-mailed to all registered IAPs on the same date (a list of registered IAPs notified of the draft EIA Report is included as Appendix F*3*).

Copies of the notification letter sent to all registered I&AP's *on 8 January 2021* are attached to the Final EIA Report *as Appendix F5*.

The report *was* accessible as an electronic copy on SRK's website www.srk.co.za (via the "Knowledge Centre" and then "Public Documents" links). Electronic, large file transfer links have been made available to each of the following authorities, to facilitate their review of the EIA Report and comment:

- DMRE;
- DEA&DP Directorates:
    - Development Management;
    - Biodiversity and Coastal Management; and
    - Pollution and Chemicals Management.
- DEFF: Oceans & Coasts;
- DHSWS;
- WCDM;
- MLM;
- HWC;
- Western Cape Department of Economic Development and Tourism; and
- CapeNature.

A 30-day comment period commenced on 8 January 2021 and IAPs were requested to submit comments to SRK Consulting by 8 February 2021. Comments received in response to the draft EIA Report / EMPr *are* included in an EIA Report Issues and Responses Summary and attached to the Final EIA Report / EMPr *as Appendix F6*.

### *5.3.2 Issues and Concerns Raised by IAPs during Impact Assessment*

*Comments received were incorporated into the Issues and Responses Summary in Appendix F7 and are appended to this report as Appendix F6. Stakeholders who submitted written comments during the Impact Assessment Phase are listed in Table 5-2.*

***Table 5-4: Stakeholders who submitted communication during the Impact Assessment Phase***

| No | Stakeholder | Date |
|---|---|---|
| 1 | Heritage Western Cape (HWC) | 11 January 2021 |
| 2 | West Coast District Municipality (WCDM) Air Quality | 12 & 26 January 2021 |
| 3 | Department of Transport and Public Works (DTPW) | 26 January 2021 |
| 4 | WCDM Town and Regional Planning | 8 February 2021 |
| 5 | Department of Environmental Affairs and Development Planning (DEA&DP) | 9 February 2021 |
| 6 | Department of Environment Forestry and Fisheries (DEFF): Oceans & Coasts (O&C) | 10 February 2021 |

*The main issues raised by stakeholders during the Impact Assessment Phase are:*

1. *Generally, no objections to the project were raised;*
2. *Impacts on the coastal zone and vegetation must be minimised; and*
3. *Dust suppression measures must be implemented.*

## 5.4 Next steps

Following the close of the comment period, an Issues and Responses Summary *was* compiled for inclusion with the Final EIA Report, which will be submitted to the DMRE.

# 6 Environmental Impact Assessment

## 6.1 Introduction

### 6.1.1 Environmental Impacts Identified

As the East OFS project is approved, only impacts specifically associated with the change in the required approach to residue management (i.e. the RSF, amended tailings deposition plan, Overburden stockpile, shallowing of the East Mine pit, upgrades to the seawater infrastructure and process water pipelines) are identified and assessed.

Based on the professional experience of the EIA team, legal requirements and existing authorisations (Section 2), the nature of the proposed activity (Section 3), the nature of the receiving environment (Section 4) and issues raised in the stakeholder engagement process (Section 5), the following key environmental issues – potential negative impacts and potential benefits –of the change in residue management were identified:

- **Air quality** – impaired air quality from dust entrained from / due to the RSF, amended tailings deposition plan and Overburden stockpile;
- **Hydrology** – alterations to surface water flow patterns;
- **Hydrogeology** – groundwater contamination from vehicles and equipment and process water infiltration from the RSF, tailings backfill areas and the Overburden stockpile in the East Mine;
- **Marine ecology** – habitat loss and pollution from construction activities in the coastal zone;
- **Freshwater ecology** – habitat loss from contamination, sedimentation and physical disturbance, and changes to plant communities in nearby ephemeral watercourses from process (sea) water infiltration;
- **Terrestrial ecology** – vegetation loss from erosion due to altered surface water flow patterns and the installation of process (sea) water pipelines;
- **Socio-economic (land capability)** – delayed return to the agricultural/grazing potential of the footprint of the RSF6 due to prolonged closure;
- **Socio-economic** – decline in salt production / quality at the Cawood Salt works from process (sea) water infiltration at, dust entrained from, the RSF, pit and Overburden stockpile or a decline in regional economic activity and unemployment from closure of the East Mine (i.e. the No-Go alternative);
- **Visual** – change in the visual character and sense of place from the STFs, RSF and altered topography of the pit; and
- **Traffic** – congestion and delays caused by increased traffic.

As construction and mining (operational) activities are in most cases very similar in nature and indistinguishable from one another, construction and operation phase impacts are in most cases combined as assessed as single impacts.

### 6.1.2 Specialist Studies Undertaken

A number of specialist studies (see Table 4-1 and below) were undertaken during the Impact Assessment Phase to investigate the key potential direct, indirect and cumulative impacts (negative and positive) identified during Scoping. These specialist impact studies are as follows:

- Hydrology / Surface Water Impact Assessment;

- Groundwater Impact Assessment;
- Marine Ecology Impact Assessment;
- Freshwater Ecology Impact Assessment;
- Visual Impact Assessment; and
- Heritage NID.

These specialist reports are included as Appendices D1 to D6 to this report. Air quality, terrestrial ecology, socio-economic and traffic impacts were assessed by SRK specialists and EAPs based on their experience and previous studies undertaken in the region, and stand-alone specialist studies were not considered necessary.

### 6.1.3 Alternatives Assessed in the EIA

During the prefeasibility phase of most projects various development alternatives are investigated. Furthermore, the EIA Regulations, 2014 require that all S&EIR processes must identify and describe “alternatives to the proposed activity that are feasible and reasonable”. Depending on the specific project circumstances the following alternatives may be considered:

- Site Alternatives;
- Design Alternatives;
- Land Use Alternatives;
- Process Alternatives; and
- The No-Go Alternative.

In the case of the project, various alternatives have been considered during the initial screening and scoping phases of the project, most of which were eliminated for technical reasons (refer to Section 3.8). The alternative analysis informed site selection for the RSF and STFs, and Tronox’s decision to select the “no liner” design alternative for the RSF and Overburden stockpile.

The following process (sea) water pipeline alternatives between the will be assessed where relevant:

**Process water pipeline from Buffer Dam to Seawater Dam near SCP (see Figure 3-19):**

- Option 1 installed underground, from the east west side of the Buffer Dam, passing the PCP north and then emerging above ground routing to the east, the north of the Freshwater Dam and turning south to the Seawater Dam; and
- Option 2 installed below ground, from the south side of the Buffer Dam below an access road, turning east to the Freshwater Dam, emerging aboveground south of the dam to the Seawater Dam at SCP (as previously authorised).

**Process water pipeline from Buffer Dam to PCP East Raw Seawater Dam (see Figure 3-19):**

- Option 1 installed underground, from the west of the Buffer Dam, turning north and then continuing east, emerging aboveground north of the Freshwater Dam, and continuing north of East RSF 4 and East RSF 5 in an access road reserve to the PCP East; or
- Option 2 installed below ground, from the south side of the Buffer Dam below an access road, turning east to the Freshwater Dam, emerging aboveground south of the dam and continuing north of East RSF 4 and East RSF 5 in an access road reserve to the PCP East.

#### 6.1.3.1 No-Go Alternative

The No-Go alternative will be considered in the EIA in accordance with the requirements of the EIA Regulations, 2014. The No-Go alternative entails the cessation of mining activities in the East Mine in 2024.

### 6.1.4 Impact Rating Methodology

The **significance** of an impact is defined as a combination of the **consequence** of the impact occurring and the **probability** that the impact will occur.

The criteria used to determine impact consequence are presented in Table 6-1 below.

**Table 6-1: Criteria used to determine the consequence of the impact**

| Rating | Definition of Rating | Score |
|---|---|---|
| **A.** ***Extent*** *– the area over which the impact will be experienced* | | |
| Local | Confined to project or adjacent areas | 1 |
| Regional | Affecting the region (e.g. West Coast District Municipality) | 2 |
| (Inter) national | Affecting areas beyond the Province | 3 |
| **B**. ***Intensity*** *– the magnitude of the impact in relation to the sensitivity of the receiving environment, taking into account the degree to which the impact may cause irreplaceable loss of resources* | | |
| Low | Site-specific and wider natural and/or social functions and processes are negligibly altered | 1 |
| Medium | Site-specific and wider natural and/or social functions and processes continue albeit in a modified way | 2 |
| High | Site-specific and wider natural and/or social functions or processes are severely altered | 3 |
| **C**. ***Duration*** *– the timeframe over which the impact will be experienced and its reversibility* | | |
| Short-term | Up to 2 years | 1 |
| Medium-term | 2 to 15 years | 2 |
| Long-term | More than 15 years | 3 |

The combined score of these three criteria corresponds to a **Consequence Rating**, as follows:

**Table 6-2: Method used to determine the consequence score**

| ***Combined Score*** **(A+B+C)** | 3 – 4 | 5 | 6 | 7 | 8 – 9 |
|---|---|---|---|---|---|
| ***Consequence Rating*** | Very low | Low | Medium | High | Very high |

Once the consequence is derived, the probability of the impact occurring is considered, using the probability classifications presented in Table 6-3 below.

**Table 6-3: Probability classification**

| ***Probability****– the likelihood of the impact occurring* | |
|---|---|
| Improbable | < 40% chance of occurring |
| Possible | 40% - 70% chance of occurring |
| Probable | > 70% - 90% chance of occurring |
| Definite | > 90% chance of occurring |

The overall **significance** of impacts is determined by considering consequence and probability using the rating system prescribed in Table 6-4 below.

**Table 6-4: Impact significance ratings**

| | | **Probability** | | | |
|---|---|---|---|---|---|
| | | Improbable | Possible | Probable | Definite |
| Co | Very Low | **INSIGNIFICANT** | **INSIGNIFICANT** | **VERY LOW** | **VERY LOW** |

| | | | | | |
|---|---|---|---|---|---|
| | Low | **VERY LOW** | **VERY LOW** | **LOW** | **LOW** |
| | Medium | **LOW** | **LOW** | **MEDIUM** | **MEDIUM** |
| | High | **MEDIUM** | **MEDIUM** | **HIGH** | **HIGH** |
| | Very High | **HIGH** | **HIGH** | **VERY HIGH** | **VERY HIGH** |

Finally, the impacts are also considered in terms of their status (positive or negative impact) and the confidence in the ascribed impact significance rating. The prescribed system for considering impacts status and confidence (in assessment) is laid out in Table 6-5 below.

**Table 6-5: Impact status and confidence classification**

| ***Status of impact*** | |
|---|---|
| Indication whether the impact is adverse (negative) or beneficial (positive). | + ve (positive – a 'benefit') |
| | – ve (negative – a 'cost') |
| ***Confidence of assessment*** | |
| The degree of confidence in predictions based on available information, SRK's judgment and/or specialist knowledge. | Low |
| | Medium |
| | High |

The impact significance rating should be considered by authorities in their decision-making process based on the implications of ratings ascribed below:

- **Insignificant:** the potential impact is negligible and will not have an influence on the decision regarding the proposed activity.
- **Very Low:** the potential impact is very small and should not have any meaningful influence on the decision regarding the proposed activity.
- **Low:** the potential impact may not have any meaningful influence on the decision regarding the proposed activity.
- **Medium:** the potential impact should influence the decision regarding the proposed activity.
- **High:** the potential impact will affect the decision regarding the proposed activity.
- **Very High:** the proposed activity should only be approved under special circumstances.

Practicable mitigation and optimisation measures are recommended, and impacts are rated in the prescribed way both without and with the assumed effective implementation of mitigation and optimisation measures. Mitigation and optimisation measures are either:

- **Essential**: measures that must be implemented and are non-negotiable; and
- **Best Practice:** recommended to comply with best practice, with adoption dependent on the proponent's risk profile and commitment to adhere to best practice, and which must be shown to have been considered and sound reasons provided by the proponent if not implemented.

### 6.1.5 Integration of Studies into the EIA Report and Review

The completed specialist studies and their findings have been integrated into the EIA Report. The key findings of each specialist were evaluated in relation to each other to provide an overall and integrated assessment of the project impacts.

SRK has considered the suite of potential impacts in a holistic manner and in certain instances, based on independent professional judgment and this integrated approach, may have altered impact significance ratings provided by the specialist. Where this has been done it is indicated in the relevant section of the report.

Specialists have made recommendations for the management of impacts, and the EIA team has assessed these recommendations. For the sake of brevity, only **key** (i.e. non-standard essential) mitigation measures are presented in impact rating tables (later in this section), with a collective summary of all recommended mitigation measures presented at the end of each discipline.

## 6.2 Less Significant (or Minor) Impacts

Certain impacts, while important, are considered likely to be less significant based on the impact rating criteria. These impacts include:

- **Hydrology** – alterations to surface water flow patterns due to the amended tailings deposition plan; and
- **Traffic** – congestion and delays caused by increased traffic.

These impacts are not expected to be significant. However, they have been assessed by the EAPs through desktop investigation and ground-truthing and are discussed below. Mitigation measures are also identified.

### 6.2.1 Potential Impact S1: Alterations to Surface Water Flow Patterns

Sub-catchments have been delineated for the site, including for all areas where project activities will take place (see Section 4.1.7.1). Figure 4-9 shows the sub-catchments based on the current baseline topography, and Figure 6-1 shows the catchments after (authorised) mining of the OFS in the East Mine. Changes to sub-catchments and their implications for stormwater hydrology at the Mine are discussed below.

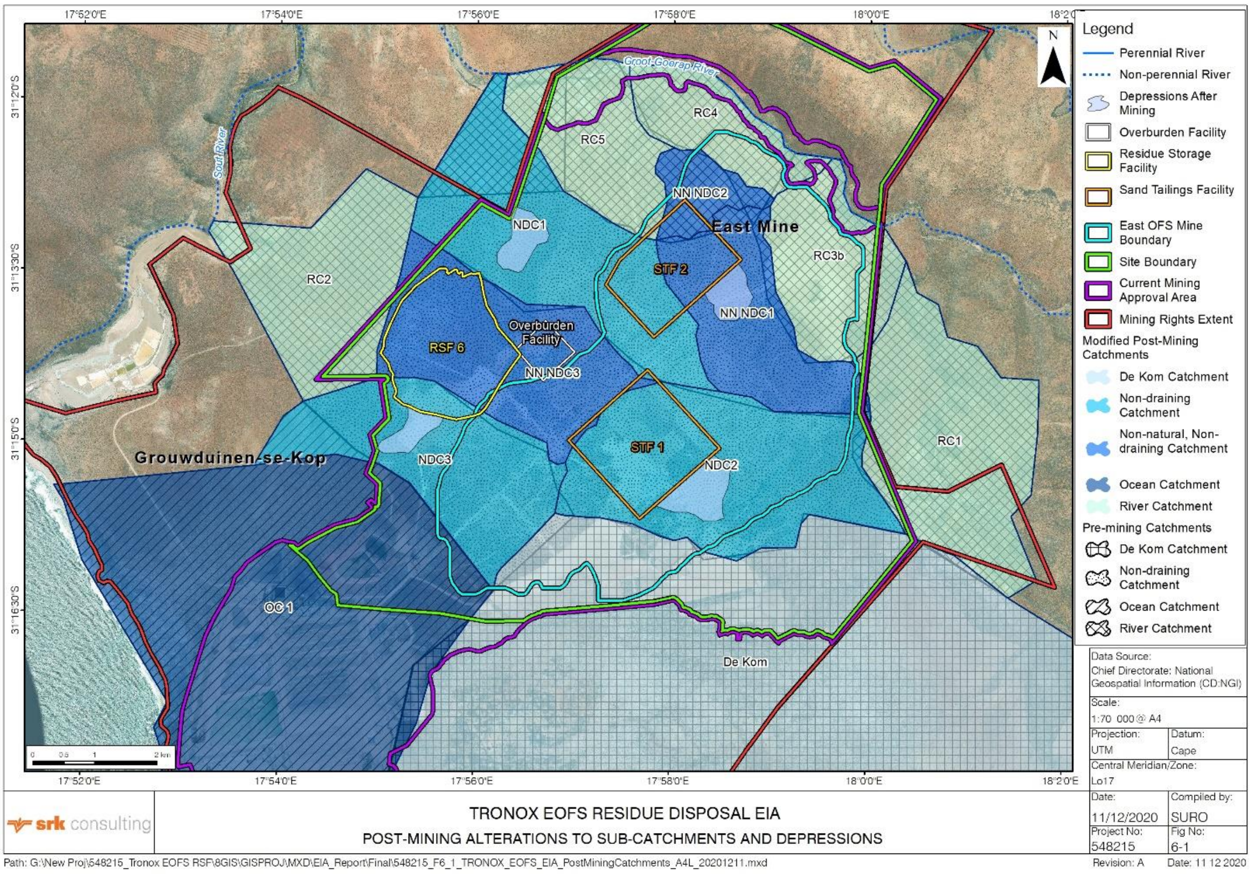



**Figure 6-1: Alterations to sub-catchments at the Mine**

At present, sub-catchments drain into the river or the ocean, and others are non-draining basins (as described in Section 4.1.7.1) (though note that surface runoff flow only occurs during very significant rainfall events). Located within these catchments are three depressions, the Northern Depression, Central Depression and Southern Depression (see Figure 4-9). Mining changes the catchments of all three depressions as follows (SRK, 2020b):

Northern Depression:

- Sub-catchment NDC 1 currently drains to the Northern Depression (see Figure 4-9). Following the East OFS mining, NDC 1 will split into two basins / non-draining catchments (NDC 1 and NN NDC 1 in Figure 6-1), and the Northern Depression will receive 24% less of the original runoff volume. As no wetland or salt pan features have been identified in the Northern Depression (Day, 2020), the reduced runoff is not expected to impact any waterbodies.
- STF 2 will straddle three sub-catchments: the new non-draining NN NDC 1, non-draining NDC 1 and a small portion of the river-draining RC 5 (see Figure 6-1). Therefore, most of the runoff from STF 2 will not reach a waterbody. However, some of the runoff could reach the Groot Goeraap river via RC 5 if not properly managed (see Section 6.6.2.2). Runoff is likely to contain elevated levels of sediment, which could disrupt river ecology and affect the downstream salt works. Engineering design in STF 2 will need to take this into account.

