EXECUTIVE SUMMARY

1. 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 (Pty) Ltd. 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.

The smelter was constructed in the early 1960s to process concentrate from the Tsumeb copper mine and is one of only five commercial-scale smelters in Africa capable of processing concentrates with a high arsenic content. 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, including the following:

- Construction of a hazardous waste disposal site (2012);
- Addition of a second oxygen plant (2012);
- Improvement of the off-gas handling systems (2012-2013);
- Closure of the reverberatory furnace (2013);
- Addition of a 1,540 t/d sulphuric acid plant and associated acid storage and dispatch facilities (mid 2015);
- Addition of two new and larger Peirce-Smith converters (end 2015);
- A new effluent treatment plant; and
- Decommissioning of the arsenic plant (end of February 2017).

The Tsumeb Smelter now 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. Up to recently, a portion of the arsenic contained in the concentrate feed was converted to arsenic trioxide (As_2O_3) through the arsenic plant and sold to third parties. The arsenic plant is currently in the process of being decommissioned and As_2O_3 production has ceased.

With additional custom concentrates available worldwide and areas for operational improvements identified, DPMT is now 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.).

The new project components and associated service infrastructure, together with the existing (approved) infrastructure/facilities, is 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) for its operations at the Tsumeb Smelter. To allow for the proposed Upgrade and Optimisation Project, an amendment of the original Environmental and Social Impact Assessment (ESIA) and Environmental Management Plan (EMP) is required. This report focuses on the above mentioned additional components not covered in the current ECC and EMP.

DPMT currently also holds various other ECCs and EMPs for different project components established after the original ECC for the Smelter operations was issued. The objective of this project and ESIA Amendment process is further to combine all of the commitments in the separate EMPs into one consolidated EMP for all DPMT's facilities and operational components. 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. 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.

