NON-TECHNICAL SUMMARY

INTRODUCTION TO THE PROPOSED PROJECT

The Tsumeb Smelter is currently owned and operated by Dundee Precious Metals Tsumeb (DPMT); a subsidiary of the Canadian based Dundee Precious Metals Inc. The smelter is located on the outskirts of Tsumeb in the Oshikoto Region of Namibia, approximately 2 km northeast of the Tsumeb town centre. The local setting of the Tsumeb Smelter is shown in Figure 1-1.

Metals have been mined at the Tsumeb mine for over a hundred years. Between 1961 and 1963 the original smelter was replaced with a new copper and lead smelter to process concentrate from the Tsumeb mine. In mid-1998 Goldfields Namibia, the holding company of Tsumeb Corporation Limited (TCL) went into liquidation and the Tsumeb Smelter was shut down. In 2000, the former TCL assets were taken over by Ongopolo Mining and Processing Limited (OMPL) and the copper and arsenic plants were re-commissioned. The cadmium plant was decommissioned and no lead processing has taken place since re-commissioning. In July 2006 the assets of OMPL were sold to Weatherly Mining International who owned and operated the plant for four years before selling it to Dundee Precious Metals Inc. (DPM) in 2010. In terms of the sales agreement, DPM is not considered liable for environmental contamination that took place prior to 2010.

Currently, it receives copper concentrate from El Brocal (Peru), Chelopech (Bulgaria), Codelco (Chile), Armenia and Opuwo (Namibia) for processing in the smelter.

Following the purchase of the smelter complex in 2010, DPMT have undertaken a series of upgrades and improvement projects in order to modernise the plant. Some of the major interventions include the following:

- Construction of a hazardous waste disposal facility (Cell 1 – 2012 and Cell 2 - 2019);
- Improvement of the off-gas handling systems (2012-2013);
- Closure of the reverberatory furnace (2013);
- Installation of a 1,540 t/d sulphuric acid plant and associated acid storage and dispatch facilities (mid 2015);
- A new effluent treatment plant and sewage treatment plant (2015);
- Decommissioning of the arsenic plant (March 2017);
- Construction of new Pollution Control Dam (PCD) and re-lining of surface water trenches (2018 and ongoing).

The current Tsumeb Smelter comprises of one primary smelting furnace, the refurbished Ausmelt furnace. Blister copper is produced from the copper concentrate and delivered to refineries for final processing.

With additional custom concentrates available worldwide and areas for operational improvements identified, DPMT is proposing to expand their current operations in order to increase their concentrate processing capacity from approximately 240,000 to 370,000 tons per annum (tpa). The proposed expansion would be
contained within the existing facility footprint and would include the following components:

- Upgrading of the existing Ausmelt feed and furnace;
- Installation of a rotary holding furnace (RHF);
- Implementation of slow cooling of the RHF and converter slag;
- Upgrading of the slag mill to improve copper recovery and handle the increased tonnage from slow cooled slags;
- Option to install an additional Peirce-Smith (PS) converter; and
- Additional related infrastructure improvements (power supply, etc.).

New facilities will be designed, constructed, operated and maintained in line with good international practice.

The new project components and associated service infrastructure, together with the existing (approved) infrastructure/facilities, are collectively referred to as the ‘Tsumeb Smelter Upgrade and Optimisation Project’.

DPMT currently holds an Environmental Clearance Certificate (ECC) in terms of the Environmental Management Act (No. 7 or 2007; EMA) of Namibia for its operations at the Tsumeb Smelter. To allow for the proposed Expansion Project, an amendment of the original ECC and Environmental Management Plan (EMP) is required. This report focuses on the above additional components not covered in the current ECC and EMP.

The objective of this project and Environmental and Social Impact Assessment (ESIA) Amendment process is further to combine all of the separate ECCs currently held by DPMT and the commitments in the separate EMPs into one consolidated Environmental and Social Management Plan (ESMP) for all DPMT’s listed activities. This is beneficial, as impacts and related management and mitigation measures will be considered cumulatively and it would be easier to manage the environmental aspects if consolidated into one document linked to DPMT’s overarching management system. DPMT shall implement the management and mitigation measures as set out in the ESMP (Appendix K). If approval is granted and an Amended ECC issued, it would then serve as a consolidated ECC for the entire DPMT Smelter complex and would supersede the previous ECCs.

This ESIA report has been primarily compiled in order to amend the Environmental Clearance Certificate; however, as part of DPMT’s corporate commitments following equity investment by the European Bank for Reconstruction and Development’s (EBRD), DPMT has sought to align the ESIA report with the EBRD’s Performance Requirements (PRs). Separately to this ESIA process EBRD is reviewing overall E&S performance at Tsumeb.

