Ministry of Mines and Energy

Strategic Environmental Management Plan (SEMP) for the Central Namib Uranium Province 2016 Annual Report

December 2017

Prepared by

Geological Survey of Namibia

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Citation

Geological Survey of Namibia (2017): Strategic Environmental Management Plan (SEMP) for the Central Namib Uranium Mining Province, 2016 Annual Report. Ministry of Mines and Energy, Windhoek, Republic of Namibia

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EXECUTIVE SUMMARY

The Strategic Environmental Management Plan (SEMP) for the Namibian uranium province is a public-private collaborative initiative housed within the Geological Survey of Namibia, Ministry of Mines and Energy. The SEMP is an over-arching framework and roadmap to address the cumulative impacts of existing and potential developments, within which individual projects have to be planned and implemented. Annual SEMP reports measure the performance around twelve Environmental Quality Objectives (EQOs) and the extent to which uranium mining is impacting the central Namib. Each EQO articulates specific goals and targets that are monitored by a set of key indicators.

The 2016 SEMP report is the sixth annual report since the inception of the process. It has become clear now that many objectives were formulated under the assumption that the "uranium rush" that triggered the SEA would lead to the development of a number of new mines. This prediction did not materialise due to the current low demand for uranium. The uranium spot price fluctuated around US$20 per pound during 2016. Langer Heinrich Uranium and Rössing Uranium were the only fully operational mines, though Swakop Uranium drummed its first product in December 2016.

The overall performance of the 2016 SEMP showed a reduction in the number of indicators being **MET** (47%) compared to previous years, while three indicators were again **EXCEEDED** (2%). The percentage of indicators that were **NOT MET** increased to 9%, while the indicators **IN PROGRESS** dropped to 23%. In 2016, 30 indicators were rated **NOT APPLICABLE** because the relevant activity did not take place (25%). Figure 1 displays the performance for each EQO, which is summarised below.

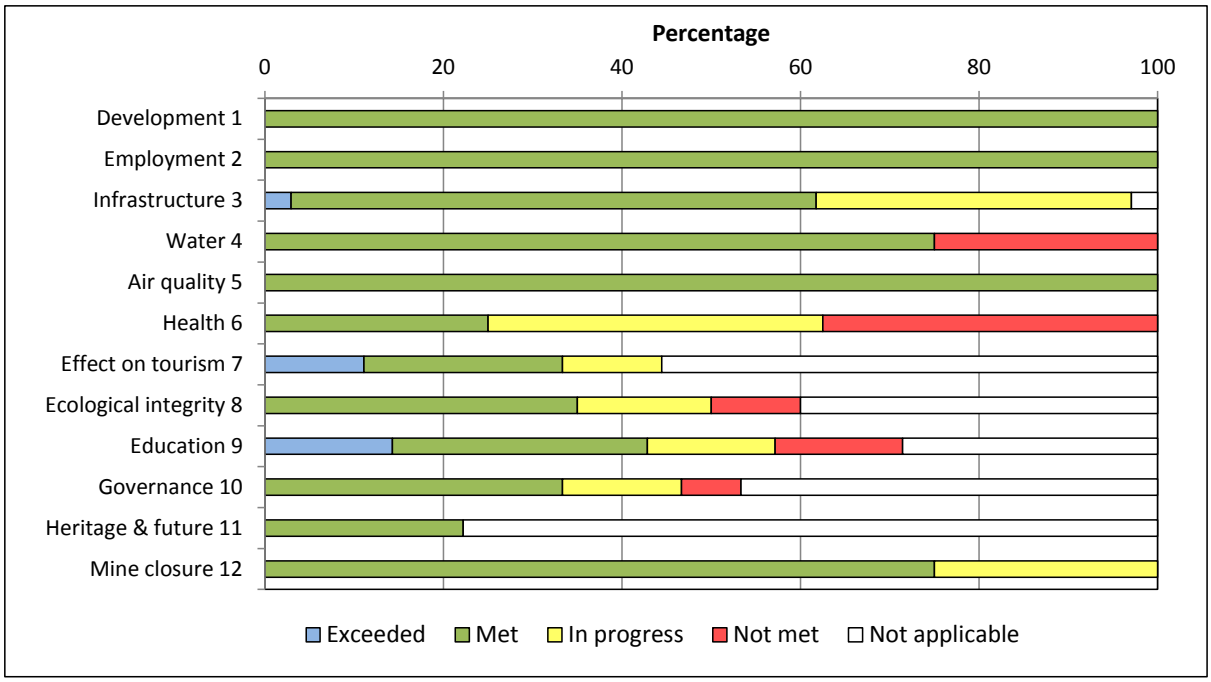

Figure 1: Performance per EQO in 2016

- The Socioeconomic Development (EQO 1), Employment (EQO 2) and Air Quality (EQO 6) objectives were 100% **MET**. The two applicable indicators in Heritage and the Future (EQO 11) were also **MET**.
- The indicators that were rated as **EXCEEDED** were in the Infrastructure EQO (average waiting time for ships to obtain a berth at Namport was much lower than 12 hours), in Effect on Tourism (tourists' expectations of their visual experience in the Central Namib were mostly

exceeded) and in the Education EQO (percentage of wage cost allocated to skills development exceeded the 3% target at operating mines).

- The objectives for Infrastructure (EQO 3), Effect on Tourism (EQO 7)and Mine Closure and Future Land Use (EQO 12) were mostly **MET** with some indicators **IN PROGRESS** or **EXCEEDED**.
- Mixed results ranging from **MET** to **NOT MET** were obtained in the following EQOs: Water (EQO 4), Ecological Integrity (EQO 8), Education (EQO 9) and Governance (EQO 10).
- In the Health EQO (6) the number of indicators **IN PROGRESS** or **NOT MET** was higher than the ones that were **MET**, mostly because it appears unlikely that the stipulated ratio of healthcare professionals and facilities per number of population will be achieved by 2020.
- Other indicators that were **NOT MET** relate to the availability of desalinated water in EQO 4 and biodiversity offsets in EQO 8. One EQO 10 indicator was **NOT MET** because there is no legislation that would allow the Ministry of Environment & Tourism to appoint honorary conservators.

In view of the cyclical nature of commodity markets it is expected that the demand for uranium will increase in future. The implementation of the EQO targets is therefore essential to ensure that the region is well positioned for future uranium mining projects. Table 36The most important actions to address the shortcomings that have been identified in this report are summarised as follows:

EQO 3: Traffic volume on the B2 has increased so that the road has become unsafe (Roads Authority)	• Upgrade the road to double lanes or create passing lanes at least up to Arandis
EQO 3: Optimum use of rail infrastructure (Transnamib)	• Upgrade the railway line so that bulk freight (e.g. fuel) can be shifted from the road
EQO 4: Continuous availability of desalinated water to meet the mines' demand and ensure that no investors are lost (NamWater)	• Communicate with bulk water users about their expected demand and inform the Erongo desalination plant of increases in demand well ahead of time
EQO 6: Number of healthcare professionals and facilities (MHSS)	• Employ the number of healthcare professionals identified in the 2015 WISN study, add or enlarge healthcare facilities (hospitals, clinics, ambulances)
EQO 8: Implementation of biodiversity offsets (MET, Mines)	• MET to create enabling legislation for the lasting protection of offsets • Mines endorse a "no net loss" policy and create offsets for irreversible damage to important biodiversity areas
EQO 12: Lack of mine closure regulations (MME)	• Create regulations for review and approval of mine closure plans; financial guarantees; implementation review; relinquishment and transfer of liabilities to the subsequent land owner

The SEMP has become a useful long-term monitoring and decision-making tool through which potential impacts are highlighted so that measures can be taken to avoid unnecessary impacts and mitigate unavoidable impacts. A continuing aim of the SEMP process is to increase the commitment of key government institutions, the uranium industry and NGOs to undertake actions that will allow communities in the Erongo region and the mining industry to co-exist in harmony.

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ABBREVIATIONS

AA	Affirmative Action
BH	Borehole
BMC	Basin Management Committee
CoM	Chamber of Mines
DWAF	Department of Water Affairs and Forestry
DWSSC	Directorate Water Supply Sanitation Co-ordination, DWAF
ECC	Environmental Clearance Certificate
EIA	Environmental Impact Assessment
EMP	Environmental Management Plan
EPL	Exclusive Prospecting Licence
EQO	Environmental Quality Objective of the SEMP
GIS	Geographical Information System
GRN	Government of the Republic of Namibia
GRTC	Gobabeb Research and Training Centre
GSN	Geological Survey of Namibia
IAEA	International Atomic Energy Agency
ISO	International Standards Organisation
IWRM	Integrated Water Resources Management
m	Metre
m^3	Cubic Metre (1,000 litres)
$mg/m^2/day$	Micrograms per Square Metre per Day
$\mu g/m^3$	Micrograms per Cubic Metre
Mm^3/a	Million Cubic Metres per Annum (year)
m/s	Metres per Second
mSv/a	Millisieverts per Annum
MAWF	Ministry of Agriculture, Water Affairs and Forestry
MHSS	Ministry of Health and Social Services
MLIREC	Ministry of Labour, Industrial Relations and Employment Creation
MME	Ministry of Mines and Energy
MEAC	Ministry of Education, Arts and Culture
MoF	Ministry of Finance
N$	Namibian Dollars
NamWater	Namibia Water Corporation (Pty) Ltd
NACOMA	Namibian Coast Conservation and Management
NBSAP2	National Biodiversity Strategy and Action Plan 2
NERMU	Namib Ecological Restoration and Monitoring Unit
NIMT	Namibian Institute of Mining and Technology
No.	Number
NRPA	National Radiation Protection Authority
NSA	National Statistics Agency
NUA	Namibian Uranium Association
Pers. comm.	Personal Communication (interview or e-mail)
PM_{10}	Inhalable dust with particles smaller than 10 micrometres

SA NDCR	South African National Dust Control Regulations
SANS	South African National Standard
SEA	Strategic Environmental Assessment
SEMP	Strategic Environmental Management Plan
VET Levy	Vocational Education and Training Levy
WHO	World Health Organisation

Abbreviations used in Radioactivity and Water Quality Analyses

Bq/m^3	Becquerel per Cubic Metre
Ca	Calcium
$CaCO_3$	Calcium Carbonate (limestone)
Cd	Cadmium
cfu/mL	Colony-forming units per millilitre
Cl	Chloride
Cu	Copper
F	Fluoride
Fe	Iron
K	Potassium
Mg	Magnesium
Mg/L	Milligrams per litre (also written as mg/l)
Mn	Manganese
mS/m	Millisiemens per metre
Na	Sodium
NO_2	Nitrite
NO_3	Nitrate
NTU	Nephelometric Turbidity Units
Pb	Lead
pH	Indicates if a solution is acid (0-7) or alkaline (7-14)
Ra-226	Radium Isotope, naturally occurring
Ra-228	Radium Isotope, naturally occurring
SiO_2	Silica
SO_4	Sulphate
TDS	Total Dissolved Solids (a measure of salinity)
U	Uranium
U_3O_8	Uranium oxide, the form that is usually traded on the market
Zn	Zinc

SEMP BACKGROUND

A Strategic Environmental Assessment (SEA) was undertaken in response to a "uranium rush" that occurred when the spot market price started rising in 2005 and reached over US$120 per pound in 2007. The Ministry of Mines and Energy (MME) announced a moratorium on the issuing of exclusive prospecting licences for nuclear fuel in 2007, in the wake of an unprecedented wave of licence applications that covered the entire Erongo region and other parts of the country. Though the uranium price quickly dropped to US$40-60 per pound in the following years a number of companies continued with exploration, feasibility studies, process development and applications for mining licences.

Members of the public and government institutions raised concerns about the impact of uranium prospecting and mining on the affected communities and the environment. The mining industry was worried that unscrupulous miners could tarnish Namibia's reputation as a responsible uranium supplier. All involved parties felt that the Erongo region did not have the infrastructure and social services to accommodate a massive influx of job seekers. The SEA was undertaken in 2009-2010 to address these concerns, provide vision and generate a culture of collaboration among the mining industry, government, and the public. As part of the SEA process a Strategic Environmental Management Plan (SEMP) was developed based on issues raised by stakeholders during consultation meetings.[1]

Figure 2: Environmental Quality Objectives of the SEMP Operational Plan

The SEA concluded that the uranium rush presented significant opportunities for Namibia in terms of growth and development. The benefits would however come at a price because the uranium deposits are partly located in a proclaimed national park and one of the most popular tourist hotspots in the country. Unless it was well managed and the necessary safeguards put in place, the uranium rush would negatively affect the environment and tourism on which livelihoods depend. To enhance the benefits and overcome these major challenges and constraints all tiers of government, the mining companies and civil society (to a lesser extent) must successfully implement the necessary measures outlined in the SEA and SEMP. The desired outcome of the SEMP is that the utilization of

[1] MME (2010): Strategic Environmental Assessment for the Central Namib Uranium Rush. Ministry of Mines and Energy, Republic of Namibia, Windhoek

Namibia´s uranium resources significantly contributes to the goal of sustainable development for the Erongo region and Namibia as a whole.

The SEMP is an over-arching framework to address the cumulative impacts of existing and potential new developments, within which individual projects have to be planned and implemented. It consists of twelve Environmental Quality Objectives (EQOs), measuring the positive and negative impact of uranium mining on the Erongo region (Figure 2). Each EQO articulates specific aims, sets standards and elaborates on key indicators that need to be monitored.

Implementation of the SEMP is guided by a steering committee that is chaired by the Geological Survey of Namibia (GSN) at the Ministry of Mines and Energy (MME). Members include the Department of Water Affairs (DWAF) in the Ministry of Agriculture, Water and Forestry (MAWF), the Ministry of Health and Social Services (MHSS), which includes the National Radiation Protection Authority (NPRA), the Ministry of Environment and Tourism (MET), the Gobabeb Research and Training Centre's Namib Ecological Restoration and Monitoring Unit (NERMU) and the Namibian Uranium Association (NUA).

Figure 3: Diagram of SEMP Stakeholders

The SEMP Office housed at the Geological Survey of Namibia (GSN) coordinates regular monitoring and sampling and ensures that data on environmental performance indicators are collected. This involves consultation with the government and non-government organisations shown in Figure 3.

The SEMP Office prepares annual SEMP reports in co-operation with NERMU and NUA. These reports are published on the MME/GSN website which is accessible to stakeholders and the public. The annual SEMP reports consist of a set of matrices, in which the desired outcomes, targets and indicators spread across the 12 EQOs are assessed. Each indicator is evaluated and a four-tiered colour-coding system is used to indicate whether it has been "exceeded", "met", "not met" or whether actions to meet the target were still "in progress" or the indicator was "not applicable", e.g. because the pertinent activity did not take place in 2016.

URANIUM MINING SCENARIO IN 2016

Kazakhstan and Canada are still the world's top uranium producers, while Namibia's contribution to the global uranium production has declined from 8% to 6% during the last few years (Figure 4) [2] due to Rössing Uranium's cut-back in production. Namibia is expected to join the ranks of the major producers when Swakop Uranium's Husab Mine reaches nameplate capacity.[3]

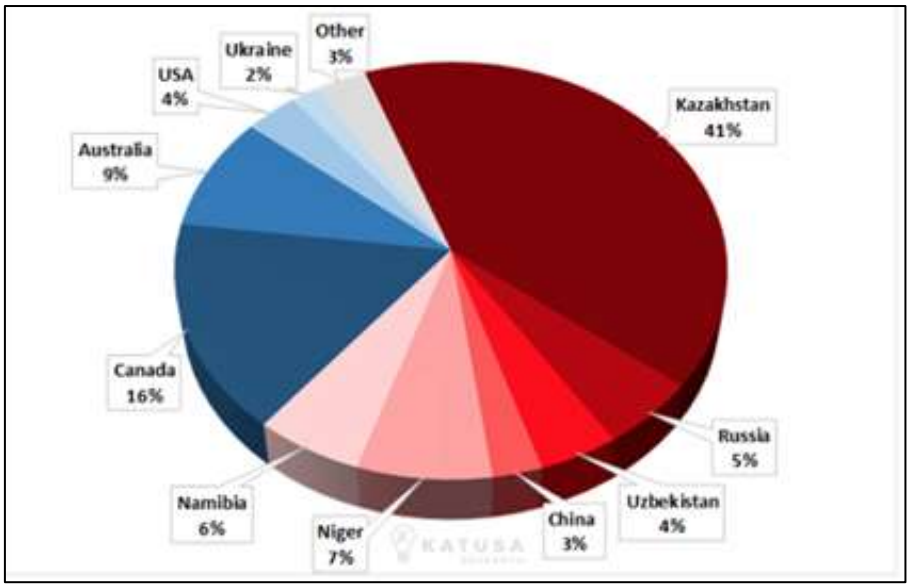

Figure 4: World Uranium Producers

The global market was characterised by a significant over-supply of uranium and low demand from utilities that saw no need to further augment their existing stockpiles. According to Index Mundi (www.indexmundi.com/commodities) the uranium spot price dropped from US$34.6 per pound of uranium trioxide (U_3O_8) in January 2016 to US$18.5 per pound in November 2016 before recovering to US$25.3 per pound in February 2017 (Figure 5). [4] The cyclical nature of commodity markets implies that an upturn can be expected sooner or later. A spot price of at least US$60-70 per pound would however be required for the profitability of many Namibian projects that are currently at the exploration or development stage.

[2] https://static.seekingalpha.com/uploads/2017/8/2/27369723-15016635781010115.png
[3] Namibian Uranium Association Annual Report 2014
[4] www.indexmundi.com/commodities

Despite the low demand and depressed commodity prices, the Namibian uranium mining sector registered a strong growth in real value added of 13.6 percent in 2016, compared to a decline of 18.1 percent recorded in 2015. This performance was attributed to an increase in the production volume of uranium (NSA Preliminary Annual National Accounts 2016).

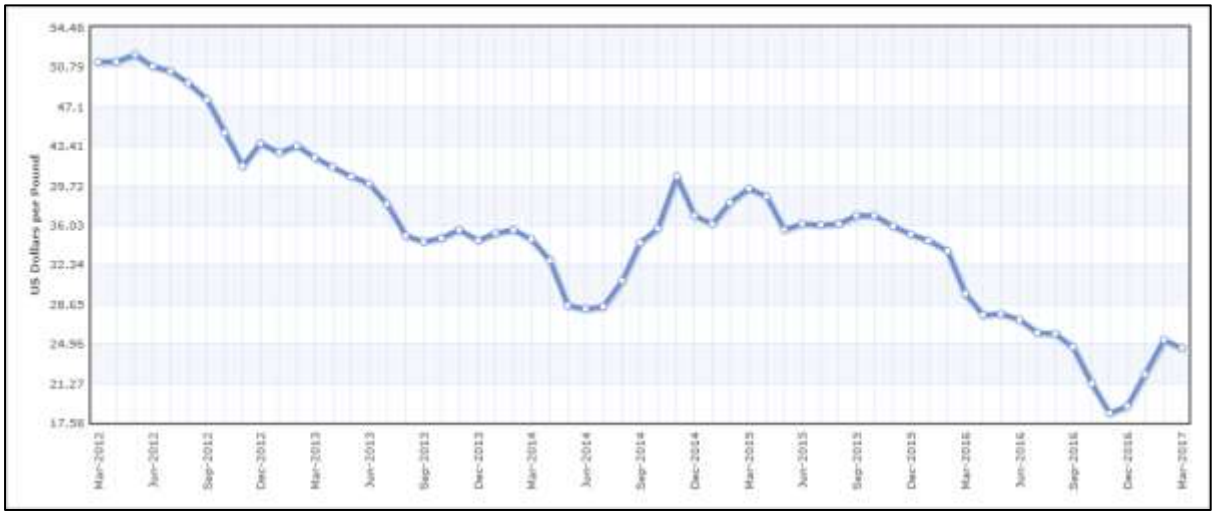

Figure 5: U_3O_8 Spot Price 2012-2016

With Husab mine entering the production phase in December 2016 Namibia now hosts three operating mines, while six projects are at various stages of development (Table 1). Figure 6 shows the location of mines and exploration areas, while the following paragraphs give short summaries of each company's activities.[5]

Table 1: List of Uranium Mines and Projects

Full company name	Parent company	Mine site name(s)
Langer Heinrich Uranium (Pty) Limited	Paladin (Australia)	Langer Heinrich
Rössing Uranium (Pty) Limited	Rio Tinto (UK)	Rössing
Swakop Uranium (Pty) Limited	Taurus Minerals (China)	Husab
AREVA Resources Namibia	AREVA (France)	Trekkopje
Bannerman Mining Resources Namibia (Pty) Limited	Bannerman (Australia)	Etango, Ondjamba, Hyena
Marenica Energy Namibia (Pty) Limited	Marenica (Australia)	Marenica
Reptile Mineral Resources and Exploration (Pty) Limited	Deep Yellow (Australia)	INCA, Omahola, Shiyela, Tubas
Valencia Uranium (Pty) Limited	Forsys Metals (Canada)	Norasa
Zhonghe Resources (Namibia) Development (Pty) Limited	China Uranium Corporation (China)	Zhonghe

AREVA Resources Namibia carried out its care and maintenance programme at Trekkopje mine as scheduled and concluded its metallurgical research programme, which explored ways of pre-

[5] Based on Chamber of Mines Annual Review for 2016

concentrating the ore by discarding most of the waste material. Investigated options such as finer crushing, scrubbing or flotation were found to be technically feasible. An optimized process was developed that enhances the permeability of the heap by adding cement at the agglomeration stage and recovers a substantial part of the reagents through membrane technology.

AREVA's desalination plant enabled NamWater to meet the demand of other uranium mines, which was especially important during the commissioning of Husab Mine towards the end of 2016.

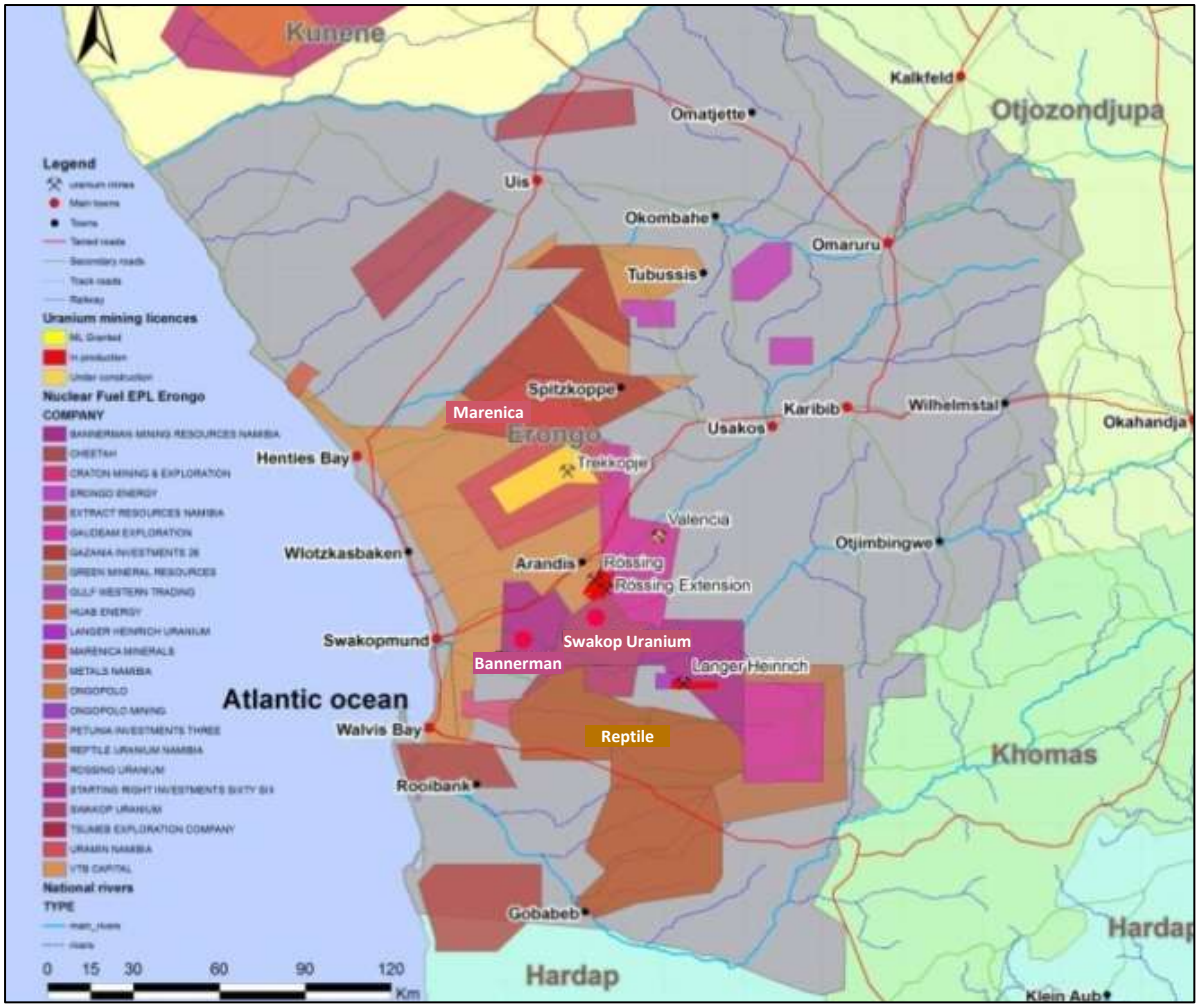

Figure 6: Nuclear Fuel Mining Licence and Exploration Areas in the Erongo region[6]

Bannerman Mining Resources (Namibia) successfully completed the 6-phased metallurgical programme at its Heap Leach Demonstration Plant significantly elevating the attractiveness of the Etango Project. Results have consistently exceeded key metallurgical assumptions and demonstrated opportunities for further cost reduction.

Langer Heinrich Uranium's main focus for the year was to achieve budget production with a strong focus on cost and efficiency control. This was especially targeted due to LHU's exposure to the continued low uranium spot price environment. Another major focus was to improve safety standards on the mine. In August 2016, LHU applied to the Minister of Mines and Energy to cease mining and implement a mining curtailment strategy. The strategy would see LHU feed the process plant from the medium grade stockpiles for up to two years and significantly reduce mining costs. At the end of

[6] Geological Survey of Namibia, 2014, modified

October 2016 the mine received approval from the Minister of Mines and Energy and proceeded with its mining curtailment strategy. Work continued on the design and construction of TSF5 as TSF3 would reach its design capacity by the end of June 2017.

Marenica Energy Namibia was granted a mineral deposit retention licence for its EPL in November 2016 to await an increased uranium price. In the meantime metallurgical test work continued on third party resources to widen application of the company's proprietary processing technology. The company is exploring opportunities to apply its process to third party resources in Namibia.

Reptile Mineral Resources and Exploration's activities included geological mapping at the Omahola, Tumas and Tubas Sand projects, ground geophysical surveys, as well as a depth-to-basement study of the Tumas/Tubas channel using remote sensing data and new modelling techniques. A bulk sample for metallurgical testing was taken from the Tumas area.

Rössing Uranium celebrated its fortieth year of production in 2016. This was also the first full year of continuous operations following two years of curtailed production. Considerable success was achieved in removing bottlenecks and improving mining efficiencies, which resulted in increased mill throughput and a 48% rise in uranium production to 1 850 tonnes, enabling the company to declare a small profit for the year 2016.

Swakop Uranium started commissioning the processing plant at its Husab Mine and produced the first drums of uranium oxide in December 2016. Overburden stripping had started in 2014 to expose the uranium-bearing ore ready for the start of processing operations and since then over 6 million tonnes of ore have been moved. Commissioning of the plant is continuing during 2017 with the aim of optimizing the throughput and progressively ramping up towards the nameplate production.

Valencia Uranium concentrated on a placement to ensure project funding for the future, coupled with cost-cutting measures. The NI 43-101 compliant uranium reserves for the expanded Norasa uranium operation area consisting of the Valencia and Namibplaas projects were updated in 2016.

Zhonghe Resources Namibia worked on the evaluation of potential resources and an economic reassessment for mining development. They implemented a supplementary exploration programme consisting of geological and ground geophysical section surveys covering 28.1 kilometres. Zhonghe Resources also paid attention to the progress of other uranium projects in Namibia to identify cooperation opportunities with other uranium mining companies.

In January 2017, the Minister of Mines and Energy lifted the moratorium on new exclusive prospecting licences for nuclear fuels that had been in place since 2007, and a few months later MME had already received more than 40 applications for new nuclear fuel EPLs.

EVALUATION OF THE ENVIRONMENTAL QUALITY OBJECTIVES

EQO 1.Socio-Economic Development

Aims of this EQO: Uranium mining improves Namibia´s and the Erongo region's sustainable socio-economic development and outlook without undermining the growth potential of other sectors.

Mining plays a vital role in the Namibian economy. In 2016, the mining sector made a direct contribution of 11.1% to the GDP of the country, compared to 11.4% in the previous year; though the contribution from uranium mining was only 1% of GDP.[7] This was mostly due to the low demand for uranium on the world market where the spot price dropped below US$20 per pound (Figure 5). Countries that are rich in natural resources such as minerals and oil are often overly reliant on mining and fail to develop secondary and tertiary industries that will sustain the economy when the primary resources run out. The term "natural resource curse" is often used to describe a situation where a government does not reinvest the income it reaps from its resources in socioeconomic development that benefits the entire population.[8] This can lead to disappointing economic growth performance compared to countries with more diversified industries and a strong agricultural sector. Namibia is susceptible to the "natural resource curse" if the income from its mining industry is not well managed. It is therefore the objective of EQO1 to ensure that the uranium industry contributes its fair share to the socio-economic development of the Erongo region and Namibia as a whole.

Four indicators are used to measure the contribution of the mining sector to the socioeconomic development of the country, the first two being the amount of fiscal revenue generated through royalties and corporate taxes paid by the mines. The third indicator assesses whether companies procure goods and services within Namibia, thus contributing to the overall industrialization of the country, while the fourth one states that uranium processing companies should not be granted EPZ status because this would reduce the state's tax income.

Another indicator that could have been considered relates to the income earned by local beneficiation of raw materials, an opportunity that the Namibian government wants to promote. The Chamber of Mines has carried out a study that identified beneficiation options for several metals and minerals. Uranium can however only be processed at a few facilities around the world due to the complexity and cost of the uranium enrichment and nuclear fuel production technology.

Desired Outcome 1.1.	**Income and economic opportunities from uranium mining are optimized.**			
Target 1.1.1.	**Contribution of mining to the economy increases over time.**			
Indicator 1.1.1.1.	**Royalties are paid in full by mining companies.**			
Data Source	**SEMP Office/MoF/NUA**			
Status:			**MET**	

[7] National Statistics Agency, Preliminary Annual National Accounts 2016

[8] McMahon, G.J. & Moreira, S. (2014): The Contribution of the Mining Sector to Socioeconomic and Human Development, Extractive Industries for Development Series, no. 30, World Bank Group

Mining royalties are levied as a percentage of the export value of the commodity that a mine produces, in this case uranium. Royalties are due when the product is sold, which means that revenue to the state is still generated even if a mining company does not make a taxable profit. The two operating mines, Rössing and Langer Heinrich, paid significantly higher royalties in 2016 as shown in Table 2 in comparison to the previous four years. Langer Heinrich reported that the royalty payments were affected by the uranium spot price and lower production in 2016 following on from the mining curtailment plan, while the impact of the Rand/US$ exchange rate had a large positive effect on the amount due in terms of Namibian Dollars.

Table 2: Royalties Paid by Uranium Mining Companies

Company	2016 (N$)	2015 (N$)	2014 (N$)	2013 (N$)	2012 (N$)
Langer Heinrich	80,421,594	60,696,272	65,175,939	56,277,197	53,990,032
Rössing Uranium	80,352,444	54,312,447	56,828,000	85,240,000	110,183,000

Motivation of status: The indicator was therefore **MET** because operating mines paid royalties**.** The indicator is not applicable to exploration companies or mines that were not yet in operation (e.g. Swakop Uranium).

Indicator 1.1.1.2.	**Corporate taxes are paid in full by mines.**			
Data Source	**SEMP Office/MoF/NUA**			
Status:			**MET**	

Companies are only required to pay corporate taxes when their profits offset the tax losses. In 2016, Langer Heinrich Uranium and Rössing Uranium remained in a tax loss position (Table 3). Rössing Uranium made some profit, but the company explained that this profit was offset against the accumulated tax loss.