Central Depression:

- The central depression currently located in sub-catchment NDC 2 will be filled in completely by the RSF.

Southern Depression:

- Sub-catchments NDC 2 and 3 will combine since the RSF (see Figure 6-1), which straddles their boundary, will divert runoff to the Southern Depression. A portion of the Southern Depression will also be filled by the RSF, but the future storage capacity of the depression will still be sufficient to contain large storm events.

Other depressions:

- Several smaller depressions will be created against the walls of the STFs.

Although the change in landform cannot be effectively mitigated, the formation of non-draining areas is not inconsistent with current drainage patterns of the area (i.e. natural basins and pans characterise the area) and is not considered a significant concern (SRK, 2020b).

The impact is therefore assessed to be ***insignificant*** during the construction and operational phases[34]. No mitigation is necessary.

#### 6.2.1.1 Mitigation Measures: Potential Hydrology Impact

**Essential** hydrology mitigation measures during **construction and operations** are as follows:

- Verify that new basins created in the post mining topography do not overtop during a 1:50 year storm event (and construct berms to prevent this occurrence should it be found that they do); and
- Shape depressions to form sustainable pans or to drain in a controlled manner.

[34] Note that the Surface Water Impact Assessment assessed this impact to be of ***low*** significance, however this impact is assessed here to be ***insignificant*** as potential ecological impacts of changes to surface water flow patterns and therefore sedimentation and erosion are sufficiently captured in Section 6.6.2.2.

#### 6.2.2 Potential Impact T1: Increased Traffic Causing Congestion or Delays during Construction

A relatively limited number of vehicles will be used to transport construction materials and equipment (mostly pipelines) to the site during construction. Increased traffic during the operational phase is not anticipated.

Public road traffic between the Mine and the MSP is currently very limited, and the number and size of vehicles used to transport construction materials will not be dissimilar to Mine vehicles that use the road on a daily basis.

The impact is therefore assessed to be ***insignificant*** during the construction phase.

No mitigation is considered necessary.

## 6.3 Potential Air Quality Impact

This impact has been assessed by SRK specialists based on previous studies at the Mine and using SRK's standard Impact Assessment rating methodology; a stand-alone specialist study was not produced.

### 6.3.1 Assessment of Impact

The following potential direct air quality impact was identified:

- A1: Impaired air quality caused by increased particulate matter concentrations and dust fallout.

#### 6.3.1.1 Potential Impact A1: Nuisance Caused by Dust

The Namakwa Sands Mine is located in a very remote part of the Western Cape, with no villages or settlements near the Mine.

Potentially sensitive receptors in the vicinity of the Mine include the saltworks located ~3.2km northwest of the RSF on the Sout River estuary, Joetsies Guesthouse located ~800m east of the eastern extent of the East OFS project, Brand se Baai (used for recreational purposes) which is located immediately west of the Mine, and the surrounding natural environment (SRK, 2014). The closest towns to the Mine are too distant to be considered receptors.

Background regional air quality is largely unaffected by anthropogenic factors (aside from the Mine), with the main sources of particulates being dust from agriculture activities (livestock), vehicles entraining dust on gravel roads and infrequent vegetation burning (SRK, 2014).

Noting that land clearing for mining, ore handling and other vehicle movements are approved as part of the broader East OFS project, additional entrainment by wind at the RSF, STFs and Overburden stockpile represent the only sources of additional dust emissions associated with this project.

Receptors here may be affected by poor air quality, especially respirable $PM_{2.5s}$ and $PM_{10s}$ and dust fallout, and the accepted method to ascertain this is to compare ground level concentrations of pollutants against standards/guidelines.

A previous air quality impact assessment considered potential impacts of mining at Rietfontein Extension 5 (the property on which the RSF is proposed, and East OFS mining activities closest to the Cawood Saltworks) and Rietfontein Extension Portion 5 (the property located closest to Joetsies) (SRK, 2014). This assessment found that during active mining at these properties $PM_{10}$ and $PM_{2.5}$ concentrations at the Mine boundary would be below the South African standard of 75 and 40 µg/m$^3$ with mitigation, and that these concentrations would be well below the National limit at Joetsies and Cawood (SRK, 2014). Similarly, dust fallout from mining was found to be below the limit of 600 mg/m$^2$/day for *residential* areas at the Mine boundary and negligible at receptors, with mitigation (for example, dust fallout at the Saltwoks was modelled to be 3 mg/m²/day – 0.5% of the limit for residential areas). Therefore, construction of the RSF, overburden stockpiling during initial phases and tailings stockpiling at the STFs are unlikely to affect receptors negatively.

The air quality impact assessment also modelled a theoretical, worst-case scenario where mining areas at the properties Rietfontein Extension 151 and Houtkraal 143 (Remainder of Portion 2) were left unrehabilitated as open pits following mining. The $PM_{2.5}$ and $PM_{10}$ dispersion modelling results as well as predicted dust fallout from wind entrainment of dust for this scenario are presented in Table 6-6.

**Table 6-6: Maximum Predicted 98th percentile 24-hr PM10, PM2.5 and dust fallout concentrations – open pit at Rietfontein Extension 151 and Houtkraal 143 (Remainder of Portion 2)**

| Variable: | Guideline Values | Within Mine Boundary | At Cawood Saltworks |
|---|---|---|---|
| Maximum predicted 98$^{th}$ percentile 24 hour $PM_{10}$ | 75 µg/m³ | 274.7 µg/m³ | 22.7 µg/m³ |
| Maximum predicted 24 hour $PM_{2.5}$ | 40 µg/m³ | 71.3 µg/m³ | 8.9 µg/m³ |
| Maximum predicted 24 hour dust fallout | 600 mg/m²/day | 309 mg/m²/day | 16 mg/m²/day |

Under this hypothetical scenario dust concentrations were modelled to be 16 mg/m²/day at Cawood Saltworks – well below the residential standard of 600 mg/m²/day – and to reduce further as one moves away from the Mine. It is therefore reliably assumed that dust and particulate matter entrained from the RSF, Overburden stockpile and STFs will not affect receptors materially, even without rehabilitation (noting that Tronox continuously backfills and rehabilitates mined out areas and intends to stabilise residue stockpiles, effectively preventing off-site air pollution in these areas in the short to medium term).

A more recent air quality impact assessment of mining at Graauwduinen 152, Portion 1, Rietfontein Extension 151, Remaining Extent (more proximate to the Cawood Saltworks) and other properties to the south of the Mine found that PMN concentrations and dust fallout at the Mine boundary during and following mining in these areas would be within South African guideline values, with mitigation (EScience, 2019). This study supports the findings of SRK (2014).

The impact is assessed to be of ***low*** significance and with the implementation of mitigation is reduced to ***very low*** (Table 6-7).

**Table 6-7: Significance of impaired air quality caused by increased particulate matter concentrations and dust fallout**

| | *Extent* | *Intensity* | *Duration* | *Consequence* | *Probability* | *Significance* | *Status* | *Confidence* |
|---|---|---|---|---|---|---|---|---|
| Without mitigation | Local<br>1 | Low<br>1 | Long-term<br>3 | **Low**<br>**5** | Probable | **LOW** | – ve | High |
| **Essential mitigation measures:**<br>• Implement dust suppression measures to prevent dust emissions from exposed areas such as the southern and western wall faces of the RSF, STFs and Overburden stockpile and access roads and the new ROM stockpile.<br>• Profile, re-vegetate and stabilise RSF, Overburden stockpile walls and backfilled areas with windbreaks as soon as practically possible, i.e. during operations.<br>• Continue to monitor dust fallout on the Mine boundary and respond to exceedances of fall-out limits as currently specified in the National Dust Control Regulations, 2013.<br>• Apply additional air quality mitigation in response to exceedances of particulate matter or dust fallout guideline thresholds at the Mine boundary. | | | | | | | | |
| With mitigation | Local<br>1 | Low<br>1 | Short-term<br>1 | **Very Low**<br>**3** | Probable | **VERY LOW** | **– ve** | High |

### 6.3.2 The No-Go Alternative

The No-Go alternative entails the cessation of mining activities in the East Mine in 2024. Under this alternative, ongoing PM and dust fallout from mining in the East Mine (assessed to be of ***low*** significance in the BA for the East OFS project - Golder, 2011a) would cease, and additional emissions from this project would not be experienced. Therefore the No-Go alternative is assessed to represent a ***low*** significance air quality benefit.

### 6.3.3 Mitigation Measures: Potential Air Quality Impact

**Essential** air quality mitigation measures during **construction** and **operations** are as follows:

- Implement dust suppression measures to prevent dust emissions from exposed areas such as the southern and western wall faces of the RSF, STFs and Overburden stockpile and access roads and the new ROM stockpile.
- Profile, re-vegetate and stabilise RSF, STFs and Overburden stockpile walls with windbreaks as soon as practically possible, i.e. during operations.
- Enforce speed limits on unpaved or untreated roads.
- Continue to monitor dust fallout on the Mine boundary and respond to exceedances of fall-out limits as currently specified in the National Dust Control Regulations, 2013.
- Apply additional air quality mitigation in response to exceedances of particulate matter or dust fallout guideline thresholds at the Mine boundary.

**Best practice** air quality mitigation measures during **construction** and **operations** are as follows:

- Suspend construction of the RSF / stockpiling at the Overburden stockpile during strong winds or when a visible dust plume is present.

## 6.4 Potential Groundwater Impacts

### 6.4.1 Introduction, Terms of Reference and Methodology

This assessment is based on the Groundwater Impact Assessment undertaken by SRK (see Appendix D1). The purpose of the study was to assess the potential impacts of the project on groundwater, indicate its environmental acceptability and recommend practicable mitigation measures to minimise potential impacts and maximise potential benefits.

The ToR for the study were to:

- Review existing information and outcomes of the Screening Study and waste classification;
- Update background information to incorporate, *inter alia*, latest monitoring data (groundwater levels and water quality) and mine plan;
- Update the numerical groundwater model of the site taking new baseline information into account;
- Identify and model potential impacts on groundwater resources (quality and supply) for design alternatives (i.e. geosynthetic liner, engineered base layer or “no liner”), including options for mitigation. This includes:
  - Estimating and quantifying:
    - Altered seepage to groundwater arising from the RSF;
    - Altered seepage to groundwater arising from the new shallower backfilling method;
    - Altered seepage to groundwater from STFs; and

    - Altered seepage to groundwater from Overburden stockpile;
  - Calculating changes in groundwater flow, contaminant footprints and water and salt mass balances;
  - Assessing the hydrogeological impacts, including liner alternatives, of the RSF, new sand tailings disposal plan, STFs, Overburden stockpile and ancillary infrastructure;
- Identify and describe potential cumulative groundwater impacts resulting from the proposed project in relation to proposed and existing developments in the surrounding area (most importantly, planned mining operations at Namakwa Sands);
- Recommend measures to reduce hydrogeological impacts to a tolerable level;
- Recommend updates Tronox's groundwater monitoring programme if necessary; and
- Make recommendations for rehabilitation and closure planning.

The Groundwater Impact Assessment included a literature review and numerical flow model.

### 6.4.2 Assessment of Impact

The following potential direct impact on groundwater was identified:

- G1: Groundwater contamination.

Potential ecological and socio-economic impacts of changes to groundwater quality and depth (mounding) are identified and evaluated in Sections 6.6.2.5, 6.6.2.6 and 6.7.1.3.

#### 6.4.2.1 Potential Impact G1: Groundwater Contamination

It is possible that relatively small volumes of fuels and oils may enter the groundwater system from leaks and spills from vehicles and machinery used during construction and operations. This may contaminate groundwater resources. However, since groundwater in the area is deep, contamination of groundwater by hydrocarbons from vehicles and machinery during construction is not expected to have a meaningful impact on groundwater quality. Spills and leaks, should they occur, will be relatively small in volume, and corrective action will be taken in accordance with standard Tronox environmental management procedures.

Fine reside in the RSF will have a moisture content of ~80% at deposition, while tailings deposited in the pit and at STFs will have a seawater content of ~20% at deposition. It is assumed that ~40% of this water will be returned to the PCP East and recycled (see Sections 3.10.5.2 and 3.10.6.4) but some of this water will liberate and enter the groundwater system.

Although groundwater is naturally saline (and therefore not fit for human consumption), process water infiltration from operations has led to a rise in EC values of groundwater at the Mine (see Section 4.1.8.4). Process water is benign and contains no harmful chemicals. However, as seawater is used during processing, infiltration contaminates groundwater by elevating the salinity[35]. The primary sources of process water infiltration are the existing slimes dams.

The Groundwater Impact Assessment for the project has found that:

- The maximum discharge of water deposited at the RSF, tailings (STFs and mine void) and Overburden stockpile are ~17 000, ~3 500 and ~110 $m^3$/d respectively;

[35] The contaminant plume arising from seepage through the slimes dams is assumed to have similar characteristics to seawater, with an EC of ~5 000 mS/m.

- Groundwater flows towards the Groot Goeraap in the north-east and towards the Sout River in the north-west;
- Groundwater flows ~10 m below the Groot-Goeraap (i.e. it does not contribute to surface flow);
- There are only a few groundwater users within ~4 km of the site, which include neighbouring farmers and the Cawood Saltworks;
- Predictive numerical groundwater scenarios simulated the additional impacts of the East OFS Project on groundwater, including the RSF and Overburden stockpile base preparation design options (see Section 3.8.3) – the study found that impacts on receptors will not be affected whether the RSF is lined with a Class C or Class D liner or not, or whether the Overburden stockpile is lined with a Class D liner or not (see Section 3.8.3.1);
- The groundwater contamination plume from the project largely mimics the shape of the seepage areas (i.e. is largely confined to the site), but does migrate from the East OFS mining area in a north-westerly direction towards the Sout River as well as a north-easterly direction towards the Groot Goeraap; and
- The majority (~70%) of the contaminant plume footprint has reduced to <5% of source concentration (i.e. ~250 mS/m) at end of LoM (year 2054).

The main local receptors include groundwater, surface water features (the Sout and Groot Goeraap Rivers and ecological receptors here) and surrounding private borehole users (including the Cawood Saltworks). Modelling demonstrated the following effects on these receptors:

- Surrounding private farming boreholes will not be affected by the East OFS mining as the contaminant plume does not migrate far beyond the MRA;
- The contaminant plume is unlikely to impact the Groot Goeraap River as the plume migrates below the river channel (~10 mbgl) with a maximum concentration of ~10% of source (i.e. ~500 mS/m) – addressed in Section 6.6.2.6;
- Surface water seepage may occur in the Groot Goeraap River when backfilling of tailings occurs within ~300 m of the channel (over a two to three year period) – addressed in Section 6.6.2.6; and
- The contaminant plume may reach up to 5% of the source concentration along a ~50m long stretch along the southern banks of the Sout River (see Figure 3-10). This stretch contributes ~5% of the baseflow of the Sout River in the study area. This maximum predicted increase in salt load of the Sout River would be within the natural salt load variations of the Sout River – also addressed in Sections 6.6.2.5 and 6.7.1.3.

Seepage to groundwater from the RSF, tailings backfill (STFs and mine void) and the Overburden stockpile also result in temporary, local increases in groundwater levels (mounding). In this regard the model found that:

- Natural local groundwater levels are deep (~60 mbgl);
- The largest increases (up to ~20 m) in local groundwater levels occur directly below the RSF and localised (see Figure 3-10);
- There is little difference (<5 m) between the modelled scenarios in terms of the water level increases whether a Class C liner, Class D liner or “no liner” is selected for the RSF; and
- Temporary seepage may occur in the Groot Goeraap River changing plant communities here during backfill in the north of the EOFS mine area from vadose zone flow, but not groundwater mounding - addressed in Section 6.6.2.6.

In summary, no material impacts on anthropogenic groundwater users is anticipated (and potential ecological impacts are discussed in Sections 6.6.2.5 and 6.6.2.6).

Post-closure model simulations cover a period of 100 years, with outputs at 20, 50- and 100-years post-closure (2070, 2100 and 2150). Post-mining groundwater levels are expected to recover very rapidly (a few years), however, the saline contamination plume is expected to take much longer (> 100 years) to dissipate and return to natural groundwater quality of the area. The model results show that the contaminant plume concentrations reduce by an average ~30%, 50% and 80% for 2070, 2100 and 2150 respectively (see Figure 3-10 to Figure 3-15). This is due to natural attenuation through dilution and dispersion, with eventual discharge into the ocean.

The impact is assessed to be of ***medium*** significance and with the implementation of mitigation is reduced to ***low*** (Table 6-8).