**PROJECT MOTIVATION**

The project motivation is economic, with the project having the potential to directly and indirectly benefit the country and surrounding communities. The project would improve the smelter’s competitive position for securing feed materials and enhance the asset’s long term viability, therefore supporting the goal of moving overall plant performance to good international practice.

The Tsumeb smelter currently employs between 600 and 700 persons in Tsumeb, with many other services
directly dependent on DPMT operations. As the proposed project would largely relate to the optimisation of existing components and processes within the facility, it would not create a high number of new employment opportunities. Some opportunities would be created for contractors during the construction phase. The proposed upgrade and optimisation of the smelter and related increase in the throughput capacity of the smelter would promote long-term efficiency and economic sustainability of the facility. By increasing the efficiency and sustainability of the facility, long-term employment security would be ensured, together with downstream economic benefits to the town of Tsumeb.

In addition, the proposed expansion would increase the amount of foreign revenue generated by DPMT through value addition and provide benefits in a region with relatively high socio-economic needs. It should thus achieve in-principle compatibility with key Namibian economic policies and plans, provided environmental and other impacts can be adequately mitigated.

ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT PROCESS

The Environmental Impact Assessment (EIA) is regulated by the Department of Environmental Affairs (DEA) within Ministry of Environment and Tourism (MET) in terms of the Environmental Management Act, 7 of 2007 and EIA Regulations of 2012.

The proposed Upgrade and Optimisation Project requires the amendment of some of the project components previously approved. Section 19 of the above mentioned EIA Regulations allows for an amendment of an ECC under section 39 of the Environmental Management Act, 2007.

Due to the significant potential environmental impacts associated with the general operations of a smelter of this nature and the ongoing public interest in the facility, MET: DEA requested that a full ESIA process (including a scoping phase and an assessment of impacts phase) be undertaken to assess the new project components. Impacts from the proposed expansion project components would be assessed as cumulative to the impacts experienced from the current Tsumeb Smelter operations.

In accordance with this legal framework the ESIA approach included the following:

- The scoping process was conducted to identify the environmental issues associated with the proposed project and to define the terms of reference for the required specialist studies (March 2016 – August 2016);
- Specialist studies were commissioned in accordance with the relevant terms of reference;
- The ESIA report was compiled on the basis of the findings of the specialist studies and distributed for public and authority review (April 2017);
- A Consolidated ESMP was prepared to elaborate on the mitigation objectives, include additional actions that were described in the ESIA report and consolidate previously approved ESMPs;
- A project specific public participation process was undertaken throughout the study. As part of this process the regulatory authorities and interested and affected parties (IAPs) were given the opportunity to attend information sharing meetings, submit questions and comments to the project
team, and review the background information document, scoping report and draft ESIA Report. All questions and comments that were raised by the authorities and IAPs have been included and addressed in this final ESIA Report. Based on comments received, a number of updates and additions were also made to specialist studies. These, however, did not result in major changes to the final outcome of the assessment findings.
FIGURE 1: LOCAL SETTING OF THE TSUMEB SMELTER COMPLEX
PROJECT OVERVIEW

The current proposed Upgrade and Optimisation Project was selected as the preferred option through a pre-feasibility study process and would increase production capacity from 240 000 tpa to 370 000 tpa. All new project components would be constructed within the current facility footprint and no greenfield areas would need to be cleared. The proposed expanded operations are illustrated in the process flow diagram in Figure 2. The new and upgraded components required in order to reach the increased throughput capacity include the following:

- Upgrading of the current Ausmelt concentrate and reverts feeders;
- Upgrading of the Ausmelt cooling system to a closed loop cooling water circuit;
- Design improvements to Ausmelt hoods and ladles;
- New RHF with shell dimensions of 4.7 m (diameter) by 15.2 m (long) and 70 m high steel stack;
- The option to install a third 13 x 30 ft Peirce-Smith converter is considered. The addition of a third converter would allow for the other two converters to be online while the third converter could be offline for maintenance;
- Slag slow cooling in pots or pits before crushing;
- Key changes/additions to the slag mill process include the following:
  - An upgrade of the milling and classification circuits;
  - Rationalization of flotation capacity by elimination of oxide rougher bank #2 and oxide cleaner cells;
  - Replacement of concentrate vacuum drum filter with a 4-leaf 6ft.(1.83m) diameter disc filter;
  - Addition of instrumentation in the grinding and flotation circuits and improved sampling practices to enhance metallurgical control and stability; and
  - Organizational changes suggested include measures to reinforce operator training and preventative maintenance to achieve 90% slag mill availability.
- Required utility upgrades include the following:
  - A new instrument air dryer;
  - Increase of the pump capacity for raw water from the old mine shaft;
  - Two additional light fuel oil supply pumps and piping to supply the RHF;
  - Two additional heavy fuel oil supply pumps and two heaters as part of the oil supply ring for the RHF burners;
  - Upgraded electricity supply system to be housed in a new electrical building.
- Implementation of a stormwater management project in order to improve stormwater infrastructure across the site.
- Improvements in the material handling area in order to manage wind-blown dust as well as to contain material spillages as well as seepage into groundwater during the rainy season.
ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT FINDINGS

A number of specialist studies were conducted as part of the ESIA Amendment process. Specialists assessed potential impacts cumulatively to current baseline operational impacts. Specialist studies conducted are the following:

- Waste Management;
- Surface Water;
- Groundwater;
- Air Quality;
- Noise;
- Socio-economic; and
- Community Health.