Table 3: Corporate Taxes Paid by Uranium Mining Companies

Company	2016 (N$)	2015 (N$)	2014 (N$)	2013 (N$)	2012 (N$)
Langer Heinrich	Nil	Nil	Nil	Nil	Nil
Rössing Uranium	Nil	Nil	74,170,000	Nil	Nil

Motivation of status: No corporate taxes were due in 2016, the indicator was **MET.**

Indicator 1.1.1.1.	**Increasingly, inputs that can be sourced locally are not imported.**			
Data Source	**NUA**			
Status:			**MET**	

The indicator to be measured here is the percentage of total procurement spent locally within Namibia. Table 4 provides figures for the last four years to see whether local procurement has been

increasing over time. Langer Heinrich maintained a high level (84-85%) of local purchasing since 2015, while Rössing Uranium remained on an increasing trend, reaching 77% in 2016.

Table 4: Percentage of Local Procurement of Goods and Services by Operating Uranium Mines

	Local procurement of goods and services as % of total procurement			
Company	**2016**	**2015**	**2014**	**2013**
Langer Heinrich	84%	85%	71%	78%
Rössing Uranium	77%	73%	68%	64%

Figures for exploration companies and mines under development are not included in Table 4 because the indicator only applies to operating mines. It should however be mentioned that the local procurement percentages for AREVA, Bannerman, Reptile and Valencia reached up to 96% in 2016. The total value of procurement that Swakop Uranium awarded to Namibian owned and registered companies was 48.9% of the total awarded value.[9] This presumably refers to procurement during the construction period of Husab Mine, not to a specific year.

Motivation of status: The indicator was **MET** because a high level of local procurement was evident for Langer Heinrich and Rössing Uranium.

Indicator 1.1.1.2.	**Processing companies connected to uranium mines are not granted EPZ status.**			
Data Source	**SEMP Office**			
Status:			**MET**	

As far as could be established no mining-related companies were granted EPZ status in 2016 and neither did any existing uranium-processing companies have EPZ status.

Motivation of status: The indicator was **MET** because no processing companies associated with uranium mining were granted EPZ status.

[9] Article in The Namibian 3 August 2016 citing Zheng KePing, CEO of Swakop Uranium, www.namibian.com.na

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Summary of performance: EQO 1

Total no. indicators assessed 4				
	NOT MET	**IN PROGRESS**	**MET**	**EXCEEDED**
Number of indicators in class	0	0	4	0
Percent of indicators in class	0%	0%	100%	0%

Overall performance: Indicators of socioeconomic development are related to the payment of royalties and taxes, local procurement and EPZ status for processing companies. As in previous years they were all **MET** in 2016.

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EQO 2.Employment

Aims of this EQO: Promote local employment and integration of society.

EQO2 refers to local employment and integration of society. The latter part comes from the original SEMP operational table where the aim of housing mine employees in existing towns that was later moved to EQO 3, was included under EQO 2. Uranium mining companies are expected to employ Namibian citizens, preferably people residing in the vicinity of the mine (locals), and to adhere to the requirements of the Affirmative Action (Employment) Act.

Namibia has put in place a number of policy measures and programmes to encourage local and foreign investment. The government's policy is aimed at the promotion of growth, increasing employment and alleviating poverty, as well as reducing the unequal distribution of income. The government has also taken measures to create employment and address labour market inequalities. Among the policy measures in place is the Affirmative Action (Employment) Act No. 29 of 1998 that aims to enhance participation and integration of previous disadvantaged groups of the society in the labour market and to promote equal opportunities in employment.

Despite all efforts, the unemployment rate increased from 28% in 2014 to 34% in 2016[10] and this remains a grave concern. The majority of employed Namibians (30%) work in the agricultural sector, which suffered from low productivity due to drought in the last three years. In 2016, the mining industry provided jobs to 9574 permanent and 669 temporary employees, as well as approximately 5400 employees of subcontracting firms[11]. Jobs in mining only accounted for 1.5% of the total workforce, but mine employees are generally better paid than those in other sectors and their purchasing power makes a sizeable contribution to the economy. The multiplier effect in service industries is estimated to support over 110 000 additional jobs according to the Namibian Chamber of Mines.

Desired Outcome 2.1.	**Mainly locals are employed.**			
Target 2.1.1.	**Uranium companies hire locally where possible.**			
Indicator 2.1.1.1.	**During operational phase all mining companies to comply with their employment equity target (certificate).**			
Data Source	**SEMP Office/EEC/NUA**			
Status:			**MET**	

The two operational mines, Langer Heinrich and Rössing, complied with the provisions of the Affirmative Action (Employment) Act and met their employment equity targets. Langer Heinrich Uranium employs 95% Namibians and has received an AA compliance certificate for the reporting period 1 July 2015-30 June 2016. At the time of writing, the AA report for the period 1 July 2016-30 June 2017 was awaiting approval. The company had to retrench 30 employees when mining was curtailed due to low uranium prices. None of the other companies reported retrenchments for 2016.

[10] National Statistics Agency (2017): Namibia Labour Force Survey 2016, nsa.org.na
[11] Chamber of Mines of Namibia (2017): Annual Review 2016

Rössing Uranium reported that 98.4% of their employees were Namibians and they had received an AA compliance certificate. Swakop Uranium did not supply information to the NUA, but stated in the CoM Annual Review 2016 that they have an approved affirmative action plan. Swakop Uranium's vice president for human resources and business support, Percy McCallum, said in a presentation at the Arandis Investment Conference on 10 November 2017 that the percentage of Namibians working on the Husab mine was currently 95%. AREVA Namibia employed 35 people in 2016 and complied with the provisions of the Affirmative Action (Employment) Act. Companies with fewer than 25 employees, such as Bannerman, Marenica, Reptile, Valencia and Zhonghe, do not need AA compliance certificates.

Another important aspect mentioned in the SEA report that was not taken up in the indicator, is the question whether contractor companies employed at uranium mines meet the employment equity target. In 2016, Rössing Uranium reported that 87.5% of their contractor companies complied with the provision of the Affirmative Action (Employment) Act, while 82.4% of Langer Heinrich's contractors were in compliance with the Act. Other companies either did not employ contractors or the contractors had fewer than 25 employees.

Motivation of status: Seeing that the two operating mines, Langer Heinrich and Rössing, complied with the provisions of the Affirmative Action (Employment) Act, met their employment equity targets and employed mostly compliant contractors, the indicator was rated as **MET**.

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Summary of performance: EQO 2

Total no. indicators assessed	1			
	NOT MET	**IN PROGRESS**	**MET**	**EXCEEDED**
Number of indicators in class	0	0	1	0
Percent of indicators in class	0%	0%	100%	0%

Overall performance: The only indicator of EQO 2 has always been **MET** because the majority of the permanent workers and contractors at uranium mines are Namibian citizens.

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EQO 3.Infrastructure

Aims of this EQO: Key infrastructure is adequate and well maintained, thus enabling economic development, public convenience and safety.

Poor infrastructure impedes a nation's economic growth and international competitiveness. Infrastructure has a bearing on a country's attractiveness to foreign investors and on its ability to compete with other countries. It ensures that people, goods and services can be moved in the most effective ways possible. Failure to invest in infrastructure means a failure to sustain and develop Namibia's social and economic wellbeing. Investment in infrastructure is an ongoing process as there are always changes in technology and the business environment. The growing economy drives new needs, while existing infrastructure has to be maintained, updated or replaced.

The aim of this EQO is to ensure that key infrastructure in the Erongo region is adequate to meet all users' requirements and well maintained, thus enabling economic development, public convenience and safety, whilst minimising environmental impacts. Amongst the relevant infrastructure developments are good housing, social services and amenities, water and electricity supply and an efficient and safe transportation system.

The 31 indicators of the infrastructure EQO examine each of these points, which are mostly in the public domain or concern linear infrastructure that public utilities use to supply water and electricity to mines. The topic of waste management mostly concerns landfill sites and recycling systems managed by urban centres, though it includes mine-specific indicators referring to the environmentally sound management of mineral waste too.

Desired Outcome 3.1.	**Existing, proclaimed towns are supported.**			
Target 3.1.1.	**Most employees are housed in proclaimed towns.**			
Indicator 3.1.1.1.	**Mines do not create mine-only townships or suburbs.**			
Status:			**MET**	
Indicator 3.1.1.2.	**There are no on-site hostels during the operational phase of a mine.**			
Data Source	**SEMP Office/NUA**			
Status:			**MET**	

All operating mines and exploration projects are housing or planning to house employees in proclaimed towns. They will not establish mine-only townships or suburbs or on-site hostels. Only Valencia plans to provide operational staff with accommodation near site while they are on-shift and then assist with transport to and from their homes during their off periods. No relocation of families will be required.

Motivation of status: Both these indicators are rated as **MET** because no operating mine has on-site accommodation or plans to establish mine-only townships.

Desired Outcome 3.2.	**Roads in Erongo are adequate for uranium mining and other traffic.**
Target 3.2.1.	**Roads are well maintained, traffic frequency is acceptable for tourism/ other road users and traffic is safe.**
Indicator 3.2.1.1.	**All key gravel roads are graded timeously to avoid deterioration.**
Data Source	**RA/NUA**
Status:	**IN PROGRESS**

The Roads Authority (RA) has followed its maintenance programme for key gravel roads, such as the M52, M44 and the M36 road from Walvis Bay into the Namib-Naukluft National Park (NNNP). Within the national park Bannerman Mining Resources grades the road along the Moon Landscape to the Welwitschia Drive every two months and once a year grades the entire road. Swakop Uranium has appointed a contractor to grade and wet the Welwitschia Drive in the NNNP from the turn-off to the Husab exploration campsite on an almost daily basis when it was the main access to the mine before the permanent access road was completed in March/April 2014 and while they were busy drilling in the EPLs in 2016. Since then the road maintenance has become a monthly activity. Generally, the volume of mine-related traffic in the park decreased significantly. A random sample of tourists confirmed that the roads in the Namib section of the park were mostly well maintained, but sections of the road further south towards the Naukluft Mountains and Sossusvlei were in very poor condition.[12]

Motivation of status: This indicator was **IN PROGRESS**. Even though most key gravel roads used by mining companies and tourists were graded timeously, there were some complaints about the condition of the Welwitschia Drive.

Indicator 3.2.1.2.	**Un-surfaced roads carrying >250 vehicles per day need to be tarred.**
Data Source	**RA**
Status:	**IN PROGRESS**

The RA confirmed that all gravel roads with traffic of more than 250 vehicles per day should be upgraded to bitumen standard, but because of insufficient funds not all such roads can be tarred immediately. To highlight the magnitude of the problem it was reported that the Road Fund Administration (RFA) collected road user charges of N$2.2 billion in the 2016/17 financial year and allocated N$1.92 billion of this amount to the road sector.[13] The expected revenue for the next five years is N$2.6 billion per year. Considering that, for instance, the new road between Windhoek and Okahandja is expected to cost N$1.3 billion[14], one can conceivably understand the slow pace of upgrades in other regions of the country.

[12] Pers. comm. Valereis Geldenhuys, NUA Farmers Working Group, November 2017
[13] Article in The Namibian of 15 November 2017 citing Ali Ipinge, CEO of RFA, www.namibian.com.na
[14] Article in New Era of 3 August 2017, www.newera.com

Most of the C28 road from Swakopmund to the Langer Heinrich mine turn-off has already been tarred, while the upgrading of the MR44 from Swakopmund to Walvis Bay east of the dunes has started and is planned for completion in 2018. There are also plans to tar the MR36 (C14) gravel road in future.

Motivation of status: Due to insufficient funds for road upgrading the Roads Authority has not yet been able to tar all roads carrying >250 v/d. Because plans are in place and progress has been made the indicator was rated **IN PROGRESS**.

Indicator 3.2.1.3.	**The B2 tar road is free of pot-holes and crumbling verges.**			
Data Source	**RA**			
Status:			**MET**	

The Roads Authority reported that the B2 tar road was free of potholes and crumbling verges and in reasonably good condition between Swakopmund and the Trekkopje turn-off. Towards Usakos, a short segment of the road T0202 (part of the B2) was deteriorating until the surface was re-sealed in 2015. Maintenance work on crumbling verges was carried out as and when required throughout the year 2016. Road users have however observed that the road has started deteriorating due to the traffic load, especially the high number of heavy vehicles. It will need a major upgrade and widening to accommodate the increased traffic in the next few years. The Roads Authority indicated that a project to upgrade the Karibib-Swakopmund road to two-plus-one lane was currently at the design stage.[15]

Motivation of status: The Roads Authority is continuously repairing potholes and crumbling verges on the B2 in the uranium province, resulting in this indicator being **MET**.

Indicator 3.2.1.4.	**Road markings and signage are in place and in good condition.**			
Data Source	**SEMP Office/RA**			
Status:		**IN PROGRESS**		

Many old, corroded road signs have already been replaced and the lines on the B2 road have been repainted, but the cat's eyes that were used in the past have not been replaced. This makes it difficult to see the road edges at night and in heavy fog, contributing to the hazards experienced on this road. The cat's eyes and the corroded direction signs in the vicinity of Swakopmund (Figure 7) should be replaced.[16]

Motivation of status: Signage along the roads was generally in place and in good condition, but cat's eyes and some direction signs still have to be replaced. The indicator was therefore rated **IN PROGRESS**.

[15] Article in The Namibian, 29 September 2016, www.namibian.com.na
[16] NUA 2017

Figure 7: Corroded Sign on B2 Road

Indicator 3.2.1.5.	**MR44 previously known as D1984 (Swakopmund to Walvis Bay east of dunes) is tarred.**			
Data Source	**SEMP Office/RA**			
Status:		**IN PROGRESS**		

Upgrading of the MR44 road to a dual carriageway and bitumen standard started in 2016 and is planned for completion in June 2019.[17]

Motivation of status: The indicator was rated **IN PROGRESS** because tarring of the MR44 started in 2016.

Indicator 3.2.1.6.	**90% of traffic on the B2 coastal road (Swakop-WB) is light vehicles.**			
Data Source	**SEMP Office/RA**			
Status:				

The recommendation in the SEA report from which this indicator was derived reads as follows: "*All heavy traffic (except local deliveries to Langstrand and the coastal developments between Swakopmund and Walvis Bay) must be directed onto the upgraded D1984*." This implies that the indicator will only be applicable once the MR44 road has been tarred, because only then can heavy vehicle traffic be banned from the coastal road.

Motivation of status: The indicator will be regarded as **NOT APPLICABLE** until the MR44 road has been tarred.

[17] Ministry of Works & Transport website

Indicator 3.2.1.7.	**Mining traffic on predominantly tourist roads meets agreed conditions.**
Data Source	**NUA**
Status:	**MET**

The 'agreed conditions' mentioned in this indicator are that 1) the traffic frequency is acceptable for tourists and other road users and 2) that traffic is safe. Some mines have constructed their own roads to avoid interference with tourist traffic. Swakop Uranium, for instance, reported that traffic was limited on NNNP roads within their mining licence and EPL areas to exploration activities and the relevant environmental monitoring and construction activities that were underway in 2016. All main traffic is directed via the permanent access road and unauthorised usage of the NNNP roads is not allowed. All personnel are inducted on the usage of these roads and security check points are in place to restrict access.

The last few years have seen a significant reduction in mining traffic on tourist roads, mostly due to the completion of Swakop Uranium's private road to Husab mine and the slowdown in uranium exploration activities. Access to Langer Heinrich mine is along a mostly tarred section of the C28 road in the Namib-Naukluft Park, while Reptile Mineral Resources and Exploration occasionally used tourist roads for exploration work in 2016.

Motivation of status: Seeing that the mine-related traffic frequency was acceptable and no safety incidents were reported it can be concluded that the agreed conditions have been **MET**.

Desired Outcome 3.3.	**Optimum use of rail infrastructure.**
Target 3.3.1.	**Most bulk goods are transported by rail.**
Indicator 3.3.1.1.	**80% of all bulk goods (all reagents and diesel) delivered to mines and associated industries, are transported by rail.**
Data Source	**NUA/Transnamib**
Status:	**MET**

The SEA report recommended that the construction of a new spur line from Rössing to Husab mine should be investigated, but did not suggest a railway line to Langer Heinrich. It states: *"The potential for rail-road and rail-pipe freight transport should also be investigated, especially to those mines lying close to the existing railways i.e. Trekkopje, Valencia and Rössing South from the main eastbound line, and Etango and Langer Heinrich from the north-south line behind the dunes. This would entail the construction of new sidings, shunting areas and rail-road or rail-pipe transfer facilities. … A cost-benefit analysis needs to be conducted to determine whether new railway links to the mines are desirable and/or feasible. Such lines would have to be privately built, owned and operated."*

Seeing that Langer Heinrich mine is actually quite far from the existing railway line it would clearly not be feasible to construct a new line or use a combination of rail and road or pipeline transport. The desired outcome "optimum use of rail infrastructure" should therefore include the proviso that

"a cost-benefit analysis is conducted to determine whether a new railway link is desirable and/or feasible." The indicator thus only refers to those operating mines that have railway access.

Rössing Uranium transported 87% of its bulk goods (sulphuric acid) by rail from Tsumeb and Walvis Bay. Some reagents that are used in smaller quantities were transported by road (Table 5). Having no rail connection Langer Heinrich and Swakop Uranium transported all their bulk goods by road.

Table 5: Transportation Mode of Bulk Goods to Mining Companies

Company	Tonnes by rail	Tonnes by road	% by rail
Langer Heinrich	0	101,279	0%
Rössing Uranium	258,283	39,429	87%
Swakop Uranium	0	70,950	0%

Motivation of status: The indicator was **MET** because 87% of Rössing Uranium's bulk goods were transported by rail in 2016.

Desired Outcome 3.4.	**Walvis Bay harbour is efficient and safe.**			
Target 3.4.1.	**The harbour authorities provide reliable, accessible and convenient loading, offloading and handling services.**			
Indicator 3.4.1.1.	**Average loading rate for containers is >25 containers per hour.**			
Status:		**IN PROGRESS**		
Indicator 3.4.1.2.	**Average waiting time for ships to obtain a berth is <12 hours.**			
				EXCEEDED
Indicator 3.4.1.3.	**No oil/chemicals/contaminants/sewerage spills enter the Ramsar site.**			
Data Source	**Namport**			
Status:			**MET**	

Walvis Bay, Namibia's largest port is progressively becoming a gateway to other countries in the southern African region. In order to deal with higher levels of throughput, NamPort has steadily improved its cargo-handling facilities such as cranes and reach stackers. The container terminal can accommodate ground slots for 3,875 containers and handle about 250,000 containers per annum.[18] NamPort is expanding the port with a new container terminal (Figure 8).[19] In 2016, the average

[18] NamPort website www.namport.com.na
[19] Google Earth with locality marker added by Namport

loading rate for containers was 24.7 moves per hour, which is close to the target of >25 containers per hour. There was no need for faster stacking because container traffic declined during 2016 due to the global and regional economic recession. The ensuing decline in marine traffic enabled NamPort to allocate berths to vessels without any waiting time. No oil, chemicals, contaminants or sewerage spills entered the Ramsar site (lagoon) in 2016. The port expansion now forms a catchment area for any oil spills originating from the port that will greatly assist in preventing pollution of the lagoon.[20]

Motivation of status: Indicator 3.4.1.1 remained **IN PROGRESS** because the container handling rate increased from 22 moves per hour in 2015 to 24.7 moves in 2016 and new container infrastructure is being built. Indicator 3.4.1.2 was **EXCEEDED** as there was no waiting time to obtain a berth. In the absence of any spills Indicator 3.4.1.3 was **MET**.

Figure 8: NamPort Expansion for Container Terminal

Desired Outcome 3.5.	**Electricity is available and reliable.**			
Target 3.5.1.	**The public do not suffer disruptions in electricity supply as a result of uranium mining.**			
Indicator 3.5.1.1.	**No disruptions in electricity supply as a result of mining.**			
Status:			**MET**	
Indicator 3.5.1.2.	**Industrial development is not delayed by electricity shortage.**			
Status:			**MET**	

[20] Pers. comm. Namport, 2017

Indicator 3.5.1.3.	No investment decision deferred because of electricity unavailability.			
Status:			MET	

The first three electricity supply indicators are discussed and assessed together. Namibian electricity consumption is strongly correlated to GDP growth. In an effort to address the increase in demand for electricity, and to complement the initiatives of NamPower, the Ministry of Mines and Energy is finalising the National Integrated Resource Plan, which is the electricity supply sector's development plan for the next 20 years. The plan spells out the electricity generation projects Namibia should pursue to be able to meet the growing demand for electricity in the country. MME is further engaged with the drafting of the Renewable Energy Policy, the Independent Power Producer Policy, and the National Energy Policy. These policies will shape the country's energy future as they are driven towards realising energy security in the country.

The four themes underpinning NamPower's 2014-2018 strategy are supported by specific strategic objectives, measures and initiatives set to guide NamPower towards fulfilling its goal of "ensuring that 100% of the peak demand and at least 75% of the electricity energy demand will be supplied from internal (Namibian) sources by 2018". This is in line with the 1998 White Paper on Energy Policy which is still the ruling expression of the Government policy on energy[21].

In 2016, NamPower was able to consistently meet the electricity needs of all sectors of the economy. Secure and uninterrupted power supply with a transmission availability 99.0% and generation plant availability 98.4% was achieved, which can be regarded as an exceptional transmission system reliability measured against best practice standards. The organization was able to contract power purchase agreements with Eskom to overcome the short-term supply deficit, while local power generation is fostered through the conclusion of 14 new power purchase agreements (PPA) with independent power producers (IPP) of 5 MW each in the renewable energy sector. Another 13 IPPs are expected to be fully operational during the 2017 financial year.

Another positive development was the upgrade of the power supply infrastructure in the Erongo region in the 2016/17 financial year. The West coast strengthening project entails a doubling of the existing 220 kilovolt (kV) ring from the Omburu substation to the Kuiseb substation to ensure a continuous power supply to the coast if the power flow along one line is interrupted. The new Lithops substation between Arandis and Husab mine forms part of the ring, serving as integration point for the 132 kV power line to the mine. In addition, the strengthening project increases the supply capacity to Walvis Bay to 80 MVA.[22]

Motivation of status: These three indicators were **MET** because there were no disruptions in electricity supply as a result of mining, industrial development was not delayed by electricity shortages and no investment decisions were deferred because of electricity unavailability. On the contrary, Husab mine was commissioned and the power-intensive Erongo seawater desalination plant operated without energy-related outages in 2016.

[21] NamPower (2016): NamPower Annual Report 30 June 2016, www.nampower.com.na.
[22] Article in The Namibian of 29 August 2016, www.namibian.com.na

Indicator 3.5.1.4.	Electricity quality of supply meets ECB standard.			
Status:			MET	

The Erongo regional electricity distributor known as Erongo RED is an institution tasked with the distribution and supply of electricity within the Erongo region. In 2016, Erongo RED had several planned and unplanned outages caused by the upgrade of the bulk power supply at Walvis Bay that was completed in 2017. The upgrade was necessary to prevent load shedding. NamPower partnered with Erongo RED to strengthen the supply infrastructure for the next 10 to 15 years. The project included the replacement of two 66 kV lines between the Kuiseb substation and Walvis Bay with two 132 kV lines; the upgrade of the Kuiseb substation and the construction of the new Paratus intake substation.

A similar upgrade to international standards is planned for Swakopmund where an interim upgrade has already been completed. However, due to the escalating demand for electricity, Swakopmund requires further upgrading. [23] Erongo RED confirmed that their electricity supply fully complies with Electricity Control Board (ECB) standards and safety standards.

Motivation of status: Based on the above information this indicator was **MET**.

Indicator 3.5.1.5.	Electricity provision does not compromise human health.			
Data Source	SEMP Office/NamPower/NUA			
Status:		IN PROGRESS		

NamPower has started to address the question whether or not electricity provision compromises human health. A baseline air quality study was conducted at Van Eck power station to determine the air quality status in the vicinity of the power station and to identify other contributing sources. The ambient monitoring was done using a dust sampler with pre-weighted filters and exposed over a period 24-hour at a time. Passive samplers were placed at eight sites around the power station to monitor for sulphur dioxide (SO_2) and oxides of nitrogen (NO_2). Ambient monitoring was deployed around the power station as part of this assessment. Two monitoring campaigns were run during September-October and November 2015. Although the power station only operated intermittently during these two sampling campaigns, the results provided some indication of the ambient air quality around Van Eck power station. The main findings were:

- The recommended evaluation criteria for daily PM10 and PM2.5 were exceeded on more than 4 days during the campaign, with elevated concentrations occurring when the power station was operational and when it was offline.
- Calculation of short-term SO_2 and NO_2 gas concentrations based on a one month sampling period suggested the potential for short-term exceedances of evaluation criteria. However, compliance with annual evaluation criteria was likely.
- A comparison between the PM10 and PM2.5 dust concentrations measured near Van Eck and the operational status of the power station showed that exceedances of the limit were

[23] Erongo RED Annual Report 2015/2016, www.erongored.com.na

not necessarily associated with the operation of the station, but likely contributions from other sources in the vicinity of the station, e.g. exhaust emissions from vehicle traffic.[24]

Based on these results it appears that more measurements will be needed to understand the portion contributed by the Van Eck power station, i.e. to better define the air quality impact of traffic while Van Eck is not in operation and determine the additional contribution when the power station is running. Mitigation methods should then be developed to ensure that concentration levels remain within the local or World Health Organization air quality standards.

Motivation of status: NamPower has started monitoring the air quality at Van Eck power station to find out if local electricity generation had an effect on human health. The indicator was rated **IN PROGRESS** because more studies are needed to reach a conclusion.

Indicator 3.5.1.6.	**Mines pursue renewable power supply options as far as possible.**			
Data Source	**NUA/NamPower**			
Status:			**MET**	

Renewable energy alternatives are gradually becoming more economic, especially if they are constructed to feed into the national supply network. During the year under review, NamPower supported the establishment of several solar power stations across the country and concluded power purchase agreements with the developers.[25] One of these solar projects is located west of Arandis, while another 5 MW photovoltaic power station is being constructed at Trekkopje mine in cooperation with AREVA Resources Namibia. It will be completed in 2017.

Some mining companies have investigated or applied renewable energy alternatives in 2016. For instance, Bannerman Mining Resources' Demonstration Plant operates partially on solar energy. When heap leach columns are in operation only solar energy is used, while cribs are operated with a silent diesel generator.

Langer Heinrich Uranium has appointed consultants to determine whether it is feasible to install photovoltaic cells for power generation during daylight hours and make use of the grid during the night. A range of options are currently being considered based on the completed pre-feasibility study.

Swakop Uranium has installed an on-site power station to capture waste heat from the acid plant, which is used to heat boilers and generate steam to turn turbines for electricity generation.

Motivation of status: Swakop Uranium has installed an on-site power station to generate power from the waste heat of the acid plant, a solar power plant is being constructed at Trekkopje mine and Langer Heinrich Uranium is investigating a PV system. This indicator was **MET** because renewable power supply options were pursued in 2016.

[24] NamPower Annual Report 2016
[25] NamPower 2016 annual report

Desired Outcome 3.6.	**Waste sites have adequate capacity.**
Target 3.6.1.	**All sewage, domestic and hazardous waste sites are properly designed and have sufficient capacity for the next 20 years, taking into account the expected volumes from mines and all associated industries.**
Indicator 3.6.1.1.	**Municipalities have sufficient capacity of sewage works and waste sites based on actual and predicted volumes of waste.**
Data Source	**Municipality of Walvis Bay and Swakopmund**
Status:	**MET**

The Walvis Bay Municipality reported that there is sufficient space for solid waste for more than 20 years.[26] The existing sewage treatment plant will be upgraded in 2017/18 to handle 11 000 m^3/day during the next five years. The EIA for the upgrade has already been completed. An additional plant for the airport, army base and industrial area with a capacity of 6 000-8 000 m^3/day is planned for the future. The design of this plant will make provision for the option of treating effluent water to potable standard to be added at a later stage.

The Swakopmund Municipality has constructed a new sewage treatment plant a few years ago to ensure sufficient capacity for the future. The new landfill site has enough space for at least 20 years.

Motivation of status: The indicator was **MET** because both municipalities confirmed that their landfills and sewage works have sufficient capacity based on actual and predicted waste volumes.

Indicator 3.6.1.2.	**Independent audits are undertaken for waste sites.**
Data Source	**Municipality of Walvis Bay and Swakopmund**
Status:	**MET**

In this indicator "independent audits" are defined to include government audits and inspections, as well as any other independent third-party audits, e.g. by consultants. Both municipalities reported that the office of the Auditor General, the Environmental Commissioner and the Ombudsman audited the solid waste disposal sites in 2016, while the Department of Water Affairs & Forestry of MAWF carried out the usual annual inspections of the sewage treatment plants. The required wastewater and effluent disposal permits were in place.[27]

Mining companies that have a product stewardship system or ISO 14001 certification also audit the waste sites they use. Rio Tinto, for instance, requires its operations to audit all waste disposal sites that the company uses, because a potential health and safety incident surrounding waste would cre-

[26] Information related to waste management at Swakopmund and Walvis Bay was provided by the Swakopmund Municipality and Walvis Bay Municipality, unless otherwise stated
[27] Swakopmund Municipality and Walvis Bay Municipality

ate a great legal risk and future liability. Rössing Uranium reported some shortcomings from their Walvis Bay hazardous waste site audit to the NUA, which subsequently resulted in a discussion among the mines about the establishment of a hazardous waste site for the industry.[28]

Motivation of status: For the first time since the inception of the SEMP report, independent audits or inspections were conducted in 2016 at the Walvis Bay and Swakopmund landfills and sewage plants. The indicator therefore changed from IN PROGRESS to **MET**.

Indicator 3.6.1.3.	**All new waste sites undergo an EIA prior to construction and receive a licence to operate.**			
Data Source	**Municipality of Walvis Bay and Swakopmund**			
Status:		**IN PROGRESS**		

An EIA for the upgrade of the Walvis Bay wastewater treatment plant has been completed. A recycling operator has carried out an EIA for a new recycling facility at Walvis Bay and obtained an environmental clearance certificate.

Regarding existing waste sites, Section 5 (3) of the Environmental Management Act states: "Where a waste disposal site already exists in terms of any law, the Minister may approve that site as a waste disposal site for the purpose of this section." The approval process involves preparing an environmental management plan (EMP) and obtaining an environmental clearance certificate (ECC) from MET. The ECC is regarded as a "licence to operate" in terms of this indicator. Both Swakopmund and Walvis Bay municipalities confirmed that they were compiling EMPs and hoping to obtain ECCs in 2017. Walvis Bay has already submitted a draft EMP and is busy implementing remedial actions that MET has requested, e.g. fencing of the landfill site.

Motivation of status: Since EIAs for new projects have been completed and licence applications for the existing landfills are under way the indicator has been rated **IN PROGRESS.**

Desired Outcome 3.7.	**Waste sites are properly managed.**			
Target 3.7.1.	**The management of waste sites meets national standards.**			
Indicator 3.7.1.1.	**Waste site managers are adequately trained (where managers have attended at least a one-week course in waste management at a reputable training institution).**			
Data Source	**Municipality of Walvis Bay and Swakopmund**			
Status:		**IN PROGRESS**		

The waste site managers at Swakopmund Municipality are qualified Environmental Health Practitioners, while the waste management contractor Envirofill is responsible for the training their per-

[28] NUA input to 2016 SEMP report, 2017

sonnel. At Walvis Bay Municipality, employees involved with wastewater treatment are trained as needed and overseen by a professional engineer. The solid waste foreman and inspector of hazardous waste have both been trained, but there may be a gap in training the contractor who is actually managing the solid waste site. Walvis Bay Municipality will look into this matter and make sure that training is included when new contracts are awarded.

Motivation of status: Municipal employees in charge of managing the waste sites are trained, but it was uncertain if contractors received adequate training. The outstanding verification of the contractor's training results in the indicator being **IN PROGRESS**.

Indicator 3.7.1.2.	**Site manifests which record non-hazardous wastes, volumes and origins are kept.**			
Data Source	**Municipality of Walvis Bay and Swakopmund**			
Status:		**IN PROGRESS**		

The Walvis Bay landfill site has a weighbridge where weight, origin and type of refuse entering the landfill site are recorded. The Swakopmund Municipality does not yet have a weighbridge, but is planning to build one as this is one of MET's requirements before an ECC can be issued. Currently only records of the number of waste trucks dumping at the landfill are kept, while the recycling operator reports the tonnage of recycled materials.

Motivation of status: This indicator was rated as **IN PROGRESS** because adequate records of non-hazardous waste were kept at Walvis Bay, while Swakopmund was planning to build a weighbridge to enable proper record-keeping.