**Table 6-8: Significance of groundwater contamination and mounding**

| | *Extent* | *Intensity* | *Duration* | *Consequence* | *Probability* | *Significance* | *Status* | *Confidence* |
|---|---|---|---|---|---|---|---|---|
| Without mitigation | Local<br>1 | Medium<br>2 | Long-term<br>3 | **Medium<br>6** | Possible | **MEDIUM** | – ve | High |
| **Essential mitigation measures:**<br>• Continue to monitor boreholes in the existing monitoring network for water quality parameters on a quarterly basis.<br>• Implement additional mitigation measures and/or corrective action if monitoring data shows a significant variation in groundwater depth (>6 m) or quality compared to the modelled outputs, such as actively pumping from a strategically placed wellfield(s) to minimise mounding and the movement of groundwater in unintended directions (such as towards private boreholes, the shoreline and/or rivers).<br>• Provide an alternative source of water should user's groundwater quality or yield be shown to be negatively affected by the Mine.<br>• Continue to monitor boreholes in the existing monitoring network for water quality parameters and water levels on a quarterly basis for a period of five years post-closure. | | | | | | | | |
| With mitigation | Local<br>1 | Low<br>1 | Long-term<br>3 | **Low<br>5** | Possible | **LOW** | **– ve** | High |

In addition to mitigation, the following recommendations are made for the monitoring programme[36]:

- Install an additional borehole (in the approximate location of -31.221185°S and 18.000656°E) to the quarterly monitoring network near the boundary of the Groot Goeraap River.
- Install two boreholes (in the approximate locations of -31.224872°S;17.895495°E and -31.234620°S;17.892371°E) to the quarterly monitoring network near the north-west boundary (towards the Sout River).

### 6.4.3 The No-Go Alternative

The No-Go alternative entails the cessation of mining activities in the East Mine in 2024. Under this alternative, additional groundwater infiltration associated with the East OFS project (also assessed to be of ***low*** significance in the BA for the East OFS project - Golder, 2011a) would not be experienced. Therefore, the No-Go alternative is assessed to represent a ***low*** significance groundwater benefit.

### 6.4.4 Mitigation Measures: Potential Groundwater Impacts

**Essential** groundwater mitigation measures during **construction** and **operations** are as follows:

- Continue to monitor boreholes in the existing monitoring network for water quality parameters on a quarterly basis.

[36] Note that some monitoring measures proposed by the groundwater specialist are captured in Sections 6.6.2.5 and 6.6.2.6.

- Implement additional mitigation measures and/or corrective action if monitoring data shows a significant variation in groundwater depth (>6m) or quality compared to the modelled outputs, such as actively pumping from a strategically placed wellfield(s) to minimise mounding and the movement of groundwater in unintended directions (such as towards private boreholes, the shoreline and/or rivers).
- Provide an alternative source of water should user's groundwater quality or yield be shown to be negatively affected by the Mine.

**Essential** groundwater mitigation measures during **decommissioning** are as follows:

- Continue to monitor boreholes in the existing monitoring network for water quality parameters and water levels on a quarterly basis for a period of 5 years post-closure.

**Best practice** groundwater mitigation measure during **operations** are as follows:

- Drill an additional monitoring borehole into preferential pathways to monitor plume migration if these are found to intercept the STFs or RSF through geotechnical analysis.

## 6.5 Potential Marine Ecology Impacts

### 6.5.1 Introduction, Terms of Reference and Methodology

This assessment is informed by the Marine Ecology Impact Assessment undertaken by Anchor Environmental (see Appendix D3). The purpose of the study was to inform the assessment of the potential impacts of the ~80 $m^2$ upgrade / expansion to the seawater intake on marine ecology, comment on the environmental acceptability of the expansion, and recommend practicable mitigation measures to minimise potential impacts and maximise potential benefits.

The ToR for the study were to:

- Review seawater intake expansion plans;
- Describe the marine ecology baseline based on previous studies undertaken for the area and desktop information;
- Identify and assess potential impacts of the additional infrastructure on the marine environment;
- Identify and describe potential cumulative marine and coastal ecology impacts resulting from additional infrastructure; and
- Recommend practicable mitigation measures to avoid and/or minimise impacts and/or optimise benefits.

The Marine Ecology Impact Assessment comprised a literature review and was informed by previous assessments undertaken by Anchor at the seawater intake.

### 6.5.2 Assessment of Impacts

The following potential direct impacts of the expansion of the seawater intake on marine ecology were identified:

- M1: Loss of Littorina habitat in the de-aeration sump development footprint; and
- M2: Contamination of seawater and the marine ecosystem.

#### 6.5.2.1 Potential Impact M1: Loss of Littorina Habitat in the De-aeration Sump Development Footprint

The proposed expansion of the intake water infrastructure entails the loss of ~50 m$^2$ of disturbed habitat for the new de-aeration sump (see Section 3.9.3 and Figure 3-20) – a disturbance footprint ~30 m$^2$ smaller than that assessed in the Marine Ecology Impact Assessment (Appendix D3). The proposed area of expansion is within the Littorina (splash zone) directly adjacent to the existing seawater intake and on habitat that is already disturbed.

As the Littorina zone on the West Coast has low natural diversity and there does not appear to be any sessile Littorina marine communities in the proposed footprint, the impact is assessed to be ***insignificant*** during the construction phase.

#### 6.5.2.2 Potential Impact M2: Contamination of Seawater and the Marine Ecosystem

Any chemical pollution is expected to be readily dispersed in the marine environment in a fairly short period of time; however, during construction litter, such as offcuts and fragments of piping and other materials, may enter the sea. These materials are transported by currents for long distances out to sea or around the coast and large numbers of aquatic organisms are killed or injured daily by becoming entangled in debris or as a result of the ingestion of small plastic particles.

The impact is assessed to be of ***medium*** significance and with the implementation of mitigation is reduced to ***very low***[37] (Table 6-9).

**Table 6-9: Significance of contamination of seawater and the marine ecosystem**

| | *Extent* | *Intensity* | *Duration* | *Consequence* | *Probability* | *Significance* | *Status* | *Confidence* |
|---|---|---|---|---|---|---|---|---|
| Without mitigation | National 3 | Low 1 | Long-term 3 | **High 7** | Possible | **MEDIUM** | – ve | High |
| **Essential mitigation measures:**<br>• Instruct staff not to litter the marine environment.<br>• Filter backwash effluent on start-up of pumps to capture plastic particles that may be in the system.<br>• Practice good housekeeping measures for the Handling of Construction and Hazardous Materials as specified in the EMPr.<br>• Implement construction phase waste management measures as specified in the EMPr. | | | | | | | | |
| With mitigation | Regional 2 | Low 1 | Med-term 2 | **Low 5** | Possible | **VERY LOW** | **– ve** | High |

### 6.5.3 The No-Go Alternative

The No-Go alternative entails the cessation of mining activities in the East Mine in 2024. Under this alternative, impacts associated with previously approved expansion activities (assessed to be of ***very low*** significance in the BA for infrastructure changes required for the East OFS project - SRK, 2015) would be avoided, and ***very low*** significance marine ecology impacts associated with this component of the project would not be experienced. Therefore, the No-Go alternative is assessed to represent a ***very low*** significance marine ecology benefit.

### 6.5.4 Mitigation Measures: Marine Ecology Impacts

**Essential** marine ecology mitigation measures during **construction** are as follows:

- Limit the extent of construction activities as far as possible.

[37] The Marine Ecology Impact Assessment assigned this impact a mitigated significance rating of "low" because its potential international extent (e.g. of a single piece of litter); however, the EAP does not believe that the potential consequences (intensity of the impact) of litter from the project warrants assessment at this (international) extent when mitigation is applied.

- Instruct staff not to litter the marine environment.
- Filter backwash effluent on start-up of pumps to capture plastic particles that may be in the system.
- Practice good housekeeping measures for the Handling of Construction and Hazardous Materials as specified in the EMPr (Appendix G).
- Implement construction phase waste management measures as specified in the EMPr.

## 6.6 Potential Aquatic and Terrestrial Ecology Impacts

### 6.6.1 Introduction, Terms of Reference and Methodology

This assessment is informed by a previous Botanical Impact Assessment of East Mine Expansion Areas (including some of the properties associated with the project which are approved for mining - Helme N., 2014) and a Freshwater Ecology Impact Assessment undertaken by Dr Liz Day for the project (see Appendix D4). The purpose of the current study was to assess the potential impacts of the project (specifically the RSF, Overburden stockpile and amended tailings deposition strategy only) on ecological receptors, indicate its environmental acceptability and recommend practicable mitigation measures to minimise potential impacts and maximise potential benefits.

The ToR for the study were to:

- Review previous ecological studies for the area and the hydrogeological model and/or other outputs of the surface water and hydrogeological impact assessments for the project, to identify habitats with potential (ephemeral) flow contributions from surface water, groundwater or interflow, or combinations thereof;
- Identify impacts of changes to surface, groundwater quality and interflow associated with the project on affected habitats;
- Undertake a site inspection of habitats with flow contributions from surface, groundwater and interflow sources which may be impacted by the project;
- Identify and assess potential ecological impacts on those habitats;
- Identify and describe potential cumulative impacts on those habitats;
- Compile a DHSWS Risk Assessment Matrix for the project; and
- Recommend mitigation measures to minimise impacts and/or optimise benefits associated with the proposed project.

The Freshwater Ecology Impact Assessment comprised a literature review and a site inspection.

### 6.6.2 Assessment of Impacts

The following potential direct ecological impacts were identified:

- E1: Degradation of natural ephemeral pans;
- E2: Vegetation loss from increased erosion;
- E3: Vegetation loss from the installation of pipelines;
- E4: Physical disturbance to aquatic ecosystems;
- E5: Changes in plant communities in the Sout River; and
- E6: Changes in plant communities in the Groot Goeraap River.

#### 6.6.2.1 Potential Impact E1: Degradation of Natural Ephemeral Pans

The RSF will encroach on the Hardpan identified by Helme (2014), of high biodiversity importance and high sensitivity (see 4.1.7.2 and Figure 3-18). Most of the Hardpan comprises terrestrial habitat and small sections are classified as ephemeral wetlands (Day, 2020). The biodiversity values of these pans are enhanced due to their linkages with terrestrial areas of high biodiversity importance. Encroachment of the RSF into this area would therefore represent damage to, or loss of a locally important ecological resource.

As the wetland pans are perched, they rely on direct precipitation rather than runoff. They are therefore expected to endure despite mining in the surrounding area, provided they remain intact.

The impact is assessed to be of ***medium*** significance and with the implementation of mitigation is reduced to ***low*** (Table 6-10).

**Table 6-10: Significance of degradation of natural ephemeral pans**

| | *Extent* | *Intensity* | *Duration* | *Consequence* | *Probability* | *Significance* | *Status* | *Confidence* |
|---|---|---|---|---|---|---|---|---|
| Without mitigation | Local 1 | Medium 2 | Long-term 3 | **Medium 6** | Definite | **MEDIUM** | – ve | High |
| **Essential mitigation measures:**<br>• Implement a 100m buffer between the RSF and Overburden stockpile and the Hardpan.<br>• Demarcate the Hardpan (and buffer) and prevent access into it.<br>• Monitor sand accretion into the Hardpan and buffer area, every six months.<br>• Install wind breaks within the buffer area if significant sand accretion is observed. | | | | | | | | |
| With mitigation | Local 1 | Low 1 | Long-term 3 | **Low 5** | Probable | **LOW** | **– ve** | High |

#### 6.6.2.2 Potential Impact E2: Vegetation Loss from Increased Erosion

Although rainfall in the area is low, the RSF, STFs and temporary Overburden stockpile(s) will change the topography and gradient of the land and consequently the velocity of (sporadic) runoff, possibly increasing erosion and transportation of sediments. Furthermore, vegetation clearance for mining may also promote erosion. While most of the East OFS Mine is a closed basin (see Figure 4-9 and Figure 6-1), STF2 and portions of the mining footprint are in catchments that (will) drain towards the Groot Goeraap River and/or Kom wetland due to changed topography in the East Mine as a result of the project. Surface water run-off from these areas could therefore lead to off-site erosion (leading to vegetation loss) and sedimentation. in this regard, vegetation in the Groot Goeraap River valley is assessed to have a medium to high sensitivity, and hosts a number of important floral Species of Conservation Concern (Helme N. , 2014).

The impact is assessed to be of ***medium*** significance and with the implementation of mitigation is reduced to ***very low*** (Table 6-10).

**Table 6-11: Significance of vegetation loss from increased erosion**

| | *Extent* | *Intensity* | *Duration* | *Consequence* | *Probability* | *Significance* | *Status* | *Confidence* |
|---|---|---|---|---|---|---|---|---|
| Without mitigation | Local<br>1 | Medium<br>2 | Long-term<br>3 | **Medium**<br>**6** | Definite | **MEDIUM** | – ve | High |
| **Essential mitigation measures:**<br>• Install stormwater a diversion berm(s) downgradient of STF2 to prevent runoff and erosion downgradient of this facility.<br>• Verify that the velocity of stormwater diverted from diversion channels and other stormwater infrastructure does not exceed 1 m/s in the 1:50 year flood during detailed design.<br>• Dissipate stormwater where it discharges from defined channels.<br>• Profile, re-vegetate and stabilise RSF, Overburden stockpile walls and backfilled areas with windbreaks as soon as practically possible.<br>• Rehabilitate (revegetate) mined out areas concurrently with mining.<br>• Inspect the site for erosion monthly during construction and annually during operations, and after storm events exceeding the 1 in 10 year event.<br>• Close erosion gullies where these are observed and rehabilitate (revegetate) these areas. | | | | | | | | |
| With mitigation | Local<br>1 | Low<br>1 | Long-term<br>3 | **Low**<br>**5** | Possible | **VERY LOW** | **– ve** | High |

#### 6.6.2.3 Potential Impact E3: Vegetation Loss from the Installation of Pipelines

The process (sea) water pipeline route alternatives between 1) the seawater Buffer Dam and the PCP West and 2) the seawater Buffer Dam and the PCP East Raw Seawater Dam are located within the approved Mine area, and within the original extent of the Namaqualand Strandveld and the Namaqualand Inland Duneveld Vegetation types. Both of these vegetation types are rated as *Least Threatened* in terms of NEM:BA, but have been assessed to be of medium to high sensitivity locally (Helme N. , 2014).

All alternative pipeline routes will be installed underground and in transformed areas (i.e. between the Buffer Dam and Freshwater Reservoir) and aboveground where the routes are located directly next to roads in areas that are partially disturbed and partially support intact vegetation (e.g. between the PCP West and the PCP East, north of East RSF 4 and East RSF 5).

Option 1 entails the installation of 2 700 m of pipeline and Option 2 the installation of 2 940 m, both aboveground in intact indigenous vegetation within the Mine area. Although no vegetation clearance will be required, SRK has assumed a 3 m wide disturbance corridor for the installation of the pipeline. As such, SRK anticipates a disturbance footprint in intact natural vegetation of 0.81 ha or 0.88 ha for Option 1 and Option 2 respectively - representing extremely small fractions of the remaining extents of the Namaqualand Strandveld and the Namaqualand Inland Duneveld habitats.

Vegetation disturbed during pipeline installation will be allowed to rehabilitate naturally (i.e. it is not anticipated that disturbances from construction will require any physical rehabilitation). However, and in accordance with existing closure commitments for the Mine, the area will be monitored to confirm whether (natural) rehabilitation has been effective such that a closure certificate can be issued. In the unlikely event that natural rehabilitation is unsuccessful in meeting the closure objective, additional rehabilitation measures will be required prior to closure.

The impact is assessed to be of ***very low*** significance with and without the implementation of mitigation regardless of the route alternatives selected (Table 6-12).

**Table 6-12: Significance of vegetation loss from pipeline installations**

| | *Extent* | *Intensity* | *Duration* | *Consequence* | *Probability* | *Significance* | *Status* | *Confidence* |
|---|---|---|---|---|---|---|---|---|
| Without mitigation | Local<br>1 | Low<br>1 | Med-term<br>2 | **Very Low**<br>**4** | Definite | **VERY LOW** | – ve | High |
| **Essential mitigation measures:**<br>• Install the process water pipelines between January and May, if possible.<br>• Access the pipeline routes from existing access roads (i.e. prohibit vehicle access into the veld for pipeline installation).<br>• Maintain good housekeeping measures for on-site refuelling of vehicles and machinery, and for spill management. | | | | | | | | |
| With mitigation | Local<br>1 | Low<br>1 | Med-term<br>2 | **Very Low**<br>**4** | Definite | **VERY LOW** | **– ve** | High |

### 6.6.2.4 Potential Impact E4: Physical Disturbance to Aquatic Ecosystems

Should access by Mine staff to the Hardpan or the Groot Goeraap not be prevented, habitat loss in these areas would be experienced. Similarly, run-off from mining areas may lead to the sedimentation of watercourses (see Sections 6.2.1 and 6.6.2.2).

The impact is assessed to be of ***low*** significance and with the implementation of mitigation is reduced to ***very low*** (Table 6-13).