The main conclusion of the overall assessment was that the proposed upgrade and optimisation project would not create any additional new environmental and social impacts to those currently being experienced and that the proposed project would not result in any significant cumulative impacts.

Summaries of the key findings of the specialist studies are provided below.

WASTE MANAGEMENT

A review of current waste management activities at the smelter was undertaken and various recommendations made for management improvement. The main findings were the need for a formalised general waste landfill site and the improvement of waste sorting at the general waste handling area on site. Since the waste management review, DPMT has continued to formalise waste collection points by providing skips for the sorting and collection of different waste items. This is a positive development in terms of improving general waste management on the smelter site. The construction of a formal general waste landfill site is currently planned for 2019/2020.

The review also included calculations of the remaining life of the on-site hazardous waste disposal site. With the additional arsenic waste volumes to be produced and disposed it is likely that the entire permitted disposal site has an estimated life span of around 8 years from 2017. These calculations were based on the conservative assumption that all arsenic waste would be disposed of at this site and no other options for disposal are considered. DPMT are, however, focused on pursuing alternatives to long-term use of this facility and are currently investigating the feasibility of other disposal options. These include disposal to a potential future regional site in Namibia or to transport the wastes to hazardous waste sites in South Africa. DPMT are also currently investigating vitrification of the flue dust which would render it non-hazardous, resulting in a reduction in the volume of hazardous waste to be disposed of. Following successful laboratory trials, a pilot vitrification plant was commissioned in February 2019 which will be in operation for six months. The aim of the pilot plant is to test the viability of the technology on a larger scale in an industrial environment.
**SURFACE WATER**

There are no natural surface water sources within the smelter property and the assessment thus relates to stormwater runoff. The proposed expansion would result in additional volumes of slag material being produced, which could require additional areas to be used for disposal of this material. Mitigation measures would thus be required in order to ensure that the stormwater system capacities would be sufficient to handle any additional contact runoff generated. The proposed expansion would not change the current situation with regards to runoff potential, assuming that the stormwater system has not been spilling into the Jordan River system after previous extreme rainfall events. The currently planned improved stormwater management measures include a ‘clean’ (non-contact) water diversion channel around the northern edge of the main smelter site in order to channel clean runoff away from the smelter site and to the Jordan River. This measure will improve the runoff from the site, as less water will flow into the smelter area and be retained in the ‘dirty’ (contact) water system at the site. Improved stormwater management measures in line with a stormwater management plan are currently being implemented in phases. Components already completed include the concrete lining of a portion of the stormwater channels through the site and the construction of a pollution control dam. With these measures in place, there should be only a small likelihood of any contact water leaving the site and reaching the Jordan River, approximately 1 km north of the site.

It is expected that the cumulative impact of the proposed expansion project on surface water runoff and quality would be of low significance. Key mitigation measures include the construction of additional infrastructure to manage contact water around the smelter expansion site and continuing with surface water monitoring at various sites along the Jordan River in order to monitor pollution levels.

**GROUNDWATER**

The geohydrology of the area shows that groundwater flow is in a northerly direction from Tsumeb. Based on measured data for heavy metal and sulphate concentrations, the baseline groundwater quality before the proposed expansion indicates that the smelter site and historic mining operations has already impacted significantly on groundwater quality on site. The findings of an updated groundwater model study in 2018 showed that while polluted groundwater could potentially move offsite in a northerly direction, it is not expected to reach the irrigation farms to the north of the smelter site. This is largely related to the geology to the north of the smelter site providing a groundwater movement barrier.

Current groundwater quality impacts are largely attributable to historic activities and it is not expected that the proposed expansion project would cumulatively contribute significantly to these. In the unmitigated case, the significance of the impacts currently being experienced is considered as high. In the mitigated case, the significance can be reduced to medium, since the Group B Namibian drinking water standard and WHO drinking water quality limit could be reached with the implementation of mitigation measures.

Key recommended mitigation measures already included in the expansion project capital and operating costs relate to targeted groundwater treatment, rehabilitation of pollution dumps, improvement in drainage and erosion control, drilling of additional monitoring boreholes and undertaking regular monitoring of...
AIR QUALITY

The main emissions from the smelter site include sulphur dioxide (SO\(_2\)), sulphuric acid (H\(_2\)SO\(_4\)), particulate matter (PM\(_{10}\) and PM\(_{2.5}\)). There have been notable decreases in air emissions from smelter operations since DPM purchased the smelter. These can largely be ascribed to the commissioning of the sulphuric acid plant, decommissioning of the reverberatory furnace and ongoing improvements in the management of fugitive emissions.