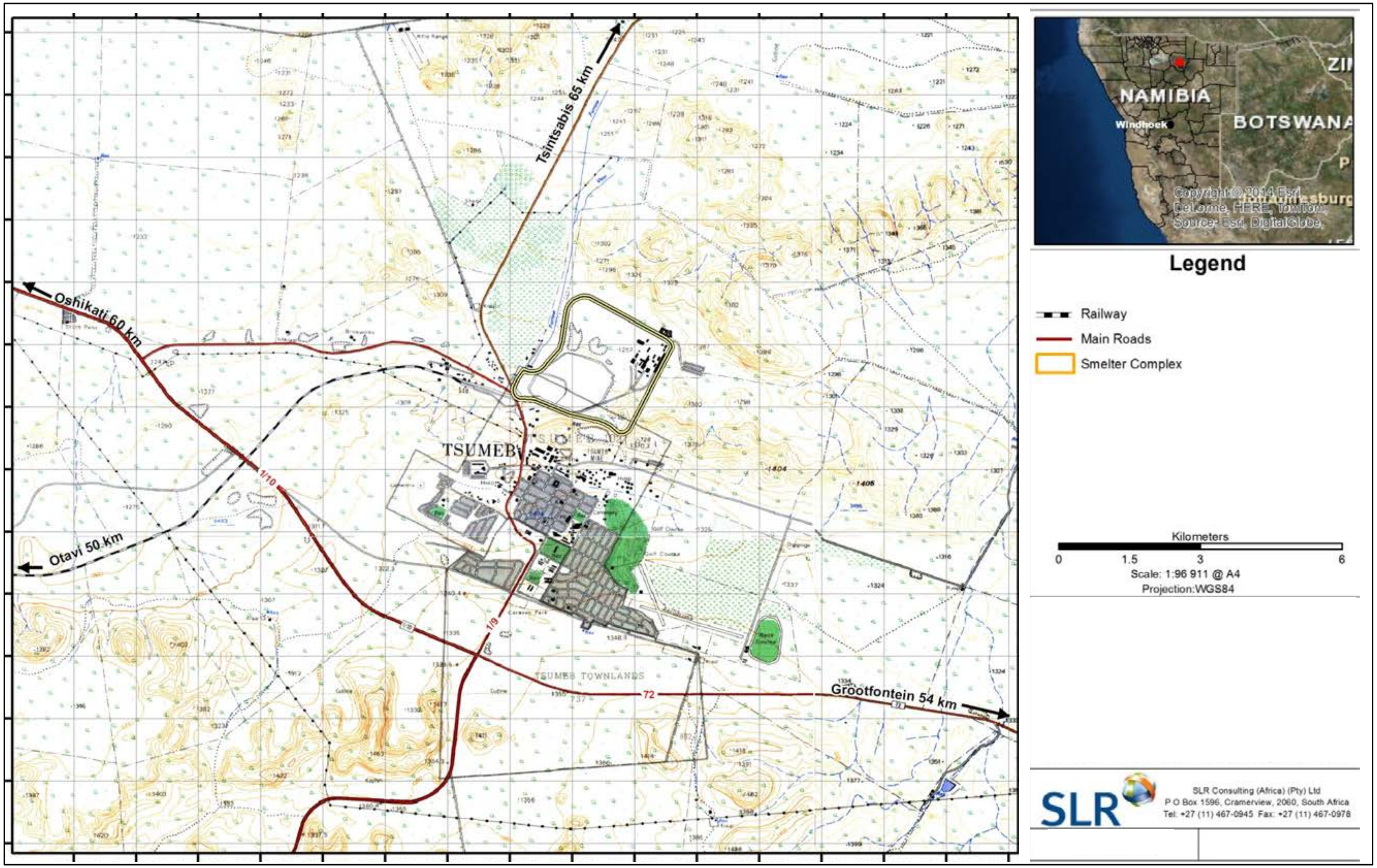

FIGURE 1: LOCAL SETTING OF THE TSUMEB SMELTER COMPLEX

2. PROJECT MOTIVATION

The motivation to support the project is economic in nature, 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.

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, however, 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, however, 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.

The Tsumeb Smelter is unique in that it has the ability to process high sulphur, high arsenic and low copper grade concentrates. It is one of only five commercial-scale smelters in Africa capable of processing concentrates with a high arsenic content. It thus provides highly specialised services to global clients. Upgrading the smelter capacity to 370 000 tpa would ensure that the facility can operate at a higher efficiency level with the related economic benefits.

The current proposed Upgrading and Optimisation Project is one of the later phases of an overall optimisation and expansion which has already required substantial capital investment. Recovering the cost of this investment would be significantly more challenging should the proposed project not go ahead, putting the future economic viability of the smelter at risk.

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.

3. ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT PROCESS

Environmental Impact Assessments (EIA) are regulated by the Ministry of Environment and Tourism (MET) in terms of the Environmental Management Act, 7 of 2007. This Act was gazetted on 27 December 2007 (Government Gazette No. 3966) and the EIA Regulations were promulgated on 6 February 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 upgraded and new 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;
- 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;
- A Consolidated EMP was prepared to elaborate on the mitigation objectives, include additional actions that were described in the ESIA report and consolidate previously approved EMPs; and
- A project specific public participation process was conducted. 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 and scoping report. All questions and comments that were raised by the authorities and IAPs have been included and addressed in the ESIA report. Similarly, IAPs have the opportunity to review the ESIA Report and provide additional comments before it will be finalised. Public feedback meetings have been arranged to present the findings of the ESIA to IAPs.

4. PROJECT OVERVIEW

The current proposed Upgrade and Optimisation Project was selected as the preferred option through a pre-feasibility study process and would increase the concentrate throughput 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 by an independent contractor;
- Key changes/additions to the slag mill process include the following:
    - An upgrade of the milling and classification circuits;

- o Rationalization of flotation capacity by elimination of oxide rougher bank #2 and oxide cleaner cells;
- o Replacement of concentrate vacuum drum filter with a 4-leaf 6ft.(1.83m) diameter disc filter;
- o Addition of instrumentation in the grinding and flotation circuits and improved sampling practices to enhance metallurgical control and stability; and
- o Organizational changes suggested include measures to reinforce operator training and preventative maintenance to achieve 90% slag mill availability.

- Required utility upgrades include the following:
  - o A new instrument air dryer;
  - o Increase of the pump capacity for raw water from the old mine shaft;
  - o Two additional light fuel oil supply pumps and piping to supply the RHF;
  - o Two additional heavy fuel oil supply pumps and two heaters as part of the oil supply ring for the RHF burners;
  - o Upgraded electricity supply system to be housed in a new electrical building.
- Increased road transport requirements of an additional two to five truckloads of copper concentrate to Tsumeb from Walvis Bay per day.