Indicator 3.7.1.3.	**Only hazardous waste classes for which the sites are licensed are accepted.**			
Data Source	**Municipality of Walvis Bay and Swakopmund**			
Status:			**MET**	

As mentioned under indicator 3.6.1.3, licensing of the waste sites is still in progress. The hazardous waste facility operated by the Walvis Bay Municipality, which is the only one in the coastal area, has from the start only accepted those hazardous waste classes for which it expects to be licensed. Arrangements have to be made with the hazardous waste inspector before any incoming load is accepted. The Walvis Bay Municipality reported they treat all waste coming from mines as hazardous and keep manual manifests of the waste type, weight and origin.[29] The Swakopmund landfill site is not authorised for and does not accept hazardous waste.

Motivation of status: Only pre-approved hazardous waste in line with the expected licence conditions is accepted at the Walvis Bay hazardous waste site, the indicator was therefore **MET**.

[29] NUA members reported that it was sometimes difficult to obtain hazardous waste disposal certificates.

Indicator 3.7.1.4.	**Water and air quality monitoring data at waste disposal sites show no non-compliance readings.**			
Data Source	**Municipality of Walvis Bay and Swakopmund**			
Status:		**IN PROGRESS**		

Water quality monitoring at waste disposal sites will form part of the waste management EMPs once they are in place. The municipalities of Walvis Bay and Swakopmund reported that this issue has been mentioned in the 2016 audits and they were considering the establishment of monitoring boreholes or trenches. Waste burning is prohibited on both landfills, but Walvis Bay does operate a small incinerator for medical waste.

The air quality at both towns is now being monitored as part of the Ministry of Mines and Energy's advanced air quality study. Measured parameters include weather conditions, including inhalable dust (PM_{10}) and very fine particulates that result from burning ($PM_{2.5}$). The results are compared to the World Health Organization (WHO) Interim Target 3 that allows PM_{10} concentrations of up to 75 micrograms per cubic metre ($\mu g/m^3$) and $PM_{2.5}$ concentrations of up to 37.5 $\mu g/m^3$, which may both be exceeded only three times per year. More relevant standards that are specific to the Erongo region are currently being developed as part of GSN's advanced air quality study. This is necessary due to the local climate with generally high wind speeds experienced at the coast and occasional berg winds with sandstorms in winter. More information about the air quality study can be found under EQO 5 Air Quality.

The data obtained so far show that the readings for Swakopmund and Walvis Bay remained below the WHO limit for $PM_{2.5}$, while the PM_{10} dust levels exceeded the WHO limit more than three times (Figure 9). The study consultants found that the natural environment was the main source of the $PM_{2.5}$ and PM_{10} dust.[30] What is important for the assessment of this indicator is that the $PM_{2.5}$ data did not show excessive fine particle pollution from the burning of waste or other sources.

Water quality monitoring is probably less important because the low rainfall at the coast reduces the possibility that leachates will emanate from the landfills and affect the groundwater quality. The Swakopmund Municipality reported that they did not observe any leachates coming from the old landfill site while it was still in operation or afterwards. The impact of leachates, if any, on the water quality would be minimal because the receiving groundwater is saline[31]. At Walvis Bay there could however be hydrocarbon pollution of seawater if oil discharged on the landfill infiltrated down to the water table and reached the ocean. The first set of monitoring results should show if this is the case, provided that the samples are analysed for hydrocarbons.

Motivation of status: This indicator was rated **IN PROGRESS** because air quality monitoring is in place and water quality monitoring is expected to start once ECCs have been issued.

[30] Liebenberg-Enslin, H (2017): Advanced Air Quality Management for the Strategic Environmental Management Plan for the Uranium and Other Industries in the Erongo region: Ambient Air Quality Monitoring Report for the Period 1 November 2016 to 30 April 2017. Report No.: 16MME01-2 Public Report

[31] Christelis, G and W Struckmeier (2001): Groundwater in Namibia - An Explanation to the Hydrogeological Map. Department of Water Affairs, MAWF, Windhoek

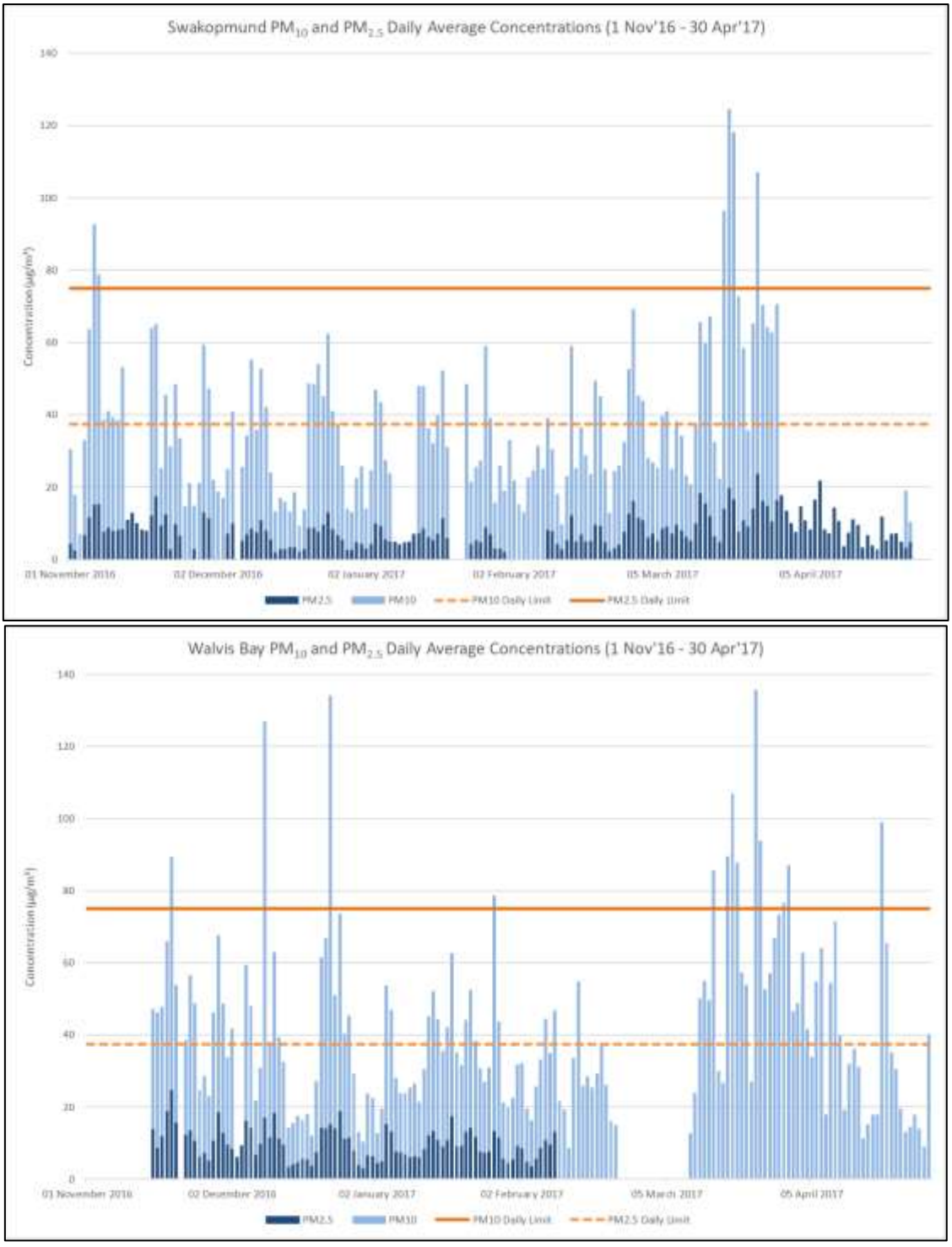

Figure 9: Swakopmund and Walvis Bay Air Quality Results 2016-17

Indicator 3.7.1.5.	**Municipal budgets are sufficient to comply with the site licence requirements relating to pollution control.**			
Data Source	**Municipality of Walvis Bay and Swakopmund**			
Status:		**IN PROGRESS**		

Both municipalities confirmed that they will receive sufficient funding to manage waste in accordance with their EMPs, once these are approved. In 2016, they only had effluent disposal permits; neither Swakopmund nor Walvis Bay had licences for their landfills.

Motivation of status: Seeing that effluent disposal permits were in place and endowed with sufficient funding, and that the application process for landfill ECCs had started the indicator was rated **IN PROGRESS**.

Target 3.7.2.	**The management of mines' mineral waste sites (tailings and waste rock facilities) meets national standards.**			
Indicator 3.7.2.1.	**Effluents from mineral waste sites are managed in compliance with DWAF industrial effluent exemption permit conditions.**			
Data Source	**DWAF**			
Status:			**MET**	

Mineral waste produced during mining consists of waste rock, which includes overburden and low-grade ore with a uranium content that is below the cut-off grade. The metallurgical process generates tailings, i.e. the leached ore that remains behind after the uranium has been removed. Mineral waste stays on the mine sites, either in form of waste rock dumps or as backfill material in pits or in a tailings storage facility.

The environmental impact of mine waste depends on its type and composition, which vary considerably with the commodity being mined, type of ore, and technologies used to process the ore. Every mine requires its own waste characterization, prediction, monitoring, control and treatment. The major environmental impacts from waste disposal at mine sites can be divided into two categories: the loss of land (and biodiversity) following its conversion to a waste storage area, and the introduction of sediment, acid and other process chemicals, as well as radioactive contaminants into surrounding surface and groundwater from water running over and/or seeping through chemically reactive wastes. These processes continue long after a mine has closed and have to be controlled. At most mines waste dumps and tailings storage facilities will remain as permanent features that need to be stabilised and integrated in the landscape.

Environmental management plans are designed to avoid or mitigate the environmental impacts resulting from the construction and operation of waste disposal facilities, as well as long-term liabilities after mine closure. They include measures to manage the impact of effluents on the ambient water quality and the control of radioactive emissions. Mines use standard operating procedures and plans to ensure that the waste disposal methodology complies with environmental regulations and good engineering practice, e.g. in terms of stability.

The application of these procedures is verified through inspections and audits (first, second and third party). Records of mineral waste volumes are kept and documented for reporting to the relevant authorities. Target 3.2.7 requires that the management of mines' mineral waste sites (tailings and waste rock facilities) meets the national standards. Four indicators cover the areas of concern and are assigned to the relevant authorities.

Indicator 3.7.2.1 is intended to ensure that mines manage effluents from mineral waste sites in compliance with DWAF effluent disposal exemption permit conditions. The purpose of the DWAF industrial effluent disposal exemption permit is to manage the impact of effluents from waste facilities on the ambient surface and groundwater quality. DWAF inspectors do not issue non-compliance reports, but write "letters of irregularities" if shortcomings are observed during mine inspections. No such letters were issued in 2016. [32]

Langer Heinrich Uranium reported that conditions are stipulated in the wastewater and effluent disposal exemption permit and were adhered to during this reporting period.

Rössing Uranium's permit does not prescribe mineral waste management activities. Compliance criteria in respect of slope stability of tailings storage facility and rock dumps are derived from site-specific conditions applying management processes prescribed by a specific Rio Tinto safety performance standard. Emission criteria are similarly derived from site-specific conditions applying air and water quality risk-based site-specific targets and Rio Tinto management processes. Rössing Uranium's permit requires that industrial effluents, including tailings solution, are recycled and that the groundwater quality at certain boreholes has to be monitored. The company complied with these permit conditions.

Motivation of status: The indicator was **MET** because operating mines complied with their permit conditions.

Indicator 3.7.2.2.	**Management of waste sites complies with NRPA regulations**			
Data Source	**NRPA**			
Status:			**MET**	

The National Radiation Protection Authority (NRPA) requires mines to implement a radiation management plan (RMP) to *inter alia* control radioactive emissions from mineral waste sites. Companies have to prepare annual reports on the implementation of the RMP. The Authority's inspectors review the annual reports and visit the mines to ensure that the RMPs are implemented in practice. The operating mines and projects submitted their annual reports in 2016 and the NRPA did not encounter any issues related to mineral waste management during their inspections.

Motivation of status: The indicator was **MET** because the NRPA did not issue any non-compliance reports related to the management of mineral waste sites in 2016.[33]

[32] Pers. comm. DWAF, 2017
[33] Pers. comm. NRPA, 2017

Indicator 3.7.2.3.	Management of waste sites complies with approved EMP			
Data Source	MET			
Status:			MET	

The Ministry of Environment and Tourism evaluates and approves environmental management plans including provisions for the mitigation of environmental impacts resulting from the construction and operation of waste disposal facilities, as well as long-term liabilities after mine closure. Currently, the Environmental Management Act does not have regulations that will enable MET to issue fines; hence none have been issued so far. MET uses a system of 1) compliance notifications as warnings to operations to allow them time to acquire an ECC or to remedy impacts following the environmental assessment process; and 2) compliance orders to stop operations for failure to comply with either a compliance notification or an EMP. With reference to SEMP, there were no compliance notifications in 2016.[34]

All operating mines and active exploration projects were covered by valid environmental clearance certificates and submitted the required biannual reports on the status of the environment. Langer Heinrich reported that a detailed approved EMP was in place and internal audits on the implementation of EMP commitments were carried out. An ISO 14001 audit was carried out to measure compliance with the commitments, standards and legal requirements that formed part of the audit programme, i.e. not the whole EMP was audited. Rössing Uranium also confirmed compliance with the MET-approved EMP. EMP and permit compliance checks form part of the ISO 14001 environmental management system auditing process at the operating mines.

Swakop Uranium maintains a detailed approved EMP with applicable procedures, which is in place for Husab Mine's activities. Internal compliance inspections and audits were carried out to measure compliance with the commitments, standards and legal requirements. The environmental management system was ISO 14001 certified from December 2016 for Mining. The mine is currently IMS certified (ISO14001:9001:OSHAS 18001) for Mining and Processing.

Motivation of status: The indicator was **MET** because the Ministry of Environment and Tourism did not issue any compliance orders to uranium mines in 2016.

Indicator 3.7.2.4.	Management of waste sites complies with approved closure plan			
Data Source	MME/MET			
Status:			MET	

High-level closure plans are usually included in mining companies' EMPs, which are reviewed and approved by the Ministry of Environment and Tourism. This is the case at Langer Heinrich mine whose EMP with closure commitments was submitted for the application of an environmental clearance certificate. In addition a Closure Management Plan exists, which is reviewed and updated periodically.

[34] Pers. comm. MET:DEA, 2017

Rössing Uranium has a Closure Management Plan with the following provisions for mineral waste facilities: The tailings storage facility will be capped with rock to prevent wind and water erosion, the waste rock dumps will be shaped to blend into the natural landscape and a fine-grained layer to prevent rainwater infiltration and promote vegetation growth will be applied at the end of waste rock deposition. This plan has been approved as part of the EMP for the mine.

Swakop Uranium has an approved EMP too, and will commence updating the mine closure plan in 2017. The EMP makes provision for the following closure measures:

- Disturbed areas other than those comprising the open pit and mineralised waste facilities will be returned to as close as practicable to their original state.
- Permanent visible features such as the mineralised waste facilities and related environmental bunds as well as safety bunds around the open pit will be left in a form that blends with the surrounds.
- Contamination beyond the mine site by wind, surface runoff or groundwater movement will be prevented through appropriate erosion resistant covers, containment bunds and drainage to the open pit.
- Linear infrastructure comprising roads, railways, pipelines, power lines, conveyors and related components will be removed and the disturbed land rehabilitated to blend with the surrounding natural environment.
- Socio-economic impacts (including the loss of employment) will be minimised through careful planning and preparation for closure beginning three to five years before closure takes place.
- The surface of the tailings storage facility (TSF) will require a specific capping in order to prevent post-closure dust emissions, water erosion and water ingress. Active seepage collection will be required so that the collected seepage can be directed to the open pit(s).
- Post-closure monitoring of TSF for seepage for an estimated 200-250 years.

Closure planning is a highly specialised field that involves modelling of the long-term behaviour of mineral waste facilities and evaluation of the risk that these facilities might pose to the environment. It is thus important that both mines and Government agencies employ experts in the compilation and review of mine closure plans.

Motivation of status: The indicator was **MET** because mines are managing their waste sites in compliance with approved closure plans. It should however be noted that the closure plans contained in EMPs approved by the Ministry of Environment and Tourism are high-level outlines that do not allow a critical review of the risks related to the long-term management of mineral waste facilities.

Desired Outcome 3.8.	**Recycling is common practice in the Central Namib**			
Target 3.8.1.	**A sustainable waste recycling system is operational in the Central Namib, servicing the uranium mines and the public**			
Indicator 3.8.1.1.	**A waste recycling depot is established**			
Data Source	**Municipality of Walvis Bay and Swakopmund**			
Status:			**MET**	

The Municipality of Swakopmund is working with a contractor who established a recycling facility in 2015. Orange waste bins for recyclable materials were distributed to households in many parts of town and are emptied regularly. The system will be rolled out to other areas together with an awareness campaign. The municipality has also registered recyclers who are working on the landfill, equipped them with personal protective equipment and is planning to assist them with marketing of the reclaimed materials. In addition, they have embarked on a Wards Cleaning Project, employing local people to clean public open spaces, which results additional volumes of recyclable materials being collected.

The Walvis Bay Municipality has entered into an agreement with a waste recycler who will establish a depot next to the landfill in 2017. They have 30 registered recyclers who specialise in certain waste types, some collecting wood, some metal, some glass; that are then weighed and sold to recycling companies. Recyclers report volumes of the various materials that they recover to the municipality. In the next few years, a PPP is planning to set up a thermochemical pyrolysis facility to generate 6 MW of electricity from unsorted household waste.[35] They have already obtained a generation licence from the Electricity Control Board and are conducting an EIA.

Mining companies also employ functioning waste management systems to reduce the volume of waste that would otherwise be taken to municipal landfills. For instance, Rössing Uranium uses a contractor to provide integrated waste management services. Minimising the volume of waste to landfill is not only eco-friendly but also reduces cost. It is essential that all recyclable material, e.g. waste oil, scrap metal, wood and paper is removed from the general waste stream at source. Langer Heinrich and Husab mines use similar systems, practising recycling as per approved EMP and procedure requirements. The recyclable materials are removed from site to the relevant recycling facilities or depots.[36]

Motivation of status: This indicator was **MET**, because sustainable waste recycling systems were in place at Swakopmund, Walvis Bay and the operating mines in 2016.

Indicator 3.8.1.2.	**Waste recycling operators have sufficient capacity to collect, transport and recycle waste in a safe and responsible manner.**			
Data Source	**Municipality of Walvis Bay and Swakopmund**			
Status:			**MET**	

As reported above both municipalities are using registered recyclers and recycling companies who have sufficient capacity to collect, transport and recycle waste in a safe and responsible manner. The waste recycling contractors employed at operating mines also provide the required capacity and safe handling.

Motivation of status: This indicator was rated as **MET** because waste recycling operators in the region had sufficient capacity to collect, transport and recycle waste in a safe and responsible manner in 2016.

[35] Pers. comm. Walvis Bay Municipality
[36] NUA input to 2016 SEMP Report

Indicator 3.8.1.3.	Volume of waste disposed to landfill per capita decreases.			
Data Source	Municipality of Walvis Bay and Swakopmund			
Status:		IN PROGRESS		

The Walvis Bay Municipality provided data from 2005/06 to 2015/16 (their financial year runs from July to June) that illustrate how waste volumes fluctuated in response to building and industrial activities. The percentage of waste recycled from the landfill varied between 2.2% and 4.7% with an average of 2.9%. This excludes recyclable materials picked up at source. To determine the mass of waste per capita census figures for 1991, 2001, 2011 and 2016 were used to interpolate the average population growth for each year. The actual (shown in **bold**) and estimated figures for the period 2005/06 to 2015/16 are listed in Table 6. The population of Walvis Bay doubled during this time, with accelerated growth between 2011 and 2016. Dividing the annual waste tonnage by the number of residents shows an impressive reduction in waste per capita from 1.0 t during the first 5 years to 0.6 t in 2015/16, i.e. a decrease by 40%.

Table 6: Walvis Bay Waste Per Capita

Year	Total waste (t)	Population	t per capita
2005/06	53669	52850	1.0
2006/07	61694	54700	1.1
2007/08	57854	56550	1.0
2008/09	58647	58400	1.0
2009/10	58208	60250	1.0
2010/11	55867	**62100**	0.9
2011/12	54729	69680	0.8
2012/13	53114	77260	0.7
2013/14	46697	84840	0.6
2014/15	64904	92420	0.7
2015/16	64616	**100000**	0.6

The Swakopmund Municipality indicated that the recycling facility that started operating in 2015 has resulted in reduced final disposal volumes. Actual figures that are kept by the waste management contractor were however not made available.

Motivation of status: Recycling has reduced the waste-to-landfill volumes per capita for Walvis Bay by 40%. The indicator could have been met, if the Swakopmund Municipality had provided the annual waste volumes. Seeing that this information may be added in the next report, the indicator was rated **IN PROGRESS**.

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Summary of performance: EQO 3

Total no. indicators assessed: 33 (1 was **NOT APPLICABLE**)

	NOT MET	IN PROGRESS	MET	EXCEEDED
Number of indicators in class	0	12	20	1
Percent of indicators in class	0%	36%	61%	3%

Overall performance: The infrastructure EQO covers housing, transportation including roads, railways and harbour, electricity supply and renewable energy, as well as waste management and recycling. The two housing indicators continued to be **MET** because mining companies do not intend to establish on-site hostels or mine-only townships. Four indicators referring to road condition and maintenance were **IN PROGRESS**, while two were **MET**. The indicator for the reduction of heavy traffic on the B2 between Swakopmund and Walvis Bay was **NOT APPLICABLE**. As in the 2015 report, the indicator of rail use for bulk goods was **MET**, while Namport's three efficiency indicators were **EXCEEDED, MET** and **IN PROGRESS**, respectively. The indicators concerning the quantity and quality of electricity supply to the region and the implementation of renewable energy projects at mines were mostly **MET**, only the indicator on the health impact of local electricity generation was **IN PROGRESS**. Eight waste management indicators were **MET** and eight were **IN PROGRESS**. Among these, all four indicators that check the mines' compliance with regulatory requirements for the management of mineral waste were **MET**.

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EQO 4.Water

Aims of this EQO: To ensure that the public have the same or better access to water in future as they have currently, and that the integrity of all aquifers remains consistent with the existing natural and operational conditions (baseline). This requires that both the quantity and quality of groundwater are not adversely affected by prospecting and mining activities.

Underground water plays an important role in the sustainable development of the country. This resource is utilized in towns and communal areas, in industries, mining and agriculture, and is an integral part of a functioning ecosystem. Namibia relies much on runoff from rainfall that is either caught in dams or flows along ephemeral rivers and infiltrates into the ground to form aquifers. The Water EQO aims to assure the quality and quantity of water that is available to the public in the Erongo region. Key stakeholders in this EQO are the Department of Water Affair and Forestry (DWAF) of the Ministry of Agriculture, Water and Forestry (MAWF) as the regulator, NamWater as the bulk-supplier and distributor, and the towns and mining industry as major consumers.

Monitoring of groundwater in the Central Namib uranium province is undertaken with the aid of 15 boreholes along the Swakop and Khan rivers. In fulfilling the monitoring responsibility, DWAF carries out an annual borehole sampling campaign, while NamWater monitors the quality of potable water supplied to the coastal towns, mines and small consumers. Data for this EQO were supplied by NamWater and by a consulting company on behalf of GSN and DWAF, while the mining industry contributed water level data for the Swakop and Khan rivers.

Desired Outcome 4.1.	**Water for urban and rural communities is of acceptable quality.**
Target 4.1.1.	**Uranium mining does not compromise community access to water of appropriate quality:** • **Urban users** • **Rural communities supplied by DWSSC** • **Commercial farmers (own supplier)** • **Lower Swakop River smallholdings**
Indicator 4.1.1.1.	**Aesthetic/physical, inorganic, radionuclide and bacteriological determinants conform to minimum required quality as prescribed in the national water quality standards.**
Data Source	**DWAF**
	MET

The monitoring scope as defined in this target includes water supplied to urban users in Arandis, Henties Bay, Swakopmund and Walvis Bay, as well as commercial and communal farmers along the lower Khan and Swakop rivers, including the lower Swakop smallholdings. The Directorate of Water Supply and Sanitation Coordination (DWSSC) does not supply rural communities from these rivers.

Water quality monitoring involves the analysis of physical parameters, major anions and cations, trace elements and radionuclides, depending on expertise and finances available in the monitoring institution. The first two indicators of this EQO focus on the quality of water that is supplied to ur-

ban users, communal and commercial farmers. To find out if the desired outcome of acceptable water quality was achieved NamWater supplied the results of drinking water analyses carried out at their laboratory in Windhoek, which were then compared to the Namibian Guideline Values in Appendix 1.

Chemical Analyses of Drinking Water

NamWater provided the results of chemical analyses and bacteriological tests of tap water samples taken at Henties Bay, Swakopmund and Walvis Bay in 2016, which are presented in the following tables. The samples were analysed at the NamWater laboratory and results confirmed that the chemical quality of the water was of good (Group B) to excellent (Group A) and suitable for human consumption (the Namibian Water Quality Standards are shown in Table 37 in the Appendix).

Table 7: Chemical Analyses of the NamWater Supply to Swakopmund

Location Description	Reservoir	Reservoir	Reservoir	Reservoir	Reservoir	Reservoir	Reservoir	Reservoir	Reservoir	Reservoir	Reservoir	Reservoir	Reservoir	Reservoir
Date sample taken	27-Jan-16	16-Feb-16	23-Feb-16	14-Apr-16	19-Apr-16	23-May-16	7-Jun-16	18-Jul-16	25-Jul-16	2-Aug-16	29-Aug-16	14-Sep-16	26-Sep-16	8-Nov-16
pH	8.7	8.7	8.2	8.2	8.3	8.8	8.3	7.9	8.1	8.2	8.2	8.0	8.1	8.1
Turbidity in NTU	0.40	0.36	0.53	0.98	0.30	0.53	0.26	1.85	0.30	0.19	2.70	0.31	0.31	0.35
Conductivity mS/m	148.3	127.2	135.8	152.9	155.3	112.0	128.1	155.6	148.3	155.3	162.7	157.0	188.1	135.6
TDS calculated	994	852	910	1024	1041	750	858	1043	994	1041	1090	1052	1260	909
Na in mg/l	200	200	185	195	235	186	215	220	230	226	220	230	320	190
K in mg/l	8	6	8	12	11	6	7	9	9	9	10	10	12	9
Ca as CaCO3	110	65	137.5	185	122.5	35	27.5	135	100	82.5	112.5	112.5	87.5	105
Mg as CaCO3	37.5	29.2	50.0	79.2	45.8	20.8	16.7	54.2	45.8	37.5	50.0	54.2	66.7	54.2
SO4 in mg/l	42	22	49	97	63	9	25	62	45	44	68	64	53	55
NO3 as N in mg/l	<0.5	<0.5	<0.5	2.8	1.6	<0.5	1.2	1	0.8	1.3	2.2	2.1	1.1	<0.5
NO2 as N in mg/l	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
SiO2 in mg/l	7	3	10	20	13	<1	<1	12	7	8	13	12	6	9
F in mg/l	0.1	0.1	0.2	0.3	0.3	<0.1	<0.1	0.3	0.2	0.2	0.3	0.2	0.2	0.2
Cl in mg/l	350	310	315	310	375	305	330	380	365	350	350	385	490	280
Alkalinity as CaCO3	92	58	112	186	110	40	34	120	112	96	112	96	72	158
Fe in mg/l	-	0.02	-	<0.01	-	-	0.02	-	-	-	0.02	0.01	0.02	<0.01
Mn in mg/l	-	<0.01	-	<0.01	-	-	<0.01	-	-	-	<0.01	<0.01	<0.01	<0.01
Cu in mg/l	-	0.01	-	<0.01	-	-	0.02	-	-	-	0.02	0.01	0.01	<0.01
Zn in mg/l	-	<0.01	-	<0.01	-	-	0.01	-	-	-	0.03	0.01	0.01	0.01
Cd in mg/l	-	<0.01	-	<0.01	-	-	<0.01	-	-	-	0.01	0.01	<0.01	<0.01
Pb in mg/l	-	<0.02	-	0.02	-	-	0.03	-	-	-	<0.02	<0.02	<0.02	<0.02

Table 8: Chemical Analyses of the NamWater Supply to Walvis Bay

Sampling Point	Walvis Bay	Walvis Bay	Walvis Bay	Walvis Bay	Walvis Bay	Walvis Bay	Walvis Bay	Walvis Bay	Walvis Bay
Location Description	Mile 7	Mile 7	Mile 7	Mile 7	Mile 7	Mile 7	Mile 7	Mile 7	Mile 7
Date sample taken	16-Feb-16	12-Apr-16	6-Jun-16	20-Jun-16	20-Jun-16	21-Jun-16	22-Jun-16	12-Sep-16	21-Nov-16
pH	8.2	8.2	8.4	7.8	7.9	7.8	7.8	8.2	8.1
Turbidity in NTU	3.16	0.85	0.24	0.17	0.49	0.34	0.18	0.74	0.76
Conductivity mS/m	110.7	112.6	114.4	115.3	116.8	114.5	115.8	112.9	119.8
TDS Calculated	741.7	754.4	766.5	772.5	782.6	767.2	775.9	756.4	802.7
Na in mg/l	100	110	98	109	123	127	124	110	94
K in mg/l	11	14	15	14	14	14	14	14	14
Ca as CaCO3	197.5	182.5	202.5	205	177.5	182.5	182.5	195	225
Mg as CaCO3	116.7	112.5	125.0	129.2	112.5	112.5	112.5	116.7	129.2
SO4 in mg/l	138	145	161	162	146	142	143	164	153
NO3 as N in mg/l	3.5	4.2	3.7	5.3	6.8	6.1	6.2	5.3	2.8
NO2 as N in mg/l	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.1	<0.1
SiO2 in mg/l	28	31	27	29	30	30	30	31	31
F in mg/l	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Cl in mg/l	123	128	115	135	149	146	147	144	127
Alkalinity as CaCO3	240	232	228	224	216	242	222	202	226
Fe in mg/l	0.04	<0.01	0.01	<0.01	<0.01	<0.01	<0.01	0.01	<0.01
Mn in mg/l	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Cu in mg/l	<0.01	<0.01	0.02	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Zn in mg/l	<0.01	<0.01	0.02	0.01	0.01	0.01	0.02	0.01	0.01
Cd in mg/l	<0.01	<0.01	<0.01	0.01	0.02	0.01	0.01	<0.01	<0.01
Pb in mg/l	<0.02	0.02	<0.02	0.02	<0.02	<0.02	<0.02	<0.02	<0.02

The water supplied to Henties Bay, Swakopmund and Arandis (Table 7) from Omdel and the Erongo desalination plant was of good quality (Group B) for most of the physical and chemical parameters. The Kuiseb River groundwater that is supplied to Walvis Bay (Table 8) is slightly less saline than Omdel water. The water supplied from Omdel to Henties Bay was of good quality too (Table 9). In terms of heavy metals, the NamWater laboratory analyses iron (Fe), manganese (Mn), copper (Cu), zinc (Zn), cadmium (Cd) and lead (Pb), but does not have a method to determine uranium in water.[37] The metal concentrations were mostly at or below the detection limit of 0.01-0.02 mg/L.

Table 9: Chemical Analyses of the NamWater Supply to Henties Bay

Sampling Point Name	Henties Bay	Henties Bay	Henties Bay	Henties Bay
Date sample taken	16-Feb-16	13-Apr-16	13-Sep-16	2-Nov-16
pH	8.1	8.3	8.1	8.0
Turbidity in NTU	0.18	0.38	0.71	0.37
Conductivity mS/m	157.4	153.5	103.9	118.4
TDS Calculated	1055	1028	696	793
Na in mg/l	205	178	173	123
K in mg/l	8	11	7	7
Ca as CaCO3	175	190	105	133
Mg as CaCO3	87.5	100	58.3	70.8
SO4 in mg/l	68	64	61	53
NO3 as N in mg/l	2.2	3.8	4.1	2.1
NO2 as N in mg/l	0.1	<0.1	0.1	<0.1
SiO2 in mg/l	22	23	23	20
F in mg/l	0.6	0.5	0.7	0.6
Cl in mg/l	320	330	215	201
Alkalinity as CaCO3	178	178	144	142
Fe in mg/l	0.01	<0.01	0.01	<0.01
Mn in mg/l	<0.01	<0.01	<0.01	<0.01
Cu in mg/l	<0.01	<0.01	<0.01	0.01
Zn in mg/l	<0.01	<0.01	0.01	0.01
Cd in mg/l	<0.01	<0.01	0.01	<0.01
Pb in mg/l	<0.02	<0.02	<0.02	<0.02

Microbiological Analyses of Drinking Water

Microbiological testing of drinking water determines the three parameters heterotrophic plate count, coliform bacteria and faecal coliform bacteria. The heterotrophic plate count is an analytical method used to measure the variety of bacteria that are common in water. The concentration of bacteria shows whether the water system is well maintained. Increases in heterotrophic plate count are due to the re-growth of bacteria in tanks and plumbing, and do not necessarily indicate the existence of a health risk, if the entry water meets the microbial water quality norms and contamination from outside is prevented. To consider water as very safe for human consumption (Group A) the total plate count may not exceed 100 colony-forming units per millilitre (cfu/mL) and faecal coliforms such as *Escherichia coli* (*E. coli*) must be absent in 100 mL in 95% of the samples. A heterotrophic plate count exceeding 1000 cfu/mL results in a classification of Group C - water with a risk factor which requires rectification. The water supply system must then be disinfected with chlorine.