**Table 6-13: Significance of physical disturbance to aquatic ecosystems**

| | *Extent* | *Intensity* | *Duration* | *Consequence* | *Probability* | *Significance* | *Status* | *Confidence* |
|---|---|---|---|---|---|---|---|---|
| Without mitigation | Local<br>1 | Low<br>1 | Long-term<br>3 | **Medium**<br>**6** | Definite | **MEDIUM** | – ve | High |
| **Essential mitigation measures:**<br>• Apply mitigation measures recommended to prevent offsite erosion and sedimentation.<br>• Implement a 100 m buffer between the RSF and Overburden stockpile and the Hardpan.<br>• Maintain buffer from the Groot Goeraap River as required in the 2015 EMPr.<br>• Demarcate the Hardpan and Groot Goeraap River buffers and prevent unauthorised access to these areas. | | | | | | | | |
| With mitigation | Local<br>1 | Low<br>1 | Long-term<br>3 | **Low**<br>**5** | Possible | **VERY LOW** | **– ve** | High |

### 6.6.2.5 Potential Impact E5: Changes in Plant Communities in the Sout River

Seepage of process (sea) water (contained in fines and tailings) into the Primary and Secondary Aquifers would emanate from the proposed RSF, the overburden facility and the STFs (see Sections 3.8.3 and 6.4).

SRK (2020) notes that the contaminant plume may reach up to 5% of the source concentration (i.e. 250 mS/m) within a ± 50 m long stretch of the southern banks of the Sout River (see Section 6.4). This concentration lies within the range of normal groundwater salinity, and it is thus not considered a significant impact to Sout River water quality. However, in the unlikely event of prolonged seepage of saline water into the river, a major but localised change in hydroperiod - to a presently ephemeral system - would occur. Long-term inflows of water along the relatively undisturbed ± 50 m long stretch of river could:

- Change plant communities, with a local increase in perennial species such as *Phragmites australis* (already present along the estuary margins just upstream of the salt processing works) abutting the salt processing facility – this species would tolerate the salinity range of inflowing water, and would thrive in perennial seepage flows; and
- Lead to shallow standing water pools/ponds likely to support *Cladophora algae* and possibly sedges such as *Bolboschoenus maritimus*, which occur in the saline lower estuary.

These impacts would be localised, affecting only a relatively small area of the river. Furthermore, *Phragmites australis* is already in the system, and is an indigenous reed species, that occurs in many slightly saline to brackish river systems, providing nesting habitat to various passerine birds.

After the end of the LoM, it is likely that these vegetated areas would slowly (over decades) revert to their more natural vegetation.

The impact is assessed to be of ***low*** significance and with the implementation of mitigation is reduced to ***very low*** (Table 6-14).

**Table 6-14: Significance of changes in plant communities in the Sout River**

| | *Extent* | *Intensity* | *Duration* | *Consequence* | *Probability* | *Significance* | *Status* | *Confidence* |
|---|---|---|---|---|---|---|---|---|
| Without mitigation | Local<br>1 | Medium<br>2 | Long-term<br>3 | **Medium<br>6** | Possible | **LOW** | – ve | High |
| **Essential mitigation measures:**<br>• Implement monitoring and associated response measures proposed to mitigate groundwater impacts.<br>• Monitor for surface seepages within a 1 km radius of the RSF on a six-monthly basis in potential discharge areas (e.g. topographically low-lying areas and riverbanks).<br>• Monitor for surface seepages within a 500 m radius of the Overburden Stockpile biannually.<br>• Inspect the 50 m long stretch of the Sout River annually.<br>• Apply additional mitigation measures if groundwater discharges are observed in the riverbanks, such as actively pumping from a strategically placed wellfield(s) to minimise mounding and the movement of groundwater in unintended directions (such as towards private boreholes, the shoreline and/or rivers). | | | | | | | | |
| With mitigation | Local<br>1 | Medium<br>2 | Med-term<br>2 | **Low<br>5** | Possible | **VERY LOW** | **– ve** | High |

### 6.6.2.6 Potential Impact E6: Changes in Plant Communities in the Groot Goeraap River

Temporary vadose zone seepage might occur into the Groot Goeraap River during backfilling of tailings within 300m of the riverbank. In the event that seepage reached the riparian area, it would be a fairly constant, of low volume during backfilling, and gradually ceasing thereafter.

The modelled EC of water seepage into the river is ~3 000 mS/m, which would be well above the expected thresholds of local plant communities and therefore promote growth of the most salt-tolerant plant species at the expense of a more diverse community, or (more likely) result in die-off in areas exposed to seepage, where crystallisation of salt on the riverbed would be likely.

Such effects could be anticipated along the length of areas abutting tailings backfill (within 300m).

Although seepage would endure over a few years only, the effects could be long-term, given the low frequency of natural surface flow in the region and slow growth rates of vegetation. When river does flow, however, it is anticipated that localised salt accumulations would be flushed downstream and that slow vegetation recovery would commence thereafter.

The impact is assessed to be of ***low*** significance and with the implementation of mitigation is reduced to ***very low*** (Table 6-15).

**Table 6-15: Significance of changes in plant communities in the Groot Goeraap River**

| | *Extent* | *Intensity* | *Duration* | *Consequence* | *Probability* | *Significance* | *Status* | *Confidence* |
|---|---|---|---|---|---|---|---|---|
| Without mitigation | Local<br>1 | Medium<br>2 | Long-term<br>3 | **Medium**<br>**6** | Possible | **LOW** | – ve | High |
| **Essential mitigation measures:**<br>• Implement monitoring and associated response measures proposed to mitigate groundwater impacts.<br>• Monitor for surface seepages within a 1 km radius of the RSF on a six-monthly basis in potential discharge areas (e.g. topographically low-lying areas and riverbanks).<br>• Monitor for surface seepages within a 500 m radius of the Overburden Stockpile biannually.<br>• Inspect the Groot Goeraap Riverbed abutting rehabilitated areas (particularly low points) monthly during active backfilling within 300 m of the Groot Goeraap River and quarterly for one year thereafter to identify significant moisture plumes likely to intercept the riverbed or banks.<br>• Install practical mitigation measures to prevent seepage into the Groot Goeraap River should seepage be identified during monitoring (e.g. the installation of cut-off drainage pipes along the closest edge to the river). | | | | | | | | |
| With mitigation | Local<br>1 | Medium<br>2 | Med-term<br>2 | **Low**<br>**5** | Possible | **VERY LOW** | **– ve** | High |

### 6.6.3 The No-Go Alternative

The No-Go alternative entails the cessation of mining activities in the East Mine in 2024. Under this alternative, rehabilitated areas will not be remined as part of the project and will return to ecological viability much sooner than if the project does not proceed (not assessed as an ecological impact by Golder, 2011), and low and very low significance ecological impacts identified as part of this project (i.e. from the changes to the residue management approach) would be avoided. Therefore, the No-Go alternative is assessed to represent a ***low*** significance aquatic and terrestrial ecology benefit.

### 6.6.4 Mitigation Measures: Aquatic and Terrestrial Ecology Impacts

**Essential** aquatic and terrestrial ecology mitigation measures during **design** are as follows:

- Verify that stormwater flows from diversion channels and other stormwater infrastructure do not exceed 1 m/s in the 1:50 year flood during detailed design.

**Essential** aquatic and terrestrial ecology mitigation measures during **construction** and **operations** are as follows:

- Implement a 100m buffer between the RSF and Overburden stockpile and the Hardpan.
- Demarcate the Hardpan (and buffer) and prevent access into it.
- Monitor sand accretion into the Hardpan and buffer every six months.
- Install wind breaks within the buffer area if significant sand accretion is observed.
- Install stormwater a diversion berm(s) downgradient of STF2 to prevent runoff and erosion downgradient of this facility.
- Verify that the velocity of stormwater diverted from diversion channels and other stormwater infrastructure does not exceed 1 m/s in the 1:50 year flood during detailed design.
- Dissipate stormwater where it discharges from defined channels.
- Profile, re-vegetate and stabilise RSF, Overburden stockpile walls and backfilled areas with windbreaks as soon as practically possible.
- Rehabilitate (revegetate) mined out areas concurrently with mining.
- Inspect the site for erosion monthly during construction and annually during operations, and after storm events exceeding the 1 in 10 year event.

- Close erosion gullies where these are observed and rehabilitate (revegetate) these areas.
- Install the process water pipelines between January and May, if possible.
- Access the pipeline routes from existing access roads (i.e. prohibit vehicle access into the veld for pipeline installation).
- Maintain good housekeeping measures for on-site refuelling of vehicles and machinery, and for spill management.
- Implement a 100m buffer between the RSF and Overburden stockpile and the Hardpan.
- Maintain buffer from the Groot Goeraap River as required in the 2015 EMPr.
- Demarcate the Hardpan and Groot Goeraap River buffers and prevent unauthorised access to these areas.
- Implement monitoring and associated response measures proposed to mitigate groundwater impacts.
- Monitor for surface seepages within a 1 km radius of the RSF on a six-monthly basis in potential discharge areas (e.g. topographically low-lying areas and riverbanks).
- Inspect the 50m long stretch of the Sout River annually.
- Apply additional mitigation measures if groundwater discharges are observed in the riverbanks, such as actively pumping from a strategically placed wellfield(s) to minimise mounding and the movement of groundwater in unintended directions (such as towards private boreholes, the shoreline and/or rivers).
- Inspect the Groot Goeraap Riverbed abutting rehabilitated areas (particularly low points) monthly during active backfilling within 300m of the Groot Goeraap River and for one year thereafter to identify significant moisture plumes likely to intercept the riverbed or banks.
- Install practical mitigation measures to prevent seepage into the Groot Goeraap River should seepage be identified during monitoring (e.g. the installation of cut-off drainage pipes along the closest edge to the river).

## 6.7 Potential Socio-Economic Impacts

These impacts have been assessed by SRK specialists informed by other specialist studies undertaken for the project and using SRK's standard Impact Assessment rating methodology; a stand-alone specialist study was not produced.

### 6.7.1 Assessment of Impacts

The following potential direct impacts of the expansion of the seawater intake on marine ecology were identified:

- SE2: Increased revenue to government and economic investment during construction; and
- SE3: Decline in production at the Cawood Saltworks.

#### 6.7.1.1 Potential Impact SE1: Delayed Return to the Agricultural Potential of the Footprint of RSF6

The baseline environment is capable of supporting grazing (i.e. has agricultural potential), but not crop farming (i.e. is not arable). Tronox current closure commitment for the Mine is to return the site to grazing potential.

While rehabilitation timeframes for both mined out areas and RSFs are not certain (and are the subject of ongoing study), what is evident is that rehabilitation of RSFs will be delayed because the surfaces need to consolidate before safe access to these facilities is possible (see Section 3.11.3).

The East OFS project (including tailings backfill) is an approved project, and the footprint of the RSF is approved for mining. Therefore, only the effect on the economic potential of the ~400 ha RSF site following the end of the operational life is considered, i.e. a delay in returning the RSF site to its prior grazing potential.

Tronox own the site, the RSF only represents a small portion of the vast, relatively unproductive agricultural region, and the reduction in land capability is limited and of limited financial consequence (especially if revenue generated from mining and the regional economic benefits are considered).

The impact is therefore assessed to be ***insignificant***.

Although Tronox continually investigate and implement measures to reduce the seawater content of fines (i.e. improve slimes density to accelerate consolidation) and enhance process water return, no formal mitigation of this impact is possible.

#### 6.7.1.2 Potential Impact SE2: Increased Revenue to Government and Economic Investment during Construction

During construction, income to the government is expected to be marginally increased by taxes (VAT) paid by Tronox on locally procured goods and services. Investment in locally procured goods and services will also have a very limited indirect and induced effect on economic performance.

Local investment (e.g. the purchase of pipelines) leads to (direct) new business sales. The suppliers of these goods and services spend their additional income, further adding to the circulation of money. This secondary expenditure, or demand, results in indirect and induced new business sales, i.e. the multiplier effect. Total new business sales are determined by the addition of direct, indirect and induced sales in the economy.

Tronox estimates the CapEx to modify the East Mine and construct additional infrastructure required for the East OFS project at R162.5 million, disbursed over a 14-month construction period. It is conservatively estimated that 25% of this expenditure (R40.5 million) will be on goods and services procured in the WCDM, representing ~1% of the local GVA-R in 2015.

Taxes generated by local procurement will contribute a small portion of provincial income.

The benefit is assessed to be of ***insignificant*** and with the implementation of optimisation is increased to ***very low*** significance (Table 6-16).

**Table 6-16: Significance of increased revenue to government and economic investment during construction**

| | *Extent* | *Intensity* | *Duration* | *Consequence* | *Probability* | *Significance* | *Status* | *Confidence* |
|---|---|---|---|---|---|---|---|---|
| Without mitigation | Regional 2 | Low 1 | Short-term 1 | **Very Low 4** | Possible | **INSIG.** | + ve | High |
| **Essential optimisation measures:**<br>• Procure goods and services from local suppliers where these are available in the WCDM. | | | | | | | | |
| With mitigation | Regional 2 | Low 1 | Short-term 1 | **Very Low 4** | Probable | **VERY LOW** | + ve | High |

#### 6.7.1.3 Potential Impact SE3: Decline in Production at the Cawood Saltworks

The Cawood Saltworks is located to the northwest of the East Mine in the Sout River Estuary. This facility abstracts saline groundwater and pumps it to the salt pans/evaporation ponds as part of their salt production process. Therefore, and as the formation of salt crystals is negatively affected by elevated levels of dust deposition, the works are considered to be sensitive air quality and groundwater receptors.

Tronox process ore with seawater and flocculant only: no contaminants (other than saline water) enter groundwater from operations. The Groundwater Impact Assessment found that the contaminant plume from the East OFS Mine may reach up to 5% of the source concentration at along a short, ~50 m stretch on the southern bank of the Sout River (see Figure 3-10 and Figure 3-11). This stretch contributes ~5% of the baseflow of the Sout River in the study area. Thus, salt concentrations in water in the Sout River could increase by a maximum of 0.0025% of source concentration, equating to an insignificant (and undetectable) maximum EC increase of ~12.5 mS/m at the Sout River (see Sections 3.8.3 and 6.4.2.1 and Appendix D1 – Groundwater Impact Assessment).

The Groundwater Impact Assessment notes that this maximum predicted increase in salt load of the Sout River would be within the natural variability of the Sout River water and is therefore not expected to affect the production of salt at the Cawood Saltworks.

Similarly, previous air quality impact assessments of mining in proximity to the saltworks and in the East Mine area found that dust fallout from mining is below South African guideline limits at the Mine Boundary, and well below these limits at Cawood Saltworks when mitigation is applied (keeping in mind that mining in the East Mine has been underway since 1994 without any apparent long-term impact on salt production to Tronox or SRK's knowledge).

The project is therefore not anticipated to have a material impact on salt production at the Cawood Saltworks; however, it is critical that this conclusion is confirmed through ongoing air quality and groundwater monitoring at the Mine.

The impact is assessed to be of ***low*** significance and with the implementation of mitigation is reduced to ***very low*** (Table 6-17).

**Table 6-17: Significance of decline in production at the Cawood Saltworks**

| | ***Extent*** | ***Intensity*** | ***Duration*** | ***Consequence*** | ***Probability*** | ***Significance*** | ***Status*** | ***Confidence*** |
|---|---|---|---|---|---|---|---|---|
| Without mitigation | Local 1 | Medium 2 | Long-term 3 | **Medium 6** | Possible | **LOW** | – ve | High |
| **Essential mitigation measures:**<br>• Conduct surface water sampling in the Sout River every six months to monitor the influence of the RSF on river salinity.<br>• Continue to monitor boreholes in the existing monitoring network for water quality parameters on a quarterly basis.<br>• Apply additional mitigation measures if monitoring data shows a significant variation in groundwater depth (>6m) or groundwater or surface water quality compared to the modelled outputs.<br>• Apply mitigation intended to mitigate potential air quality impacts of the project.<br>• Continue to monitor dust fallout on the Mine boundary and respond to exceedances of fall-out limits as currently specified in the National Dust Control Regulations, 2013.<br>• Apply additional air quality mitigation in response to exceedances of particulate matter or dust fallout guideline thresholds at the Mine boundary. | | | | | | | | |
| With mitigation | Local 1 | Low 1 | Long-term 3 | **Low 5** | Improbable | **VERY LOW** | **– ve** | High |

### 6.7.2 The No-Go Alternative

The Namakwa Sands operation (including the smelter in Saldanha Bay) employed approximately 1 200 people as at May 2019 of which ~80% fall within the category of Historically Disadvantaged (South African) Individuals. The Mine and MSP also sustain many more indirect employment opportunities in the region.

As well as CapEx required for the project, the operation also procures approximately R900 million worth of goods and services annually from the local economy and contributes approximately R100 million annually in royalties.

A number of companies and enterprises in surrounding towns, and in the district, rely on the Mine to operate, and Namakwa Sands plays a very important function as a local and regional economic driver.

The No-Go alternative entails the cessation of mining activities in the East Mine in 2024. The financial viability of the Mine (operating out of the West Mine only) and smelter in Saldanha Bay would be threatened, and those employed directly at the East Mine would be retrenched.

The impact of the No-Go alternative on the regional economy is assessed to be of ***very high*** significance.

### 6.7.3 Mitigation Measures: Socio-Economic Impacts

**Essential** socio-economic mitigation measures during **construction** and **operations** are as follows:

- Procure goods and services from local suppliers where these are available in the WCDM.
- Continue to monitor boreholes in the existing monitoring network for water quality parameters on a quarterly basis.
- Apply additional mitigation measures if monitoring data shows a significant variation in groundwater depth (>6m) or quality compared to the modelled outputs.
- Apply mitigation intended to mitigate potential air quality impacts of the project.
- Continue to monitor dust fallout on the Mine boundary and respond to exceedances of fall-out limits as currently specified in the National Dust Control Regulations, 2013.
- Apply additional air quality mitigation in response to exceedances of particulate matter or dust fallout guideline thresholds at the Mine boundary.