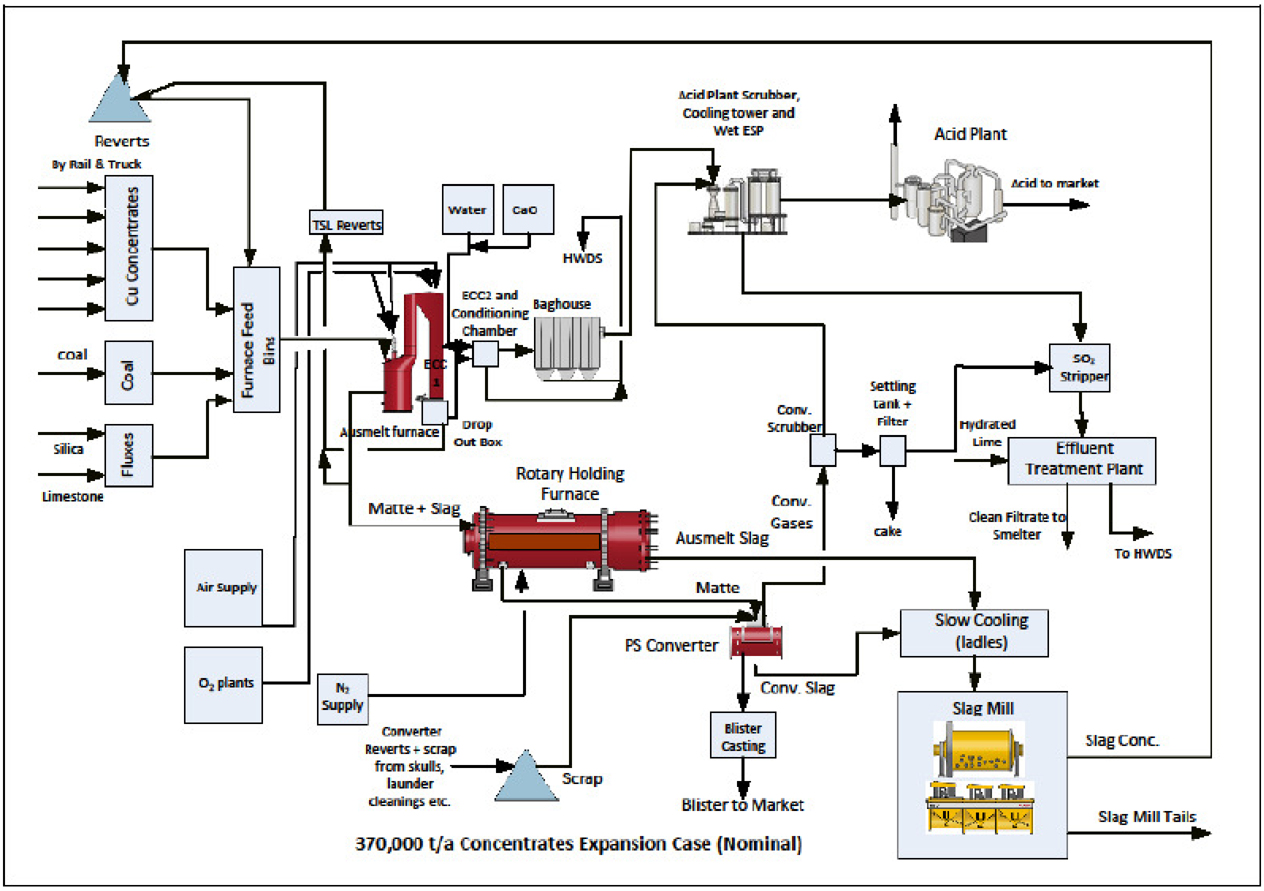

FIGURE 2: PROCESS FLOW DIAGRAM FOR THE EXPANDED TSUMEB SMELTER OPERATIONS. [RED AND YELLOW ITEMS INDICATE THE NEW/UPGRADED COMPONENTS LINKED INTO THE EXISTING PROCESS STEPS] (WORLEYPARSONS, 2015)

5. ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT FINDINGS

WASTE MANAGEMENT

A review of current waste management activities at the smelter was undertaken and various recommendations made for management improvement. Main findings related to the need for a formalised general waste landfill site or further investigation into the establishment of a waste incinerator 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 regarded as a positive development in terms of improving general waste management on the smelter site.

The review also included calculations of the remaining life of the on-site hazardous waste disposal site. The findings showed that with the additional arsenic waste volumes to be produced and disposed it is likely that the existing waste cell has a life span of one and a half to two years from February 2017. The entire permitted disposal site has an estimated life span of around 8 years. These calculations were based on the assumption that all arsenic waste would be disposed of at this site and no other options for disposal are considered. DPMT are, however, 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, and saleable, resulting in a reduction in the volume of hazardous waste to be disposed of.