[37] The towns' drinking water is pumped from the Kuiseb and Omaruru rivers where there is no uranium mining, it is therefore not possible for uranium from the mines to enter the potable water supply.

Coliform bacteria are commonly found in the environment (e.g. soil or vegetation) and are generally harmless. If only total coliform bacteria are detected, the source is probably environmental rather than faecal. Faecal coliforms (more *E. coli*) indicate faecal pollution by warm-blooded animals or humans, which implies the potential presence of waterborne pathogens. The results of the examination of a single sample from a source are considered inadequate to evaluate the water quality. An evaluation should be based on the examination of a series of samples collected over a long period of time. If the guideline values are exceeded in one sample, a second sample should be taken from the same source as soon as possible.[38]

The results in Table 10, Table 11 and Table 12 show that the water supplied to the coastal towns was mostly very safe (Group A) or safe (Group B). The only exceptions were high heterotrophic plate counts at Swakopmund in November, accompanied by elevated coliforms and faecal coliforms, and at Walvis Bay on two occasions in June and November 2016, with some coliforms in the June sample. These cases, probably caused by insufficient disinfection of the water, were treated by increasing the chlorine dose and flushing the system. As of July 2016, NamWater increased the sampling frequency from once every two months to weekly for better health protection.

Table 10: Microbiological Analyses of the NamWater Supply to Swakopmund

Date	Town	Sample taken at:	Heterotrophic plate count	Coliforms	Faecal coliforms	Quality
16/02/2016	Swakopmund	Reservoir	13	Not detected	Not detected	A
14/04/2016	Swakopmund	Reservoir		Not detected	Not detected	A
07/06/2016	Swakopmund	Reservoir	3	Not detected	Not detected	A
13/07/2016	Swakopmund	Reservoir	4	Not detected	Not detected	A
18/07/2016	Swakopmund	Reservoir	5	Not detected	Not detected	A
25/07/2016	Swakopmund	Reservoir	1	Not detected	Not detected	A
01/08/2016	Swakopmund	Reservoir	20	Not detected	Not detected	A
08/08/2016	Swakopmund	Reservoir	Not detected	Not detected	Not detected	A
15/08/2016	Swakopmund	Reservoir	Not detected	Not detected	Not detected	A
22/08/2016	Swakopmund	Reservoir	4	Not detected	Not detected	A
05/09/2016	Swakopmund	Reservoir	Not detected	Not detected	Not detected	A
12/09/2016	Swakopmund	Reservoir	Not detected	Not detected	Not detected	A
14/09/2016	Swakopmund	Reservoir		Not detected	Not detected	A
19/09/2016	Swakopmund	Reservoir	1	Not detected	Not detected	A
28/09/2016	Swakopmund	Reservoir		Not detected	Not detected	A
03/10/2016	Swakopmund	Reservoir	1	Not detected	Not detected	A
10/10/2016	Swakopmund	Reservoir	2	Not detected	Not detected	A
17/10/2016	Swakopmund	Reservoir	Not detected	Not detected	Not detected	A
24/10/2016	Swakopmund	Reservoir	5	Not detected	Not detected	A
31/10/2016	Swakopmund	Reservoir	Not detected	Not detected	Not detected	A
07/11/2016	Swakopmund	Reservoir	1	Not detected	Not detected	A
14/11/2016	Swakopmund	Reservoir	4	Not detected	Not detected	A
21/11/2016	Swakopmund	Reservoir	4224	86	2	C
28/11/2016	Swakopmund	Reservoir	4	Not detected	Not detected	A
05/12/2016	Swakopmund	Reservoir	1	Not detected	Not detected	A
12/12/2016	Swakopmund	Reservoir	3	Not detected	Not detected	A
20/12/2016	Swakopmund	Reservoir	5	Not detected	Not detected	A

[38] Analytical Laboratory Services – Microbiological Analysis Report Form

Table 11: Microbiological Analyses of the NamWater Supply to Henties Bay

Date	Town	Sample taken at:	Heterotrophic plate count	Coliforms	Faecal coliforms	Quality
15/02/2016	Henties Bay	Reservoir	6	Not detected	Not detected	A
13/04/2016	Henties Bay	Reservoir		Not detected	Not detected	A
23/05/2016	Henties Bay	Tower Reservoir	23	Not detected	Not detected	A
25/07/2016	Henties Bay	Tower Reservoir	Not detected	Not detected	Not detected	A
30/08/2016	Henties Bay	Reservoir	3	Not detected	Not detected	A
13/09/2016	Henties Bay	Reservoir		Not detected	Not detected	A
27/09/2016	Henties Bay	Reservoir	320	Not detected	Not detected	B
02/11/2016	Henties Bay	Reservoir		Not detected	Not detected	A
21/11/2016	Henties Bay	Reservoir	13	Not detected	Not detected	A
12/12/2016	Henties Bay	Reservoir	Not detected	Not detected	Not detected	A

Table 12: Microbiological Analyses of the NamWater Supply to Walvis Bay

Date	Town	Sample taken at:	Heterotrophic plate count	Coliforms	Faecal coliforms	Quality
16/02/2016	Walvis Bay	Mile 7 Reservoir	23	76	Not detected	C
12/04/2016	Walvis Bay	Mile 7 Reservoir		Not detected	Not detected	A
06/06/2016	Walvis Bay	Mile 7 Reservoir	1024	Not detected	Not detected	C
20/06/2016	Walvis Bay	Mile 7 Reservoir	2	Not detected	Not detected	A
21/06/2016	Walvis Bay	Mile 7 Reservoir	3	Not detected	Not detected	A
22/06/2016	Walvis Bay	Mile 7 Reservoir	1	Not detected	Not detected	A
13/07/2016	Walvis Bay	Mile 7 Reservoir	7	Not detected	Not detected	A
19/07/2016	Walvis Bay	Mile 7 Reservoir	Not detected	Not detected	Not detected	A
25/07/2016	Walvis Bay	Mile 7 Reservoir	Not detected	Not detected	Not detected	A
25/07/2016	Walvis Bay	Mile 7 Reservoir		Not detected	Not detected	A
01/08/2016	Walvis Bay	Mile 7 Reservoir	7	Not detected	Not detected	A
08/08/2016	Walvis Bay	Mile 7 Reservoir	Not detected	Not detected	Not detected	A
15/08/2016	Walvis Bay	Mile 7 Reservoir	2	Not detected	Not detected	A
22/08/2016	Walvis Bay	Mile 7 Reservoir	24	Not detected	Not detected	A
05/09/2016	Walvis Bay	Mile 7 Reservoir	1	Not detected	Not detected	A
12/09/2016	Walvis Bay	Mile 7 Reservoir	1	Not detected	Not detected	A
12/09/2016	Walvis Bay	Mile 7 Reservoir		Not detected	Not detected	A
19/09/2016	Walvis Bay	Mile 7 Reservoir	Not detected	Not detected	Not detected	A
26/09/2016	Walvis Bay	Mile 7 Reservoir	Not detected	Not detected	Not detected	A
23/05/2016	Walvis Bay	Mile 7 Reservoir	619	Not detected	Not detected	B
03/10/2016	Walvis Bay	Mile 7 Reservoir	1	Not detected	Not detected	A
10/10/2016	Walvis Bay	Mile 7 Reservoir	Not detected	Not detected	Not detected	A
17/10/2016	Walvis Bay	Mile 7 Reservoir	Not detected	Not detected	Not detected	A
24/10/2016	Walvis Bay	Mile 7 Reservoir	4	Not detected	Not detected	A
31/10/2016	Walvis Bay	Mile 7 Reservoir	Not detected	Not detected	Not detected	A
07/11/2016	Walvis Bay	Mile 7 Reservoir	3	Not detected	Not detected	A
14/11/2016	Walvis Bay	Mile 7 Reservoir	Not detected	Not detected	Not detected	A
21/11/2016	Walvis Bay	Mile 7 Reservoir	8	Not detected	Not detected	A
28/11/2016	Walvis Bay	Mile 7 Reservoir	Innumerable	Not detected	Not detected	D
05/12/2016	Walvis Bay	Mile 7 Reservoir	Not detected	Not detected	Not detected	A
12/12/2016	Walvis Bay	Mile 7 Reservoir	3	Not detected	Not detected	A
20/12/2016	Walvis Bay	Mile 7 Reservoir	Not detected	Not detected	Not detected	A

Chemical Analyses of Groundwater in the Swakop and Khan Rivers

The commercial farmers along the rivers and on the lower Swakop smallholdings use groundwater for livestock watering and crop irrigation. Table 13 shows the relevant parameters of the June 2016 water quality analyses in milligrams per litre compared to the Namibian water quality standard for livestock watering. An evaluation of the salinity trends and major ions, chloride, sodium and sulphate can be found in the Appendix to this SEMP annual report, while the full results are contained in a separate report that is available on the GSN website[39].

Table 13: Khan and Swakop River Water Quality for Stock Watering 2016

	Livestock limits	Khan BH4	Khan TR5A	Khan 200411	Khan 202082	Swakop 41184	Swakop 41182	Swakop 41181	Swakop SW2	Swakop 200898
Total dissolved solids	6000	6034	6213	5090	6247	2989	7348	7586	3901	3139
Chloride as Cl^-	1500-3000	2616	2756	2132	2668	1043	3255	3393	1796	1335
Fluoride as F^-	2.0-6.0	1.0	1.0	1.1	1.2	0.1	0.2	0.1	0.2	0.1
Sulphate as SO_4^{2-}	1000	725	454	804	933	588	966	952	605	336
Nitrate as N	100	6.2	<0.5	12	7.9	<0.5	<0.5	<0.5	0.5	8.0
Nitrite as N	10	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Sodium as Na	2000	1052	1257	1042	1188	524	1535	1677	852	599
Magnesium as Mg	500	250	188	140	186	79	169	175	79	72
Calcium as Ca	1000	517	532	386	517	292	614	640	485	302
	Livestock limits	**Swakop 200898a**	**Swakop 41075**	**Swakop 41072**	**Swakop 200413**	**Swakop 200850**	**Swakop 201569**	**Swakop 201570**	**Swakop 201571**	
Total dissolved solids	6000	3074	4536	7113	9092	10909	10510	10976	18188	
Chloride as Cl^-	1500-3000	1328	1943	2979	4215	4832	4561	5218	9237	
Fluoride as F^-	2.0-6.0	0.1	0.7	0.4	0.4	0.3	0.4	0.4	0.1	
Sulphate as SO_4^{2-}	1000	399	577	1412	1210	1382	1288	1326	1585	
Nitrate as N	100	8.4	5.7	4.9	2.0	4.3	13	14	0.5	
Nitrite as N	10	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	
Sodium as Na	2000	599	964	1750	1984	2305	2095	2739	4583	
Magnesium as Mg	500	71	92	191	242	298	262	254	421	
Calcium as Ca	1000	297	358	586	745	910	827	832	1239	

Groundwater quality results for the Swakop and Khan rivers cannot be evaluated against the drinking water standard, because the groundwater is naturally brackish to saline. The salinity generally increases towards the coast, but pockets of fresher water formed by recent flood recharge can be found all along the lower Swakop, except for the area of the smallholdings. Water quality studies from the time before the start of uranium mining, especially a detailed survey of the entire Swakop River in the 1960s, show that the excess salinity has natural causes such as evaporation and transpiration from wetlands, upwelling at compartment boundaries, as well as the inflow of saline groundwater from tributaries and bedrock. [40][41]

[39] SLR (2017): Central Namib Uranium Province, Specialised Groundwater Monitoring and Training in the Swakop/Khan River for the Strategic Environmental Management Plan (SEMP). SLR Project No. 733.07042.00001, Report No. 2016-WG31 submitted to Geological Survey of Namibia, MME, Windhoek

[40] NIWR (1966): Verslag oor Opname van die Swakoprivier, Suidwes Afrika, met Spesiale Verwysing na die Chemiese Kwaliteit en die Faktore wat die beinvloed. Contract Report C WAT 10

[41] National Institute for Water Research, CSIR, Pretoria, and DWAF (1977): Gehalte- en Potensiaalopname van Grondwater in die Swakoprivier vanaf Horebis-Noord tot by Nabas. Internal Report No. WW 30/95/3, Hydrology Division, Department of Water Affairs, Windhoek

Khan River groundwater slightly exceeds the limit for TDS at three sites, but is otherwise fine for stock watering. Swakop River water is of suitable quality at five sites in the Langer Heinrich, Ida Dome and Etango compartments, whereas groundwater in the Husabberg and Etango compartments, as well as the Farming area compartment is too saline for stock watering.

There is no Namibian water quality standard for crop irrigation water, though there are indicators like salinity index and sodium adsorption ratio that agricultural organisations use to assess the suitability of a water source for this application. Farmers along the Swakop and Khan rivers know that only certain plants, e.g. olive trees and asparagus, can tolerate brackish to saline groundwater. They use freshwater from the NamWater pipeline for other crops.

Motivation of status: The indicator requires that aesthetic/physical, inorganic, radionuclide and bacteriological determinants conform to the minimum required quality as prescribed in the national water quality standards. The quality of the NamWater supply to Henties Bay, Swakopmund and Walvis Bay was good to excellent and suitable for human consumption. Monitoring results for the Swakop and Khan rivers showed that the water quality was within the range of historical variations and as fit for stock watering and irrigation as it used to be in the past. Both parts of the indicator have therefore been **MET**.

Target 4.1.2.	**Uranium mining does not compromise the water quality in the lower Khan and Swakop rivers.**			
Indicator 4.1.2.1.	**Radionuclide and heavy metal concentrations conform to the national water quality standards.**			
Data Source	**DWAF**			
Status:			**MET**	

Groundwater samples from the SEMP boreholes were taken in June 2016 and the whole suite of physical and inorganic components, including trace metals and uranium was analysed at various laboratories. The Geological Survey, supported by BGR, engaged a consultant to assist with this project and at the same time train GRN and DWAF officials in sampling and analysis evaluation techniques. The analysis results were presented and evaluated in a report by SLR.[42] In order to assess Indicator 4.1.2.1, only the metals and trace elements determined in the Khan and Swakop river groundwater samples are shown in Table 14.

The figures highlighted in red in Table 14 indicate concentrations exceeding the limits for potable water Group B as given in the first column of the table according to the Water Act (Act 54 of 1956) and its requirements in terms of water supplies for drinking water. New water quality guidelines have been compiled, but they will only be applicable once the 2013 Water Resources Management Act has commenced. Note that the standard should only be used as a benchmark for comparison because the salinity renders the water unsuitable for human consumption. Some of the tested borehole waters contained excessive quantities of aluminium, iron, manganese and selenium. All other trace elements and heavy metals, including uranium, were within the allowable limits.

[42] SLR (2017): Central Namib Uranium Province, Specialised Groundwater Monitoring and Training in the Swakop/Khan River for the Strategic Environmental Management Plan (SEMP). SLR Project No. 733.07042.00001, Report No. 2016-WG31 submitted to Geological Survey of Namibia, MME, Windhoek

Table 14: Concentrations of Metals and Trace Elements in Micrograms per Litre

	Potable limits	Khan BH4	Khan TR5A	Khan 200411	Khan 202082	Swakop 41184	Swakop 41182	Swakop 41181	Swakop SW2	Swakop 200898
Aluminium	**500**	1233	859	56	8.8	3	3.0	6	12	7.0
Antimony	**100**	<0.001	0.1	<0.001	0.1	0.1	<0.001	<0.001	<0.001	<0.001
Arsenic	**300**	3.9	5.8	5.6	7.9	2.1	5.5	10.8	2.9	4.2
Barium	**1000**	42	51	32	32	57	59	60	53	93
Beryllium	**5**	0.1	0.4	<0.001	<0.001	0.2	0.188	0.3	<0.001	<0.001
Bismuth	**500**	0.02	0.02	0.02	0.02	<0.001	0.04	0.04	0.03	0.03
Boron	**2000**	360	860	740	800	120	360	340	240	180
Cadmium	**20**	0.1	<0.001	<0.001	0.1	0.1	<0.001	<0.001	<0.001	<0.001
Chromium	**200**	4.3	6.5	3.2	1.9	0.2	0.1	0.3	0.5	1.2
Cobalt	**500**	1.0	3.1	0.3	0.04	0.3	1.36	0.2	0.7	0.04
Copper	**1000**	4.4	1.6	8.8	0.6	0.9	1.1	0.7	1.2	0.9
Iron	**1000**	7015	4617	2663	34	13	17	865	172	19
Lead	**100**	2.3	14	2.3	0.1	0.1	0.1	0	0.1	0.1
Manganese	**1000**	150	617	50	1.1	280	2254	1562	2176	3.5
Mercury	**10**	1.5	3.9	2.5	2.5	2.7	0.6	0.9	0.8	1.2
Nickel	**500**	2.4	13	0.8	0.3	0.7	1.3	1	1.0	0.4
Selenium	**50**	35	38	28	45	9	34	53	13	17
Tin	**200**	0.4	0.1	0.2	0.06	0.2	0.06	0.1	0.05	<0.001
Titanium	**500**	50	9.8	3.7	0.6	<0.001	0.2	0.3	0.9	0.6
Uranium	**4000**	128	65	147	233	18	88	60	89	31
Vanadium	**500**	6.7	7.4	7.8	6.3	6.3	6.4	0.4	0.9	7.4
Zinc	**5000**	58	49	12	1.5	2	2.0	2	1.5	1.6

	Potable limits	Swakop 200898a	Swakop 41075	Swakop 41072	Swakop 200413	Swakop 200850	Swakop 201569	Swakop 201570	Swakop 201571	
Aluminium	**500**	6.7	44.7	5.1	3.0	2.9	39.8	4.6	27.5	
Antimony	**100**	<0.001	<0.001	0.1	0.1	0.1	<0.001	0.1	0.1	
Arsenic	**300**	2.4	3.2	4.6	9.2	12.1	8.8	19.6	22.1	
Barium	**1000**	98	30	38	35	31	39	33	93	
Beryllium	**5**	<0.001	<0.001	<0.001	<0.001	<0.001	0.2	0.2	<0.001	
Bismuth	**500**	0.03	0.03	0.03	0.05	0.02	<0.001	0.02	0.03	
Boron	**2000**	200	520	880	1060	960	900	1000	1320	
Cadmium	**20**	0.08	0.080	0.1	<0.001	0.19	0.224	0.12	<0.001	
Chromium	**200**	1.5	1.5	<0.001	0.5	0.3	6.1	1.6	0.4	
Cobalt	**500**	0.03	0.12	0.6	0.66	1.5	0.11	0.3	1.69	
Copper	**1000**	0.8	2.0	0.9	1.6	0.9	1.3	1.9	1.0	
Iron	**1000**	17	1569	30	5899	34	240	47	3825	
Lead	**100**	0.2	0.8	0.1	0.1	0.1	1.9	0.3	0.1	
Manganese	**1000**	2.8	46	599	361	692	68	35	798	
Mercury	**10**	2.9	0.6	1.1	0.0	0.2	2.7	1.0	2.1	
Nickel	**500**	0.3	0.8	1.3	0.4	1	2.3	1	1.9	
Selenium	**50**	15	20	32	56	62	69	97	163	
Tin	**200**	<0.001	<0.001	<0.001	0.10	0.3	<0.001	0.1	0.16	
Titanium	**500**	12	2.9	23	18.4	20.6	17.9	0.2	42.2	
Uranium	**4000**	28	69	157	141	135	95	81	71	
Vanadium	**500**	8.6	5.1	8.6	2.5	4.6	6.3	6.0	4.3	
Zinc	**5000**	2.3	4	2	2.7	1	2	2	1.1	

Two sites in the Khan River close to Rössing mine had very high aluminium concentrations for which no obvious explanation could be found. High iron concentrations do cause health effects and are mostly due to rusting steel borehole casings. The same applies to manganese where the upper limit is intended to avoid staining of laundry. Elevated uranium concentrations in the 100-200 microgram per litre range were measured in the Khan River at Rössing mine and further downstream, and in the Swakop River between Palmenhorst and Goanikontes. Specialist studies carried out as part of the Strategic Environmental Assessment for the Central Namib Uranium Rush concluded that uranium in Khan and Swakop groundwater originated from weathering of uranium-bearing rock types that occur in the catchment areas[43].

Motivation of status: The indicator was **MET** because the radionuclide and heavy metal concentrations largely conformed to the current national water quality standards. Some excessive aluminium, iron, manganese and selenium concentrations may be linked to the high salinity of the groundwater and to the corrosion of steel casing in the boreholes. It should be noted that the evaluation of naturally saline Khan and Swakop groundwater against the standard for drinking water does not make sense.

Desired Outcome 4.2.	**The natural environment, urban and rural communities have access to adequate water.**
Target 4.2.1.	**Uranium mining does not compromise surface and groundwater availability.**
Indicator 4.2.1.1.	**Groundwater abstraction from NamWater's Central Namib water scheme does not exceed the aquifers' sustainable yield.**
Data Source	**DWAF, NamWater**
Status:	**MET**

Following good recharge of the Kuiseb River aquifers in 2011 NamWater increased the pumping rate from 4.8 Mm^3/a to 7 Mm^3/a. The Omdel abstraction permit for 9 Mm^3/a expired in 2013 and since then studies are being conducted to determine the new permit quota. [44] In the meantime, NamWater has reduced the Omdel abstraction to 6 Mm^3/a and subsequently to 3 Mm^3/a. NamWater appealed against the 3 Mm^3/a permit and it was agreed in 2017 to update the Omdel groundwater model. The 2017 Omdel model recommended an abstraction of 4.5 Mm^3/a to be reviewed on a two-yearly basis. The application was submitted to MAWF and the approved permit is awaited. [45]

NamWater's graph for the status of the Swartbank and Rooibank wellfields in the Kuiseb River (Figure 10) shows the monthly abstraction rates and average water levels up to July 2016. Abstraction was close to the sustainable yield and the water level dropped faster than before, though the rate was probably not excessive for a recently recharged aquifer.[46]

[43] MME (2010): Strategic Environmental Assessment for the Central Namib Uranium Rush. Ministry of Mines and Energy, Republic of Namibia, Windhoek
[44] Pers. comm. DWAF, 2017
[45] Pers. comm. NamWater, 2017
[46] Pers. comm. NUA, 2017

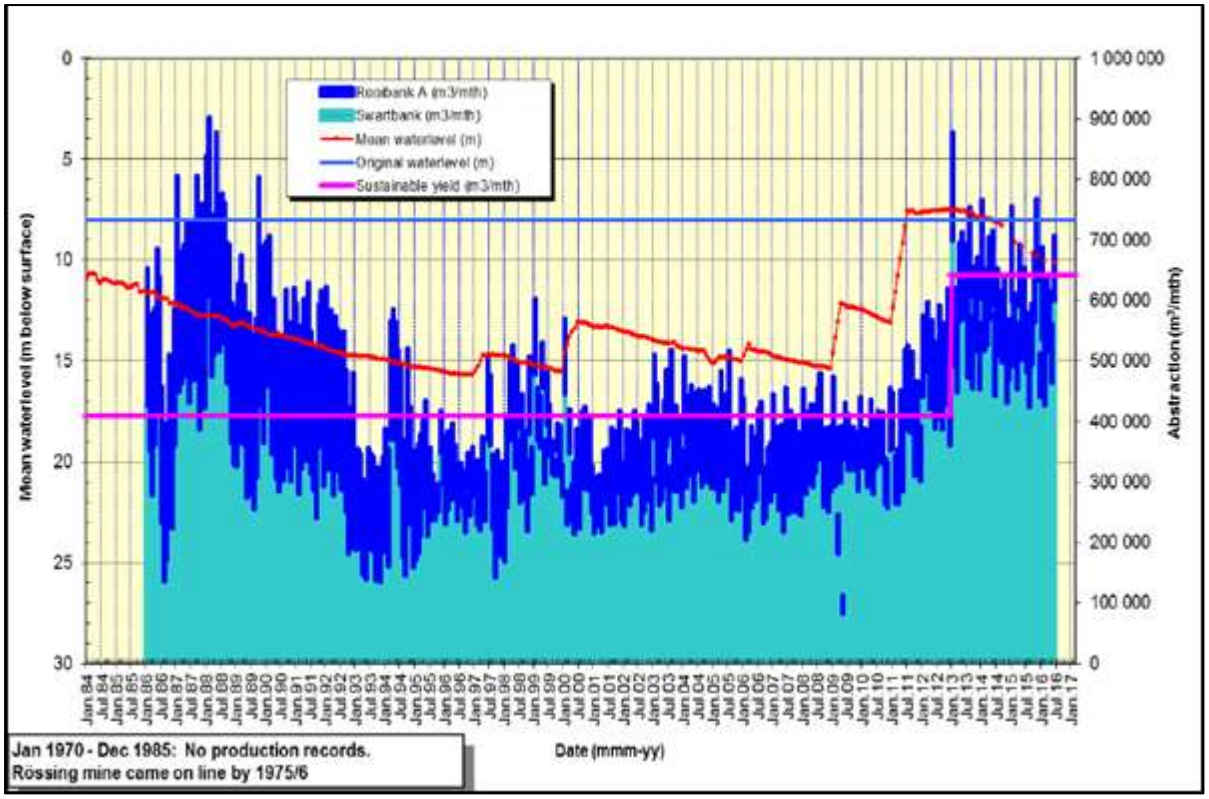

Figure 10: Abstraction and Average Water Level of the Kuiseb Aquifer

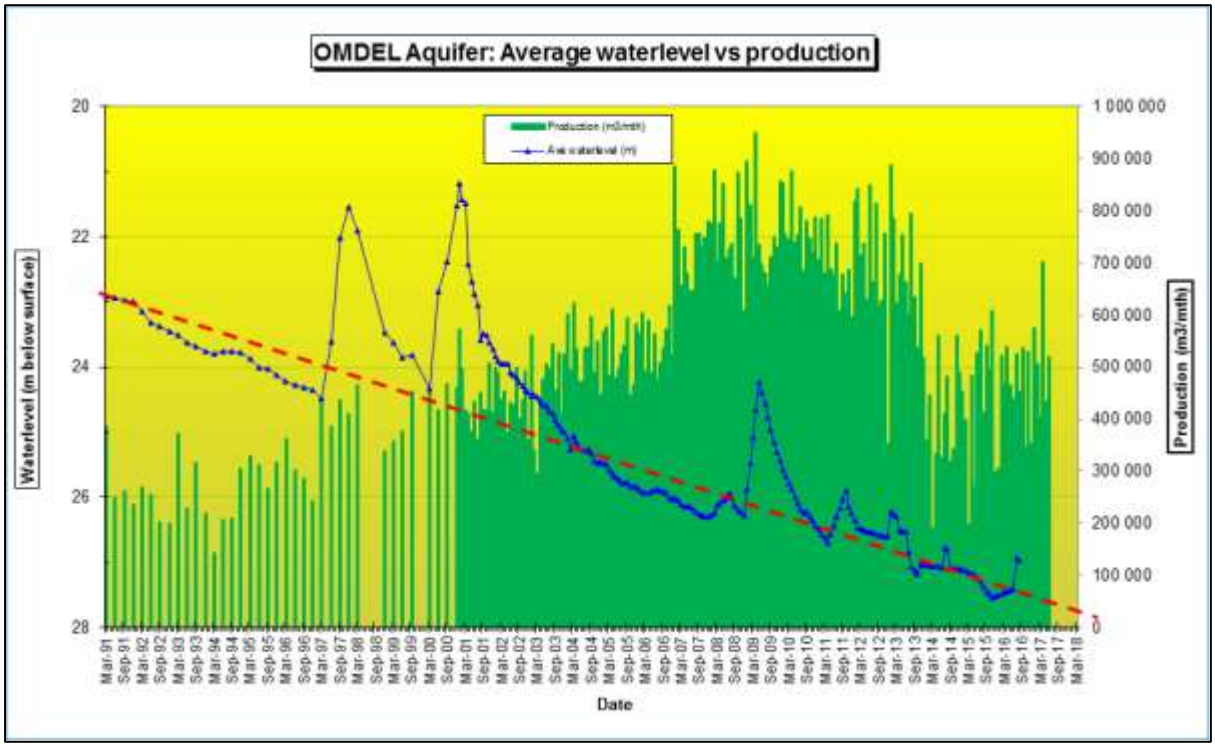

Figure 11: Abstraction and Average Water Level of the Omdel Aquifer

The average water level of the Omdel aquifer recovered in 2015 and 2016 after the abstraction was reduced in 2014 (Figure 11). Occasional water level peaks in this graph show when there was re-charge from the Omdel dam.

Motivation of status: Based on the information provided for 2015/16 it appears that the groundwater abstraction from the Kuiseb and Omdel water schemes did not exceed the aquifers' sustainable yield as determined by DWAF. The indicator was **MET**.

Indicator 4.2.1.2.	**Borehole levels fluctuate within existing norms.**			
Data Source	**NUA/DWAF**			
Status:			**MET**	

The effect of groundwater abstraction on the stored water resources of the Khan and Swakop rivers is assessed by monitoring the water level fluctuations in boreholes that MAWF and mines drilled in these rivers. Groundwater levels in the SEMP monitoring boreholes along the Swakop and Khan Rivers were monitored in 2016 with the results shown in Table 15 compared to previous measurements.

Table 15: SEMP Borehole Locations and Water Levels 2013-2016

WW no.	Latitude	Longitude	Location	WL 2013	WL 2014	WL 2016
KEM3	-22.4579	15.1202	Rössing	8.92	9.32	
BH4	-22.4945	15.0750	Rössing	9.51	8.42	9.98
200411	-22.6496	14.9304	Rössing	17.80		19.18
202082	-22.5626	14.9965	Rössing	11.79	11.86	12.14
41184	-22.7273	15.3924	Langer Heinrich	5.20	5.77	7.16
41182	-22.7316	15.2461	Langer Heinrich	2.94	2.70	3.67
41181	-22.7308	15.2272	Langer Heinrich	3.66	3.38	4.16
SW1	-22.7613	15.0584	Husab	2.42	3.01	collapsed
200898 (SW4)			Husab	replaces SW1		4.20
SW2	-22.7316	15.0213	Husab	2.30	2.54	2.99
41075	-22.6928	14.9001	Bannerman	4.67	3.94	4.43
41072	-22.6766	14.8694	Bannerman	4.86	4.18	4.83
200413	-22.6679	14.8225	Bannerman	3.65	2.79	3.43
200850	-22.6595	14.7925	Bannerman	3.99	3.01	3.49
201569	-22.6444	14.7092	Lower Skp Farms		3.10	6.13
201570			Lower Skp Farms			3.76
201571	-22.6739	14.5998	Lower Skp Farms		1.82	2.83

The water level trends of the SEMP boreholes in Figure 12 show a moderate decline compared to 2013 and 2014, which is normal in the absence of recharge during the last two years. An exception is the drop from 3.10 to 6.13 m below surface at WW201569 in the upper part of the farming area, which could indicate substantial abstraction (unless the 2014 measurement was incorrect). Water levels close to 20 m in the Khan Confluence compartment around borehole WW200411 show that there has been no recharge from recent floods.