## 6.8 Potential Visual Impacts

### 6.8.1 Introduction, Terms of Reference and Methodology

This assessment is informed by the Visual Impact Assessment undertaken by SRK (see Appendix D5). The purpose of the study was to inform the assessment of the potential visual impacts the RSF and change in the authorised post-mining topography of the East Mine.

The ToR for the study were to:

- Describe the baseline visual characteristics of the study area, including landform, visual character and sense of place, and place this in a regional context;
- Identify potential impacts of the RSF, the Overburden stockpile and change in the authorised post-mining topography of the East Mine on the visual environment through analysis and synthesis of the following factors:
  - Visual exposure;
  - Visual absorption capacity;
  - Sensitivity of viewers (visual receptors);
  - Viewing distance and visibility; and
  - Landscape integrity.

- Identify and assess potential the impacts of the project on the visual environment and sense of place;
- Identify and assess potential cumulative impacts resulting from the proposed project in relation to other proposed and existing developments in the surrounding area; and
- Recommend practicable mitigation measures to avoid and/or minimise impacts and/or optimise benefits.

The Visual Impact Assessment included a literature review and was informed by a site inspection.

### 6.8.2 Assessment of Impacts

The following potential direct impacts of the project on the visual environment were identified[38]:

- V1: Altered sense of place and visual intrusion caused by earthworks and dust; and
- V2: Altered sense of place and visual intrusion caused by the RSF, Overburden stockpile and change in topography of the East Mine.

#### 6.8.2.1 Potential Impact V1: Altered Sense of Place and Visual Intrusion caused by Earthworks and Dust

The construction of the RSF and associated infrastructure will generate visual impacts related to earthworks, installation of conveyors, vehicles/plant/machinery and workers on site. STFs will be established via ongoing deposition of sand tailings throughout the East Mine operation, and therefore may generate dust throughout operations. These activities will, however, not be out of character with existing and approved mining activities in the East Mine and are thus not expected to affect the sense of place or present an (additional) visual intrusion or be expected to be perceived as a discrete (additional) impact. As such, only negligible change in the sense of place and visual intrusion are expected as a result of dust entrained by the project.

Dust generating activities have a greater impact within the foreground (<2 km). Only motorists on the district road through the Mining Rights Area would be affected at that distance. The transient nature of views when travelling, and the historic exposure of frequent travellers on this road to the visual impact of the existing Mine will reduce the significance of the visual (and sense of place) impact of dust generation to receptors.

The impact is assessed to be of ***high*** significance and with the implementation of mitigation is reduced to ***medium*** (Table 6-18).

**Table 6-18: Significance of altered sense of place and visual intrusion caused by earthworks and dust**

| | *Extent* | *Intensity* | *Duration* | *Consequence* | *Probability* | *Significance* | *Status* | *Confidence* |
|---|---|---|---|---|---|---|---|---|
| Without mitigation | Regional 2 | Medium 2 | Long-term 3 | **High 7** | Definite | **HIGH** | – ve | High |
| **Essential mitigation measures:**<br>• Apply mitigation recommended to mitigate air quality impact / dust generation from the project. | | | | | | | | |
| With mitigation | Regional 2 | Low 1 | Long-term 3 | **Medium 6** | Probable | **MEDIUM** | **– ve** | High |

[38] The impacts identified by the visual specialists were grouped to align with impact reporting in this EIA report, i.e. construction phase and operational impacts are reported together, and operational visual intrusion and long term (i.e. post closure) visual intrusion are considered as a single impact (reporting the higher, long-term, impact rating assessed by the specialist). Mitigation measures recommended by the specialist are fully captured in this document but are reworded to align with existing mitigation at the Mine, and are in places captured in impact reporting for other aspects (e.g. air quality).

#### 6.8.2.2 Potential Impact V2: Altered Sense of Place and Visual Intrusion caused by RSF, Overburden Stockpile and Change in Topography of the East Mine

Tronox proposes to amend the backfilling methodology, i.e. by single stacking sand tailings and/or RAS tailings overburden in the approved EOFS pit, and backfilling surplus sand tailings in two STFs. As a consequence, the EOFS pit area (with the exception of the STFs) will be a profiled and rehabilitated void (more accurately, a depression) across most of the East Mine, on average 7 m deeper than current ground level.

The RSF, STFs and to a lesser extent Overburden stockpile will be readily distinguishable from natural landforms in the area insofar as they will assume a different, angular geometry. The side slopes will be initially steeper and more regular than natural features, and the (top) surface will be (unnaturally) flat and uniform. During operations, when the facilities are in use, they will also have a contrasting and discordant colour compared to the surrounding landscape.

However, many of the project visual aspects will be compatible with, and effectively absorbed by, the Mine in which the facilities will be located. The palette of the unrehabilitated facilities is similar to that of stripped soil in the surrounding mining area. Associated infrastructure will be located within or on the walls of the RSF (e.g. fines and return water pipelines) and STFs (e.g. conveyors) or within the East Mine pit. As such, most of the additional infrastructure will be comparable to infrastructure already located within the East Mine, except for the stackers that will operate at each STF[39].

The (unfilled) RSF will assume its final dimensions and shape early during operations, in preparation to receive fines. The more prominent STFs, which have a higher elevation above mean sea level, will establish through ongoing deposition of sand tailings over East Mine operation.

Both the RSF and STFs will remain at the site following closure and in perpetuity. These facilities may further expand the overall viewshed of the mine area, particularly in the far background (>10 km) where the East Mine is not currently readily noticed (see Figure 6-2). However, this will mostly occur in the later years of East Mine operation, when the STFs are higher.

The significance of the visual (and sense of place) impact of the project to receptors will be somewhat reduced by the fact that receptors have become accustomed to the existing mine. The RSF and STFs will screen portions of each other from many viewpoints. Furthermore, the remoteness of the project area also ensures that there are only a limited number of receptors.

Due to the scale of the pit and assuming the pit edges are profiled, the 7 m drop in landscape elevation is likely to present and be perceived as the new, acceptable normal and visual impacts of this reduction in topography are not expected to be noticeable or readily discernible, nor impact on the post closure sense of place.

Tronox will close and rehabilitate the RSF and backfilling areas (including the STFs) in accordance with methods prescribed in the EMPr for the project. The sides of the RSF and STFs will be profiled to a slope not exceeding 1:5, capped and revegetated. Nevertheless, the closed facilities are likely to remain an unnatural form in the landscape as they will have very large regular shapes with flat tops. However, over time and with ongoing and successful rehabilitation, the visibility of the RSF and STFs will reduce and after ~20 years of rehabilitation, the facilities are likely to blend more effectively into the landscape, especially when viewed in the background.

[39] These units and the associated link conveyors will be partly elevated above the STFs. They will thus be visible from a distance and appear outsized relative to other plant currently used at the East Mine. Conveyors and stackers will also introduce additional, and elevated, light sources at night, though their light is likely to be perceived as an extension of existing plant / conveyer lighting at the East Mine.

The size and number of required East Mine tailings facilities is dictated by operational requirements and cannot be significantly altered without affecting project feasibility.

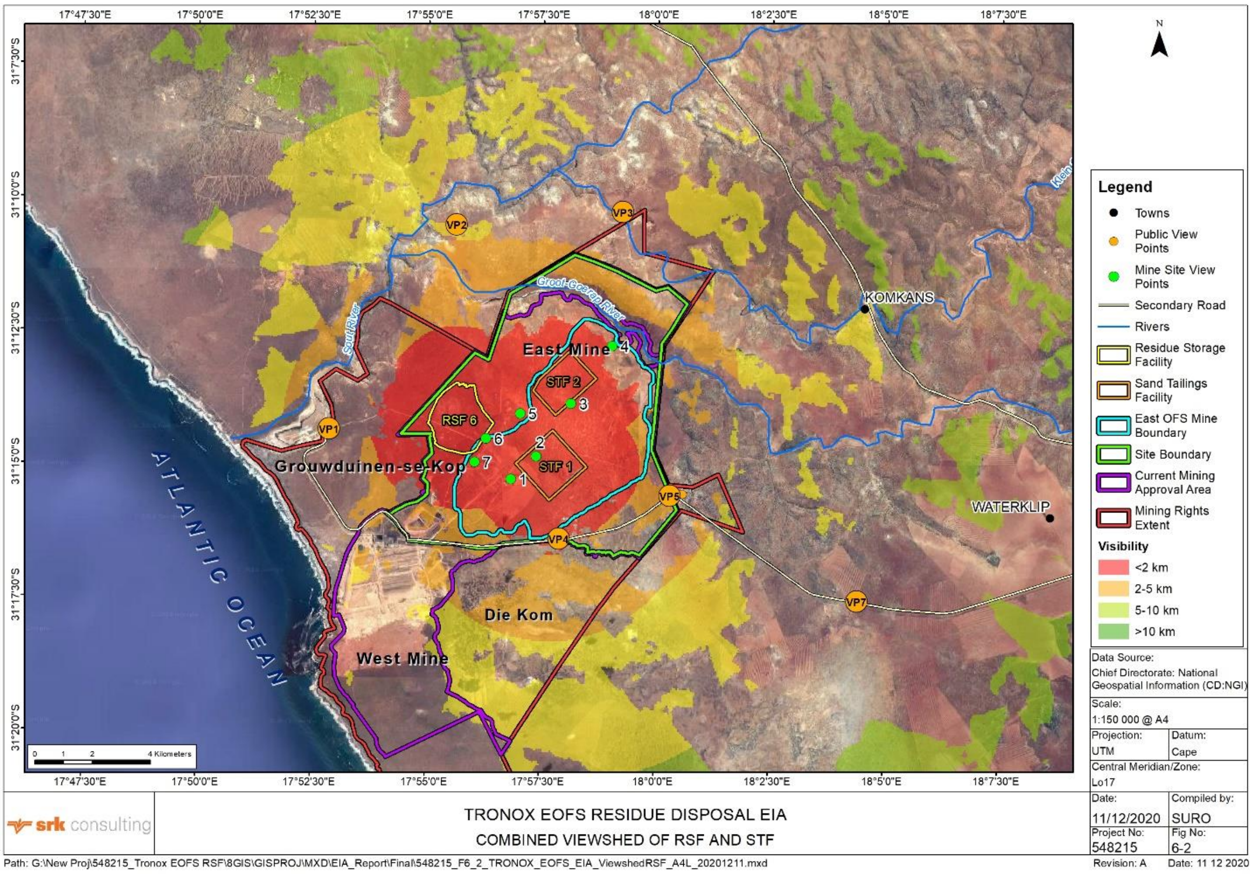



**Figure 6-2: Combined viewshed of RSF and STFs**

The impact is assessed to be of ***high*** significance and with the implementation of mitigation is reduced to ***medium*** (Table 6-18).

**Table 6-19: Significance of altered sense of place and visual intrusion caused by caused by RSF, Overburden Stockpile and change in topography of the East Mine**

| | *Extent* | *Intensity* | *Duration* | *Consequence* | *Probability* | *Significance* | *Status* | *Confidence* |
|---|---|---|---|---|---|---|---|---|
| Without mitigation | Regional 2 | Medium 2 | Long-term 3 | **High 7** | Probable | **HIGH** | – ve | High |
| **Essential mitigation measures:**<br>• Apply mitigation recommended to mitigate air quality impact / dust generation from the project.<br>• Profile, re-vegetate and stabilise RSF, Overburden stockpile walls and backfilled areas with windbreaks as soon as practically possible (i.e. during operations).<br>• Investigate options to shape deep backfill areas to be slightly sloped / undulating.<br>• Slope unmined pinnacles in the mining pit.<br>• Backfill tailings and overburden to a minimum of 1 m in the mined out pit.<br>• Install no or indirect low intensity lighting on remote (mobile) plant (e.g. stackers and conveyors), if possible.<br>• Place associated infrastructure so as to be screened by the RSF and STFs as far as possible. | | | | | | | | |
| With mitigation | Regional 2 | Low 1 | Long-term 3 | **Medium 6** | Probable | **MEDIUM** | **– ve** | High |

## 6.8.3 The No-Go Alternative

The No-Go alternative entails the cessation of mining activities in the East Mine in 2024. Under this alternative, impacts associated with previously approved expansion activities (assessed to be of ***low*** or moderate significance with mitigation in the BA for the overall East OFS project – Golder, 2011) would be avoided, and ***medium*** significance visual impacts associated with this component of the project would not be experienced. It is expected that visual impacts of the existing East Mine would be significantly mitigated through rehabilitation by ~2044, some 25 years earlier than if the project is implemented (and mining continues). Therefore, the No-Go alternative is assessed to represent a ***medium*** significance visual benefit.

### 6.8.4 Mitigation Measures: Visual Impacts

**Essential** visual mitigation measures during **construction** and **operations** are as follows:

- Apply mitigation recommended to mitigate air quality impact / dust generation from the project.
- Profile, re-vegetate and stabilise RSF, Overburden stockpile walls and backfilled areas with windbreaks as soon as practically possible (i.e. during operations).
- Backfill tailings and overburden to a minimum of 1m in the mined out pit.
- Slope / profile unmined pinnacles in the mining pit.
- Investigate options to shape deep backfill areas to be slightly sloped / undulating.
- Install no or indirect low intensity lighting on remote (mobile) plant (e.g. stackers and conveyors), if possible.
- Place associated infrastructure so as to be screened by the RSF and STFs as far as possible.

## 6.9 Potential Heritage Impact

### 6.9.1 Introduction, Terms of Reference and Methodology

This assessment is informed by the Heritage NID undertaken by ACO (see Appendix B). The purpose of the study was to inform the assessment of the potential heritage impacts of the demolition of three structures in the East Mine that are older than 60 years.

The ToR for the study were to:

- Compile a NID in relation to the proposed project, notably demolition of two farmhouses and an outhouse, installation of two powerlines and submit to HWC;
- Identify and assess potential heritage impacts of the demolition of two farmhouses and an outhouse and installation of two powerlines, based on a desktop evaluation;
- Identify and assess potential cumulative impacts resulting from the proposed project in relation to other proposed and existing developments in the surrounding area; and
- Recommend practicable mitigation measures to avoid and/or minimise impacts and/or optimise benefits.

The Heritage NID included a literature review and was informed by previous studies undertaken at the Mine, including previous grading of two of the three structures scheduled for demolition.

### 6.9.2 Assessment of Impact

The following potential direct impact of the project on the heritage resources was identified:

- HR1: Loss of heritage structures.

#### 6.9.2.1 Potential Impact H1: Loss of Heritage Structures

Two vacant farmhouses (HK12 and "East Mine House") and a vacant outhouse (HK13) all older than 60 years and located on the East Mine are to be demolished (see Section 4.2.4.2).

HK12 is a cottage most likely dating to the 1930's (ACO, 2020). It is in relatively poor condition due to a lack of maintenance and is graded as a Grade 3c heritage site (a site of low local heritage significance). HK13 is a structure that probably dates from the 19th century and is also graded as a Grade 3c heritage site. "East Mine House" is an ungraded, single-storey bungalow situated on Farm Rietfontein Extension, 151.

According to ACO (2020) all three structures are not conservation worthy and have been positively assessed for demolition. HWC have approved the NID for the project which reported these findings. The impact is therefore assessed to be ***insignificant*** and no mitigation is necessary.

### 6.9.1 The No-Go Alternative

The No-Go alternative entails the cessation of mining activities in the East Mine in 2024. Under this alternative, ***insignificant*** heritage impacts associated with the demolition of the three structures located at the Mine would be forgone.

## 6.10 Cumulative Impacts

### 6.10.1 Introduction

Anthropogenic activities can result in numerous and complex effects on the natural and social environment. While many of these are direct and immediate, the environmental effects of individual activities (or projects) can combine (additive impact) and interact (synergistic impact) with other activities in time and space to cause incremental or aggregate effects. Effects from ongoing but unrelated activities may accumulate or interact to cause additional effects (Canadian Environmental Protection Agency, no date), known as "cumulative" effects or impacts (hereafter cumulative impacts).

Cumulative impacts are defined by the International Finance Corporation (IFC, 2013) as "those that result from the successive, incremental, and / or combined effects of an action, project, or activity when added to other existing (i.e. ongoing), planned, and / or reasonably anticipated future" actions, projects or activities.

Key to the theoretical understanding of cumulative impacts is that the effects of previous and existing actions, projects or activities are already present and assimilated into the biophysical and socio-economic baseline. For the purposes of this report, cumulative impacts are defined as 'direct and indirect project impacts that act together with external stressors and existing or future potential effects of other activities or proposed activities in the area/region that affect the same resources and/or receptors, also referred to as Valued Environmental and Social Components (VECs)'.

For the most part, cumulative effects or aspects thereof are too uncertain to be quantifiable, due to mainly lack of data availability and accuracy.

### 6.10.2 Methodology

The IFC Good Practice Handbook for Cumulative Impact Assessment (2013), describes five / six key steps and considerations in the assessment of cumulative impacts:

- Definition of the Area of Influence (AoI);
- Identification of VECs, and their baseline condition;

- Identification of activities or stressors that contribute or are anticipated to contribute to cumulative effects in the foreseeable future (i.e. for all phases of the project);
- Implementation of a suitable methodology to assess cumulative impacts and evaluate their significance; and
- Identification of measures to manage and monitor cumulative impacts.