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 is currently being implemented in phases and include, amongst other measures, the establishment of lined polluted water collection dams. 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

Due to there not being any downstream water users between the smelter site and the Jordan River to the west of the site, which has a limited flow for a short distance downstream, and the implementation of improved stormwater management measures, 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, if required and the establishment of a surface water monitoring programme at various sites along the Jordan River in order to monitor pollution levels.

GROUNDWATER QUALITY

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 has already impacted significantly on groundwater quality on site. Modelling data showed that polluted groundwater could potentially migrate offsite. Contamination plume modelling from 2013 and 2016 groundwater reports by GCS indicate that arsenic concentrations could potentially become elevated offsite and the plume is likely to continue to move to the north, potentially eventually impacting on irrigation boreholes if no action is taken to prevent this. The accuracy of this model has been brought into question as part of the current assessment and it has been proposed that an updated model be developed, taking Government groundwater studies to the north of Tsumeb into consideration, for more accurate predictions of groundwater flows.

It is not expected that the proposed expansion project would contribute significantly to the current groundwater impacts from historic and current operations. 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) water quality limit could be reached with the implementation of mitigation measures. As the impact is already being experienced, the impact of the proposed expansion on groundwater quality is assessed as cumulative, with the impact largely being attributable to historic activities.

Some of the key mitigation measures include the following (included in expansion project capital and operating costs):

- Refine the current groundwater model in order to make accurate predictions of groundwater flow.
- Complete the study on sources of contamination and potential remedial action (currently only in a planning stage with scope of work developed with the intention of tendering the work out in 2017).
- Investigate targeted solutions for groundwater treatment and pollution source elimination in order to reduce potential offsite pollution. Also consider an increase in the number of recovery boreholes.
- Rehabilitate polluting dumps in line with the closure plan recommendations.
- Dispose of waste material at a suitable disposal site. This would require the establishment of a formal waste site or addition of incinerator for the additional waste volumes to be generated.
- Implement the phytoremediation trials in line with the closure plan.
- Drill additional monitoring boreholes offsite in the downgradient direction and into different geological / hydrogeological environments.

- Include regional groundwater monitoring from existing farm and municipal boreholes and produce a detailed groundwater monitoring schedule.
- Regularly sample monitoring boreholes in order to timeously identify changes in groundwater quality.

AIR QUALITY

There have been notable decreases in air emissions from smelter operations during 2016 which can be ascribed to the commissioning of the sulphuric acid plant and decommissioning of the reverberatory furnace.

Sulphur Dioxide

After commissioning of the sulphuric acid plant in 2015, ambient air quality monitoring stations have reported significant downward trends in sulphur dioxide (SO_2) emissions from October 2015 to September 2016. 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. Based on average monthly SO_2 levels, the only exceedance of the annual limit (50 µg/m^3) was recorded at the Sewerage Works monitoring station to the west of the smelter site in 2016. Short term assessment criteria (South African 24-hour limit) were, however still exceeded at the monitoring stations in close proximity to the smelter site on a number of occasions during 2016.

It is expected that SO_2 emissions will increase most notably because of the introduction of the RHF where SO_2 will be released during charging and pouring. In order to determine the dispersion of SO_2 from the smelter as a result of the proposed expansion, SO_2 concentrations were simulated at ambient air quality monitoring locations. As the sulphuric acid plant conversion efficiency rate was on average at 76% during 2016, a 76% efficiency rate was used in the simulations. The 76% efficiency rate is considered to be a worst case scenario and it is expected that the acid plant would reach between 90 and 95% efficiency rate on average. The 53% increase in SO_2 emissions from the smelter is expected to result in similar increases in ambient SO_2 concentrations. The simulation results showed that SO_2 concentrations associated with the proposed plant expansion, would exceed the South African 1-year average assessment criterion of 50 µg/m^3 at the Sewerage Works station (123 µg/m^3) and eastern parts of Tsumeb. The 24-hour average criterion (4 days of exceedance of 125 µg/m^3) is exceeded at the Sewerage Works (304 µg/m^3) and most of Tsumeb (see Figure 3). The 99th percentile of 1-hour average concentrations (equivalent to the 88th highest hour) exceeds the adopted criterion of 350 µg/m^3 (or 88 hours of exceedance of 350 µg/m^3) across Tsumeb.

As mentioned above, in 2016 the average conversion efficiency of the sulphuric acid plant was 76%. It was calculated that an efficiency rate of 95% would be required to ensure that ambient SO_2 levels remain within the adopted SO_2 assessment criteria (see Figure 4). Since commissioning of the plant towards the end of 2015, the plant performed at its best in May 2016 when a conversion efficiency of 90% was reached.