The applicable monitoring standards for the parameters below are provided in Section 3.2 of this report.

Sulphur Dioxide

After commissioning of the sulphuric acid plant in 2015, ambient air quality monitoring stations have reported significant downward trends in SO\(_2\) emissions from October 2015. No limits exist for SO\(_2\) emissions in Namibian environmental legislation. Levels are thus evaluated by DPMT against best practice guidelines of 125 µg/m\(^3\) over a 24-hour period (South African and EU standard). Although there has been major improvement in the capturing of SO\(_2\), there are still some exceedances of the 24-hour limits recorded at the monitoring stations in close proximity to the smelter site during upset conditions at the sulphuric acid plant.

It is expected that SO\(_2\) emissions will increase in line with the proposed increased material throughput and production rates. With the sulphuric acid plant being fully operational for 90% of the time when the Ausmelt furnace is active, the air quality study findings showed, however, that for the proposed expanded smelter project the simulated concentrations emitted would comply with the annual and daily monitoring criteria. There could, however, still be some exceedances of the hourly concentration criteria at the three closest modelled receptor locations: the Sewerage Works and Plant Hill monitoring stations and in the closest residential area of Ondundu (see Figure 3). If the acid plant is, however, only efficiently utilised for 75% of the time (which was the average case during 2016) SO\(_2\) emissions could exceed the daily and hourly concentration limits at off-site at sensitive receptors in Tsumeb (see Figure 4).
FIGURE 3: SIMULATED 1-HOUR SO₂ CONCENTRATIONS AT 90% ACID PLANT UTILISATION FOR EXPANDED PROJECT (350 µg/m³ ASSESSMENT CRITERIA INDICATED WITH BLACK LINE)

FIGURE 4: SIMULATED 1-HOUR SO₂ CONCENTRATIONS AT 75% ACID PLANT UTILISATION FOR EXPANDED PROJECT (350 µg/m³ ASSESSMENT CRITERIA INDICATED WITH BLACK LINE)
Sulphuric Acid

Although ambient sulphuric acid (H$_2$SO$_4$) levels are expected to increase due to the proposed increased throughput capacity, simulations showed that average off-site concentrations will be well within ambient air quality limits.

PM$_{10}$ and PM$_{2.5}$

Based on data from ambient air quality monitoring stations in Tsumeb town itself, the main contribution of airborne particulate matter (PM$_{10}$) sources seem to not be from the smelter site. However, the monitoring station immediately to the west of the smelter (Sewerage Works) reflects activities and sources associated with the smelter operations, likely from the tailings facilities. The proposed increased throughput capacity is expected to increase both long and short term ambient PM$_{10}$ and PM$_{2.5}$ concentrations. Simulated levels associated with the proposed upgrade project do, however, not exceed air quality limits off-site.

Arsenic

Arsenic in the PM$_{10}$ fraction is measured at all ambient air quality stations and showed a marked decrease in annual average concentrations observed during 2013 to 2016. 2017 concentrations were slightly higher but still significantly lower than concentrations recorded between 2012 and 2014. These levels exceed the EU ambient air quality reference concentration outside of the smelter footprint. It was found that furnace building fugitives (fumes escaping primary and secondary capture systems), as well as emissions from the Ausmelt and Copper stacks, contribute significantly to these off-site exceedances. The results clearly show higher ambient arsenic levels during dry and windy months. This also indicates fugitive dust rather than stack emissions from the smelter contributes to elevated arsenic concentrations.

Simulations showed that ground level ambient arsenic levels could potentially increase by approximately 54% due to the proposed increased throughput capacity of the smelter. The increase is attributed to the conservative assumption that furnace building fugitive emissions will increase linearly with increased production rates. The contribution of additional arsenic emissions from the proposed RHF to ground level arsenic concentrations is, however, minimal. Efforts should therefore be made to reduce building fugitive emissions through suitable and effective engineering controls.

Simulated arsenic levels at the smelter boundary and at sensitive air quality receptors at Ondundu and Endombo are predicted to be above the EU annual exposure criteria for the expansion scenario. Based on urine arsenic levels tested as part of the community health assessment, the measured arsenic in air levels are, however, low and unlikely to impact urine arsenic levels or to pose a lung cancer risk for Tsumeb residents.