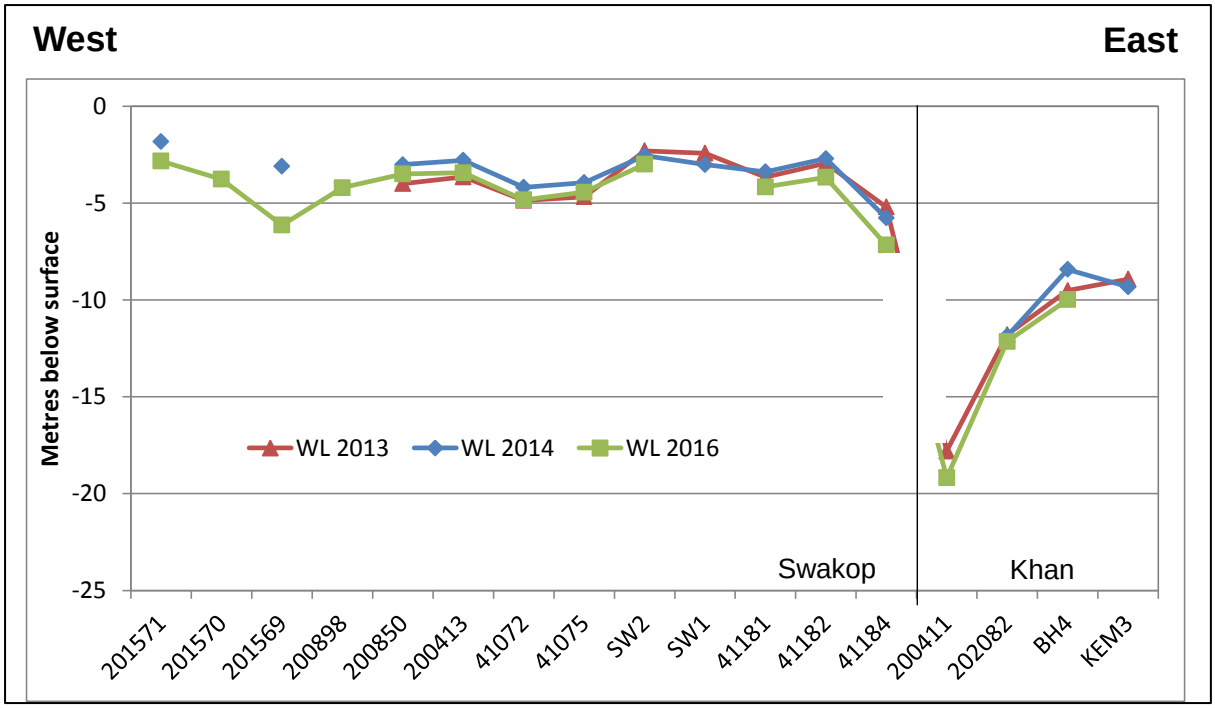

Figure 12: Water Levels Trends of SEMP Boreholes

Bannerman, Langer Heinrich, Rössing and Swakop Uranium monitor water levels in the Khan and Swakop rivers. They provided their data to complement the SEMP water levels and broaden the data set on which the definition of fluctuation "within existing norms" is based. Generally water levels in the rivers rise when the aquifers are recharged during floods and fall as a result of evapotranspiration and drawdown due to pumping. It is important to note that water levels always drop except during and just after runoff. The natural decline results in gently sloping lines like the upper four lines in Figure 13, while a slightly steeper decline occurs where abstraction is taking place, e.g. the lower three lines in Figure 13. An even steeper drop beyond the "normal" trend, like the Omdel water level in Figure 11, indicates that pumping may exceed the sustainable yield of the aquifer.

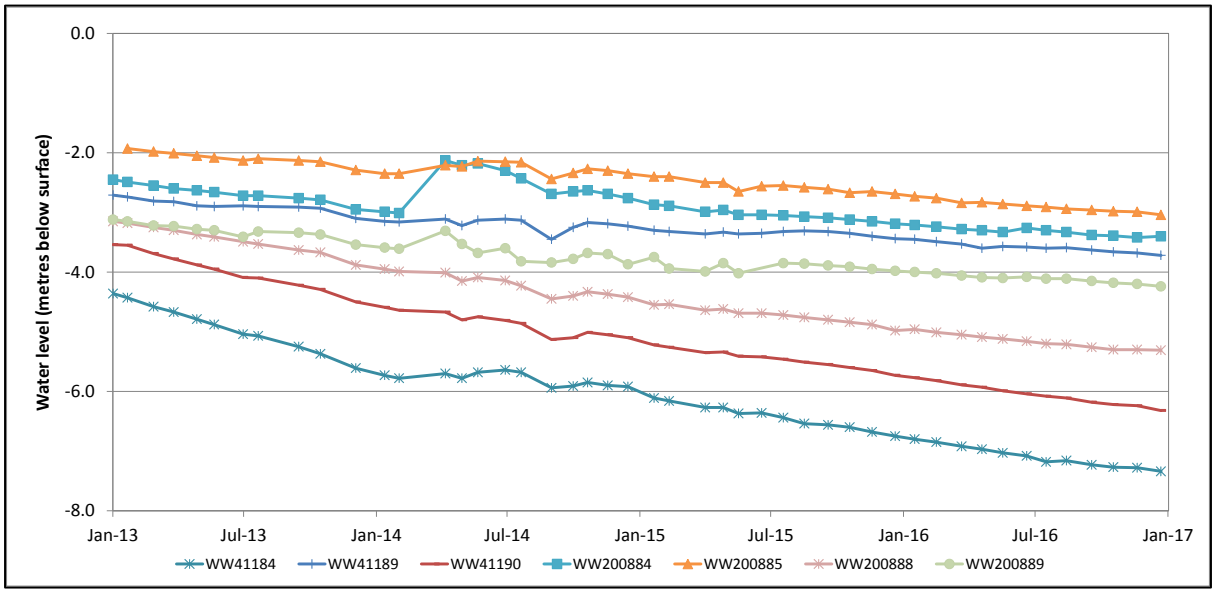

Figure 13: Water Level Trends in the Swakop River at Langer Heinrich Mine

Langer Heinrich mine takes monthly water level measurements at 18 boreholes in the Swakop River to monitor the effect of abstraction on the aquifer. The company operates a production borehole to abstract saline groundwater for industrial purposes. Figure 13 shows the water level trends over the last three years at seven representative sites. Recharge last occurred in early 2014 as indicated by rising water levels at some boreholes. Since then, water levels have followed the normal declining trend caused by evapotranspiration losses and sustainable abstraction.

Swakop Uranium and Bannerman monitor the stretch of the Swakop River between Langer Heinrich and Goanikontes. This area received some recharge at the end of 2013. Since then, the water levels have dropped slowly but continuously (Figure 14).

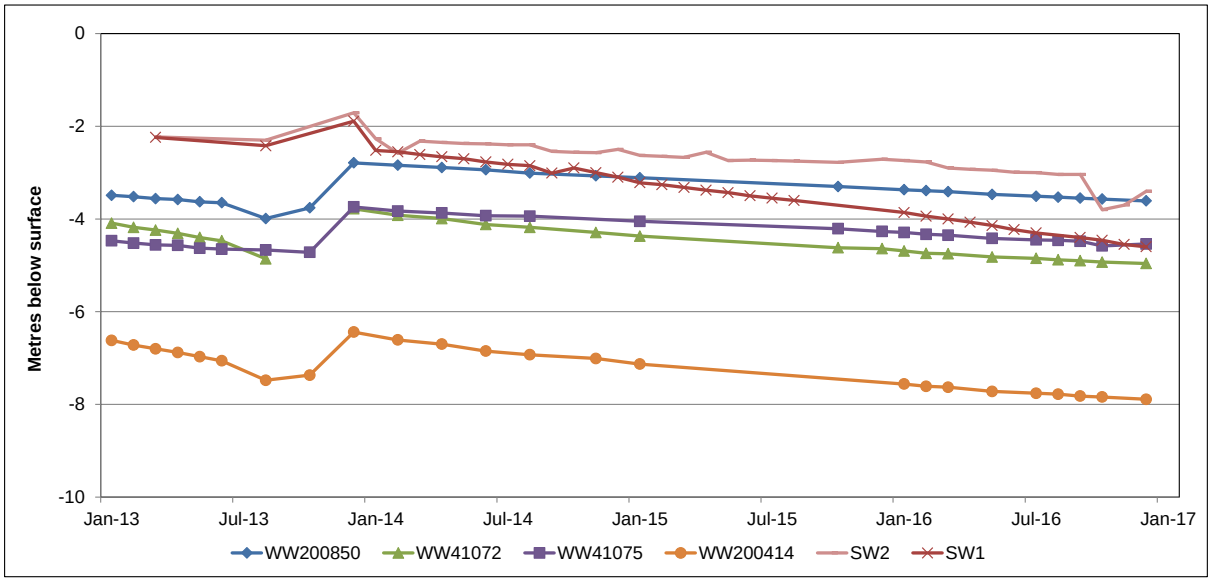

Figure 14: Water Level Trends in the Swakop River at Swakop Uranium and Bannerman Boreholes

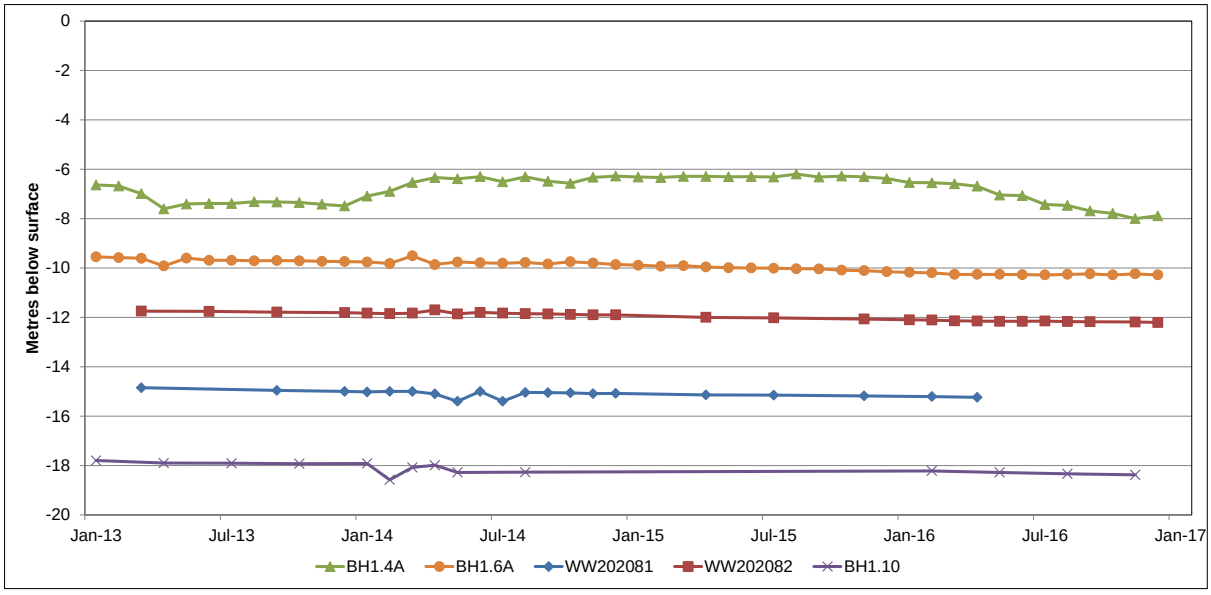

Figure 15: Water Level Trends in the Khan River at Rössing Uranium

An even slower decline can be observed in the lower Khan River boreholes monitored by Rössing Uranium and Swakop Uranium (Figure 15). While the water table in the Swakop River is situated 2-7 m below surface, it is generally deeper at 6-17 m below surface in the Khan. No major fluctuation occurred during the last three years, except for a slight rise at BH1.4A when abstraction was sus-

pended in 2014. This trend was reversed when the mine resumed pumping in 2016. The monitoring data indicate that the fluctuations observed in the Swakop and Khan rivers were in line with the normal trend that is caused by evaporation of water from wet sand and uptake by trees and shrubs growing in the river beds.

Motivation of status: The range of water level fluctuation in 2016 was found to be within existing norms, indicating that groundwater abstraction by mines and other consumers did not negatively affect the water resources. The indicator was regarded as **MET**.

Indicator 4.2.1.3.	**Aquifer water will be made available to domestic users at approved NamWater rates.**			
Data Source	**NamWater**			
Status:			**MET**	

Bulk water users supplied from NamWater's Central Namib scheme paid water rates approved by Government. The gazetted tariffs for consumers supplied from the Central Namib scheme increased by 10% compared to 2015 (Table 16).[47] Aquifer water was provided to the Walvis Bay Municipality at a rate of N$9.10/$m^3$ and to the Swakopmund Municipality at N$10.65/$m^3$. The municipalities determine their own tariffs for domestic and industrial users, which are generally higher than the NamWater rates. For instance, Swakopmund Municipality charged only N$9.65/$m^3$ for the first 8 m^3 (below NamWater tariff), N$13.00/$m^3$ for 9-30 m^3, N$18.40/$m^3$ for 31-60 m^3 and N$27.80/$m^3$ for over 60 m^3 in 2016.[48] The intention of these staggered tariffs is to encourage water saving.

Table 16: Water Tariff Increases for 2016 (from Government Gazette No. 5991)

Scheme Description	Tariff 2015	% Increase	Tariff 2016
Henties Bay	8.45	10%	9.30
Rooibank Mile 7 Reservoir (Walvis Bay)	8.25	10%	9.10
Swakopmund reservoir	9.70	10%	10.65
Omdel-Swakopmund	9.70	10%	10.65
Swartbank Schwarzekuppe	8.05	10%	8.85
Arandis Town	10.10	10%	11.10

NamWater stated in Gazette No. 5991: "Commercial customers in the central coastal area will be supplied desalinated water at cost." Tariffs for mines are not gazetted because they are subject to confidential contracts between NamWater and the individual companies. Mining companies reported to NUA that they paid the full price for desalinated water. To give an indication of this price, desalinated water can be produced at a cost of approximately US$0.45-1.00/$m^3$.[49] These rates were however determined in countries like Saudi Arabia and Australia where the seawater does not need extensive pre-treatment and the desalination plants are running at full capacity.

[47] Government Gazette No. 5991, April 2016
[48] Government Gazette No. 6063, July 2016
[49] Information from various internet websites

Namibian seawater is very rich in plankton that is best removed by ultrafiltration, a process that can easily double or triple the treatment cost.

Motivation of status: The tariffs gazetted in 2016 were based on the cost of aquifer water and did not include additional increases to recover the higher cost of desalinated water from domestic consumers. The indicator was **MET**.

Indicator 4.2.1.4.	**NamWater disaster management plans are in place and implemented in case of flood damage to supply schemes.**			
Data Source	**NamWater**			
Status:			**MET**	

The uninterrupted water supply to urban and industrial users, even in case of flood damage to one of the wellfields, is NamWater's responsibility. NamWater reported the following status of the disaster management plan in 2016:[50]

- An early flood warning system is in place at Gobabeb weir, as well as some monitoring upstream by DWAF.
- The Kuiseb power lines and pipelines have been replaced or reinforced to withstand flood damage.
- Resources such as manpower and spare parts are provided to repair flood damage to infrastructure as soon as possible.
- A project to upgrade the pipeline between Swakopmund and Walvis Bay, so that Omdel water can be pumped to Walvis Bay in case of damage to the Kuiseb system is ongoing, but no completion date has been set.

Motivation of status: Because most of the required components of the flood emergency plan were in place the indicator was **MET.**

Desired Outcome 4.3.	**Water for industrial purposes is available and reliable.**			
Target 4.3.1.	**Additional water resources (notably desalinated water) are developed to meet industrial demand.**			
Indicator 4.3.1.1.	**Industrial investors are not lost because of water unavailability.**			
Data Source	**DWAF**			
Status:	**NOT MET**			

[50] Pers. comm. NamWater, 2017

NamWater secured the water supply for industrial development in 2016 by augmenting the groundwater resources with desalinated seawater as required by Target 4.3.1. The Governor of the Erongo region however stated that industrial investment opportunities have been lost due to a lack of water,[51] though it is also possible that potential investors were put off by the high cost of the water that is available. The authors of the SEA report saw desalination as a solution to the supply problem without realising the economic reality that international investors will look at all input costs and rather establish water-intensive businesses in countries with more plentiful, cheap water supplies.

NamWater had indicated in the 2014 SEMP report that they were planning to develop the Omdel southern palaeochannel to access more groundwater, but funds for this project were not provided in the 2015/16 budget[52], probably because Government's focus shifted to the construction of a new desalination plant.[53]

Motivation of status: Though the water supply was secure in 2016 it came at a higher cost for industry because the groundwater supply shortfall had to be made up with desalinated water. This situation seems to have resulted in lost investment opportunities, meaning that the indicator was **NOT MET**.

Indicator 4.3.1.2.	**Desalinated water meets mine demand**
Data Source	**DWAF/NUA**
Status:	**NOT MET**

In 2016, NamWater supplied 6.54 Mm^3 of desalinated water to Langer Heinrich, Rössing Uranium and Swakop Uranium (Figure 16).[54] Scheduled and unscheduled prolonged outages however occasionally disrupted the constant water supply to the mines and caused loss of production.[55]

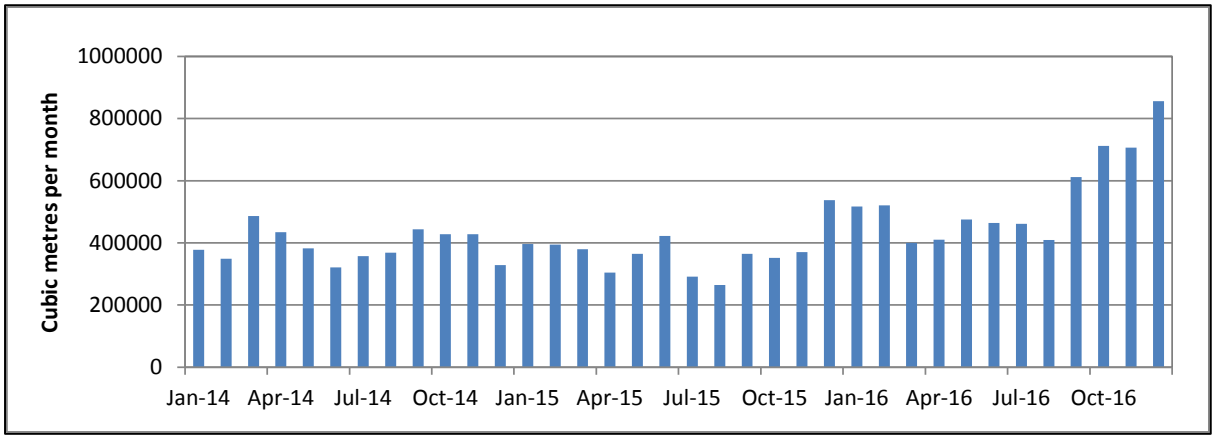

Figure 16: Volumes of Desalinated Water Supplied in 2014-2016

[51] Hon. Cleophas Mutjavikua, speech at Swakopmund, 22 August 2016
[52] Dr. Vaino Shivute, presentation at Swakopmund, 22 August 2016
[53] Hon. Min. J. Mutorwa, presentation at Swakopmund, 22 August 2016
[54] Data and graph provided by AREVA Resources Namibia
[55] Pers. comm. NamWater, 2017

This statement refers to the desalination plant's planned shutdowns for maintenance, which are needed a few times per year and take up to five days, and possibly to the unexpected supply reduction in February 2017 when the plant was affected by a sulphur outbreak and algal bloom. Some supply bottlenecks were also experienced during the commissioning of Husab Mine's processing plant in the fourth quarter of 2016 because the date for the required increase in the desalination plant's capacity had not been communicated to AREVA in time.[56]

Operating mines were concerned that the high cost of desalinated water was affecting their financial viability in a time of low uranium prices. This has prompted Rössing Uranium to plan its own desalination plant. The company completed an EIA and received environmental clearance in 2016. To meet prerequisites for receipt of the certificate, Rössing Uranium applied for the water permits required by the Directorate Water Resources Management of the Ministry of Agriculture, Water and Forestry in September 2016. No reply from the directorate had been received by the end of 2016.[57]

Motivation of status: The desalination plant would have been able to meet the mines' demand in 2016, but a lack of proper planning caused the target to be missed. The indicator was **NOT MET**.

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Summary of performance: EQO 4

Total no. indicators assessed: 8

	NOT MET	IN PROGRESS	MET	EXCEEDED
Number of indicators in class	2	0	6	0
Percent of indicators in class	25%	0%	75%	0%

Overall performance: Six of the eight indicators in the Water EQO were **MET** (75%), while the two indicators related to the availability of desalinated water changed from MET in 2015 to **NOT MET** in 2016 (25%). The comprehensive sampling and disaster management indicators that were IN PROGRESS in 2015 have now been **MET**. Contrary to fears expressed in the SEA process uranium mining did not compromise the water quality or lower the water table in the rivers. The water tariff for domestic users did not increase to the level required to cover the cost of desalinated water. Negative developments in 2016 related to reports of industrial investors being lost due to water unavailability and an insufficient supply of desalinated water to meet the mines' demand.

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[56] AREVA Resources Namibia input to 2016 SEMP report

[57] Rössing Uranium input to 2016 SEMP report

EQO 5.Air Quality

Aims of this EQO: Workers and the public do not suffer significant increased health risks as a result of exposure to dust emission from the uranium mines.

The objective of the Air Quality EQO is the assessment of the background dust concentrations in the region, especially at the major towns, and the quantity of dust blown from the uranium mining sites into the environment. Dust emissions may occur during each stage of the mine cycle, in particular due to exploration drilling, mine construction and operational activities. The principal dust sources at mines include blasting, loading, hauling and crushing, wind erosion of exposed surfaces such as tailings, stockpiles, waste dumps and haul roads, and to a lesser extent fine particulates from combustion of diesel fuel.

The SEMP Office is in the process of developing an overarching Air Quality Management Plan (AQMP) for the uranium and other industries within the Erongo region. The aim is to establish mitigation measures that can be implemented by the various role players in a coordinated and integrated manner. At the core of the AQMP is an advanced air quality study SEMP Office commissioned towards the end of 2016 that monitors and reports public exposure from dust, which includes both nuisance dust and inhalable dust. The latter is also known as PM_{10} dust because its particles are smaller than 10 micrometres.

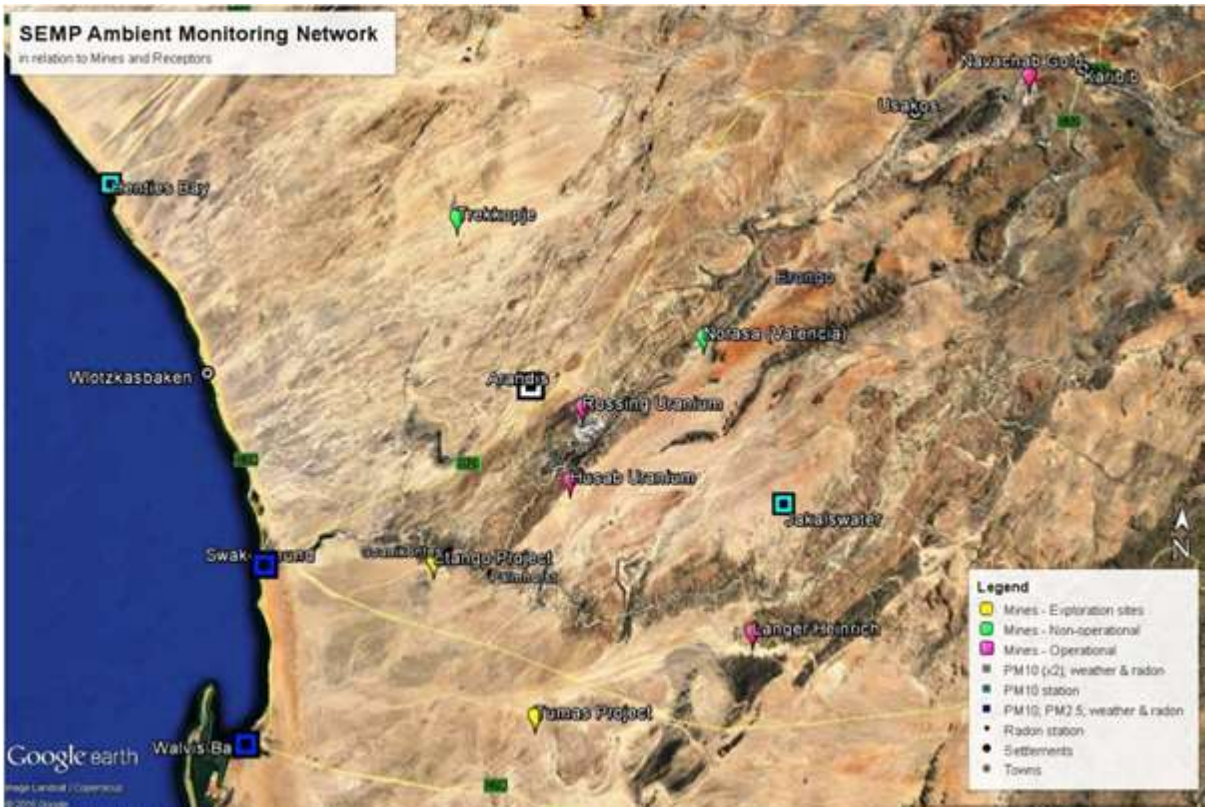

Figure 17: Location of Monitoring Stations

Five monitoring stations have been placed at Swakopmund, Walvis Bay, Henties Bay and Jakkalswater to measure the dust concentration, ambient temperature, barometric pressure, wind speed, rel-

ative humidity, and wind direction (Figure 17).[58] The stations at Swakopmund and Walvis Bay are also equipped with $PM_{2.5}$ monitors to establish whether there is air pollution from the combustion of fuel or waste. In addition, radon monitors have been placed at Arandis, Swakopmund and Walvis Bay.

The purpose of monitoring is to ensure that ambient PM_{10} concentrations at public locations do not exceed the targets or limits set for the area. The preliminary limits set in the SEA report for the Erongo region were based on the World Health Organisation (WHO) IT-3 guidelines for PM_{10} dust: 75 µg/m³ for the average over 24 hours and 30 µg/m³ for the annual average. The WHO IT-3 correlates with the South African limit that was based on environmental, social and economic conditions that are similar to Namibia. The WHO allows three days where the 24-hour guideline may be exceeded and South Africa allows four days per calendar year. One of the aims of the GSN's advanced air quality study is to review this recommendation and propose a realistic standard for the region.

Desired Outcome 5.1.	**Annual human exposures to particulate concentrations are acceptable (IFC Standard).**
Target 5.1.1.	**Ambient PM_{10} concentrations at public locations and mines should not exceed the required target/limit to be set for the Erongo region for both annual and 24-hour averages. The target/limit should be based on international guidelines but should consider local environmental, social and economic conditions.**
Indicator 5.1.1.1.	**Ambient PM_{10} monitoring (µg/m³) is carried out at Swakopmund, Arandis and operating mines.**
Data Source	**SEMP Office/NUA**
Status:	**MET**

Dust monitoring results for the period from 1 November 2016 to 30 April 2017 at Henties Bay, Swakopmund, Walvis Bay and Jakkalswater are summarised in Table 17.[59] The daily PM_{10} concentrations at Swakopmund occasionally (3% of all readings) exceeded the WHO IT-3 limit of 75 µg/m³ with peak value up to 104.5 µg/m³. Walvis Bay recorded 6% exceedances with a maximum of 135.5 µg/m³. All other stations remained below the WHO limit. The $PM_{2.5}$ concentrations at Swakopmund and Walvis Bay were below the WHO limit of 37.5 µg/m³, though the data availability of 46% at Walvis Bay was unacceptable. Figure 9 under EQO 3 shows an example of the dust monitoring results for Swakopmund and Walvis Bay in December 2016.

[58] Map from Liebenberg-Enslin, H et al (2017): Advanced Air Quality Management for the Strategic Environmental Management Plan for the Uranium and Other Industries in the Erongo region: Ambient Air Quality Monitoring Report for the Period 1 November 2016 to 30 April 2017 Report No.: 16MME01-2

[59] Liebenberg-Enslin, H et al (2017): Advanced Air Quality Management for the Strategic Environmental Management Plan for the Uranium and Other Industries in the Erongo region: Ambient Air Quality Monitoring Report for the Period 1 November 2016 to 30 April 2017. Report No.: 16MME01-2

Table 17: Summary of Ambient Dust Levels in November 2016-April 2017

	Swakopmund	Walvis Bay	Henties Bay	Jakalswater	Rössing Arandis	Areva Arandis(a)
PM_{10} Concentrations						
Adopted Daily Guideline (µg/m³)	75	75	75	75	75	75
Management Alert (non-compliance)	3%	6%	0%	0%	0%	0%
Min. (µg/m³)	5.36	7.08	4.25	0.33	2.1	1.5
Max (µg/m³)	104.5	135.5	54.1	72.1	63.3	37.3
Ave. (µg/m³)	30.5	35.3	18.4	19.0	17.1	8.4
Data availability	72%	79%	83%	94%	89%	100%
$PM_{2.5}$ Concentrations						
Adopted Daily Guideline (µg/m³)	37.5	37.5	N.D.	N.D.	N.D.	N.D.
Management Alert (non-compliance)	0%	0%	N.D.	N.D.	N.D.	N.D.
Min. (µg/m³)	2.2	3.2	N.D.	N.D.	N.D.	N.D.
Max (µg/m³)	23.8	24.8	N.D.	N.D.	N.D.	N.D.
Ave. (µg/m³)	8.3	10.1	N.D.	N.D.	N.D.	N.D.
Data availability	81%	46%	N.D.	N.D.	N.D.	N.D.
Colour code						
Acceptable result (no exceedances of the Air Quality guideline)(>80% data availability)						
Potentially unacceptable result (less than 1% exceedances of the Air Quality guideline)(60-80% data availability)						
Unacceptable result (1% and more exceedances of the Air Quality guideline)(<60% data availability)						

As required by the indicator, operating uranium mines monitor PM_{10} dust at the mine sites and at Arandis where both AREVA Resources Namibia and Rössing Uranium have monitoring stations. The annual average PM_{10} dust concentrations for 2013-2016 at the relevant receptor locations are summarised in Table 18.

Table 18: PM_{10} Dust Concentrations at Arandis Town and Uranium Mines

Locality	Average Annual PM_{10} Dust Concentration (µg/m³)			
Year	2016	2015	2014	2013
Arandis, AREVA	9.0	9.8	9.1	10.4
Arandis, Rössing	15.9	8.6	11.4	15.8
Rössing CMC	23.3	21.7	No data	No data
LHU, entrance gate	34.3	45.4	42.1	44.3
Husab Mine	40.5	41.0	28.2	34.1

AREVA Resources Namibia recorded an average PM_{10} dust concentration of 9.0 µg/m³ in the centre of Arandis, while Rössing Uranium measured 15.9 µg/m³ on the eastern edge of the town. This was well below the WHO IT-3 limit of 30 µg/m³ for the annual mean. The average daily dust concentrations at the Arandis station were below the WHO IT-3 limit of 75 µg/m³ (Figure 18). Peak dust levels in the Erongo region are normally associated with east wind events in winter, but the data for the last two years do not show evidence of severe sandstorms. The AREVA station's highest reading was 52 µg/m³ on 9 October 2016 when there were strong south-westerly winds.

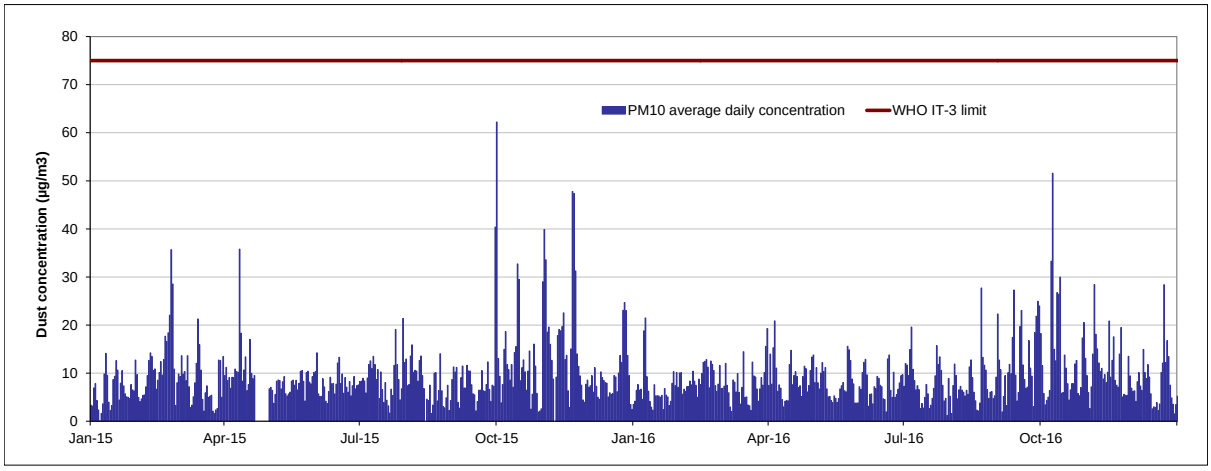

Figure 18: Average Daily PM10 Dust Concentration at Arandis (AREVA) in 2014-2016

Langer Heinrich Uranium uses high volume dust samplers fitted with PM_{10} heads to monitor dust levels in the environment. Samples are collected generally over a seven day period. There are three samplers placed around the site with the one used for critical group assessments situated at the entrance gate to the mine. During September 2016 Langer Heinrich commissioned anemometers at these monitoring stations to determine where the dust comes from. The anemometer data collected at the entrance gate indicated that the majority of dust originated outside the Langer Heinrich mining area and hence was an indication of the ambient conditions experienced in the surrounding desert region. The dust concentrations monitored may be influenced by vehicle traffic on the entrance road, which is some 100 metres from the monitoring station. PM_{10} concentrations of 34.3 µg/m³ measured at this station were below the WHO-IT-2 interim guideline of 50 µg/m³ for annual mean concentrations.