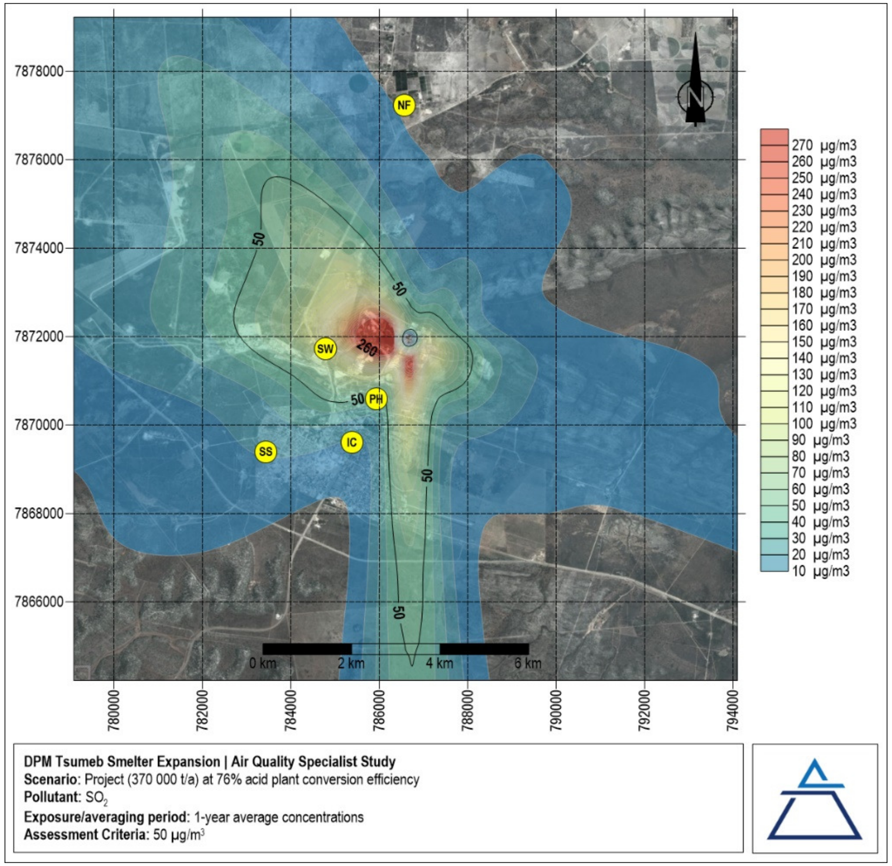

FIGURE 3: SIMULATED 1-YEAR AVERAGE SO2 CONCENTRATIONS AT 76% ACID PLANT CONVERSION EFFICIENCY

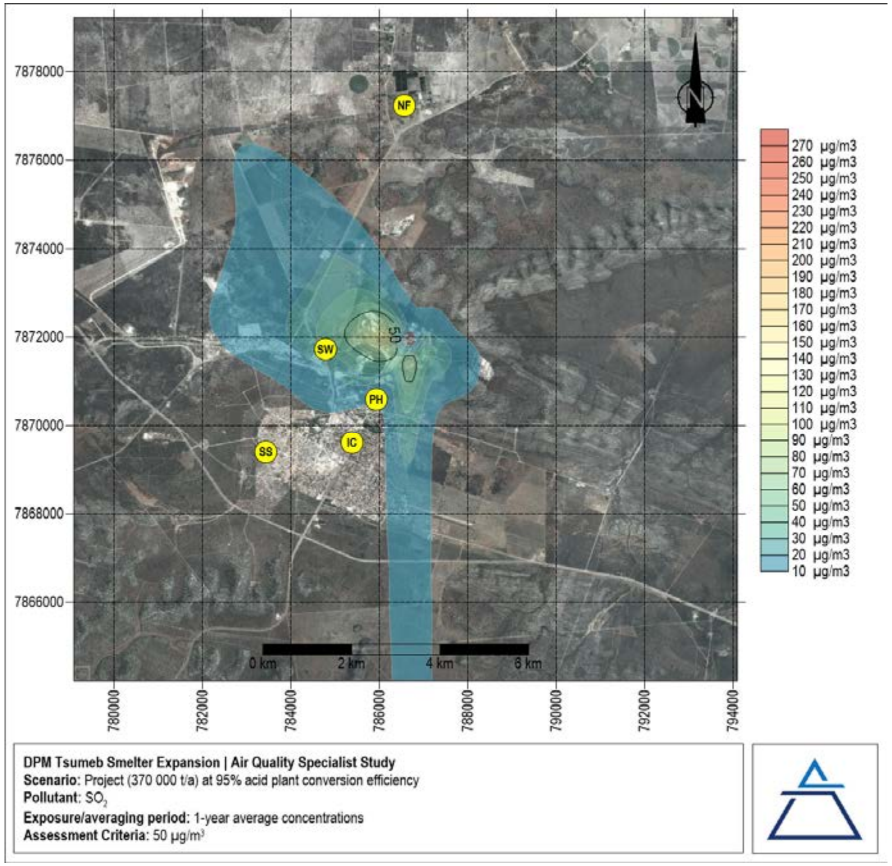

FIGURE 4: SIMULATED 1-YEAR AVERAGE SO2 CONCENTRATIONS AT 95% ACID PLANT CONVERSION EFFICIENCY

Sulphuric acid

Ambient sulphuric acid (H_2SO_4) levels are expected to increase by a factor of 1.4 due to the proposed increased throughput capacity. Simulations showed that both the annual and 1-hour average off-site concentrations will, however, be well within ambient air quality limits.

PM_{10}

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. The monitoring station immediately to the west of the smelter (Sewerage Works station) 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} concentrations by a factor of approximately 1.2. Simulated levels associated with the proposed upgrade project do, however, not exceed PM_{10} 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 from 2013 to 2016 with average concentrations ranging between 0.1 $\mu g/m^3$ and 0.3 $\mu g/m^3$. These levels are considered to exceed the chronic inhalation reference concentration of 0.015 $\mu g/m^3$ outside of the smelter footprint. It was found that furnace building fugitives (fumes escaping primary and secondary capture systems) contribute most notably to these off-site arsenic impacts. 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 as the cause of 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 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.

Applying the WHO unit risk factor of 0.0015 $\mu g/m^3$ to the annual average concentrations, the increased lifetime cancer risk in Tsumeb was rated as low for the current and increased throughput capacity and as moderate on the smelter boundary. The level at the smelter boundary is considered to be at the upper level of what might be considered acceptable, from a non-carcinogenic and carcinogenic inhalation health exposure perspective. This result, however, assumes that arsenic in air might be the main exposure pathway for Tsumeb residents. This matter was investigated further by a community health specialist and is further assessed in the community health impact section later in this executive summary.