The **Area of Influence** (AoI) can be defined as the area likely to be affected, and the period or duration of occurrence of effects. In practice the AoI is a function of a large number of factors which have changing and varying degrees of influence on the areas surrounding the project throughout the course of the project cycle. The geographical extent of some of these factors can be partially quantified (e.g. air emissions can be defined by a delineated plume under specified meteorological conditions), whilst the extent of others is very difficult to measure (e.g. direct and indirect socio-economic effects).

In CIA it is good practice to focus on **VECs**, which are environmental and social attributes that are considered to be important in assessing risks and can be defined as essential elements of the physical, biological or socio-economic environment that may be affected by a proposed project. Types of VECs include physical features, habitats, wildlife populations (e.g. biodiversity), ecosystem services, natural processes (e.g. water and nutrient cycles, microclimate), social conditions (e.g. health, economics) or cultural aspects (e.g. traditional spiritual ceremonies). VECs should reflect public concern about social, cultural, economic, or aesthetic values, and also the scientific concerns of the professional community (Beanlands and Duinker, 1983).

In addition to the project, other past, present and future activities might have caused or may cause impacts and may interact with impacts caused by the project under review:

- **Cumulative impacts of past and existing activities**: It is reasonably straightforward to identify significant past and present projects and activities that may interact with the project to produce cumulative impacts, and in many respects, these are taken into account in the descriptions of the biophysical and socio-economic baseline (see respective sections in Section 4); and
- **Potential cumulative impacts of planned and foreseen activities**: Relevant future projects that will be included in the assessment are defined as those that are ‘reasonably foreseeable’, i.e. those that have a high probability of implementation in the foreseeable future; speculation is not sufficient reason for inclusion.

Stressors can be defined as natural or anthropogenic aspects which cause a change in, i.e. impact to the structure or function of the environment. Natural and anthropogenic stressors often have similar components, e.g. both drought and wood harvesting result in a loss of habitat. Due to rapid increases in human population, anthropogenic stressors on the environment have increased greatly (Cairns, 2013).

### 6.10.3 Cumulative Impact Assessment

Cumulative impacts for this project have been identified based on the extent and nature of the AoI of the projects, status of VECs and understanding of external natural and social stressors. These insights have been informed by engagements with project stakeholders, review of existing documentation, field observations and data collection. The cumulative impacts considered relevant are:

- Groundwater contamination;
- Loss of vegetation;
- Employment and income generation; and
- Change in sense of place

By and large, the cumulative impacts of past and existing projects are incorporated in the baseline (Section 4) and the focus hereafter is on planned and foreseen projects and activities. Given the limited detail available regarding such future developments, the analysis is of a more generic nature and focuses on key issues and sensitivities for the project and how these might be influenced by cumulative impacts with other activities. The future developments that are considered are:

- Those for which EAs have already been granted;
- Those that are currently subject to environmental authorisation applications and for which there is currently information available; and
- Those forming part of Provincial or National initiatives.

Where further developments are identified, but are not yet at the stage of planning as detailed above, these are noted in the cumulative impact assessment.

Projects that have been considered in the cumulative impact analysis are listed below:

- Past and existing projects / activities:
  - Tormin Mines operate a mineral sands mining operation 27 km south of the Namakwa Sands Mine;
  - Extensive diamond mining has taken place 100 km north of the Mine at Hondeklipbaai for the past 100 years;
  - Diamond mining exploration trenches are scattered throughout this stretch of coastline, both north and south of Brand se Baai;
  - Trans Hex mines diamonds on beaches ~27 km south of the Namakwa Sands Mine;
  - The Sere Wind Energy Facility (WEF) is now in operation near Koekenaap; and
  - Tronox have applied to further expand their mining footprint both north and south of the existing Mine footprint.
- Future projects / activities:
  - It is probable that Namakwa Sands will require additional RSFs in the West Mine;
  - It is probable that Tormin Mines will apply to expand their operation south of the Namakwa Sands Mine;
  - A number of applications for prospecting for Rare Earth Elements have been made further inland in Matzikama Municipality, and at least two mines are either in the advanced stages of planning or are under construction (though have stalled);
  - Exploration for diamonds continues on the coast further to the north, including a proposal to mine diamonds onshore at the Groen River about 55 km north of the Mine;
  - Aquaculture development is (or was) envisaged at the coastline;
  - PPC propose the extraction of gypsum from a mining site outside Vanrhynsdorp; and
  - At least four WEF projects have been approved in the municipal area.

In the sections below, the severity and extent of cumulative impacts is qualitatively rated to derive a high, medium or low significance rating.

#### 6.10.3.1 Cumulative Groundwater Impacts

Natural background water quality (mean ~1000 mS/m) exceeds potable drinking water standards and active RAS mining (underway at the East Mine since 1994) has contributed to increased salinity locally.

Thus, baseline groundwater quality is of a generally poor water quality (~1 050 mS/m). To assess the impact of groundwater contamination of all continued, approved operations of the mine (West Mine, East Mine, processing plants, satellite sites etc.) and proposed expansions (such as the Grouwduin se Kop and Die Kom mine), are assumed to be active in this cumulative impact analysis.

Other local contributors to the degradation of groundwater quality are limited to:

- Neighbouring farmers who may irrigate and/or fertilize their land. Fertilizer is a source of nitrogen which is highly soluble, thus has the potential to leach into groundwater; and
- The Cawood Saltworks may enhance salinisation in the Sout River and enable additional saline intrusion. The increase in salinity is inferred since abstracted groundwater in evaporation ponds, evaporates and precipitates concentrated salts. Potential saline intrusion of seawater further inland is inferred from the increase in hydraulic gradient towards abstraction boreholes.

The cumulative impact is assessed to be of ***medium*** significance without mitigation.

### 6.10.3.2 Cumulative Botanical Impacts

There are large areas of Namaqualand Strandveld (358 000 ha as of 2014) on the West Coast. It is used primarily for small stock grazing, and it is considered *Least Threatened,* but is under-conserved and large areas have been heavily and persistently overgrazed, and thus degraded (Helme N. , 2014), and it is therefore vulnerable to future transformation. This region is also a recognised biodiversity hotspot.

Namaqualand Sand Fynbos (of which Namaqualand Inland Duneveld is a vegetation type) is widespread but it occurs only in a narrow (usually <10km wide), discontiguous band, typically about 5 to 15km inland. The vegetation type is regarded as *Least Threatened* on a national basis. The unit is botanically poorly known and displays a high degree of variation from place to place and is under threat from mining in the region.

Vegetation in watercourses and riparian areas is also highly variable depending on the availability (or scarcity) of surface water and soil types, and therefore hosts more rare and sensitive plant species than the surrounding areas.

Disruption of composition and spatial extent of botanical species has potential consequences for their survival in the regional landscape because there is an overall reduction in availability of seed (reproductive potential). A reduction in the total amount of available habitat potential impacts on species whose minimum viable spatial thresholds are compromised.

Although the project is located within an area that has been mined or is approved for mining, and therefore vegetation loss and disturbance associated with this project is minimal, Tronox have proposed to expand mining activities at Namakwa Sands both north and south of existing operations, and Tormin are likely to apply for future expansions in the future. These and other projects will result in the loss of well represented vegetation types that will be impacted by this project. The cumulative impact is assessed to be of ***medium*** significance on the assumption that intensive rehabilitation plans to provide a mosaic of vegetation cover at least partially restore ecological function, are implemented.

### 6.10.3.3 Cumulative Economic Impacts

Economic impacts, such as employment and income generation are cumulative in nature, i.e. all new development will contribute to employment and income generation to a certain extent. The East OFS project will help to secure more than 1 000 direct employment opportunities at the Namakwa Sands Mine in the long term.

Increased economic activity is desirable, or even critical, in the context of high unemployment and low income levels (see Section 4.2.2.5). Together with all other productive economic activities in the region, economic activity at the Mine benefits the local community cumulatively.

Conversely, mining sterilises the agricultural (economic) potential of mining areas in the long-term. Noting the relatively low agricultural potential in Namaqualand (per ha), this opportunity “cost” is outweighed by the high socio-economic benefits of mining.

The net cumulative economic impact of mining in the region is positive and is arguably of a ***high*** significance.

#### 6.10.3.4 Cumulative Visual Impacts

The project is located within an active mine that has been subjected to mining activities for many years. The Namakwa Sands Mine contains other very large tailings facilities and vast areas have been stripped of vegetation. The project will thus add to the cumulative visual impact of mining activities in the area.

However, this existing visual impact is taken into account in the baseline, and the presence of the active mine and other tailings facilities partially mitigates some of the visual impacts of the project.

Tronox is currently applying for further expansions of the Namakwa Sands Mine, which will result in additional vegetation clearing and installation of mining infrastructure and facilities. This will further exacerbate visual impacts of already authorised activities (e.g. East Mine and West Mine) and the project. Specifically, the visually scarred area will increase, and differences in texture and topography will remain visible for the long term until rehabilitation has sufficiently advanced to form a contiguous vegetation cover. As further expansions will form part of the same mining complex, the impacts will be largely perceived as part of existing mine. However, expansion may affect new viewpoints from where mining activities could previously not be seen. The cumulative impact is reduced by the absence of sensitive receptors in the area.

In the wider region, large areas have been cleared for dryland agriculture and present as open, unvegetated strips in the landscape.

There are no other projects or developments in this remote area that significantly impact on the sense of place and visual quality of the area. The few farmsteads and traditional windmills enhance rather than detract from the sense of place and visual quality.

Existing mining in the area is one of a number of factors mitigating visual impacts. At some point the cumulative (sense of place) impacts of mining in the area may reach a threshold beyond which the relevant authority may not be prepared to grant EA. This threshold cannot be readily determined.

The cumulative impact is assessed to be of ***medium*** significance.

### 6.10.4 Management of Cumulative Impacts

The management of cumulative impacts will depend on the context in which the development is occurring, i.e. the impacts from other projects and natural drivers that affect the VECs, and the characteristics of the project impacts. Since cumulative impacts result from the actions of multiple stakeholders, the responsibility for their management is collective.

## 6.11 Climate Change Impacts

Climate change is widely recognised as a serious potential threat to the world’s environment. Climate change differs fundamentally from other potential environmental considerations in that it has global impacts that cannot be directly linked to one specific source. The majority of projects subject to EIA are likely to either contribute to or be affected by climate change, or both. Two aspects of climate change thus need to be addressed when considering project impacts: firstly, the contribution of a specific project toward global climate change, and secondly the vulnerability or resilience of the project to the effects of projected climate change in the region.

Assessment of climate change impacts is thus likely to comprise:

- Climate change impacts **of** the project: an assessment of the project's prospective contribution to climate change through the emission of greenhouse gases (GHG), including carbon dioxide ($CO_2$), methane ($CH_4$) and nitrous oxide ($N_2O$) – collectively referred to throughout this report as $CO_2$-e (carbon dioxide equivalent);
- Climate change risks **to** the project: an assessment of the impact of climate change on the project's life and operations in terms of its resilience to climate change; and
- An indication of the possible mitigation or adaptation measures that can be adopted to ensure minimised impact on/by climate change.

While climate change is increasingly well understood, the development of legal provisions and policy related to climate change in the South African regulatory framework is still underway. There is thus limited guidance in the field of climate change impact assessment in South Africa and, where necessary, climate change assessments must be guided by international best practice.

In the absence of specific provisions prescribing consideration of climate change impacts in EIA in South Africa, applying the principles of NEMA and the EIA Regulations (promulgated to govern activities which have an impact on the environment in South Africa) to a global phenomenon such as climate change presents some challenges; however legal precedent with respect to climate change assessments in South Africa has been set by the Thabametsi case in 2016. Also, in *Earthlife Africa Johannesburg v Minister of Environmental Affairs and others [2017] 2 All SA 519 (GP),* Murphy J found that "the legislative and policy scheme and framework overwhelmingly support the conclusion that an assessment of climate change impacts and mitigating measures will be relevant factors in the environmental authorisation process, and that consideration of such will best be accomplished by means of a professionally researched climate change impact report."

Climate change impacts should thus be considered in EIA; however as noted by the IFC *Guidance Note on Assessment and Management of Environmental and Social Risks and Impacts* (International Finance Corporation, 2012), the level of assessment required should be informed by a project's vulnerability to climate change and its potential to increase the vulnerability of ecosystems and communities to climate change.

Sectoral guidelines, e.g. the International Council on Mining & Metals' (ICMM) guidance document: "*Adapting to a changing climate: implications for the mining and metals industry"* (International Council on Mining and Metals, 2013), provides principles for assessing the climate change impacts of a mining operation, proposing that the core operations of a proposed mine, the mine's value chain, as well as the broader network[40] should be considered when assessing climate change impacts of a mine.

In addition, the recent *Global Industry Standard for Tailing Management* provides guidance on the considerations required when designing tailing facilities, to take into account climate change.

### 6.11.1 Contribution to Climate Change

The greenhouse effect of the earth's atmosphere is a natural phenomenon whereby atmospheric concentrations of water vapour and $CO_2$ trap infrared radiation, without which the earth's temperature would be much lower. Over the past ~100 years there have been sustained increases in atmospheric

[40] Often referred to as Scope1, Scope 2 and Scope 3 emissions

concentrations of anthropogenic GHG and halogenated compounds such as Chlorofluorocarbons (**CFCs**), Hydrofluorocarbons (HFCs) and perfluorinated compounds (PFCs). Over the same period a considerable increase in global mean temperature has been observed and there is a broad evidence base that emissions of GHG are exaggerating the greenhouse effect, thus contributing to global climate change.

### 6.11.2 South Africa's Existing GHG Balance

According to South Africa's Intended Nationally Determined Contribution (NDC) submitted in Paris in 2015[41], national GHG emissions up to 2050 are expected to follow a peak– plateau-decline trajectory: emissions are expected peak between 2020 and 2025, plateau for approximately a decade and decline in absolute terms thereafter. As a developing nation, South Africa motivates that it requires some allowances to increase its emissions in the short-term, to foster economic growth and transition towards a low carbon economy. South Africa has therefore not committed to specific emissions numbers, but the NDC rather provides a peak, plateau and decline trajectory range from 2016 (reference year) to 2050.

The national GHG inventory as presented in *South Africa's Third Biennial Update Report to the United Nations Framework Convention on Climate Change* DEA, 2019 indicates that:

- South Africa's aggregated **gross** GHG emissions excluding Forestry and Other Land Uses (FOLU[42]) were 439 238 Gigagram (Gg) $CO_2$e in 2000 increasing by 23.1% to 540 854 Gg $CO_2$e by 2015; and
- South Africa's aggregated **net** GHG emissions, including FOLU, were 426 214 Gg $CO_2$e in 2000 increasing by 20.2% to 512 383 Gg $CO_2$e by 2015.

Between 2000 and 2015 the average annual growth was 1.43%, with the energy sector being the main contributor. Gross emissions increased by 1.2% between 2012 and 2015, predominantly due to increases in emissions by the energy, waste and industrial sectors (Department of Environmental Affairs, 2019).

South Africa's emissions per capita increased from 9.93 tonnes (t)$CO_2$e per person in 2000 to 10.8 t$CO_2$e per person in 2007, thereafter declining to 9.8 t$CO_2$e per person in 2010. High emissions per capita are due to South Africa's strong reliance on a coal-based energy production sector and high emissions from the transport sector. South Africa was the 14$^{th}$ largest emitter of GHG in 2018, and 12$^{th}$ largest per capita.