Key mitigation measures for the management of all emissions from smelter operations include efficient capture / prevention of fugitive dust emissions across the smelter site, ensuring the sulphuric acid plant is utilized at least 90% of the time and undertaking continuous monitoring of SO$_2$ emissions through the acid plant stack in order to provide a true reflection of SO$_2$ emissions over time and an accurate dispersion plume.
NOISE

The only noise sensitive receptors where activities from the smelter complex were audible was a farmstead approximately 650 m northwest of the smelter boundary and 600 m east of the M75 road. Noise levels in the town are greatly influenced by community activities and highly dependent on wind speed. Noise simulations indicated that the proposed increased throughput capacity would not result in exceedances of noise level guidelines at noise sensitive receptors in and around Tsumeb. The increases in noise levels above the background levels during the day and night would not be detectable. Key mitigation measures included improvement of the silencer at the No. 2 oxygen plant (already implemented) and establishing a noise monitoring programme at noise sensitive receptors.

SOCIO-ECONOMIC

Construction phase project expenditure (positive impact)
The construction phase of the project would result in spending injections that would lead to increased economic activity. All expenditures will lead to linked direct, indirect and induced impacts on employment and incomes. In the case of employment, impacts would be direct where people are employed directly for the construction of new project components (e.g. jobs for construction workers). Indirect impacts would be where the direct expenditure associated with the project leads to jobs and incomes in other sectors (e.g. purchasing building materials maintains jobs in that sector) and induced impacts where jobs are created due to the expenditure of employees and other consumers that gained from the project. Preliminary estimates indicate that a total of around N$722 million would be spent on all aspects of construction over the roughly one and a half year construction period and that approximately 185 person years of temporary employment would be created. Approximately N$155.8 million would be spent on suppliers in the Tsumeb municipal area. It is recommended that local labour and sub-contractors be used as far as possible in line with local employment targets and that opportunities for the training of unskilled and skilled workers from local communities be maximised.

Operational phase expenditure and increase in corporate social responsibility spending (positive impact)
It is not expected that new direct employment opportunities would be created at the smelter during the operational phase, but rather that existing employees would be redeployed within the facility. Economic benefits during the operational phase largely relate to indirect employment opportunities for service providers (e.g. electricity, transport and handling services, engineering services and local municipal services). It is expected that these benefits would be experiences on a local to national scale.

It is also expected that there may be an increase in DPMT’s corporate social responsibility spending with the increased revenue to be generated by the upgrade project. This would be in addition to the already significant contributions being made by DPMT through the Tsumeb Community Trust.

Macro-economic benefits (positive impact)
In terms of macro-economic benefits, it is expected that foreign exchange earnings resulting from the
proposed expansion would average around US$66 million per year for copper blister and sulphuric acid exports. These would be in addition to current earnings of approximately US$140 million per year. This increase is likely to have a strong positive impact on the Namibian economy and the macro-economic benefit. In this regard, it is recommended that DPMT favour Namibian suppliers of goods and services, where possible.

**Potential Negative Impact of Construction Workers on Local Communities**

The presence of construction workers from outside the local area could have the potential to impact on local communities by disrupting existing family structures and social networks through their conduct. Risks include an increase in alcohol and drug use and related crime levels. Due to the rapid increase in the population of Tsumeb in the last decade linked to general internal migration from rural to urban areas and the high numbers of truck drivers and other road users passing through the town on a monthly basis, the presence of additional workers from outside the area over a one and a half year construction period is unlikely to have a significant impact on the local community. While these impacts may be considered unlikely at a community level, at an individual and family level they may be more significant, especially in the case of contracting a sexually transmitted disease or having an unplanned pregnancies. Recommended measures include the appointment of local labour as far as possible and the briefing of local communities on the potential risks associated with construction workers.

**Potential Negative Impacts Related to Increased Storage and Transport Between Walvis Bay and Tsumeb**

Concerns raised at the Walvis Bay storage and handling facility relate to wind-blown dust and, to a limited extent, contaminated run-off. Ongoing improvement in management measures in line with the current ISO standards for the facility should limit the impacts of dust and run-off. Options for enclosed storage and potential storage and transport of concentrate in bags will be investigated. By increasing the volumes of concentrate transported via rail, the increased impacts of heavily loaded trucks on the road network and other road users would be limited. DPMT will keep their emergency response plans for road and rail transport up to date and in line with government road and rail safety initiatives.

**Potential Negative Impact of Smelter Decommissioning and Closure**

Given the relatively high number of permanent employees (667) the potential impacts associated with potential future decommissioning and closure of the smelter would be significant. The major social impacts associated with the decommissioning phase are linked to the loss of jobs and associated income. This has implications for the households who are directly affected, the communities within which they live, and the relevant local authorities. Without an effective plan to manage the social and economic impacts associated with smelter closure and decommissioning, the impacts will be significant. However, the potential impacts associated with the decommissioning phase can be effectively managed with the implementation of an effective and well planned retrenchment and downscaling programme. Appropriate retrenchment packages, the implementation of skills training programmes and ensuring that DPMT’s Asset Retirement Obligations are accurate and current in order to fund its Closure Plan objectives will be measures considered within revision of the Closure plan (due to be revised during 2019/2020). The current proposed project would extend the
viability of the smelter and thus delay the ultimate negative impacts related to decommissioning and closure.