Rössing Uranium operates four PM_{10} stations at Arandis, the tailings storage facility, the Communications Management Centre and at the western mine boundary. The sampler at Arandis measures the PM_{10} dust concentration, wind speed and wind direction in intervals of 15 minutes (Figure 19). This allows the allocation of a dust concentration as mining-related (if the wind blows from the mine) or background (when the wind is blowing from any other direction). In 2016, it was found that the wind was blowing towards Arandis only 14% of the time, and towards other directions for the remainder of the time. The average PM_{10} dust concentration measured at Arandis was 16 µg/m^3, which is below the World Health Organization (WHO) annual guideline value. The concentration coming from the mine was 19 µg/m^3, while the average from other wind directions was 16 µg/m^3. The daily limit of 75 µg/m^3 was however exceeded on many days.

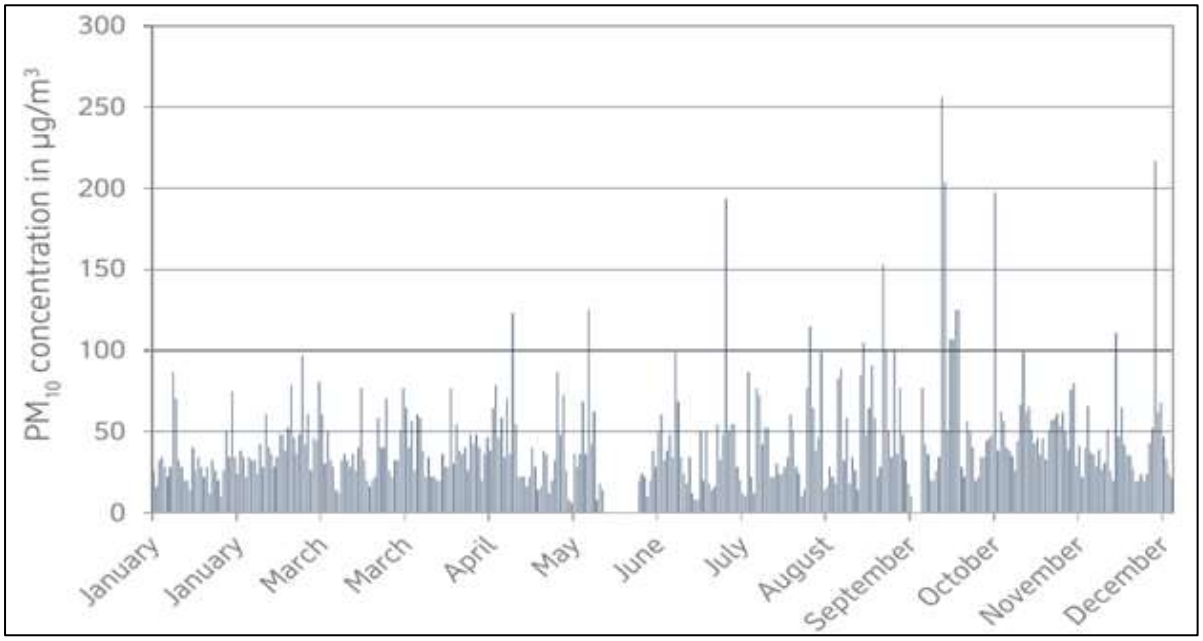

Figure 19: PM10 Dust Concentration at Arandis (Rössing) in 2016

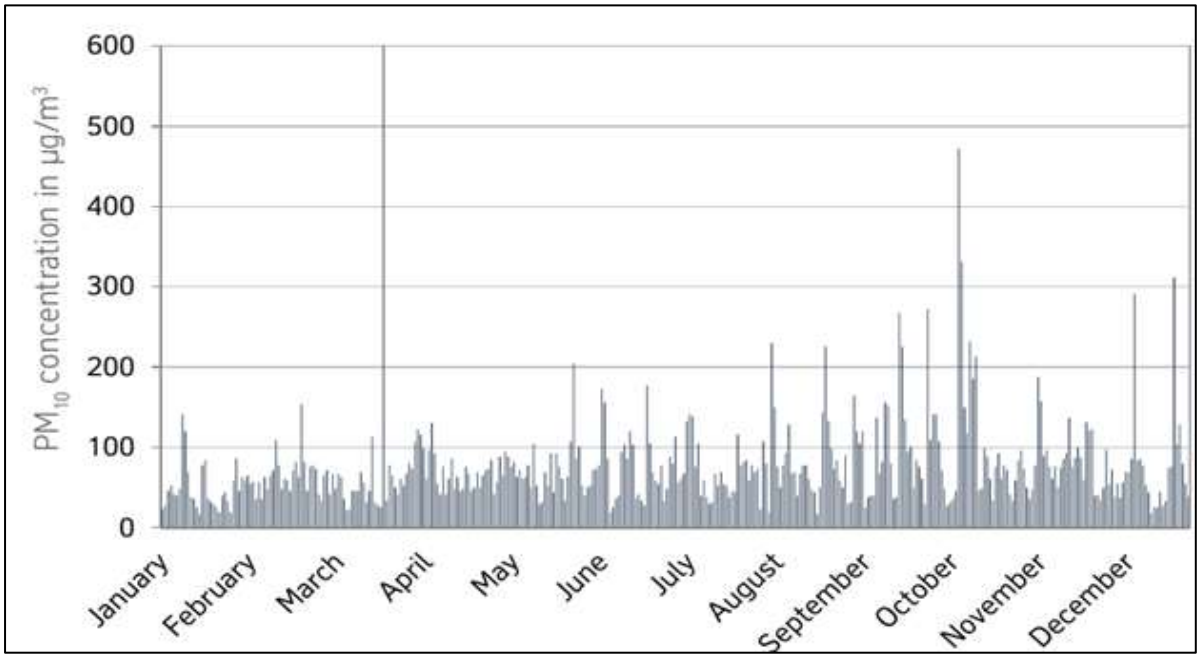

Figure 20: PM10 Dust Concentration at Rössing SW Boundary in 2016

The average PM_{10} concentration at the south-western mine boundary was 32 µg/m^3 (Figure 20). The weather data indicate that the wind was blowing from the mine 23% of the time with an average dust concentration of 33 µg/m^3, while the average PM_{10} concentration upwind of the mine was very similar at 32 µg/m^3. At this station the daily limit of 75 µg/m^3 was often exceeded as well.

Swakop Uranium's Grimm PM10 and PM2.5 monitor was functional during April-November 2016 (Figure 21). The measured average of 40.5 µg/m³ at Husab Mine exceeded the annual mean WHO IT-3 limit of 30 µg/m³, while the average daily dust limit of 75 µg/m³ was exceeded on 37 days.

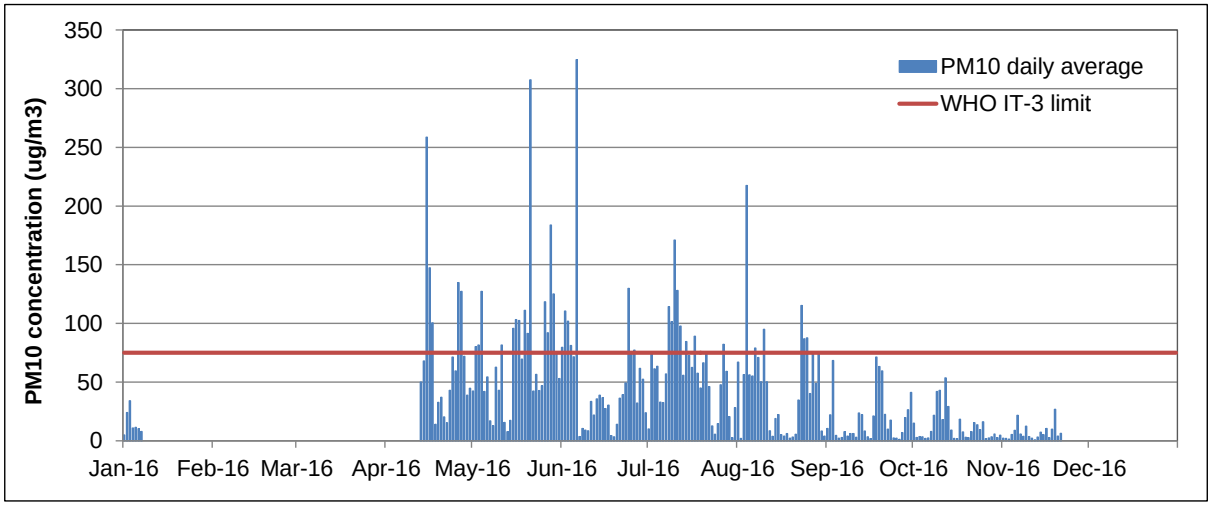

Figure 21: Average Daily PM10 Dust Concentration at Husab Mine in 2016

Motivation of status: The indicator was **MET** since PM_{10} dust was monitored at Swakopmund, Arandis and the operating mines. PM_{10} concentrations in residential areas were generally below the WHO IT-3 daily limit of 75 µg/m^3 with 3-6% exceedances at Swakopmund and Walvis Bay (Table 17). Note that the WHO daily limit is just a preliminary guideline until more applicable standards are proposed in the advanced air quality study.

Desired Outcome 5.2.	**Nuisance dust resulting from uranium mining is within acceptable thresholds.**
Target 5.2.1.	**Dust fallout levels at residences in towns should not exceed the recommended limit of 600 mg/m^2/day.**
Indicator 5.2.1.1.	**Continuous dust fallout measurements (mg/m^2/day) on a regional scale e.g. maintain existing SEA dust fallout network.**
Data Source	**SEMP Office/NUA**
Status:	**MET**

Dust fallout or nuisance dust has particles larger than 10 micrometres and is usually monitored by means of dust buckets. Monitoring of the SEA dust fallout network ended in 2012 after an adequate baseline of regional dust fallout levels had been established. It was found during this survey that the highest dust concentrations outside of mining areas occurred in the vicinity of gravel roads and that none of the towns in the region were affected by dust fallout exceeding the 600 mg/m^2/day residen-

tial imit. To establish whether this was still the case in 2016 dust fallout was measured at three sites in Arandis. The results presented in the graphs for AREVA (sites DM33 and DM34 in Figure 22) and Rössing (Figure 26) under indicator 5.2.2.1 showed dust levels below 150 mg/m^2/day.

Motivation of status: Target 5.2.1 specifies that dust fallout levels at residences in towns should not exceed the recommended limit of 600 mg/m^2/day. If this target is read together with the indicator that requires continuous dust fallout measurements to be carried out, it can be concluded that the intention has been **MET**.

Target 5.2.2.	**Mitigation measures to be implemented by mines at all major dust generating sources such as haul roads, materials transfer points and crushing operations. The best practical dust suppression methods should be implemented and monitored through dust fallout buckets at strategic locations**			
Indicator 5.2.2.1.	**Mines must implement a dust fallout network, measuring dust fall-out at main dust generating sources and mine license boundaries**			
Data Source	**SEMP Office/NUA/NRPA**			
Status:			**MET**	

All operating mines and mines under development applied mitigation measures and maintained dust fallout monitoring networks in 2016. The results are evaluated against the South African National Dust Control Regulations (SA NDCR) limit for residential areas of 600 mg/m^2/day and the limit for industrial areas of 1200 mg/m^2/day. Both limits may be exceeded up to three times within any year, but not in successive months. This provision may not be realistic for the Erongo region where the east wind might blow for several months during the winter season.

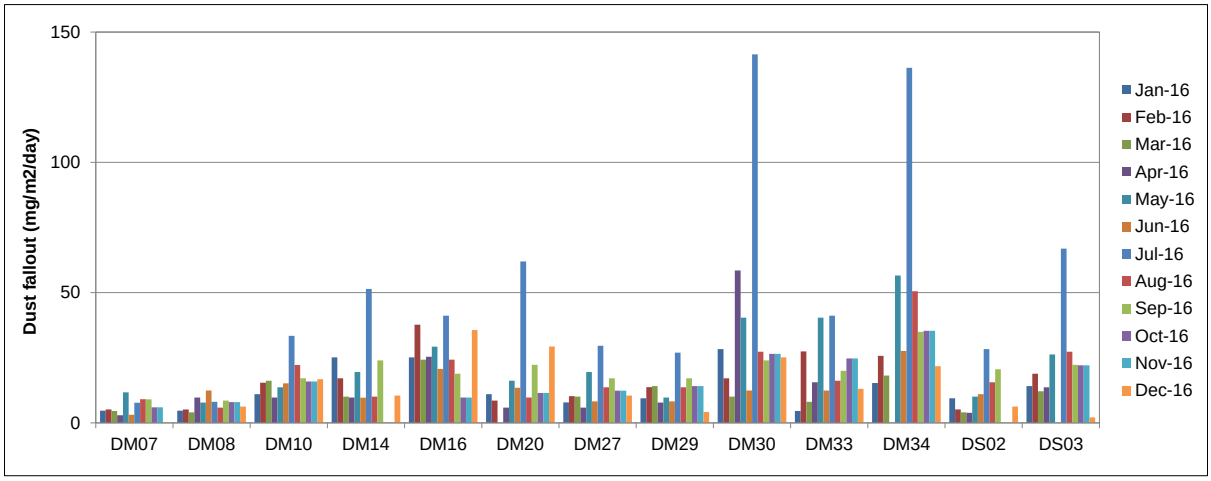

Figure 22: AREVA Resources Namibia Average Monthly Dust Fallout Concentrations

AREVA Resources Namibia monitored dust fallout at 13 sites on Trekkopje mine, at Arandis and at the Erongo desalination plant. Dust levels were generally low with annual average values of 6-42 mg/m^2/day. The highest readings were 141 mg/m^2/day at the western security gate and 136 mg/m^2/day at Arandis in July 2016 (Figure 22). Many monitoring sites showed slightly higher dust concentrations during the second half of the year, which may be caused by generally drier conditions

and higher wind speeds during this time. The dust fallout at all sites was below the SA NDCR limit for residential areas of 600 mg/m^2/day.

Figure 23: Bannerman Mining Resources Air Quality Monitoring Sites

Dust fallout rates at Bannerman Mining Resources' Etango project were generally low and within the 1200 mg/m²/day SA NDCR industrial limit (Figure 23 and Figure 24). The dust levels at farms Goanikontes (PPDF07) and Palmenhorst (PPDF09) however exceeded the 600 mg/m^2/day residential limit in May-June 2016 when the dust buckets were left in place for two months.

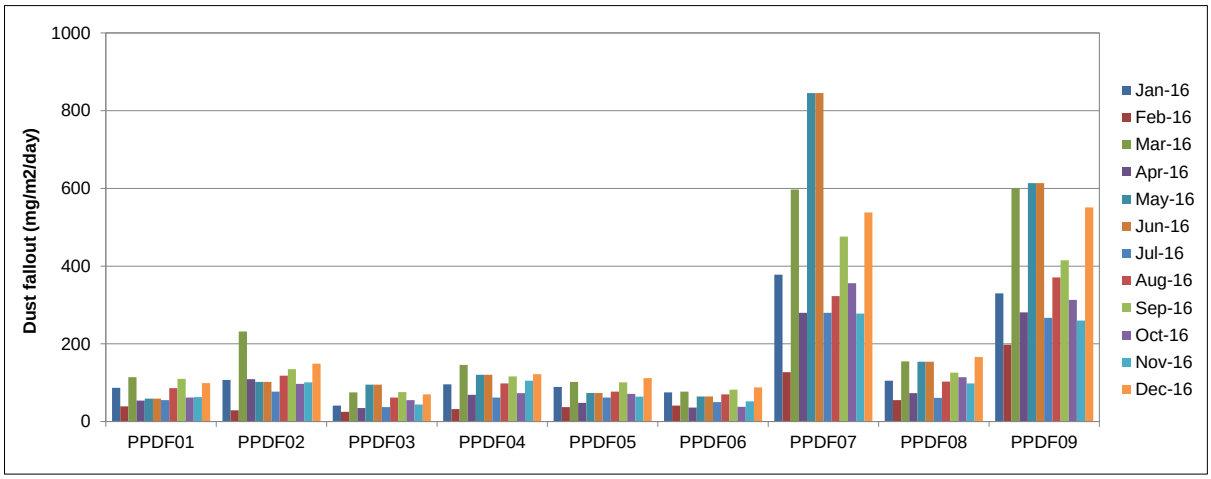

Figure 24: Bannerman Mining Resources Average Monthly Dust Fallout Concentrations

Bannerman Mining Resources did not carry out any unusual dust-generating activities at the heap leach facility.[60] Even though strong easterly winds occurred during this time, a comparison with

[60] Pers. comm. Bannerman Mining Resources Namibia, 2017

Swakop Uranium's data in Figure 28 points towards localised dust sources at or near the farms or even vandalism as the cause of high dust levels, rather than sandstorms.

In 2016, Langer Heinrich Mine monitored dust fallout at 11 sites on and around the ML 140 area. The results shown in Figure 25 are only for the sites outside of the main operational area, where members of the public or visitors might be affected. The readings were below the SA NDCR limit for residential areas of 1200 mg/m^2/day. The Bloedkoppie site where tourists may camp and the Gecko campsite remained below the residential limit of 600 mg/m^2/day.

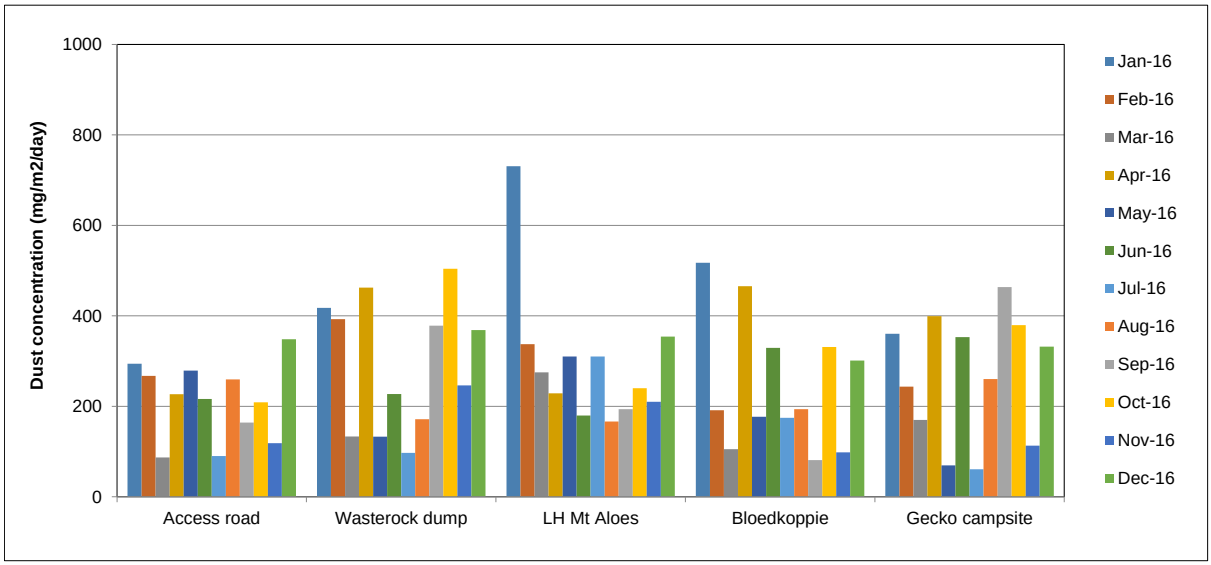

Figure 25: Langer Heinrich Mine Average Monthly Dust Fallout Concentrations

Rössing Uranium reported dust fallout results for Arandis and five sites on the mine boundary south-west and north-east of the open pit and tailings dam (Figure 26 and Figure 27). These directions correspond with the prevailing wind directions in the coastal region. The readings were below 50 mg/m^2/day, except for a peak of 84 mg/m^2/day recorded at the NE Tailings station in January 2016.

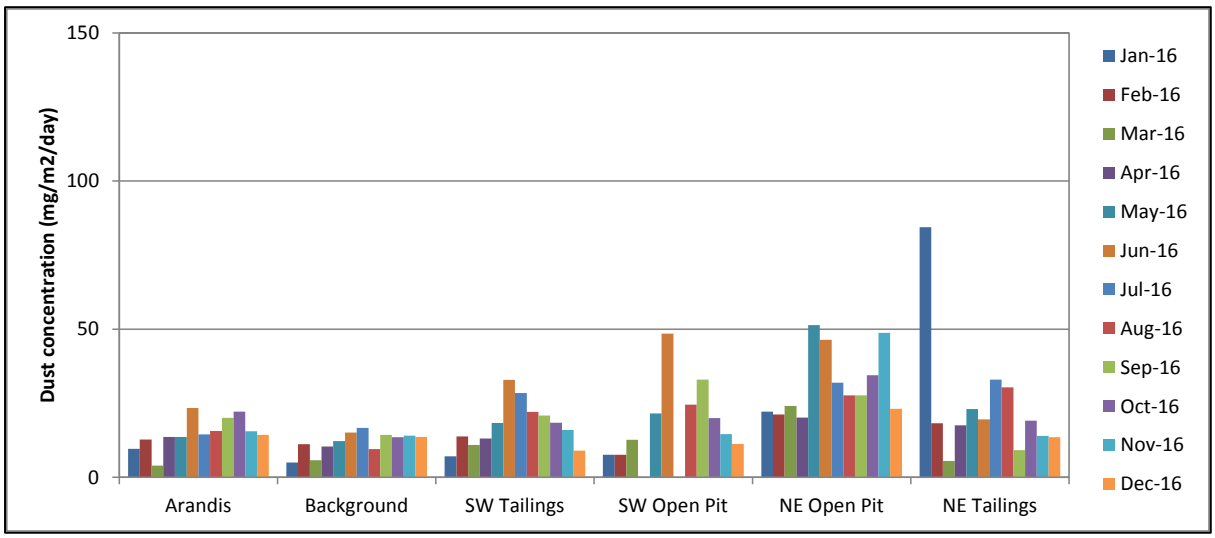

Figure 26: Rössing Uranium Average Monthly Dust Fallout Concentrations

Note the different vertical scales in the graphs for the mines on the plains (AREVA, Husab and Rössing) with a maximum of 350 mg/m^2/day compared to the mines in valleys (Bannerman and Langer Heinrich) with a maximum of 1000 mg/m^2/day.

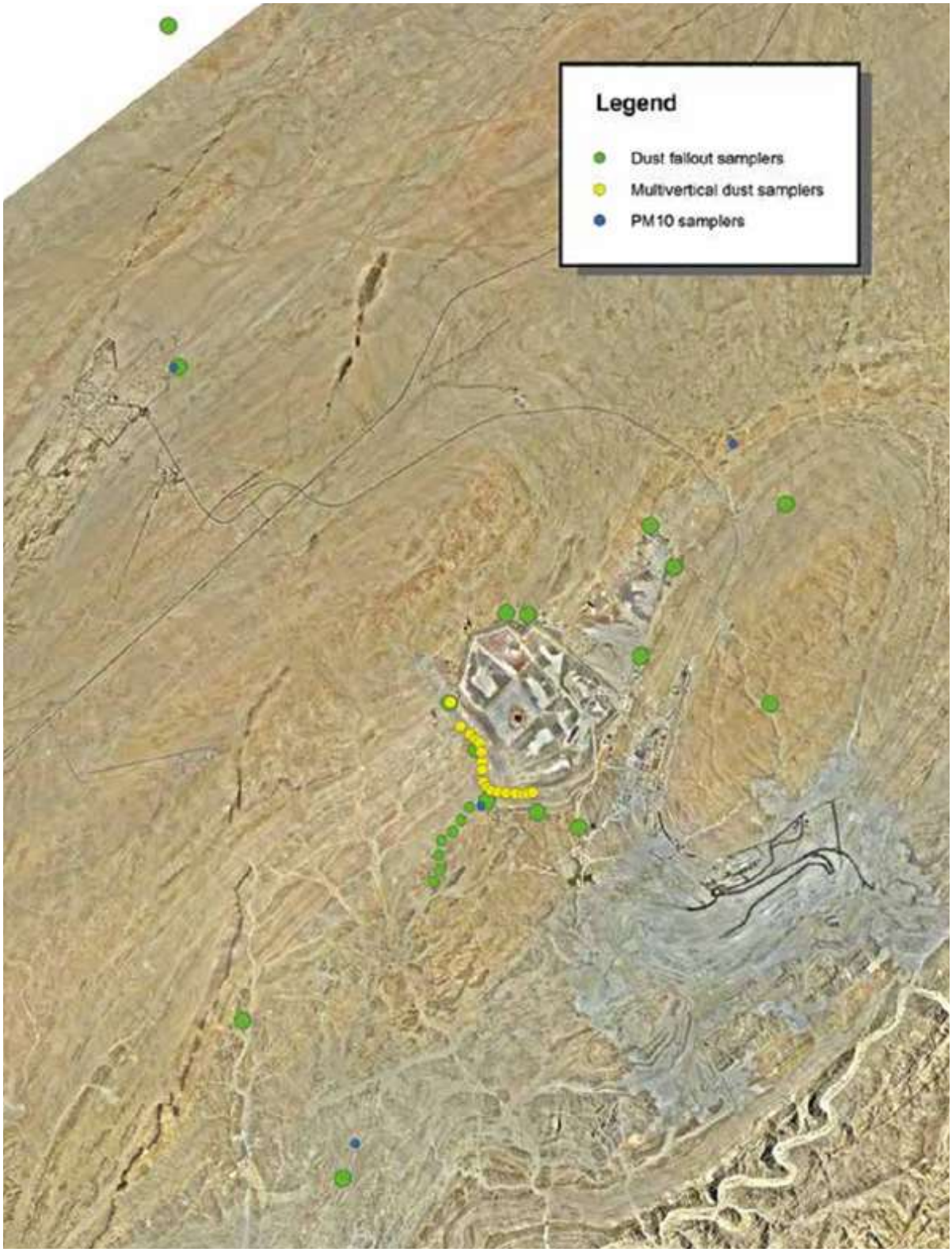

Figure 27: Rössing Uranium Air Quality Monitoring Sites

Swakop Uranium monitored 33 dust fallout buckets on and around the Husab mine site in 2016, though only stations outside the operational area are shown in Figure 28. The 30-day monitoring period does not coincide with a calendar month, i.e. the month shown as “Jan-16” in the graph is actually December 2015 to January 2016 and “Jan-17” is from December 2016 to January 2017.

All the dust levels were below the SA NDCR limit for residential areas of 600 mg/m^2/day, varying between <50 mg/m^2/day to around 150 mg/m^2/day with a maximum of 318 mg/m^2/day at EXT 31 in Sep/Oct 2016. Comparing the Swakop Uranium data to those of Bannerman's PPDF09 it is interesting to note that EXT 29 at farm Palmenhorst in the Swakop River did not record dust concentrations up to 600 mg/m^2/day.

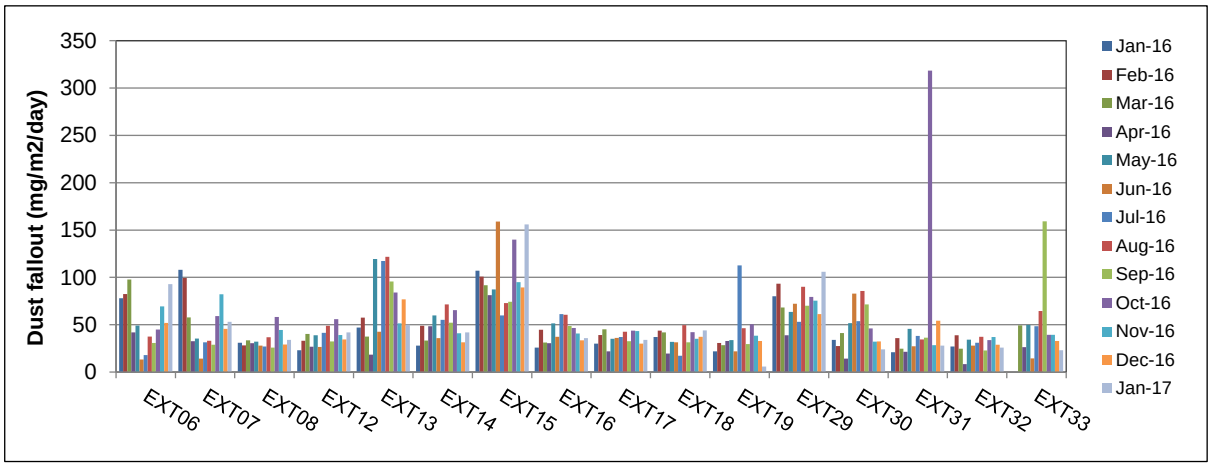

Figure 28: Swakop Uranium Average Monthly Dust Fallout Concentrations

Motivation of status: The indicator requires that mines implement dust fallout networks, measuring dust fallout at main dust generating sources and mine licence boundaries. The indicator was **MET** as demonstrated by the results presented above.

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Summary of performance: EQO 5

Total no. indicators assessed: 3

	NOT MET	IN PROGRESS	MET	EXCEEDED
Number of indicators in class	0	0	3	0
Percent of indicators in class	0%	0%	100%	0%

Overall performance: There was no change from the 2015 report as all three indicators continued to be **MET** (100%). Progress towards the long-awaited regional air quality standard was made when the advanced air quality study started in the last quarter of 2016. The consultants have set up a new regional monitoring system that will be handed over to GRN after the study.

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EQO 6.Health

Aims of this EQO: Workers and the public do not suffer significant increased health risks from uranium mining.

Radiation has existed in the universe since the beginning of time. Light, heat, infrared and ultraviolet rays have bombarded the earth since it was formed. We have learned to harness the energy of many types of radiation, such as radio waves, microwaves and the radioactivity emitted by unstable atoms of elements such as uranium, and we have added human-made sources to those that occur in nature. Because radiation occurs naturally on earth, both people and the environment have adapted to certain levels of ionising radiation. We are exposed every day to background radiation from cosmic rays, building materials, food, the earth we walk on, and the air we breathe. The naturally occurring background radiation in the Erongo region is approximately 1.8 millisieverts per annum (mSv/a).[61]

Uranium miners can be exposed to naturally-occurring radioactive materials (NORM) and more concentrated uranium. This occupational health hazard needs to be monitored and controlled. A dose is the amount of medically significant radiation a person receives. Although uranium itself is not very radioactive, the ore which is mined also contains decay products such as radon, and must be regarded as potentially hazardous, especially if it is high-grade ore. Radon gas emanates from the ore and mineral waste as radium decays. It then decays further into solid radon daughters, which are energetic alpha-radiation emitters. Precautions are required at uranium mines to protect the health of workers and the surrounding environment. The air quality as discussed in EQO 5 also plays an important role in relation to health. Adequate monitoring data must be available to assess the performance of the industry.

The National Radiation Protection Authority (NRPA) is a division within the Ministry of Health and Social Services (MHSS). Its objective is to protect human beings (workers, patients and the public), as well as the environment from undue risks, resulting from the harmful effects of ionising radiation, while allowing for its beneficial application in medical, industrial, scientific and other purposes.

Namibian legislation requires that radiation originating from mines is constrained so that the cumulative radiation dose to members of the public is minimized as far as reasonably practicable and does not exceed 1 mSv per annum above background. Public dose assessments model the predicted dose to the group of residents that lives closest to the mine, the so-called “critical group”. If several towns or settlements are situated around a mine there can be several critical groups. Some predictions from public dose models can be checked against actual measurements. Radon gas makes a significant contribution to the public dose: The weighted average for the Erongo region was estimated as 0.5 mSv/a in the SEA report. The SEMP Office therefore monitors and reports public exposure arising from the ambient concentration of radon and short-lived radon progeny at Arandis, Swakopmund and Walvis Bay.