### 6.11.3 Contribution to Climate Change

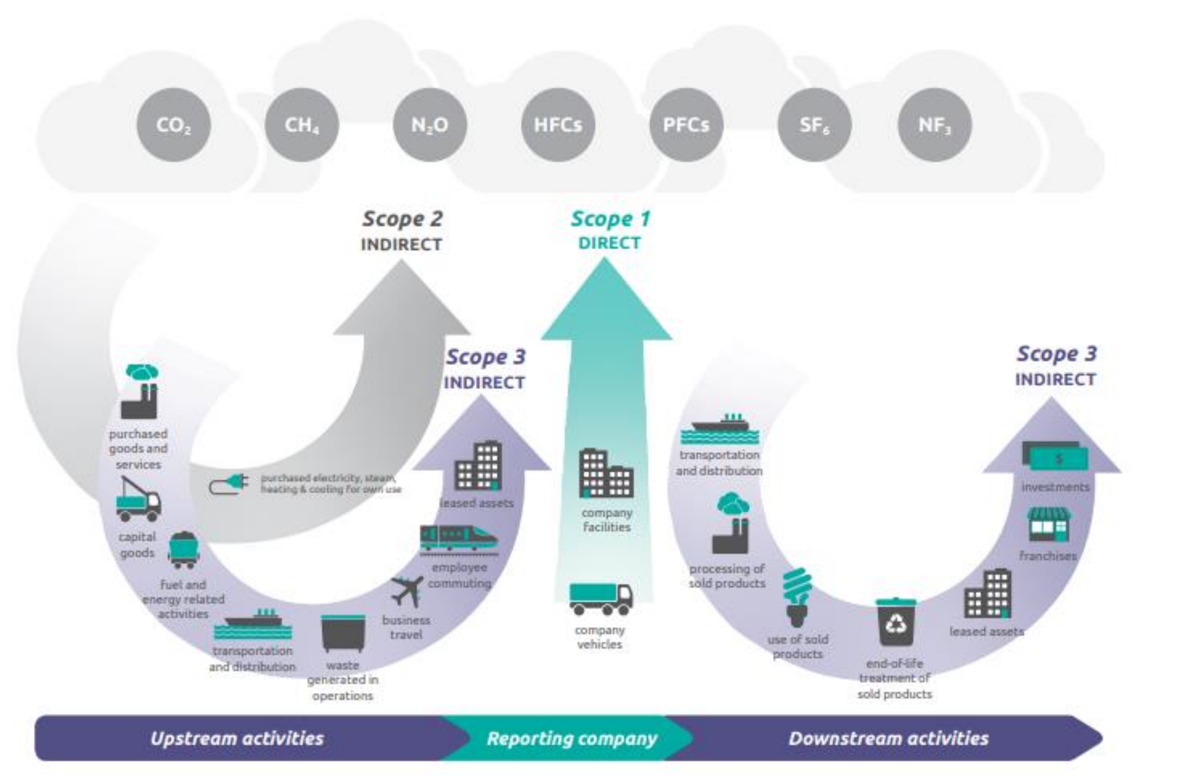
As indicated above, the contribution of any project or activity to climate change is a function of the GHG emissions associated with the project. GHG emissions can be grouped into three categories or scopes, as defined by the GHG Protocol (2019) (see Figure 6-3):

- **Scope 1** emissions are direct GHG emissions from sources owned or controlled by the owner of the Project. They can include emissions from combustion in owned or controlled boilers, furnaces, vehicles and emissions from chemical production in owned or controlled process equipment;
- **Scope 2** emissions are indirect emissions from the generation of purchased energy consumed by a company / Project. Purchased electricity is defined as electricity that is purchased or

[41] In terms of the **Paris Agreement** under the United National Framework Convention on Climate Change, each country must determine, plan and report on the contribution that it undertakes to mitigate global warming e.g. by setting specific emissions targets.
[42] Which are estimated to be net carbon sinks.

otherwise brought into the organisational boundary of the company. Scope 2 emissions physically occur at the facility where electricity is generated; and

- **Scope 3** emissions are all indirect emissions (not included in Scope 2) in the value chain of the reporting company, including upstream and downstream emissions. Scope 3 emissions are a consequence of the activities of the company but emanate from sources not owned or controlled by the company. Examples of Scope 3 activities are extraction and production of procured materials, transportation of procured fuels and use of products and services.




| srk consulting | East OFS Residue Storage Project<br>GHG emissions categories | Project No.<br>584215 |
|---|---|---|

**Figure 6-3: GHG emission categories**

Source: (Greenhouse Gas Protocol, 2019a)

In addition to emitting GHGs, projects may lead to an increase or (more often) loss of **carbon sequestration capacity**. Vegetation removes carbon (in the form of $CO_2$) from the atmosphere during photosynthesis. Until the carbon is cycled back into the atmosphere, it resides in one of a number of "carbon pools" including: above ground biomass (e.g. vegetation), below ground biomass (e.g. roots) and biomass products (e.g. wood products). Carbon can remain in some of these pools for long periods of time.

An increase in the stock of sequestered carbon stored in these pools represents a net removal of carbon from the atmosphere; a decrease in the stock represents a net addition of carbon to the atmosphere (Greenhouse Gas Protocol, 2019b).

### 6.11.4 EOFS Climate Change Impact Assessment Boundary

While the existing heavy minerals sand mining operations at the Namakwa Sands Mine may lead to GHG emissions during mining, processing and transport of mineral sands, the project which is the subject of this assessment is limited to modification of the Namakwa Sands East OFS Project Residue

Disposal Plan, which entails construction of an additional RSF, two large STFs, an Overburden stockpile and upgrade of infrastructure.

The consideration of climate change impacts is in this case this limited to the development and operation of the new facilities.

#### 6.11.4.1 Description of Project Activities

The project will include the following activities which will either contribute to GHG emissions or reduce carbon sequestration capacity:

- Delayed rehabilitation (and therefore return of sequestration potential) of ~ 400 ha of Namaqualand Strandveld vegetation[43] at the RSF;
- Transport of ore, overburden and tailings using 20 haul vehicles with a total daily fuel consumption of 15 239 litres (see Table 6-20);
- Two electricity powered stackers and
- An electricity powered dual conveyor system.

### 6.11.5 East OFS Residue Disposal Project Contribution to Climate Change

A project's **prospective** contribution to climate change is estimated based on the anticipated emission of GHG, typically reported in units of $CO_2$-e, considered in the context of the country's existing GHG inventory as well as commitments to emission reduction targets.

#### 6.11.5.1 Scope 1 Emissions

Scope 1 emissions for the project are relatively limited and include:

- Combustion of liquid fuels (hydrocarbons) by construction equipment, emitting GHG. However, the construction phase is relatively short and activities limited. Exhaust emissions are not expected to exceed normal operational emissions already generated during mining operations; and
- Combustion of liquid fuels by haul trucks and mechanical tailings stackers, emitting GHG.

Based on the calculation that vehicles will utilise approximately 5 562 megalitres of diesel per year (see Table 6-20), GHG emissions due to fuel combustion is roughly estimated at 18 002 $tCO_2e$. This is the approximate equivalent of 0.003% of South Africa's total GHG emissions per year, as reported in the 2015 emissions inventory.

**Table 6-20: Fleet fuel total usage per day**

| Vehicles | # of vehicles | Hrs / day | Fuel consumption (l/h) | Daily fuel consumption (l/day) |
|---|---|---|---|---|
| HM400 | 14 | 17.52 | 42.35 | 10 387 |
| PC1250 | 2 | 17.52 | 57.91 | 2 029 |
| WA600 | 1 | 17.52 | 52.48 | 919 |
| D10 Track Dozer | 2 | 17.52 | 44.30 | 1 552 |
| CAT 14H Grader | 1 | 17.52 | 20.00 | 350 |
| **Total:** | **20** | | | **15 239** |

[43] Noting that the clearance of vegetation has already been authorised

#### 6.11.5.2 Scope 2 and 3 Emissions

An additional 3.5 MVA of electrical power will be required for the project, procured from Eskom, primarily to power stackers at the STFs in the East Mine. Scope 2 emissions are thus calculated to be 3 $tCO_2e$ per annum, approximately equivalent of 0.00000055% of South Africa's total GHG emissions per year.

It is assumed that the following elements of the EOFS **residue disposal** will not materially contribute towards the GHG footprint during the operational phase:

- Stationary combustion from backup generators;
- Employees commuting;
- Emissions associated to electricity utilised to run pumps and other equipment;
- Purchase of capital goods, such as vehicles; and
- Business travel.

#### 6.11.5.3 Loss of Carbon Sequestration Capacity

The delayed rehabilitation of ~400 ha of Strandveld vegetation is estimated to reduce carbon sequestration capacity by approximately 12 150 $tCO_2e$ of.

### 6.11.6 Climate Change Impact

The effects of climate change are global, and $CO_2$ is emitted worldwide from a vast number of sources. Seldom is any one source a significant emitter, but combined they emit enormous quantities of $CO_2$. The $CO_2$ emissions and loss of carbon sequestration capacity associated with the project represent a relatively insignificant percentage of South Africa's total GHG emissions per year, and the impact is considered to be ***insignificant***.

Essential mitigation measures to reduce loss of carbon sequestration capacity are as follows:

- Reduce vegetation clearance to the minimum required for development of the project; and
- Rehabilitate (and replant) disturbed areas.

Recommended (best practice) mitigation measures to reduce GHG emissions are as follows:

- Implement measures to increase energy efficiency / reduce energy wastage;
- Maintain haul trucks and equipment; and
- Investigate the potential use of cleaner (e.g. renewable) energy.

### 6.11.7 Climate Change Vulnerability and Resilience

Understanding the vulnerability of a project to climate change requires an understanding of the observed and predicted climate change trends in the area.

#### 6.11.7.1 Climate Change in the Western Cape

The Western Cape has a very diverse climate, with vast variations in annual rainfall. Temperatures also range widely from cool coastal mountains where summer temperatures rarely exceed 25 °C, through to semi-arid Karoo valleys where summer temperatures can average 35 °C (Department of Environmental Affairs, 2017).

Some locations in the Western Cape have experienced temperature increases of more than 2 °C between 1931-2015, with an increased incidence of very hot days over the same period. Annual rainfall has increased significantly over the eastern interior of the province over the last few decades, with the rate of increase as high as 10 mm/decade. Associated with this, the number of days with extreme rainfall (daily rainfall above the 90th percentile threshold) has increased at a rate of about 2 days per decade. The measured rate of sea-level rise along the Western Cape coast over the last five decades is in the order of 20 cm/century, and 15 cm/century along the south coast (Department of Environmental Affairs, 2019).

Given the uncertainties in future climate change trends, *South Africa's Third National Communication under the United Nations Framework Convention on Climate Change* (DEA, 2017) presents two climate change scenarios for the Western Cape: *a drier, hotter, windier future*; and a *warmer, wetter future*.

Predicted future climate change trends in the Western Cape under a ***drier, hotter, windier future*** scenario include:

- Cycles of drier years and wetter years for the next 20 to 30 years;
- Increases in average temperatures of around 0.5 °C per decade, with the average temperatures reaching 1.5 °C higher than recent historical averages somewhere between 2040 and 2060;
- Increases in frequency and duration of hot spells in summer, and a decrease in the frequency and duration of cold spells in winter;
- Stronger summer south-easterly winds, which together with higher temperatures will strongly influence (increase) evaporation and evapotranspiration; and
- Higher evaporation from dams, combined with competing demands from agriculture and rapidly growing urban populations placing significant strain on urban water supply systems.

Toward the middle of the 21st century, more frequent and consecutive dry years are predicted, which, with continued increases in temperature and high summer wind speeds and reduced rainfall, will exacerbate the challenge of increased evaporation. Competition for water between agriculture, industry and urban water supply could become critical with water cuts becoming the only viable solution during extreme dry years.

With average temperatures now reaching 2 °C higher than the recent past, agricultural activities will become unviable. Added to these summer stresses, winter storm intensity begins to increase resulting in more frequent heavy rainfall events in winter which produce flooding and related damage.

Predicted future climate change trends in the Western Cape under a ***warmer, wetter future*** scenario are aligned with those predicted under ***drier, hotter, windier future*** scenario, with key changes in average rainfall emerging towards the middle of the 21$^{st}$ century.

During this period, rainfall in the mountains increases as a result of more moist and energetic winter storms, as well as increased moist warm southerly flow off the ocean in the summer months. While coastal and inland plains do not experience these changes directly, they have important impacts on water supply and irrigation as river flows and runoff into dams increase.

Increased rainfall is however offset by increased evaporation due to higher temperatures (reaching 2 °C higher than current) and stronger winds. While the relatively small increases in rainfall may partly delay the need for adaptation measures, adaption to reduce water demands is still required. Inland plains are not predicted to receive increased rainfall, and will experience similar conditions to the drier scenario above.

For the area surrounding the Namakwa Sands Mine, the GreenBook tool[44] (which indicates the projected impact that climate change will have on various regions of South Africa by 2050[45]) predicts that average temperature will increase by around 1.3 ℃ under the Representative Concentration Pathway (RCP) 4.5 scenario[46] and around 1.5℃ under an RCP 8.5, and average rainfall will decrease by around 28 to 31 mm under the same scenarios. Negligible changes to extreme rainfall events [47]are expected with an increase of 2 per year in the number of very hot days[48].

Recent studies have shown that surface waters along South Africa's subtropical east coast are warming significantly, linked to warming and strengthening of the Agulhas current. In contrast, sections of the country's south and west coast are cooling seasonally as winds that favour upwelling increase. The sea-level along the West Coast of South Africa is projected to rise between 4 cm and 9cm over a 30 year period (Brundrit, 1995)

#### 6.11.7.2 Vulnerability to Climate Change

The IPCC Fifth Assessment Report defines vulnerability as: "the propensity or predisposition to be adversely affected. Vulnerability encompasses a variety of concepts including *sensitivity* or susceptibility to harm and lack of *capacity* to cope and *adapt*."

Sustained warming and increased rainfall vulnerability over the short term (i.e. the next decade) will have increasingly adverse effects on key sectors of South Africa's economy in the absence of effective adaptation responses.

Impacts of climate change will initially largely be experienced by poor and vulnerable groups in society, who are both more exposed and more sensitive to fluctuations in weather patterns and climatic events such as droughts and floods (Promethium, 2018). Water, health and human settlements are key sectors negatively affected by climate change, with increases in droughts, high temperatures and rainfall variability posing a significant risk to the agricultural sector and food security in the country (Department of Environmental Affairs, 2019).

Highly populated regions are most vulnerable to climate change effects. In areas with high population growth, such as the Western Cape, climate change is expected to exacerbate high unemployment and rising urban poverty rates and further intensify the competition for basic resources such as water, healthcare, sanitation and electricity (Department of Environmental Affairs, 2019).

There is a growing awareness that a changing climate and its impacts represent a physical risk to mining operations for a number of reasons, including that mines:

- Are often located in challenging geographical areas frequently in unique and fragile environments with ecosystems that are highly sensitive to a changing climate;
- Rely on fixed assets with long design lifetimes;
- Are often dependent on long global supply chains, such that climate-related disruptions can have significant impacts across operations in multiple locations;
- Are heavily reliant on water and energy, both of which can be highly climate sensitive; and

[44] CSIR, 2019, [Website] GreenBook, Available at: https://riskprofiles.greenbook.co.za/
[45] Considering risks associated with climate change impacts on temperature, water, biodiversity, transitional risks and the social context
[46] The RCP 4.5 (as adopted by the IPCC Fifth Assessment Report) assumes emissions peaking around the middle of the 21st century and RCP 8.5 assumes business as usual/ worst-case scenario.
[47] i.e. 20 mm of rain occurring within 24 hours over the 8 x 8 km grid point.
[48] Temperature exceeding 35 ℃

- Balance the interests of various stakeholders, including local communities that may themselves be vulnerable to climate change risks from human health impacts, water availability and impacts on climate-sensitive industries such as agriculture. Climate change risks may impact workforce availability, economic growth and social development in local communities (International Council on Mining and Metals, 2013).

While the nature of climate change impacts on mining will be location-specific, climate-related risks due to increased temperatures, changing patterns of precipitation and higher sea levels, include:

- Physical risks to assets and infrastructure from flood or storm damage;
- Supply chain risks arising from disruption to transport networks; and
- Increased competition for climate-sensitive resources such as water and energy.

These impacts may affect asset values and require additional maintenance or upgrades, reduce efficiency, increase the risks of regulatory non-compliance and necessitate changes in operating practices. They may also reduce or increase demand for specific products or services.

Mining operations are dependent on substantial fixed assets and infrastructure, which are vulnerable to damage as a result of flooding, subsidence, erosion and storms. Mining infrastructure can be affected by a changing climate in several ways:

- Increased temperatures can reduce the efficiency of major equipment and cooling or water treatment processes;
- Equipment operating thresholds may be exceeded during episodes of extreme high temperature or wind speed;
- Intense rainfall events and storms can jeopardize the integrity of surface impoundments e.g. tailing dams and other mine related infrastructure (haul roads, access roads etc.); and
- In the event of storms and floods, emergency response procedures can be compromised by poor ground conditions and lack of site access.

In addition to impacts on physical infrastructure, climate change impact also impacts on labour in a number of ways.

A summary of the potential effects of climate change related events on the project with recommended mitigation and adaptation strategies are presented in Table 6-21 below.

**Table 6-21: Potential climate change impacts and adaptation measures**

| Event | Effect | Adaptation strategies |
|---|---|---|
| Extreme temperatures | Reduced labour productivity due to excessive heat. | • Ensure that Health and Safety policies and procedures address working under excessively hot conditions. |
| | Increased number of staff casualties due to work in excessive heat. | |
| Extreme wind | Extreme wind may lead to additional dust generation from residue stockpiles requiring additional mitigation. | • More frequent/adapted dust mitigation strategies may be required, which may increase the demand for water, windbreak netting, and require more intensive revegetation, etc., with financial implications. |
| Decreasing annual precipitation | Decreasing water availability and quality is unlikely to affect Tronox's operations (or management of tailings and residue) as seawater is used as process water at the mine. | • - |
| | A decrease in natural dust suppression may lead to dust generation from residue stockpiles requiring additional mitigation. | • More frequent/adapted dust mitigation strategies may be required. |
| Extreme rainfall events and flooding | The increasing frequency and intensity of extreme weather events will bring more severe flooding, potential disrupting operations and posing additional safety risks. | • Design stormwater systems to deal with more frequent and severe flood events.<br>• Design tailing and residue storage facilities to withstand more frequent and severe flood events.<br>• Review operational and safety management plans to identify additional operational risks and implement additional management measures. |
| | Increased number of power outages, water supply and transport disruptions. | |
| Higher ambient mean temperatures | Increased workforce discomfort and OHS risks | • Increased cooling of buildings required, especially those housing key instrumentation and control equipment. |
| | Can facilitate rampant growth in seaweed which could restrict/block seawater water intake. | • Increased maintenance of screens to ensure unclogged water intake. |
| Sea level rise | Sea level rise in combination with more severe storms events could lead inundation and additional erosion impacts on coastal infrastructures (e.g. the seawater intake). | • Monitor the integrity of coastal (seawater intake) infrastructure to ensure that damages don't cause water supply disruptions.<br>• Design new (future) coastal infrastructure to withstand more frequent and severe coastal storm events.<br>• Where possible set new coastal infrastructure back from the existing HWM. |
| | Damage to seawater intake infrastructure could disrupt water supply and compromise mine operations. | |

# 7 Conclusions and Recommendations

This chapter evaluates the impact of the proposed RSF, Overburden stockpile and amended approach to tailings backfill including the establishment of two large STFs, and associated infrastructure at the Namakwa Sands Mine at Brand se Baai. The principal findings are presented in this chapter, followed by an analysis of the need and desirability of the project and a discussion of the key factors DMRE will have to consider in order to take a decision which is aligned with the principles of sustainable development. Key recommendations are also presented.