**COMMUNITY HEALTH**

**Impacts Related to SO\(_2\) and PM\(_{10}\) Exposure**

Although a marked decrease in SO\(_2\) emissions has been experienced after the installation of the sulphuric acid plant and other capital improvements at the smelter, exceedances of the South African and WHO 24-hour limits are still recorded on a monthly basis outside of the smelter boundary in the northern parts of town. These exceedances can cause temporary mild upper respiratory symptoms of cough and throat irritation. Less frequently, more severe lower respiratory symptoms may also be experienced. A survey of residents showed that compared with Oshakati (which is a completely unexposed control area) there is evidence of respiratory symptoms being significantly more prevalent in Tsumeb. While the level of exposure is not likely to cause a substantial symptom burden or irreversible effects, there is definitely a nuisance burden experienced by Tsumeb residents. Long-term monitoring data shows that the SO\(_2\) exposures to the community, however, continue to decline. This was confirmed by the results of the respiratory health questionnaire survey in the community health study conducted in 2016.

It was noted in the specialist assessment that capital improvements were not yet fully implemented during 2016 when the study was undertaken and that it can be assumed that when these improvements function optimally, it would result in further reduction in SO\(_2\) exposures going forward. Improved ventilation extraction from new converters and new methods of slag cooling may be expected to bring about further future reductions in exposure. With the sulphuric acid plant functioning at its optimal design capacity, the appropriate use of hoods at the RHF and improved ventilation extraction, increasingly more efficient capture of SO\(_2\) would be likely, notwithstanding any increase in the production throughput.

The current burden of disease caused by PM\(_{10}\) for Tsumeb residents is considered to be small. Simulation results of the air quality assessment showed that it is not expected that increased PM\(_{10}\) emissions as a result of the expanded smelter operations would add cumulatively to the current burden of disease experienced from other PM\(_{10}\) sources in the area.

Based on the above, the potential community health impacts largely relate to the upper and lower respiratory symptoms attributable to SO\(_2\) exposures experienced in all areas of Tsumeb. The impact is assessed as cumulative to the current effects experienced by Tsumeb residents and rated as of low significance after mitigation. In addition to achieving optimum sulphuric acid plant conversion efficiency, the key mitigation measure is the implementation of engineering solutions to better control fugitive emissions at all components of the smelter operations.

**Arsenic Exposures**

It must be noted that there are currently significant contamination levels on the smelter property and surrounds due to historic mining and smelter operations and legacy waste stockpiles. Although it is acknowledged that the current DPMT smelter operations, since DPMT purchased the facility in 2010, have
contributed to and continue to contribute to the overall contamination loads, the majority of the measured contamination levels and related impacts (i.e. groundwater and community health) are attributable to historic operations prior to DPMT taking control of operations, and various improvement measures have been implemented by DPMT since 2010. DPMT is currently undertaking a Contaminated Land Assessment that will inform community health assessment studies and the Closure Plan (due to be revised 2019/2020).

The community health assessment included analysis of urine arsenic levels in community members from different residential areas in Tsumeb, compared with an unexposed control group in Oshakati. When considering the latest emissions data together with the results of the urine arsenic levels, elevated urine arsenic levels were found in Tsumeb when compared to the unexposed control samples in Oshakati. The main findings of the community health investigation, however, showed that there did not seem to be a general systemic overexposure problem based on urine inorganic (attributable to mining/smelter operations) arsenic for Tsumeb residents as a whole. The geometric mean was actually found to be below the most conservative international occupational hygiene standard. The overall impacts on Tsumeb communities were thus estimated to be negligible. Further detailed investigations were recommended for the Town North community (particularly Ondundu), where mean levels were higher, and showed a high proportion (18.9%) of outliers above the Namibian Biological Exposure Index for inorganic arsenic. The results of the investigation showed that airborne arsenic and drinking water are not responsible for the elevated urine arsenic levels in outlier samples from Ondundu. More likely exposure pathways are expected to be to arsenic in dust from roadways and garden soil, arsenic in vegetables and fruit grown locally in Ondundu, and hand to mouth behaviour by both children and adults resulting in arsenic ingestion. Preliminary results of a follow-up soil sampling programme confirmed that there are numerous historic mine dump sites, exposed reefs and ongoing small scale mining sites surrounding Ondundu which showed elevated soil arsenic levels, further indicating soil as an arsenic exposure pathway.