Based on the above findings for all the emissions considered, the overall significance of exceedances of ambient air quality standards in Tsumeb due to the proposed increased throughput capacity of the smelter is considered to be medium without mitigation given 2016 performance levels of the sulphuric acid plant and fugitive emissions management systems. With mitigation, the impact significance may be reduced to low-medium. Key mitigation measures include efficient capture of fugitive dust emissions across the smelter site, improving the sulphuric acid plant conversion efficiency to 95% and undertake 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 noise assessment found that the only noise sensitive receptors where where activities from the smelter complex were audible was the farmstead on the property of Mr Danie Potgieter, approximately 650 m northwest of the smelter boundary and 600 m east of the M75 road. It was found that noise levels in the town are greatly affected 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 levels guidelines at noise sensitive receptors. The increases in noise levels above the measured background level of 44.8 dBA during the day and 39.4 during the night were found to be less than 3 dBA at all noise sensitive receptor and thus not detectable. The potential noise impacts were thus rated as of low significance. Key mitigation measures included improvement of the silencer at the No. 2 oxygen plant 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 such as 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 local Tsumeb municipal area. The overall construction phase expenditure is assessed to be of low-medium positive significance. It is recommended that local labour and sub-contractors be utilised as far as possible 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 and is considered to be of medium positive significance.

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 potential benefit is rated as of medium positive significance. When assessed as cumulative to current contributions, the significance is increased to high positive, given the already significant contributions being made.

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 is thus rated as of medium to high positive significance. In this regard, it is recommended that DPMT favour Namibian suppliers of goods and services, where possible.

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, e.g. an increase in alcohol and drug use and related crime levels. Due to the rapid increase in the population of Tsumeb in the last five years 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 of having an unplanned pregnancy. The overall impact is considered as of low negative significance after the implementation of mitigation measures. 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.