As is to be expected, the RSF, Overburden stockpile and amended approach to tailings backfill have the potential to cause impacts, both negative and positive. However, since the development is located within a mined out area and/or in an area already approved for mining in a remote, but active, mining region, negative impacts are generally of low intensity, and are not predicted to be of major concern. Impacts from the project will, however, persist in the long term.

The EIA has examined the available project design information and drawn on both available (secondary) and acquired (primary) baseline data to identify and evaluate environmental (biophysical and socio-economic) impacts of the proposed project. The EIA Report aims to inform decision-makers of the key considerations by providing an objective and comprehensive analysis of the potential impacts and benefits of the project, and has created a platform for the formulation of mitigation measures to manage these impacts, presented in the EMPr attached as Appendix G.

This chapter presents the general conclusions drawn from the S&EIR process, which should be considered in evaluating the project. It should be viewed as a supplement to the detailed assessment of individual impacts presented in Chapter 6.

## 7.1 Environmental Impact Statement

The EIA Regulations, 2014 prescribe the required content of an EIA Report, including, *inter alia*, an EIS, which is presented in the section below.

### 7.1.1 Evaluation and Summary of Positive and Negative Impacts

The evaluation is undertaken in the context of:

- The project information provided by the proponent;
- The assumptions made for this EIA Report;
- The assumption that the recommended (essential) mitigation measures will be effectively implemented; and
- The assessments provided by specialists.

This evaluation aims to provide answers to a series of key questions posed as objectives at the outset of this report, which are repeated here:

- Assess in detail the environmental and socio-economic impacts that may result from the project;
- Evaluate the benefits and costs of RSF and Overburden stockpile liner alternatives;
- Identify environmental and social mitigation measures to address the impacts assessed; and
- Produce an EIA Report that will assist DMRE to decide whether (and under what conditions) to authorise the proposed development.

The evaluation and the basis for the subsequent discussion are represented concisely in Table 7-1, which summarises the potentially significant impacts and their significance ratings before and after application of mitigation and/or optimisation measures.

Relevant observations with regard to the overall impact ratings, assuming mitigation measures are effectively implemented, are:

- The predicted *air quality* impact, mainly associated with the creation of dust and resulting air quality effects, notably to the Cawood Saltworks, Joetsies Guesthouse, recreational users of Brand se Baai and the surrounding natural environment is rated as *very low* significance due to the distance of the project from the Cawood Saltworks and Brand se Baai, and the prevailing wind direction.
- The predicted *hydrological* impact of alterations to surface water flow patterns at the Mine is rated as *insignificant* as rainfall in the region is low, infiltration levels are high and the formation of non-draining basins is consistent with current mosaic of drainage patterns (i.e. natural basins and pans characterise the area) and will not discernibly affect higher order catchments.
- The predicted *groundwater* impact of contamination from process water infiltration is rated as *low* as groundwater is not considered fit for potable or agricultural use due to its high baseline salinity, and no existing groundwater users will be affected by potential changes to groundwater quality (regardless of containment alternatives selected).
- The predicted *marine ecology* impacts of the loss of Littorina habitat and marine pollution is rated as *insignificant* and *very low* respectively due to the low natural diversity of Littorina zone on the West Coast and disturbed nature of the seawater intake footprint.
- The predicted *ecological* impacts of a localised loss / change of floral habitat from physical disturbance, infiltration or seepage of saline water into the environment (particularly the Groot Goeraap and, potentially, Sout Rivers), and erosion due to altered surface water flow patterns are rated to be of *low* and *very low* significance.
- The predicted *socio-economic* benefit of increased revenue to government and economic investment during construction is rated as *very low* significance,
- The predicted *socio-economic* impacts of lower production at the Cawood Saltworks and a delayed return to the agricultural potential of the footprint of RSF6 are rated as *very low* significance and *insignificant* respectively.
- The predicted *visual* impacts of altered sense of place and visual intrusion from earthworks and dust, as well as the altered topography of the East Mine are rated as *medium* significance due to the visibility of the Mine and persistence of impacts in the (very) long term, but noting the absence of sensitive receptors locally.
- The predicted *traffic* impact during construction is rated as *insignificant* due to low baseline traffic levels and number of deliveries required for the project.
- The predicted *heritage* impact of a loss of structures older than 60 years is rated as *insignificant*.
- The No-Go alternative entails the cessation of mining activities in the East Mine in 2024 (effectively cancelling the approved East OFS Project). As such, air quality, groundwater, ecology and visual benefits of the No-Go alternative are rated *low* to *medium* significance, while the socio-economic impact of the No-Go alternative is rated *very high* significance.

There is no difference in the significance of impacts regardless of the process water pipeline route alternative selected.

**Table 7-1: Summary of potential impacts of the RSF, Overburden stockpile and amended approach to tailings backfill, and associated infrastructure**

*Potential negative impacts are shaded in reds, benefits are shaded in greens. Insignificant impacts have not been shaded. Only* ***key (non-standard essential)*** *mitigation/optimisation measures are presented.*

| ID # | Impact | Significance rating<br>Before mitigation/ optimisation | <br>After mitigation/ optimisation | Key mitigation/optimisation measures |
|---|---|---|---|---|
| A | **Air Quality Impact** | | | |
| A1 | Nuisance caused by increased particulate matter concentrations and dust fallout | *Project* | | • Implement dust suppression measures to prevent dust emissions from exposed areas, such as the southern and western wall faces of the RSF, STFs and Overburden stockpile and access roads and the new ROM stockpile.<br>• Profile, re-vegetate and stabilise RSF, Overburden stockpile walls and backfilled areas with windbreaks as soon as practically possible, i.e. during operations.<br>• Continue to monitor dust fallout on the Mine boundary and respond to exceedances of fall-out limits as currently specified in the National Dust Control Regulations, 2013.<br>• Apply additional air quality mitigation in response to exceedances of particulate matter or dust fallout guideline thresholds at the Mine boundary. |
| | | Low | Very low | |
| | | *No-Go Alternative* | | |
| | | Low | | |
| | | Insignificant | Insignificant | |
| | | *No-Go Alternative* | | |
| | | Insignificant | | |
| H | **Hydrology Impact** | | | |
| H1 | Alterations to surface water flow patterns | *Project* | | • No mitigation is necessary |
| | | Insignificant | Insignificant | |
| | | *No-Go Alternative* | | |
| | | Insignificant | | |

| ID # | Impact | Significance rating | | Key mitigation/optimisation measures |
|---|---|---|---|---|
| | | Before mitigation/ optimisation | After mitigation/ optimisation | |
| G | **Groundwater Impact** | | | |
| H1 | Groundwater contamination | *Project* | | • Continue to monitor boreholes in the existing monitoring network for water quality parameters on a quarterly basis.<br>• Implement additional mitigation measures and/or corrective action if monitoring data shows a significant variation in groundwater depth (>6m) or quality compared to the modelled outputs, such as actively pumping from a strategically placed wellfield(s) to minimise mounding and the movement of groundwater in unintended directions (such as towards private boreholes, the shoreline and/or rivers).<br>• Provide an alternative source of water should user's groundwater quality or yield be shown to be negatively affected by the Mine.<br>• Continue to monitor boreholes in the existing monitoring network for water quality parameters and water levels on a quarterly basis for a period of five years post-closure. |
| | | Medium | Low | |
| | | *No-Go Alternative* | | |
| | | Low | | |
| M | **Marine Ecology Impacts** | | | |
| M1 | Loss of Littorina habitat in the de-aeration sump development footprint | *Project* | | • Restrict the extent of the construction footprint as far as possible. |
| | | Insignificant | Insignificant | |
| | | *No-Go Alternative* | | |
| | | Very Low | | |
| M2 | Pollution of the marine ecosystem and seawater contamination | *Project* | | • Instruct staff not to litter the marine environment.<br>• Filter backwash effluent on start-up of pumps to capture plastic particles that may be in the system.<br>• Practice good housekeeping measures for the Handling of Construction and Hazardous Materials as specified in the EMPr.<br>• Implement construction phase waste management measures as specified in the EMPr. |
| | | Medium | Low | |
| | | *No-Go Alternative* | | |
| | | Insignificant | | |
| E | **Aquatic and Terrestrial Ecology Impacts** | | | |
| E1 | Degradation of natural ephemeral pans | *Project* | | • Implement a 100m buffer between the RSF and Overburden stockpile and the Hardpan.<br>• Demarcate the Hardpan (and buffer) and prevent access into it.<br>• Monitor sand accretion into the Hardpan and buffer area, every six months.<br>• Install wind breaks within the buffer area if significant sand accretion is observed. |
| | | Medium | Low | |
| | | *No-Go Alternative* | | |
| | | Low | | |

| ID # | Impact | Significance rating: Before mitigation/ optimisation | Significance rating: After mitigation/ optimisation | Key mitigation/optimisation measures |
|---|---|---|---|---|
| E2 | Vegetation loss from increased erosion | *Project* | | • Install stormwater a diversion berm(s) downgradient of STF2 to prevent runoff and erosion downgradient of this facility.<br>• Verify that the velocity of stormwater diverted from diversion channels and other stormwater infrastructure does not exceed 1 m/s in the 1:50 year flood during detailed design.<br>• Dissipate stormwater where it discharges from defined channels.<br>• Profile, re-vegetate and stabilise RSF, Overburden stockpile walls and backfilled areas with windbreaks as soon as practically possible.<br>• Rehabilitate (revegetate) mined out areas concurrently with mining.<br>• Inspect the site for erosion monthly during construction and annually during operations, and after storm events exceeding the 1 in 10 year event.<br>• Close erosion gullies where these are observed and rehabilitate (revegetate) these areas. |
| | | Medium | Very low | |
| | | *No-Go Alternative* | | |
| | | Low | | |
| E3 | Vegetation loss from the installation of pipelines | *Project* | | • Install the process water pipelines between January and May, if possible.<br>• Access the pipeline routes from existing access roads (i.e. prohibit vehicle access into the veld for pipeline installation).<br>• Maintain good housekeeping measures for on-site refuelling of vehicles and machinery, and for spill management. |
| | | Very Low | Very low | |
| | | *No-Go Alternative* | | |
| | | Low | | |
| E4 | Physical disturbance to aquatic ecosystems | *Project* | | • Implement a 100m buffer between the RSF and Overburden stockpile and the Hardpan.<br>• Implement a 120m buffer from the Groot Goeraap River.<br>• Demarcate the Hardpan and Groot Goeraap River buffers and prevent unauthorised access to these areas. |
| | | Low | Very low | |
| | | *No-Go Alternative* | | |
| | | Insignificant | | |
| E5 | Changes in plant communities in the Sout River | *Project* | | • Monitor for surface seepages within a 1 km radius of the RSF on a six-monthly basis in potential discharge areas (e.g. topographically low-lying areas and riverbanks).<br>• Inspect the 50m long stretch of the Sout River annually.<br>• Apply additional mitigation measures if groundwater discharges are observed in the riverbanks, such as actively pumping from a strategically placed wellfield(s) to minimise mounding and the movement of groundwater in unintended directions (such as towards private boreholes, the shoreline and/or rivers). |
| | | Low | Very low | |
| | | *No-Go Alternative* | | |
| | | Insignificant | | |
| E6 | Changes in plant communities in the Groot Goeraap River | *Project* | | |
| | | Low | Very low | |
| | | *No-Go Alternative* | | |

| ID # | Impact | Significance rating: Before mitigation/ optimisation | Significance rating: After mitigation/ optimisation | Key mitigation/optimisation measures |
|---|---|---|---|---|
| | | Insignificant | | • Implement monitoring and associated response measures proposed to mitigate groundwater impacts.<br>• Monitor for surface seepages within a 1 km radius of the RSF on a six-monthly basis in potential discharge areas (e.g. topographically low-lying areas and riverbanks).<br>• Inspect the Groot Goeraap Riverbed abutting rehabilitated areas (particularly low points) monthly during active backfilling within 300m of the Groot Goeraap River and for one year thereafter to identify significant moisture plumes likely to intercept the riverbed or banks.<br>• Install practical mitigation measures to prevent seepage into the Groot Goeraap River should seepage be identified during monitoring (e.g. the installation of cut-off drainage pipes along the closest edge to the river). |
| SE | **Socio-economic Impacts** | | | |
| SE1 | Delayed return to the agricultural potential of the footprint of RSF6 | *Project*<br>Insignificant | Insignificant | • No mitigation is necessary |
| | | *No-Go Alternative*<br>Insignificant | | |
| SE2 | Increased revenue to government and economic investment during construction | *Project*<br>Insignificant | Very low | • Procure goods and services from local suppliers where these are available in the WCDM. |
| | | *No-Go Alternative*<br>Very High | | |
| SE3 | Decline in production at the Cawood Saltworks | *Project*<br>Low | Very low | • Apply additional mitigation measures if monitoring data shows a significant variation in groundwater depth (>6m) or groundwater or surface water quality compared to the modelled outputs.<br>• Apply additional air quality mitigation in response to exceedances of particulate matter or dust fallout guideline thresholds at the Mine boundary. |
| | | *No-Go Alternative*<br>Insignificant | | |

| ID # | Impact | Significance rating: Before mitigation/ optimisation | Significance rating: After mitigation/ optimisation | Key mitigation/optimisation measures |
|---|---|---|---|---|
| V | **Visual Impacts** | | | |
| V1 | Altered sense of place and visual intrusion caused by earthworks and dust | *Project*: High | *Project*: Medium | • Apply mitigation recommended to mitigate air quality impact / dust generation from the project. |
| | | *No-Go Alternative*: Medium | | |
| V2 | Altered sense of place and visual intrusion caused by the RSF, Overburden stockpile and change in topography | *Project*: High | *Project*: Medium | • Profile, re-vegetate and stabilise RSF, Overburden stockpile walls and backfilled areas with windbreaks as soon as practically possible (i.e. during operations).<br>• Install no, or indirect low-intensity lighting on remote (mobile) plant (e.g. stackers and conveyors), if possible.<br>• Place associated infrastructure so as to be screened by the RSF and STFs as far as possible. |
| | | *No-Go Alternative*: Medium | | |
| T | **Traffic Impact** | | | |
| A1 | Increased traffic causing congestion or delays during construction | *Project*: Insignificant | *Project*: Insignificant | • No mitigation is necessary |
| | | *No-Go Alternative*: Insignificant | | |
| HR | **Heritage Impact** | | | |
| HR1 | Loss of heritage structures | *Project*: Insignificant | *Project*: Insignificant | • No mitigation is necessary |
| | | *No-Go Alternative*: Insignificant | | |

<table>
<tr><th rowspan="2">ID #</th><th rowspan="2">Impact</th><th colspan="2">Significance rating</th><th rowspan="2">Key mitigation/optimisation measures</th></tr>
<tr><th>Before mitigation/ optimisation</th><th>After mitigation/ optimisation</th></tr>
<tr><td>CC</td><td colspan="4">Climate Change Impacts</td></tr>
<tr><td rowspan="4">V1</td><td rowspan="4">$CO_2$ emissions and loss of carbon sequestration capacity</td><td colspan="2">Project</td><td rowspan="4">• Reduce vegetation clearance to the minimum required for development of the project.<br>• Rehabilitate (and replant) disturbed areas.</td></tr>
<tr><td>Insignificant</td><td>Insignificant</td></tr>
<tr><td colspan="2">No-Go Alternative</td></tr>
<tr><td colspan="2">Low</td></tr>
</table>

Cumulative impacts, and socio-economic benefits, in the region mainly derive from agricultural activities and mining. In the context of the project, cumulative impacts on groundwater contamination, terrestrial ecology and a change in sense of place will be suitably mitigated through strict implementation of the EMPr. At some point the cumulative (sense of place) impacts of mining in the area may reach a threshold beyond which the relevant authority may not be prepared to grant EA. This threshold cannot be readily determined.

Current operations at the Namakwa Sands Mine, future expansions of the Namakwa Sands Mine and Tormin and saline groundwater infiltration at the Cawood Saltworks are expected to contribute to the cumulative loss of floral habitat and groundwater contamination in the area. Cumulative impacts are therefore generally rated as being of *medium* significance, while the cumulative socio-economic benefit of mining and agriculture in this socio-economically stressed region is considered to be *very high*.

As regards climate change, the $CO_2$ emissions and loss of carbon sequestration capacity associated with the project represent a relatively insignificant percentage of South Africa's total GHG emissions per year, and the impact is considered to be ***insignificant***.

### 7.1.2 Integrated Project and Sensitivity Map

The EIA Regulations, 2014 prescribe that an integrated map at an appropriate scale is presented. The map should, so far as it is applicable, superimpose the proposed activity and associated structures and infrastructure on the environmental sensitivities of the preferred site indicating any areas that should be avoided, including buffers.

Figure 7-1 shows key project infrastructure relative to environmentally sensitive areas ("restricted areas").