From the available data and with the implementation of further engineering improvements for the capture of fugitive emissions, the risk of lung cancer due to environmental arsenic exposure for both the current baseline and proposed expansion project are considered to be low for Tsumeb as a whole, however, results from the 2018 monitoring programme will be required to confirm the level of risk due to historic and current operations.

No significant increase in airborne arsenic exposures for residents is expected at the proposed increased throughput capacity.

As the results indicated that arsenic in air emissions from smelter operations are not linked to elevated urine arsenic levels recorded in Ondundu (the community closest to the smelter) recommendations were made for further community health investigations in order to confirm the arsenic exposure pathways and identify areas for remediation in partnership with the Tsumeb Municipality. As part of this recommendation, a follow-up community health monitoring programme commenced in the fourth quarter of 2018. The results of this monitoring programme would be further informed by the Contaminated Land Assessment which is currently underway. Should soil and home grown food arsenic levels be high, initial prohibition of growing home crops
and removal of the topsoil layer should be considered. These additional investigations should inform further actions, which may include an exclusion zone being negotiated around the smelter. In this regard, DPMT recently extended their boundary fence between the hazardous waste disposal site and Ondundu in order to provide a buffer and limit community activities in an area that showed elevated arsenic levels linked to historic mining.

**Arsenic exposure to DPMT employees**

The assessment of occupational health impacts do not as a rule form part of an ESIA process as occupational health is not dealt with in terms of environmental legislation. To address concerns raised by unions and other I&APs during the scoping phase and to align with EBRD’s Performance Requirements, occupational health concerns were also addressed in an appendix to the community health assessment. DPMT has developed a comprehensive Arsenic Exposure Reduction Plan which is currently being implemented. More focus is placed on emission controls versus the focus on personal protective equipment (PPE).

**ENVIRONMENTAL IMPACT STATEMENT AND CONCLUSIONS**

Based on the findings of this ESIA, it is not expected that the proposed expansion project to allow increased throughput capacity of the DPMT smelter would have a significant contribution (i.e. without mitigation measures) to current negative operational impacts. However, with the implementation of the proposed mitigation measures and further optimising of the already implemented engineering solutions for the management of air emissions, it is expected that cumulative negative impacts related to smelter operations would be reduced to a great extent.

A tabulated summary of the potential impacts is presented in Table 1 below. As can be seen, the impacts associated with the project vary from high positive to high negative without mitigation.

It is possible to mitigate the potential negative impacts by committing to apply related mitigation objectives and actions as presented in the ESMP.

The key areas of concern were centred around air quality, community health and groundwater. However, the key findings in this regard are set out below:

**Air Quality:**
- Continuous improvement in ambient air quality has been recorded for all measured parameters since 2012;
- With the implementation of the recommended mitigation measures for utilisation of the sulphuric acid plant and management of fugitive emissions, the proposed expansion project should not lead to any significant increases in emissions experienced within Tsumeb;

**Community Health:**
- Since the installation of the Sulphuric Acid Plant, residential areas in Tsumeb rarely experience exceedances of the World Health Organisation (WHO) daily limits for SO₂. Short-term exceedances of
the hourly limits are, however, still being experienced in the northern parts of the town which can cause temporary mild upper respiratory symptoms of cough and throat irritation.

- For the expansion project, exceedances of the hourly criteria for SO₂ might still be experienced in the northernmost parts of Tsumeb during upset plant conditions, leading to temporary respiratory irritation.

- Elevated urine arsenic levels recorded for residents closest to the smelter site were found not to be attributable to arsenic in air from smelter operations, and were more likely as a result of behavioural exposures linked to soil from historic sources, hand-to-mouth and eating wild harvested plants. The draft 2018 results indicate that the legacy waste sites may also be a possible source.

**Groundwater:**

- Groundwater quality on and beyond the site boundary is related to both current and historic impacts processing activities on the site.

- It is not expected that the proposed expansion project would lead to any measurable cumulative contribution to current groundwater quality impacts.

- A conservative update of the current groundwater model indicated that contaminated groundwater may be moving in a north-easterly direction to outside of the smelter boundary, but due to the geological formations present providing a groundwater barrier, it is not expected that contaminated groundwater would reach the irrigation farms to the north of the smelter complex.

With regards to the potential benefits of the proposed expansion project, the positive cumulative impacts related to socio-economic aspects (i.e. direct construction and operational project expenditure, indirect business opportunities, CSR contributions and macro-economic benefits) were all rated as of high significance after mitigation.

As stated above, there are currently significant contamination levels on the smelter property and surrounds due to historic mining and smelter operations and legacy waste stockpiles. Although it is acknowledged that the current DPMT smelter operations, since DPMT purchased the facility in 2010, have contributed to and continue to contribute to the overall contamination load, the majority of the measured contamination levels and related impacts (i.e. groundwater and community health) are attributable to historic operations prior to DPMT taking control of operations, and various improvement measures have been implemented by DPMT since 2010. These are described in Section 5.2.