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. In the absence of 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. With these plans in place, the negative impacts associated with the potential future decommissioning and closure of the smelter could be reduced to of low negative significance. Recommendations in this regard include 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. The current proposed project would extend the viability of the smelter and thus defer 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, exceedance of the South African and WHO 24-hour limits was still recorded on a monthly basis outside of the smelter boundary during 2016. Exceedances of the SA NAAQS standards (125 µg/m^3) were recorded at the monitoring stations closest to the smelter (i.e. Plant Hill and Sewage Works), but not at the monitoring stations within Tsumeb (i.e. Info Centre and Sport Stadium). When considering the long-term effects of SO_2 exposure, findings of previous studies (Linn *et al*., 1987) found that there was no irreversible adverse respiratory impact as measured by lung function on asthmatics and atopic individuals under conditions of exposure at least an order of magnitude higher than levels experienced in the Tsumeb area. These findings were also confirmed by the results of the respiratory health questionnaires completed by Tsumeb residents as part of the community health assessment. Elevated SO_2 concentrations, however, have an irritant effect on the respiratory system, causing a symptom burden for the receptor population, especially for those with asthma-related symptoms. 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.

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 converts 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 cause an exceedance of daily PM_{10}

WHO interim targets (i.e. 75 µg/m^3) or stricter WHO first world targets (i.e. 50 µg/m^3) outside of the smelter footprint. It is thus not expected that the proposed project would add cumulatively to the current burden of disease experienced from PM_{10} sources.

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

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 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 of 35 µg/l (American Conference for Governmental Industrial Hygienists -ACGIH). 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 of 50 µg/l. As the results of the investigation showed that arsenic in airborne PM_{10} and in drinking water could not be responsible for the elevated urine arsenic levels in outlier samples from Ondundu, attention must be directed 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.

From the available data, the risk of lung cancer due to environmental arsenic exposure is low for Tsumeb overall. There is no risk above baseline occurrence of cancer for Tsumeb suburbs, with the exception of the northern town area (principally Ondundu) where the risk is considered to be low (further details regarding the calculations of cancer risk factors are provided in Section 13.2 of the community health assessment in Appendix I).

Based on regression analysis, no significant increase in airborne arsenic exposures for residents is expected at the proposed increased throughput capacity. Alternative options for hazardous arsenic waste disposal are currently being investigated by DPMT, with investigations at an advanced stage. This will lead to the eventual closure and capping of the hazardous waste site when the approved capacity is reached, which would likely result in a further reduction in environmental arsenic exposures to both the smelter employees and Tsumeb residents, particularly the closest residential areas at Ondundu. It was noted in the specialist assessment that capital improvements were not yet fully implemented during 2016 and that it can be assumed that when these improvements function optimally, it would result in further reduced arsenic exposures going forward.

While the shutdown of the arsenic plant, one of the most antiquated components at the facility, during the first quarter of 2017 will result in a reduction in arsenic exposure for employees at the plant, it would also result in an increase (up to 25%) in the volumes of arsenic waste to be disposed of at the hazardous waste disposal site. If not well managed, windblown arsenic-containing dust (albeit of a less concentrated form of arsenic) from the waste site could contribute to an increase in arsenic exposures which could potentially increase proportionally with an increase in the throughput capacity, as a worst case scenario. Appropriate dust suppression measures are thus critical for arsenic containment. Given the presumptive predominance of the air exposure pathway in determining the impact of the soil exposure pathway on absorbed arsenic as measured in urine arsenic, the latter should decline with the closure of the arsenic plant, further engineering improvements for the management of fugitive dust emissions at the smelter and the eventual closure of the hazardous waste disposal site once the approved capacity is reached. Based on the above, the significance of the impact for Tsumeb as a whole is rated low (overall town area) to medium (Ondundu area closest to the smelter) before mitigation and low for both areas after mitigation. In addition to the closure of the arsenic plant (during first quarter of 2017) and improved control of all fugitive emissions, recommendations were made for further community health investigations. The investigations are to focus on determining arsenic levels in soil and vegetables/fruit and the effect of hand to mouth behaviours, along with further comparing Ondundu and control areas within and outside of Tsumeb. 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.

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. As concerns were, however, raised by unions and other I&APs during the scoping phase, occupational health concerns were also addressed as part of the community health assessment. This study component included a review of the use of personal protective equipment (PPE) by employees and assessed the likelihood of an increased cancer risk to employees from the proposed increased throughput capacity. The results of the study showed that PPE and some engineering controls do not seem to be working and there is thus an appreciable occupational lung cancer risk on average for the plant as a whole; more in some business units than in others, depending upon the average air concentration in those units. The corresponding risks are considered to be 2 to 3 times the expected background risk for lung cancer at the current levels of exposure and are thus deemed as a low to medium risk. Modelling results showed that there is little likelihood of increased exposure (increased urine arsenic levels) going forward. As the capital improvements are completed in the near future, and point of emissions are better controlled, the arsenic plant is shut down and the hazardous waste disposal site is eventually closed and covered after the approved capacity is reached, urinary arsenic levels will decline further. Based on the above, the occupational health impact from increased cancer risk due to arsenic exposure is assessed as of low to medium significance after mitigation. In addition to the closure of the arsenic plant, the key recommended mitigation measures include improved control of fugitive emissions, strengthening the industrial hygiene programme, reducing arsenic exposure pathways, continuing to implement job rotations (but at lower arsenic cut-off values) and improving safe work practices.