NB: The term “designated radiation workers” that was used in Target 6.1.2 and Indicator 6.1.2.1 of the SEA report has been changed to “radiation workers”, though this term is not defined in the Atomic Energy & Radiation Protection Act (Act No 5 of 2005) and can have different meanings at each mining company. The Act uses the term “occupationally exposed persons” for all mine workers and medical personnel who may be exposed to ionising radiation. Though medical professionals are mentioned in 6.1.2.1 their exposure is not included within the scope of the SEMP report.

[61] Rössing Uranium Radiation Management Plan 2015

Desired Outcome 6.1.	**Disease rates amongst the public and employees of the mines are not increased as a result of uranium mining**
Target 6.1.1.	**Increments in the concentrations of uranium, thorium and health-relevant nuclides of the uranium, thorium and actinium decay chains such as Ra-226 and Ra-228 (above respective background concentrations) in air and water (ground and surface) that originate from uranium mines, must be constrained so that the cumulative radiation dose to members of the public is reasonably minimized and does not exceed 1 mSv per annum above background**
Indicator 6.1.1.1.	**Public dose assessments produced by each new mine project include the cumulative impact of other operating mines**
Data Source	**NUA/NRPA**
Status:	**IN PROGRESS**

There is still a data gap because the only assessment that considered the cumulative impact of the existing mines and new exploration projects on the public dose in the Erongo uranium province was carried out as a specialist study in the SEA.[62] The mines' public dose assessments completed after the SEA only considered the dose to the nearest critical group(s) or the dose at the mine boundaries in the absence of residents in the vicinity.

The uranium mines are required to report annually regarding the implementation of their Radiation Management Plans (RMP) relating to radiation protection or radiation safety standards, pursuant to Section 29(2) of the Act of the Atomic Energy & Radiation Protection Act, Act No 5 of 2005. This provision is intended to give assurance to the Authority that the operations are indeed maintained within legislative and regulatory requirements as approved in the RMP and any safety assessments that have been done as contemplated in the RMP. The dose assessments with regard to the member of the public or critical groups are evaluated in relation to the potential exposure pathways that reach certain public groups.[63]

Public doses were assessed based on exposure pathways such as the inhalation of dust and radon progeny and consumption of potentially contaminated groundwater or vegetables grown in the area. Seeing that each pathway can potentially reach different critical groups the impact of exposure to members of the public contributed by various mines was not yet clearly estimated. For example the air quality data collected from some of public areas do not include radionuclide analyses of the dust samples. Also there are not enough data or baseline data against which to compare.[64] This is one of the reasons why the SEMP Office has commissioned an advanced air quality study for the uranium province that will re-evaluate the 2010 air quality model and produce an updated cumulative radiation dose assessment.

[62] MME (2010): Strategic Environmental Assessment for the Central Namib Uranium Rush. Ministry of Mines and Energy, Republic of Namibia, Windhoek
[63] NRPA contribution to 2016 SEMP report, 2017
[64] NRPA contribution to 2016 SEMP report, 2017

Motivation of status: The advanced air quality and radiation study to be completed in 2018 is expected to provide a comprehensive re-assessment of the cumulative impact of all operating mines. The indicator can thus be rated **IN PROGRESS**.

Indicator 6.1.1.2.	**Modelled cumulative radiation dose to critical groups of the public does not exceed 1 mSv/a above background**			
Data Source	**NUA/NRPA**			
Status:			**MET**	

Public dose assessments have been carried out by AREVA Resources Namibia[65], Swakop Uranium[66], Bannerman Mining Resources, Langer Heinrich Uranium and Rössing Uranium[67] to determine the additional doses to critical groups or persons present at the mine boundaries (Table 19). The results ranged from 0-0.4 mSv/a in addition to the natural background radiation. More details for each mine are reported below.

Table 19: Public Dose Assessment Results of Various Mines

Company	**Public dose assessment results (mSv/a)**		
	Additional dose at mine boundary	Additional dose to critical group	Critical group location
AREVA RN	0.04-0.4	0	Arandis
Bannerman MR	-	1.08 (including background)	Goanikontes warehouse
Langer Heinrich	-	2.3 (incl. background)	Entrance gate
Rössing Uranium	0.03	0.02	Arandis
Swakop Uranium	<0.1	0	Khan River, Welwitschia plains

AREVA Resources Namibia: Trekkopje mine is still under care and maintenance. The critical group, residents of Arandis, could potentially be exposed due to inhalation of radioactive dust and radon progeny; other pathways like ingestion of groundwater are not applicable because it is naturally saline and unsuitable for consumption. The maximum dose to the public was modelled to be 0.04-0.40 mSv for hypothetical groups of people residing at the boundaries of the mining licence. The mining operation is not contributing to the dose at Arandis in the current situation.

Langer Heinrich Uranium: The dose to members of the public is estimated for a theoretical group living on the boundary of the mine. The exposure pathway are assumed to be due to long-lived ra-

[65] Blerk, J.J. van and N. Potgieter (2011): Radiological Public Impact Assessment for the Trekkopje Uranium Mine: Swakopmund (Namibia). Report No. ASC-1012B-1 prepared by AquiSim Consulting (Pty) Ltd, Pretoria, South Africa

[66] SLR Environmental Consulting (2013): Environmental impact assessment report amendment for the proposed changes to the Husab mine. SLR Project No. 7NA.13001.00004

[67] NECSA (2011): Report on the Radiological Public Hazard Assessment for the Expansion of Rössing Uranium Mine in Namibia as a Specialist Study for the Phase II SEIA. Report no. NLM-REP-10/098, Pretoria, RSA

dioactive dust (LLRD), radon gas (RDP dose) and external gamma dose which gave a total of 2.3 mSv/a at Langer Heinrich's mine boundary (entrance gate) including the natural background radiation.

There are no residents nearby because the mine is situated in the Namib-Naukluft Park; the critical group in this case consists of security guards manning the gate. Langer Heinrich commissioned anemometers at their environmental monitoring stations to determine the origin of the long-lived radioactive dust and radon decay products monitored. The anemometer results at the entrance gate indicate that most of the dust comes from the surrounding desert; hence the majority of the assessed radiation dose will originate there too. When a full year's worth of anemometer data has been collected a better estimate of the additional contribution to the dose at the boundary will be made. The main contributor to the current dose at Langer Heinrich is the gamma radiation pathway (1.75 mSv/a).

Rössing Uranium: The critical group is comprised of the people of Arandis. The exposure pathways include the emission of radioactive dust, radon emitted as a result of the mining process and potential groundwater contamination. For potential groundwater contamination there are currently no critical groups that can be affected as the direction of water flow from the mine is toward the Khan River in the south and contamination is well controlled with no impact in the immediate environment.[68] The exposure to the public is considered to be very low to negligible as there has been no change to the mining operation that could increase the exposure compared to 2015.

Swakop Uranium: There are no settlements in the immediate vicinity of the mine, even though the construction camp is still in use. The closest permanent critical groups are various smallholdings in the Swakop River as well as farms situated towards the east and northeast of the mine. The critical group may potentially be exposed due to inhalation of radioactive airborne dust, inhalation of radon/thoron progeny and ingestion of radionuclides by way of consuming food or water. In 2016 the company reported doses below 0.1 mSv/a to the critical groups.

Table 20: SEMP Radon Monitoring Network Results for 2014, 2015 and Oct 2016-May 2017

	Average Radon Concentration (Bq/m^3)			**Dose (mSv/a)[69]**
	2016/17	**2015**	**2014**	**2016/17**
Arandis	17.4	19.5	20.3	0.4
Swakopmund	8.2	12.7	11.7	0.2
Walvis Bay	4.6	7.9	7.9	0.1

The three radon monitoring stations that the SEMP Office has established at Arandis, Swakopmund and Walvis Bay now form part of the monitoring network for the advanced air quality study. There was a gap in data collection during most of the year 2016 until the study started in October. Table

[68] Rössing Uranium RMP, 2016 cited by NRPA

[69] The doses were calculated as follows: Average radon concentration in Bq/m^3 * 0.4 (equilibrium factor between radon and progeny) * 0.00000556 mJ/m^3 (conversion factor) * 1.1 mSv (dose conversion factor) * 8760 hours.

20 compares data for the period mid-October 2016 to mid-May 2017 with readings for 2014 and 2015. The ambient radon concentrations measured in 2016/17 varied from 4.6 Bq/m^3 at Walvis Bay to 17.4 Bq/m^3 at Arandis. Radon is emitted from any type of soil but not from ocean water, so one would expect lower values at the coast.

Public doses calculated from the measured data are in the range of 0.1-0.4 mSv/a. These results confirm that the contribution of radon to the public dose at Arandis, Swakopmund and Walvis Bay did not increase compared to the 2010 SEA baseline study.[70]

Motivation of status: The indicator was **MET** because the modelled radiation doses to critical groups are much lower than 1 mSv/a above background.

Target 6.1.2.	**The cumulative radiation dose to members of the public and radiation workers does not exceed the legal limit.**			
Indicator 6.1.2.1.	**Measured change in absorbed radiation dose of uranium mine workers and medical professionals (radiation workers)**			
Data Source	**NUA**			
Status:			**MET**	

Uranium mines are required to provide assurance that all occupational radiation exposures are within the regulatory limit of 20 mSv/a in addition to the natural background and that reasonable attempts have been made to minimise all exposures. Also protection and safety must be optimised in order that the magnitude of worker doses, the number of people exposed and the likelihood of incurring exposure are kept as low as reasonably achievable, economic and social factors being taken into account, with the restriction that the doses to individuals delivered by the source be subject to dose constraints. Some mining companies have adopted a dose constraint of 6 mSv/a for optimisation purposes.[71]

Workers are classified as either designated workers or non-designated workers. The designated workers are referred to as radiation workers in this report because they work in areas where they can potentially be exposed to 5 mSv or more in year. The non-designated persons are working in areas without radiation risk such as offices.

The individual doses shown in Table 21 are calculated by summing all the exposure pathways and all types of radiation exposure. The figures show the mine-wide weighted average doses to all occupationally exposed persons including background and extrapolated to an average working time of 2000 hours per annum. The only exception is Bannerman Mining Resources, where the dose shown in the table excludes the natural background.

[70] MME (2010): Strategic Environmental Assessment for the Central Namib Uranium Rush. Ministry of Mines and Energy, Republic of Namibia, Windhoek

[71] Information under this indicator provided by NRPA based on the following reports:
Langer Heinrich Uranium: Annual radiation report 2016
Bannerman Resources: Annual report on the implementation of the radiation management plan 2016
Rössing Uranium Limited: Implementation of radiation management plan annual report 2016
AREVA Resources Namibia: 2016 annual report on radiation management at Trekkopje mine
Swakop Uranium, Implementation of radiation management plan annual report 2016

The average doses varied between 1.1 mSv/a at Rössing Uranium and 2.3 mSv/a at AREVA Resources Namibia, while the maximum individual doses at operating mines were 2.6-7.2 mSv/a. Langer Heinrich Uranium reported an average annual dose to all monitored workers of 1.6 mSv/a. This figure includes workers who were not designated radiation workers and workers who were not present for the full twelve months of 2016. The theoretical average dose to a person working full-time at Langer Heinrich mine would be 2.3 mSv/a.

Motivation of status: None of the measured doses to workers exceeded the limit of 20 mSv/a in 2016. This indicator was therefore **MET**.

Table 21: Radiation Dose to Uranium Mine Workers

Company	Average dose to all occupationally exposed persons (mSv/a)	Number of occupationally exposed workers	Number of workers exposed to >5 mSv/a	Number of workers exposed to >20 mSv/a	Individual maximum dose (mSv/a)
AREVA RN	2.3	81	0	0	2.6
Bannerman	0.19	11	0	0	0.34
Langer Hein.	1.6	852	2	0	7.2
Rössing U	1.1	1500	1	0	6.0
Swakop U	0.24	1517	0	0	1.97

Target 6.1.3.	**No measurable increase, directly or indirectly attributable to uranium mining and its support industries in the incidence rates of the following:** • **Industrial lung disease (including pneumoconiosis)** • **Lung cancer and other industrial-related cancers** • **Industrial induced renal damage** • **HIV/ AIDS, tuberculosis** • **Industrial dermatitis**
Indicator 6.1.3.1.	**Measured change in the incidence rate of industrial diseases amongst uranium mine workers.**
Data Source	**NUA**
Status:	**MET**

The information about industrial diseases presented in Table 22 has been obtained from Medixx Occupational Health Services in Swakopmund who carry out occupational medical examinations for all

the operating uranium mines and most of their contractors. During 2014-2016 Medixx examined many short-term contractors working at the Husab project. The health profile of this group of employees may be different from that of permanent mine employees. That is why Table 22 shows the industrial disease rates of permanent mine employees, while Table 23 provides a summary of all mine and contractor employees that were examined.

Table 22: New Industrial Disease Cases among Permanent Mine Employees

Disease	2012	2013	2014	2015	2016
Noise-induced hearing loss	1	1	3	0	1
Contact dermatitis	4	4	2	2	1
Pneumoconiosis	0	0	0	0	0
Occupational asthma	0	0	1	0	0
Lung cancer	0	1	1	0	0
Asbestosis	0	0	0	0	0
Industrial-induced renal damage	0	0	0	0	0
Number of medical examinations	2801	2563	2358	2727	3171
New cases as % of all examinations	0.2%	0.2%	0.3%	0.1%	0.1%

The number of new cases varied from 2 to 7 per year among permanent mine employees and 7-18 if contractors are included. The average incidence rate was 0.1-0.2%, with a peak of 0.3% in 2014. The most common disease was contact dermatitis, a skin complaint that is caused by prolonged exposure to chemicals or other irritants. Noise-induced hearing loss was also relatively common, while respiratory diseases including pneumoconiosis, asthma, lung cancer and asbestosis occurred occasionally. Only three of the latter cases were permanent mine workers, while nine were contractors. It is possible that some of these contractors have been exposed to hazardous conditions during their previous employment history, but it would be inappropriate to go into more detailed medical information in the SEMP report.

Table 23: New Industrial Disease Cases among Mine and Contractor Employees

Disease	2012	2013	2014	2015	2016
Noise-induced hearing loss	1	8	9	6	5
Contact dermatitis	4	7	5	6	3
Pneumoconiosis	1	2	0	0	0
Occupational asthma	0	0	1	0	1
Lung cancer	1	1	1	1	2
Asbestosis	0	0	1	0	0
Industrial-induced renal damage	0	0	0	0	0
Number of medical examinations	9920	9820	12049	15197	11784
New cases as % of all examinations	0.1%	0.2%	0.1%	0.1%	0.1%

HIV/AIDS and tuberculosis (TB) occur among all sectors of the population and are only defined as industrial diseases if workers are infected under specific circumstances. For instance in South Africa,

TB is recognised as an industrial disease if contracted by underground mine workers who have been exposed to high levels of silica in dust.[72] HIV/AIDS has been identified as a problem among mine workers who live in hostels far from their families and may therefore engage in unsafe sexual practices. This situation does not apply to the Namibian uranium industry where employees live with their families in established towns. The only exception is during the construction phase when large numbers of contractor employees are accommodated in temporary camps.

Table 24: New HIV and TB Cases among Permanent Mine Employees

	2012	2013	2014	2015	2016
Newly diagnosed HIV cases (self-reported)	1	2	0	2	1
Rate of newly reported HIV cases per 100 000	36	78	0	73	32
Known HIV cases (diagnosed during lifetime)	7	56	50	49	59
Percentage of known HIV+ cases	0.2%	2.2%	2.1%	1.8%	1.9%
Newly diagnosed TB cases	3	0	1	5	2
Rate of new TB cases per 100 000	**107**	**0**	**42**	**183**	**63**
Known TB cases (diagnosed since birth)	8	6	15	54	94
Rate of known TB cases per 100 000	286	234	636	1980	2964

The reported HIV infection rate of about 2% for mine employees (Table 24) and almost 3% including contractors (Table 25) is much lower than the national average of 17-19% during the reporting period. The figures may however be too low because they are based on voluntary self-reporting by workers. HIV testing is not included in the scope of occupational medical examinations, but can be conducted if a person wants to be tested.[73]

The most recent Namibian national rate of new TB cases was 449 per 100 000, while the most recent rate of new TB cases in the Erongo region was over 1000 per 100 000.[74] The rate of new cases diagnosed at the uranium mines in the Erongo region was much lower at 63 per 100 000 permanent employees (Table 24) and 85 per 100 000 if contractor employees are included (Table 25).

Table 25: New HIV and TB Cases among Mine and Contractor Employees

	2012	2013	2014	2015	2016
Newly diagnosed HIV cases (self-reported)	20	3	8	10	16
Rate of newly reported HIV cases per 100 000	202	31	66	66	136
Known HIV cases (diagnosed during lifetime)	276	216	327	378	323
Percentage of known HIV+ cases	2.8%	2.2%	2.7%	2.5%	2.7%
Newly diagnosed TB cases	15	2	4	19	10
Rate of new TB cases per 100 000	**151**	**20**	**33**	**125**	**85**
Known TB cases (diagnosed since birth)	27	32	136	550	451
Rate of known TB cases per 100 000	272	326	1129	3619	3827

[72] Ministry of Health and Social Services, National Tuberculosis and Leprosy Programme, Summary Report 2014-15

[73] Pers. comm. Medixx Occupational Health Services

[74] www.mhss.gov.na/files/downloads/c38_NTLP%20Annual%20Report%202015.05.pdf

Some additional information on TB may be of interest to show the extent of this disease. Roughly one-third of the world's population has been infected with tuberculosis, and new infections occur at a rate of one per second. In Africa, TB primarily affects adolescents and young adults. According to data for 2013 the World Health Organisation ranked Namibia as the country with the fourth highest per capita incidence of TB in the world (Figure 29).

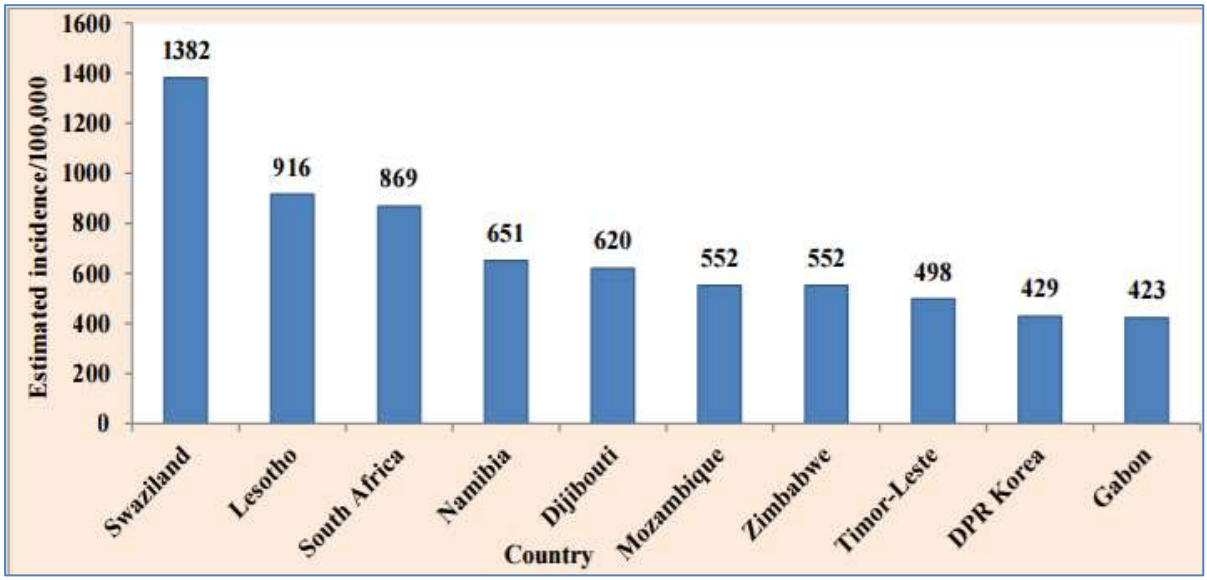

Figure 29: Countries with Highest TB Incidence

Within Namibia the highest number of TB infections and new smear positive (NSP) cases was recorded in the Khomas, Ohangwena and Erongo regions (Figure 30).[75] TB predominantly occurs where people live under poor conditions in crowded dwellings without sufficient ventilation.

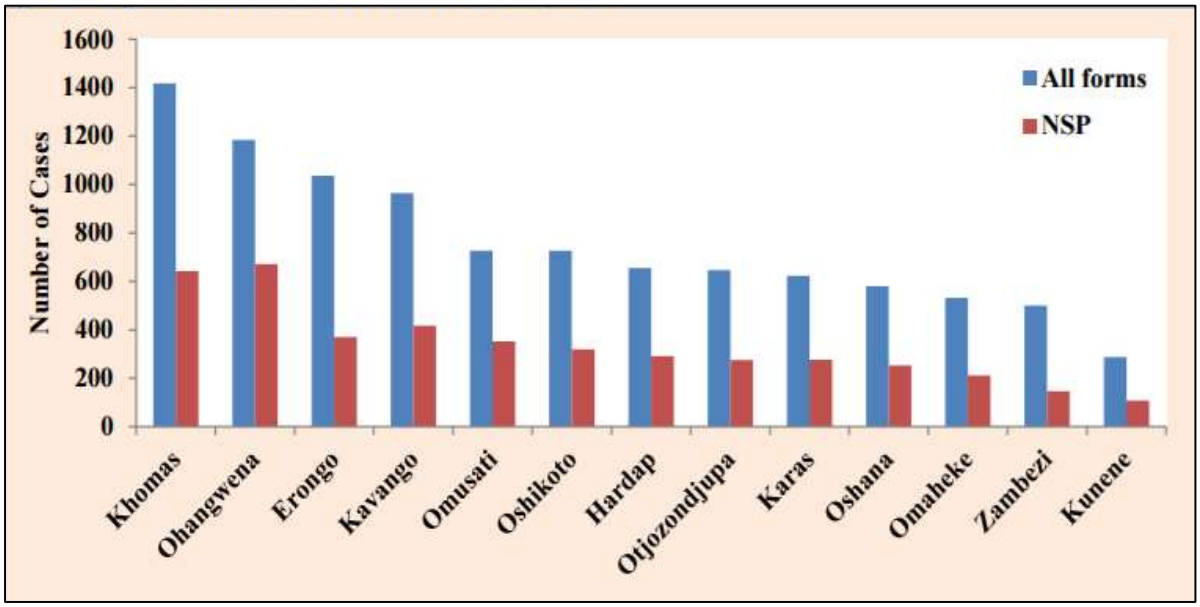

Figure 30: Regional Distribution of TB Cases in Namibia

[75] www.mhss.gov.na/files/downloads/c38_NTLP%20Annual%20Report%202015.05.pdf

Motivation of status: This is the first time that information on industrial diseases has been included in the SEMP report. The indicator to be measured is the change in the incidence rate of industrial diseases amongst uranium mine workers. Looking at the number of recognised industrial disease cases in Table 22 and Table 23 it is evident that the rate has remained around 0.1-0.2% during the period from 2012 to 2016, with an exception of 0.3% in 2014. The absence of an increasing trend means that the indicator has been **MET**.

Indicator 6.1.3.2.	**Measured change in the incidence rate of diseases scientifically attributed to radiation amongst members of the public, uranium mine workers and medical personnel**			
Data Source	**NUA**			
Status:		**IN PROGRESS**		

As mentioned in the previous SEMP report Rössing Uranium started a comprehensive epidemiological study of former and current employees of the mine, from which conclusions about the incidence rate of radiation-related diseases may be drawn. The aim of the epidemiological study is to determine whether there is an excess, work-related cancer risk for uranium miners.[76] The research project is being conducted by the University of Manchester's centres for Occupational & Environmental Health and Biostatistics, the Institute of Population Health and the Faculty of Medical and Human Sciences.

All former and current workers who have worked at the mine between 1976 and 2010 for more than one full year were identified as suitable candidates for the study cohort. During 2016, Rössing Uranium started identifying the occupational exposure of all these workers. The company initiated collaboration with the Namibian Cancer Registry and the South African Cancer Registry, who will help to identify cancer cases for the study. The identities of participating individuals are protected, since only anonymised data will be used in the study.

An external advisory committee consisting of members of the Mineworkers Union of Namibia, the Namibian Uranium Association, the Ministry of Health and Social Services and the Ministry of Mines and Energy has been appointed to provide community oversight and input to the project. Regular updates and information sessions are provided to keep interested stakeholders informed about progress. The collection of data and subsequent analysis is expected to take approximately two years, after which the study would be submitted for publication in the international peer-reviewed literature.[77]

Motivation of status: Seeing that the Rössing Uranium study has started in 2016 and is expected to be completed within the next two years the indicator was rated **IN PROGRESS**.

[76] Werner Duvenhage, Rössing Uranium, media briefing on 26 February 2016
[77] Rössing Uranium Limited (2017): Report to stakeholders 2016 – Taking the long-term view

Desired Outcome 6.2.	**Improved healthcare facilities and services are able to meet the increased demand for healthcare resulting from uranium mining.**
Target 6.2.1.	**An increase in qualified health workers available to all in the Erongo region, reaching 2.5 per 1000 of the population by 2020.**
Indicator 6.2.1.1.	**Number of available qualified healthcare personnel: 2.5 per 1000 of population;** **Number of Medical Practitioners: 1 per 1000 of population;** **Number of Dental Practitioners: 1 per 2000 of population;** **Number of nurses: 2.5 per 1000 of population;** **Pharmacists: 1 per 2000 of population.**
Data Source	**SEMP Office/MHSS**
Status:	**NOT MET**

Target 6.2.2.	**An increase in registered healthcare facilities in Erongo, available to all, reaching 2.5 acute care beds per 1000 population and 0.5 chronic care beds per 1000 population by 2020.**
Indicator 6.2.2.1.	**Number of available registered healthcare facilities: 1 per 1000.**
Data Source	**SEMP Office/MHSS**
Status:	**NOT MET**

Target 6.2.3.	**An increase in ambulances in Erongo, reaching 1 per 20,000 by 2020.**
Indicator 6.2.3.1.	**Number of available ambulances: 1 per 20,000.**
Data Source	**SEMP Office/MHSS**
Status:	**NOT MET**

Namibians have access to three types of health services: public, private and not-for-profit healthcare systems. Only 15% of the country's population, mostly middle and high income earners can afford private healthcare services, while 85% of the population uses public and non-profit health care facili-

ties. Certain services like organ transplantations are only available from private medical centres, putting them out of reach of the majority of Namibia's citizens.

Ensuring the provision of quality health care is one of the most important goals of the Ministry of Health and Social Services (MHSS). Although efforts are being made to build capacity and skills of health workers to provide quality essential services, past evidence shows that Namibia's public health facilities face several challenges related to governance, financing, resources and coordination. MHSS conducted a Workload Indicators of Staffing Need (WISN) exercise in 2015 to generate evidence to inform the Ministry's staffing decisions.[78] Staffing norms in Namibia had not been revised in over ten years. This fact, along with the general shortage of certain cadres, necessitated that the MHSS review both the staffing norms and number of health workers. The WISN method was applied to all 13 regions in Namibia and focused on four particular cadres of health workers perceived by the MHSS to be the most critical, i.e. doctors, dentists, nurses, pharmacists and pharmacist assistants.

The WISN results estimate the number of health professionals required to practice according to national practice standards in Namibia. Although the results of the WISN application raised grave concerns around the quality of health service provision, the results have been useful in guiding policy recommendations to the MHSS, including increasing the number of positions for cadres with critical shortages, redistributing existing staff, reviewing health facility classifications, promoting appropriate task sharing, introducing a new cadre, focusing on competency training, reviewing health information systems indicators, and basing all policy on health service priorities. The report stated that MHSS used the WISN results to justify additional positions in the staff establishment.

Table 26: Health Professionals in the Erongo Region

	Doctor		Dentist		Pharmacist		Pharmacist assistant		Registered nurse		Enrolled nurse	
Health District	Actual	Required	Actual	Required	Actual	Required	Actual	Required	Actual	Required	Actual	Required
Omaruru district	3	4.6	0	0.8	0	2.8	1	2.5	0	33	0	30
Swakopmund district	5	14	2	1	0	4.3	4	6.7	49	64	27	43
Usakos district	2	4.7	0	2	0	2.8	1	4.2	24	36	16	30
Walvis Bay district	4	14	3	1	0	4.5	2	9.3	12	89	9	69
Total	**14**	**37**	**5**	**5**	**0**	**14**	**8**	**23**	**85**	**223**	**52**	**172**
Target ratio per 1000	1:1000		1:2000		1:2000		1:2000		2.5:1000		2.5:1000	
Actual ratio per 1000	1:12550		1:35150		None		1:22000		1:2070		1:3380	

Currently, the Erongo region's public health infrastructure consists of 21 clinics, 1 health centre and 5 hospitals. Table 26 summarises the WISN results for the Erongo region compared to the SEMP targets. It also shows the target ratios of health care professionals against the actual numbers in 2015, assuming a population of 175,750 in Erongo[79]. Ten times more doctors and pharmacists or pharmacist assistants would be needed to meet the required ratios. The WISN report regarded the number of five dentists in Erongo as adequate, even though the ratio is only 1:35,150. If the number of registered and enrolled nurses is combined the actual ratio is 1:1280, which is still far from the desired coverage of 1 per 400 persons (2.5:1000). The number of healthcare facilities was 27 for 175,750 inhabitants, which translates to a ratio of 1:6500 compared to the target of 1:1000. The indicator proposes one ambulance per 20,000 inhabitants, i.e. nine for the region. The actual number was not given in the MHSS reports. Information obtained from a local paramedic indicates that there are quite a few state ambulances, but some have been damaged by untrained or inexperienced drivers.[80] The private healthcare system figures were not reviewed because it is not accessible to all.

[78] MHSS (2016): Namibia National WISN Report 2015: A Study of Workforce Estimates for Public Health Facilities in Namibia. Report by IntraHealth International-Namibia on behalf of MHSS, Windhoek

[79] NSA (2016): Presentation-NIEHS 2015-2016 Preliminary Indicators, www.nsa.org.na.

[80] Pers. comm. Eagle Ambulance Services, 2017

Motivation of status: The indicators were previously rated IN PROGRESS because there were some improvements in the public healthcare system and the due date was still five years away. Now that the WISN study has provided the actual figures for 2015 it appears doubtful that the indicators will be met by the year 2020, especially taking into consideration the state's current budget constraints that will prevent significant progress in the coming years. The indicators were regarded as **NOT MET** for 2016.

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Summary of performance: EQO 6

Total no. indicators assessed 8

	NOT MET	IN PROGRESS	MET	EXCEEDED
Number of indicators in class	3	3	2	0
Percent of indicators in class	37.5%	37.5%	25%	0%

Overall performance: Two indicators were **MET** (25%): The radiation dose to workers at mines did not exceed the legal limit and the incidence of occupational diseases did not increase. Three indicators **IN PROGRESS** (37.5%) related to public dose assessments that will be re-assessed as part of the advanced air quality study and the Rössing Uranium epidemiological study. The three indicators measuring the ratio of healthcare professionals and facilities per number of population were rated **NOT MET** (37.5%) because it appears unlikely that MHSS will be able to meet them by the year 2020.

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EQO 7.Effect on Tourism

Aims of this EQO:

- **The natural beauty of the desert and its sense of place are not compromised unduly by uranium mining; and to identify ways of avoiding conflicts between the tourism industry and prospecting/mining, so that both industries can coexist in the Central Namib.**
- **Uranium mining does not prevent the public from visiting the usually accessible areas in the Central Namib for personal recreation and enjoyment; and to identify ways of avoiding conflicts between the need for public access and mining.**

The hotel and restaurant sector of the tourism industry recorded a growth of 1.4% in 2016 and its contribution to the Namibian GDP increased from 2.0% in 2016 to 2.1% in 2016.[81] The economic contribution of the entire tourism sector including travel agents, airlines and other passenger transportation services, as well as leisure activity operators is not reflected in the national accounts. The number of tourists arriving in Namibia increased by 5% from 1.4 million in 2014 to 1.5 million in 2015. Most of these tourists were coming from Angola, South Africa, Zambia, Germany, Zimbabwe, Botswana, the USA and France.[82] The NSA Sectorial Report on Tourism of September 2016 (the latest that is available) shows that the index of regional and international arrivals increased from 114 to 119, while the room occupancy rate of 119 in 2015 rose to 129 in 2016. [83] The FNB/FENATA Travel Index (Figure 31) [84] shows that tourism was doing well until the end of 2016, but started feeling the recession in 2017. Most international travellers spend a few nights at the coast and take part in leisure activities, which are an important contributor to the economy of the Erongo region.