The ongoing Contaminated Land Assessment and community health monitoring programme will aim to quantify the historic and current contributions. DPMT will continue to support the Tsumeb Municipality in finding ways to address legacy impacts outside of the smelter boundary. It is, however, suggested that MET instruct the owner of the old mine infrastructure and land surrounding Ondundu to become involved in addressing these matters.

The following key aspects with regards to current and future operations are to be addressed as a matter of
priority by DPMT:

- Ensure that the sulphuric acid plant and other recent engineering interventions (e.g. fume extraction hoods) are operating at optimal design levels in order to control SO$_2$ and other fugitive dust emissions;
- Improve waste management practices through the establishment of a formalised general landfill site within the smelter footprint;
- A final solution for the long term disposal of hazardous (arsenic) waste well in advance of the onsite hazardous waste disposal site reaching its full design capacity. The following alternatives will be further considered and a final decision should be made as soon as possible:
  - Disposal to a potential future national site in Namibia; or
  - Transport of waste to a suitable hazardous waste site in South Africa; or
  - Vitrification of flue dust which would render arsenic wastes non-hazardous; or
  - A combination of the above options;
- Completion of the contaminated land assessment and further detailed investigations into arsenic exposure pathways in order to inform priority actions to be taken with regards to remediation; and
- Completion of studies into the options for groundwater treatment.

**TABLE 1: SUMMARY OF POTENTIAL IMPACTS ASSOCIATED WITH THE PROPOSED UPGRADE AND OPTIMISATION PROJECT**

<table>
<thead>
<tr>
<th>Section</th>
<th>Potential impact</th>
<th>Significance of the impact (the ratings are negative unless otherwise specified)</th>
<th>Unmitigated</th>
<th>Mitigated</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Surface water</strong></td>
<td>Changes in surface water runoff</td>
<td>L</td>
<td>L</td>
<td>L</td>
</tr>
<tr>
<td></td>
<td>Surface water pollution</td>
<td>M</td>
<td>L</td>
<td>L</td>
</tr>
<tr>
<td><strong>Groundwater</strong></td>
<td>Groundwater quantity</td>
<td>M</td>
<td>L</td>
<td>L</td>
</tr>
<tr>
<td></td>
<td>Groundwater quality</td>
<td>H</td>
<td>M</td>
<td>M</td>
</tr>
<tr>
<td><strong>Air quality</strong></td>
<td>Cumulative air pollution impacts</td>
<td>M</td>
<td>L-M</td>
<td>L-M</td>
</tr>
<tr>
<td><strong>Noise</strong></td>
<td>Cumulative noise pollution impacts</td>
<td>L</td>
<td>L</td>
<td>L</td>
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<tr>
<td><strong>Socio-economic impacts</strong></td>
<td>Construction phase project expenditure, including employment and downstream business opportunities</td>
<td>L-M$^+$</td>
<td>L-M$^+$</td>
<td>L-M$^+$</td>
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<tr>
<td></td>
<td>Employment phase project expenditure, mainly related to indirect employment opportunities</td>
<td>L-M$^+$</td>
<td>M$^+$</td>
<td>H$^+$ (cumulative)</td>
</tr>
<tr>
<td></td>
<td>Increased Corporate Social Responsibility expenditure</td>
<td>L-M$^+$</td>
<td>M$^+$</td>
<td>H$^+$ (cumulative)</td>
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<tr>
<td>Section</td>
<td>Potential impact</td>
<td>Significance of the impact (the ratings are negative unless otherwise specified) (L=low, M= medium, H= high)</td>
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<tr>
<td>------------------------------------------------</td>
<td>----------------------------------------------------------------------------------</td>
<td>----------------------------------------------------------------------------------------------------------</td>
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<tr>
<td>Macro-economic benefits</td>
<td></td>
<td><strong>M-H</strong>&lt;sup&gt;+&lt;/sup&gt;</td>
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<tr>
<td>Impact of construction workers on local</td>
<td></td>
<td><strong>M-H</strong>&lt;sup&gt;+&lt;/sup&gt;</td>
<td></td>
<td></td>
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<tr>
<td>communities</td>
<td></td>
<td>H&lt;sup&gt;+&lt;/sup&gt; (cumulative)</td>
<td></td>
<td></td>
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<tr>
<td>Impacts of increased storage and transport</td>
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<td>M</td>
<td></td>
<td></td>
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<tr>
<td>Smelter decommissioning and closure</td>
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<td></td>
<td></td>
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<tr>
<td>Community health impacts</td>
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<td>M</td>
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<td>and PM&lt;sub&gt;10&lt;/sub&gt; exposure</td>
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<td>Tsumeb communities</td>
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<td>Health impacts of arsenic exposures to DPMT</td>
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<tr>
<td>employees</td>
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<td>L</td>
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