6. ENVIRONMENTAL IMPACT STATEMENT AND CONCLUSIONS

A tabulated summary of the potential impacts is presented in Table 1 below. As can be seen from the table below, 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 the findings of the assessment and related mitigation objectives and actions as presented in the EMP. One of the potential negative impacts will remain of medium negative residual significance even with mitigation. This negative impact relates to the impact of the smelter operations on groundwater quality on and potentially beyond the site boundary. It is important to note that current groundwater quality impacts are related to historic impacts of mining and processing activities on the site prior to the establishment of DPMT's current smelter operations. It is not expected that the proposed expansion project would lead to any measurable cumulative contribution to current groundwater quality impacts. The residual medium cumulative impact rating can thus be ascribed to the baseline groundwater quality conditions and not to the proposed expansion project. It was, however, noted that the current groundwater model would need to be updated in order to provide a more accurate prediction of the likelihood of contaminated groundwater migrating beyond the smelter boundary and build on already recommended mitigation measures for further reducing the significance of impacts on groundwater quality in the vicinity 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.

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 load, the majority of the measured contamination levels and related impacts (i.e. groundwater and to some extent community health) are attributable to historic operations. The ongoing Contaminated Land Assessment will aim to quantify the historic and current contributions.

Based on the findings of this ESIA, it is not expected that the proposed increased throughput capacity of the DPMT smelter would have a significant contribution to current negative operational impacts. 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 acceptably lower levels.

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. hoods) are operating at optimal design levels in order to control SO_2 and other fugitive dust emissions;
- Disposal of general waste by implementing one of the following options:
  - Establishment of a general landfill site within the smelter footprint;
  - Development of a small waste incinerator (would require an additional EIA process); or
  - Disposal at a formalized/licensed municipal landfill site (additional municipal application process would be required).
- A final solution for the disposal of hazardous waste well in advance of the onsite hazardous waste disposal site reaching its full design capacity. The following alternatives should be further considered and a final decision made as soon as possible:
  - Disposal to a potential future regional site in Namibia;
  - Transport of waste to a suitable hazardous waste site in South Africa;
  - Vitrification of flue dust which would render arsenic wastes non-hazardous and saleable; or
  - A combination of the above options.

SLR is of the opinion that the proposed expansion project may be approved, on the condition that the above key aspects are addressed by DPMT as a priority.

TABLE 0-1: SUMMARY OF POTENTIAL IMPACTS ASSOCIATED WITH THE PROPOSED PROJECT

Section	Potential impact	Significance of the impact (the ratings are negative unless otherwise specified)	
		Unmitigated	Mitigated
Surface water	Changes in surface water runoff	**L**	**L**
	Surface water pollution	**M**	**L**
Groundwater	Groundwater quantity	**M**	**L**
	Groundwater quality	**H**	**M**
Air quality	Cumulative air pollution impacts	**M**	**L-M**
Noise	Cumulative noise pollution impacts	**L**	**L**

Section	**Potential impact**	**Significance of the impact (the ratings are negative unless otherwise specified)**	
		Unmitigated	**Mitigated**
Socio-economic impacts	Construction phase project expenditure, including employment and downstream business opportunities	**L-M$^+$**	**L-M$^+$**
	Employment phase project expenditure, mainly related to indirect employment opportunities	**L-M$^+$**	**M$^+$** **H$^+$ (cumulative)**
	Increased Corporate Social Responsibility expenditure	**L-M$^+$**	**M$^+$** **H$^+$ (cumulative)**
	Macro-economic benefits	**M-H$^+$**	**M-H$^+$** **H$^+$ (cumulative)**
	Impact of construction workers on local communities	**M**	**L**
	Smelter decommissioning and closure	**M**	**L**
Community health impacts	Community health impacts related to SO_2 and PM_{10} exposure	**M**	**L**
	Community health impacts of arsenic exposures to Tsumeb communities	**L-M**	**L**
	Health impacts of arsenic exposures to DPMT employees	**H**	**L**