Figure 31: FNB/FENATA Travel Index 2010-2017

[81] NSA (2017): Preliminary National Accounts 2016, www.nsa.org.na.
[82] Namibian Statistics Agency 2016
[83] Data from www.nsa.org.na/page/publications/SectorialReports/Tourism Sept 2016
[84] Graph from Namibia Economist via Google

To ensure that visitors will be able to enjoy the natural beauty of the desert and its sense of place EQO 7 advises the uranium mining industry to reduce its visual impact and to identify ways of avoiding conflict between the tourism industry and prospecting/mining, so that both industries can coexist in the Central Namib. Uranium mining should not prevent the public from visiting the usually accessible areas in the Central Namib for personal recreation and enjoyment. A compromise has to be found between the public's need for access and the mines' requirement to safeguard their properties against unauthorised incursions.

Desired Outcome 7.1.	**Central Namib is accessible to the public (within the regulations of the National Parks).**
Target 7.1.1.	**Uranium mining does not result in net loss of publicly accessible areas.**
Indicator 7.1.1.1.	**Areas of importance for recreation that are not yet alienated by mining or prospecting are declared 'red flag' for prospecting or mining. These include: The Walvis-Swakop dunes, Messum Crater, Spitzkoppe (Gross and Klein), Brandberg, the Ugab, Swakop, Khan, and Kuiseb rivers, the coastal area between the Ugab River mouth and the tidal mud banks south of Sandwich Harbour (between lower mark and the main coastal road), the Welwitschia Drive and Park campsites.**
Data Source	**NERMU/NUA**
Status:	**IN PROGRESS**

The SEA envisaged that areas of importance for recreation would be red or yellow flagged, meaning that mining or prospecting activities would not be permitted in red-flagged areas and special conditions would be imposed in yellow-flagged areas (Figure 32).[85] Some of the areas identified in this indicator are situated in national parks and thus fall under the ambit of the National Policy on Prospecting and Mining in Protected Areas (refer to EQO 8 for background on the policy).[86]

Table 27 indicates if mining activities will be prohibited in the listed areas once the policy has been approved. Prospecting and mining will not be allowed along the Kuiseb River, including a buffer zone to the north, the Ugab River and along the entire coastline. The policy however does not give specially protected status to the Welwitschia drive, Moon landscape and park campsites (Figure 33 and Figure 34). The Messum Crater, Gross and Klein Spitzkoppe and Brandberg are located outside of national parks, but within the communal Tsiseb and #Gaingu conservancies. MME allows mining in conservancies, though it should also be approved by the conservancy committee and relevant traditional authority. The implementation of red and yellow flagged status would require MME to formally recognise the protected areas identified in the SEA or in any future regional integrated land use plan. Currently, the only possible protection is the declaration of national monuments, as is the case for the Brandberg and the rock paintings at Spitzkoppe (* in Table 27).

[85] MME (2010): Strategic Environmental Assessment for the Central Namib Uranium Rush. Ministry of Mines and Energy, Republic of Namibia, Windhoek

[86] National Policy on Prospecting and Mining in Protected Areas

Table 27: Protection Status of Central Namib Tourism Hotspots

EQO 7 Tourism Area	Protected Area Name	Flag	Policy prohib-its mining?[87]
Walvis-Swakop dunes	Dorob National Park	Red	No
Messum Crater	Dorob, Tsiseb Conserv.	Red	No
Spitzkoppe (Gross and Klein)	#Gaingu Conservancy	Red	Partly*
Brandberg	Tsiseb Conservancy	Red	**Yes***
Ugab River	Dorob and Tsiseb	Yellow	**Yes**
Swakop/Khan River	Namib Naukluft NP	Yellow	No
Kuiseb River	Namib Naukluft, Dorob	Yellow	**Yes**
Coastal area from Ugab River mouth to tidal mud banks south of Sandwich Harbour	Namib Naukluft and Dorob National Parks	Yellow	**Yes**
Welwitschia drive	Namib Naukluft NP	Yellow	No
Moon landscape	Namib Naukluft NP	Yellow	No
NNNP campsites	Namib Naukluft NP	Yellow	No

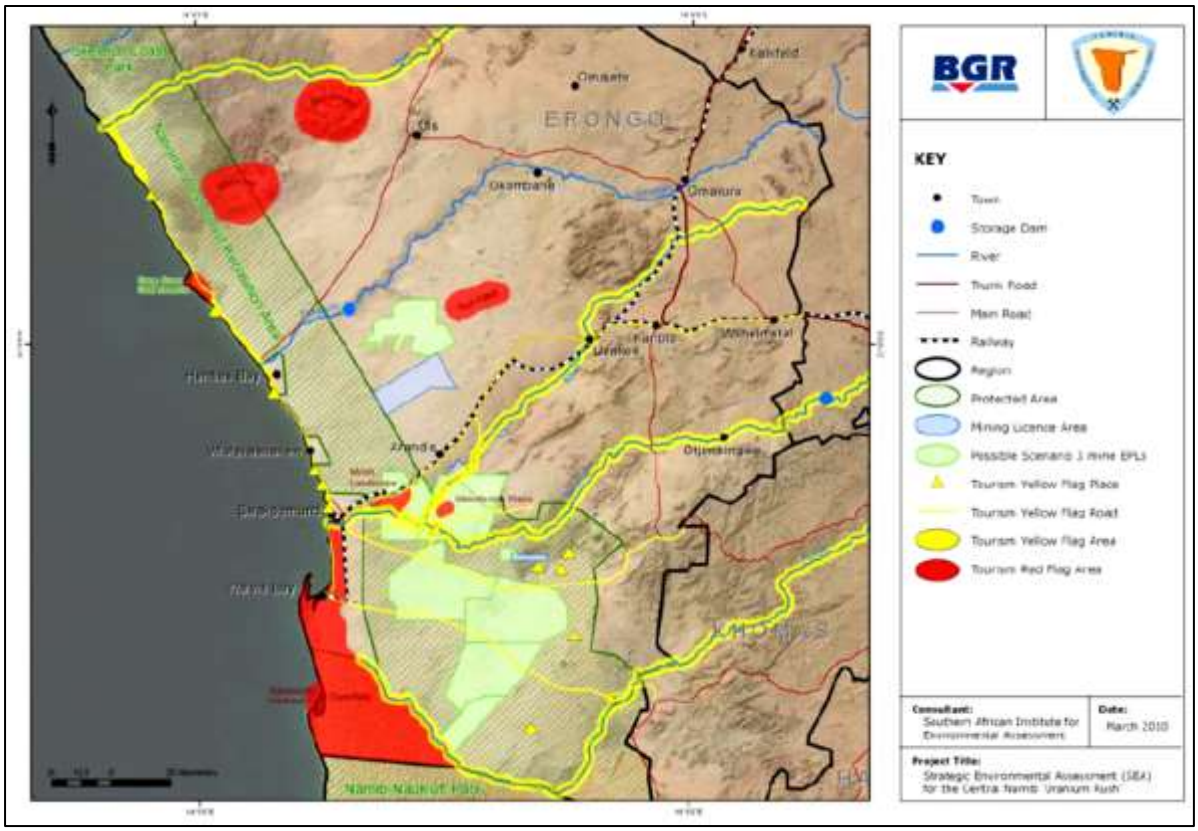

Figure 32: Red and Yellow Flag Tourism Areas

The Minerals (Prospecting and Mining) Act (No. 33 of 1992) makes provision for the "reservation of land from prospecting operations and mining operations" in section 122 which reads: "*Subject to the provisions of this section, the Minister may at any time by notice in the Gazette, if he or she deems it necessary or expedient in the national interest, declare that no person other than the holder of a re-*

[87] National Policy on Prospecting and Mining in Protected Areas

connaissance licence shall … carry on any prospecting operations or mining operations in, on or under any land or area described by the Minister in such notice." This section has however been challenged in court with the result that mining had to be permitted in areas identified as reserved land.

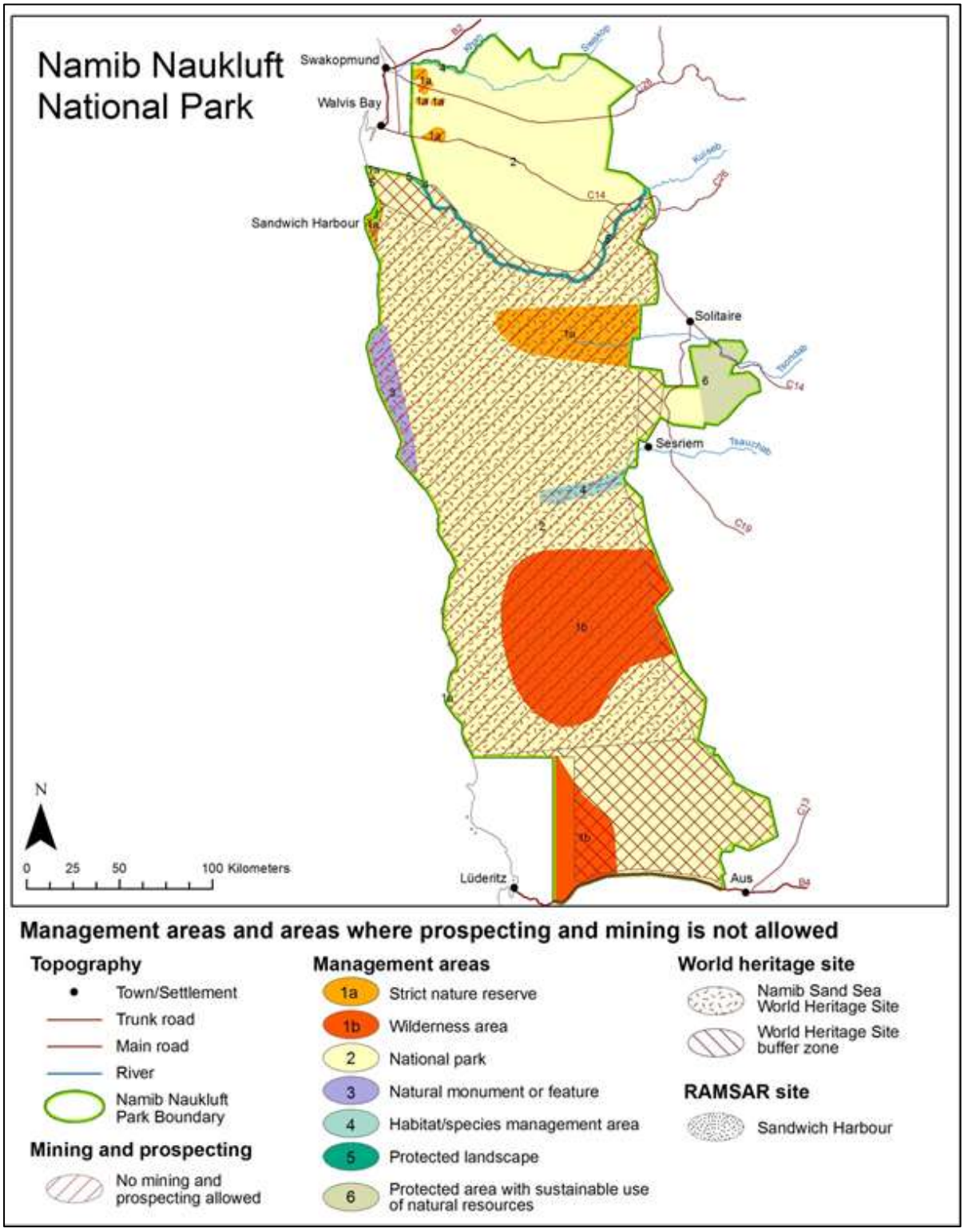

Figure 33: Protected Areas of the Namib Naukluft National Park

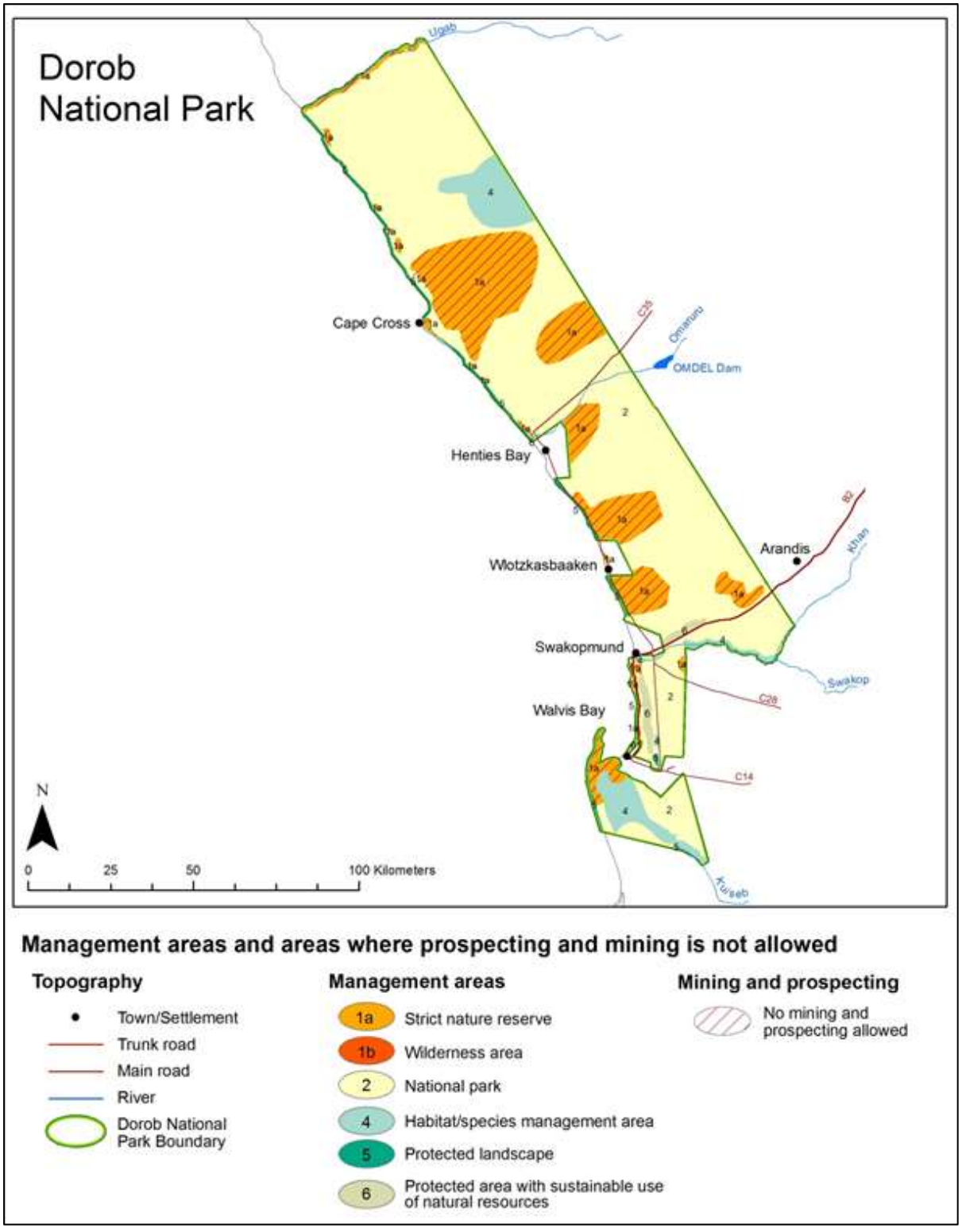

Figure 34: Protected Areas of the Dorob National Park

Motivation of status: Some of the most popular recreation areas listed in the indicator have been excluded from the final draft of the prospecting and mining in protected areas policy. Some areas are not within national parks and will need to be protected by other means. Seeing that the policy has been signed and five important areas are or will be protected the indicator was rated **IN PROGRESS** for 2016.

Indicator 7.1.1.2.	**EIAs for all new listed mineral developments address the issue of public access.**			
Data Source	**NERMU/NUA**			
Status:				

NUA reported that none of its member companies had carried out any EIAs for new mineral developments in 2016.

Motivation of status: The indicator was **NOT APPLICABLE.**

Indicator 7.1.1.3.	**Mine closure plans and environmental contracts of exploration companies address public access after project closure.**			
Data Source	**NERMU/NUA**			
Status:			**MET**	

To evaluate this indicator one has to distinguish between operating mines and exploration companies. The latter can rehabilitate exploration drilling and trenching sites to restore public access without any restrictions and this has in fact happened as reported by Bannerman Mining Resources, Reptile Mineral Resources and Exploration, Rössing Uranium (Z20 area), Valencia Uranium and Zhonghe Resources (Namibia) Development. Swakop Uranium has addressed this requirement as per current approved EMP for exploration activities. Once work at exploration sites is completed, the roads are closed off and rehabilitated where required. Public access is never restricted during exploration activities apart from the road to the drill site and physical drill site.

Even though the full restoration of public access after closure of an operating mine would be ideal, the radioactive nature of the remaining mineral waste will generally require the public to be excluded from waste storage facilities and in the case of Rössing also from the open pit, which will remain unfilled. In terms of the IAEA standards for uranium mining waste management and international good practice public access to an open pit backfilled with tailings would only be permitted if a tailings cover was in place and designed to reduce the radon emanation to such an extent that a person living on the site would be exposed to less than the public dose limit of 1 mSv/a above the natural background.

EQO 7 specifies that uranium mining should not prevent the public from visiting the usually accessible areas in the Central Namib for personal recreation and enjoyment. It should be noted that Rössing Uranium has not been accessible for the last 40 years and the Langer Heinrich Uranium area has been out of bounds since the Namib Naukluft Park was proclaimed in 1979. Even if sections of these mine sites were to remain cordoned off after mine closure it would not result in a net loss in usually accessible areas (as per Target 7.1.1).

Motivation of status: Exploration companies have rehabilitated their sites and mining companies have made provision for public access to the extent that is feasible in their closure plans. The indicator was **MET**.

Desired Outcome 7.2.	**Uranium mining does not significantly reduce the visual attractiveness of the Central Namib.**			
Target 7.2.1.	**Direct and indirect visual scarring from uranium mining is avoided or kept within acceptable limits.**			
Indicator 7.2.1.1.	**Tour operators continue to regard areas such as the dunes, the coastline, Moon Landscape, Welwitschia Flats, Swakop and Khan River areas, and Spitzkoppe as a 'significant' component of their tour package.**			
Data Source	**CTAN, NERMU, Ministry of Environment and Tourism**			
Status:			**MET**	

Evidence presented in this section is based on a tourism survey conducted in 2014 and confirmed by checking the operators' tour packages that are advertised on the internet in 2016. Trips to the dunes, Moon Landscape and Welwitschia are offered by Living Desert Adventures, Charly's Desert Tours and Tommy's Tours, among others. Turnstone Tours and Swakop Tour Company conduct day trips in the Khan and Swakop River valleys, while Charly's Desert Tours offer trips to Spitzkoppe.

Seeing that the operators' tour packages still include the sites listed in the indicator it can be accepted that the findings of the 2014 survey continue to be relevant. Tour operators (n = 12) interviewed during the 2014 survey, rated the Central Namib a median score range of 4 and 5 on a five-point scale (1=not used at all, 5=highly significant component) for the attractions listed in this indicator. When the tour operators' responses are clustered into three classes (i.e. not significant, significant or highly significant) for each attraction, more than 70% of operators rated the specific attraction as "significant" or "highly significant" (Figure 35).

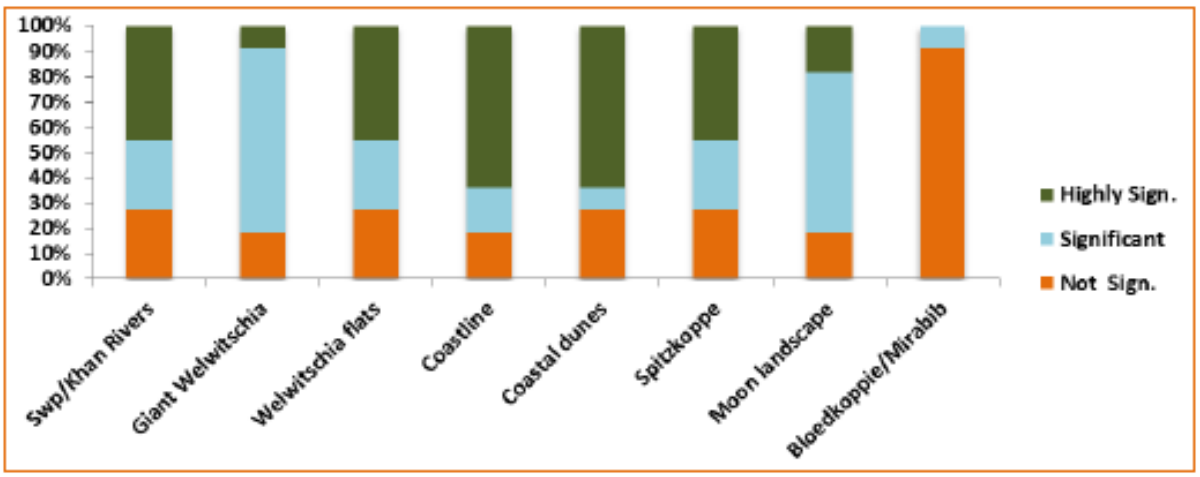

Figure 35: Significance of Particular Sites for Central Namib Tour Operators

The coastline and coastal dunes were most popular with the highest percentage of "highly significant" ratings. Sites closer to exploration or mining operations such as the Giant Welwitschia, Welwitschia Flats, Moon Landscape and the Swakop and Khan rivers were regarded as "significant" or "highly significant" by more than 70% of the respondents. Spitzkoppe is included in the indicator, but there is currently no uranium exploration in this area. The site with the least significance

(Bloedkoppie/Mirabib) in this graph was not part of the initial SEMP 'yellow or red flag' areas reserved for tourism, but was listed by one operator as significant to his package.

Motivation of status: Because the relevant tour operators were still offering trips to the listed attractions as a significant component of their tour packages in 2016, the indicator was rated **MET.**

Indicator 7.2.1.2.	**Tourists' expectations are 'MET OR EXCEEDED' more than 80% of the time in terms of their visual experience in the Central Namib.**			
Data Source	**NERMU/NUA**			
Status:				**EXCEEDED**

The SEMP steering committee decided at its April 2017 meeting that the use of internet sites that allow tourists to give feedback on their travel experience was an appropriate data collection method for this indicator. The most widely used platform with thousands of reviews related to Namibia is TripAdvisor (www.tripadvisor.com). On the day of writing, they had 29,458 reviews of the Erongo region, which included self-drive and guided desert tours. To access the detailed reviews one has to search each of the listed attractions or tour companies. The relevant options are listed in Table 28 together with the number of ratings in the various categories. There are more tour operators in the region, but not all of them were reviewed on TripAdvisor. Another limitation is that only reviews in English were evaluated, resulting in a total of 1318 reviews.

Table 28: Tourist Ratings of Uranium Province Trips on TripAdvisor

Name	Excellent	Very good	Average	Poor	Terrible	Total
Spitzkoppe	154	72	13	2	0	241
Welwitschia Plains	117	86	41	7	2	253
Living Desert Adventures	217	11	5	1	1	258
Charly's Desert Tours	75	17	4	1	1	58
Namibia Tours & Safaris	284	28	4	2	0	318
Turnstone Tours	72	9	3	2	0	86
Batis Birding Trips	69	4	0	2	0	75
Bush Bird Flights	22	4	0	0	3	29
Total	**1010**	**231**	**70**	**17**	**7**	**1318**

Tourists who went to the Welwitschia Plains also mentioned the Moon Landscape, which was rated "very good" to "excellent". People who gave "poor" or "terrible" ratings were disappointed by their tour guides, the number of animals seen or the cost of the trip. TripAdvisor has a function that allows the reviews to be searched for key words. To find out if anybody was put off by the impact of mining activities, the reviews were checked for the words "uranium", "mining", "mine" and "tracks". None of the reviews from 2015 or 2016 mentioned any of these key words in the context of uranium prospecting, probably because there was no more drilling in the Namib-Naukluft Park. Some tours visited salt and mica mines and reviewers mentioned them as "amazing". Even looking at the possi-

bility that tourists taking scenic flights, e.g. from Swakopmund to Sossusvlei, could easily see tracks across the desert from exploration activities did not turn up any negative reviews.

Motivation of status: There were no critical remarks about uranium mining made in 2016. If "excellent" is defined as "exceeded" and "very good" means "met" then the percentage of both ratings adds up to 94%, while the indicator only requires more than 80%. The indicator was **EXCEEDED**.

Indicator 7.2.1.3.	**All EIAs for mine development address visual impacts and sense of place.**
Data Source	**NERMU/NUA/MET**
Status:	

No new EIAs or EMPs were published during the current review period.

Motivation of status: The indicator was **NOT APPLICABLE**.

Desired Outcome 7.3.	**Areas of significant natural beauty or sense of place are afforded proper protection (without undermining existing legal rights).**
Target 7.3.1.	**Improved protection of listed areas.**
Indicator 7.3.1.1.	**MME recognizes and respects 'red flag' status for areas regarded as being significantly beautiful.**
Status:	
Indicator 7.3.1.2.	**MME recognizes and respects 'yellow flag' status for areas regarded as being scenically attractive.**
Data Source	**NERMU/MME**
Status:	
Indicator 7.3.1.3.	**No new mining and prospecting licences are awarded in the red and yellow flag areas as identified by the SEA.**
Data Source	**NERMU/NUA**
Status:	

Indicators 7.3.1.1, 7.3.1.2 and 7.3.1.3 refer to the red and yellow flagged areas as identified in the SEA report (Figure 32). It is expected that MME will be guided by the National Policy on Prospecting and Mining in Protected Areas that is still awaiting submission to Cabinet. However, as described

under Indicator 7.1.1.1, the policy does not cover all the red and yellow flagged areas that were identified in the SEA. Whether or not MME will take the SEA recommendations into consideration will only become apparent once new EPLs and MLs are issued. The uranium EPL moratorium, which remained in effect in 2016, prohibited the issuing of new prospecting licenses in the area of relevance to the SEMP. No new mining licenses were issued either even though a few applications were pending.

Motivation of status: The three indicators were **NOT APPLICABLE** because no new EPLs or MLs were issued in 2016.

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Summary of performance: EQO 7

Total no. indicators assessed: 4 (5 were **NOT APPLICABLE**)

	NOT MET	IN PROGRESS	MET	EXCEEDED
Number of indicators in class	0	1	2	1
Percentage of indicators in class	0%	25%	50%	25%

Overall performance: The tourism EQO's five indicators related to EIAs and new licences issued by MME could not be assessed because there were no new developments in 2016 (**NOT APPLICABLE**). Of the remaining four indicators, the one about tourists' expectations was again **EXCEEDED** (25%) and two indicators were **MET** (50%), showing that tourism operators and mining industry manage to coexist in the Central Namib. It seems that conflict between the need for public access and mining has so far been avoided and uranium mining did not prevent the public from visiting the usually accessible areas in the Central Namib for personal recreation and enjoyment. One indicator concerning the Policy on Prospecting and Mining in Protected Areas was still **IN PROGRESS** (25%).

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EQO 8.Ecological Integrity

Aims of this EQO: The ecological integrity and diversity of fauna and flora of the Central Namib is not compromised by uranium mining. Integrity in this case means that ecological processes are maintained, key habitats are protected, rare and endangered and endemic species are not threatened. All efforts are taken to avoid impacts to the Namib and where this is not possible, disturbed areas are rehabilitated and restored to function after mining/development.

There are major overlaps in the location of rare species, critical biodiversity areas and the presence of minerals in Namibia. The potential negative impacts of exploration and mining activities can be devastating to biodiversity and ecosystems. Landscape alteration, soil and water contamination and the loss of critical habitats can lead to the loss of important and endemic plant and animal species, which can compromise ecosystems and reduce tourism potential. While a number of strategies were employed to address exploration and mining activities in protected areas, it had become evident that strong policy frameworks and tools had to be developed to improve decision-making and provide protection for biodiversity, ecosystem services and cultural heritage from development impacts.

It is on this basis that MME and MET developed a National Policy on Prospecting and Mining in Protected Areas. The vision of the policy is to allow sustainable prospecting and mining in Namibia to support economic growth, whilst maintaining the integrity of ecosystems and natural resources, and avoiding degradation of highly sensitive areas of ecological, social or cultural heritage value. This is to be achieved through the identification of key ecologically and culturally sensitive areas within Namibia's protected areas, including the red and yellow flagged areas identified in the uranium province SEA[88]. Supportive measures to enhance the areas' protection include improved decision-making in the awarding of exploration and mining licences. Approval of the policy by parliament will be a major step forward in meeting several targets and indicators of EQO 7, EQO 8 and EQO 10. The Minister of Mines and Energy has signed the final draft of the policy in early 2017.

The annual SEMP reports offer the inhabitants of the uranium province an opportunity to review and understand the cumulative impacts of uranium mining on their ecological environment. This is achieved through the assessment of indicators within this EQO, which also allows stakeholders to track the progress of actions taken to collectively address concerns about likely impacts on biodiversity including rare, endangered and endemic species, and other aspects of ecological integrity such as the protection of ecological processes and key habitats.

Feedback from previous SEMP reports confirmed that the central Namib's conservation objective of species diversity and integration remained a priority, and that efforts by both the regulating authorities and mining companies were made to avoid, mitigate or rehabilitate mining impacts. Continued monitoring of the extent of direct impacts and the measures put in place to ensure persistence of all species remains relevant, even though the pace of new mine development has slowed down considerably in the last three years.

Biodiversity conservation in parts of the central Namib without uranium mining remains a challenge. Uncontrolled urban development along the coast continues to exert pressure on the natural environment, despite NACOMA's efforts to put in place a National Policy on Coastal Management. Many other developments go ahead without environmental assessment or EMP.

[88] MME (2010): Strategic Environmental Assessment for the Central Namib Uranium Rush. Ministry of Mines and Energy, Republic of Namibia, Windhoek

Desired Outcome 8.1.	**The ecological integrity of the Central Namib is maintained.**
Target 8.1.1.	**The mining industry and associated service providers avoid impacts to biodiversity and ecosystems, and where impacts are unavoidable, minimisation, mitigation and/or restoration and offsetting of impacts is achieved.**
Indicator 8.1.1.1.	**Important biodiversity areas [red or yellow flag areas] are taken into consideration when adjudicating prospecting and mining applications.**
Data Source	**NERMU/NUA/MET**
Status:	

The SEA envisaged that important biodiversity areas would be red flagged or yellow flagged in the National Policy on Prospecting and Mining in Protected Areas, meaning that mining or prospecting activities would not be permitted in these areas (Figure 36). Table 29 indicates in which areas mining and prospecting will be prohibited once the policy has been approved. No-mining areas include the Ugab River, the entire coastline between Ugab and Sandwich Harbour with some hotspots further inland (Figure 33), the Kuiseb River and delta, the lichen fields east of Wlotzkasbaken and three small sites along the C28 and C14 roads (Figure 34). The policy will not give "specially protected" status to the Welwitschia plains, the Omaruru, Swakop and Khan rivers, and numerous larger and smaller biodiversity hotspots within the northern Namib Naukluft National Park.

Table 29: Protection Status of Red-flagged Central Namib Biodiversity Hotspots

EQO 8 Biodiversity Area	Protected Area Name	Policy prohibits mining?
Brandberg	Tsiseb Conservancy	**Yes**
Messum Crater	Dorob, Tsiseb Conservancy	No
Ugab River	Dorob NP and Tsiseb	**Yes**
Coastal area between Ugab River and Sandwich Harbour	Namib Naukluft and Dorob National Parks	**Yes**
Omaruru River	Dorob National Park	No
Spitzkoppe (Gross and Klein)	#Gaingu Conservancy	Partly
Wlotzkasbaken lichen fields	Dorob National Park	**Yes**
Swakop/Khan River	Namib Naukluft NP	No
Welwitschia Plains	Namib Naukluft NP	No
Langer Heinrich Mountain	Namib Naukluft NP	No
Several spots in Northern NNNP	Namib Naukluft NP	No
Kuiseb River and Delta	Namib Naukluft, Dorob	**Yes**

Even though the policy to enforce the protection of certain important biodiversity areas is not yet in place the final draft clearly showed that many biodiversity red flag areas and most yellow flag areas proposed in the SEA have not been included as "no-mining" areas in the policy. This will make it impossible for the indicator to be fully met in future, unless the Minister decides that the Mineral Rights Committee should be guided by the SEA in addition to the policy. This issue will be further explored in the 2017 SEMP report.

Motivation of status: No new EPLs or MLs were issued in 2016, which means that this indicator was **NOT APPLICABLE**.

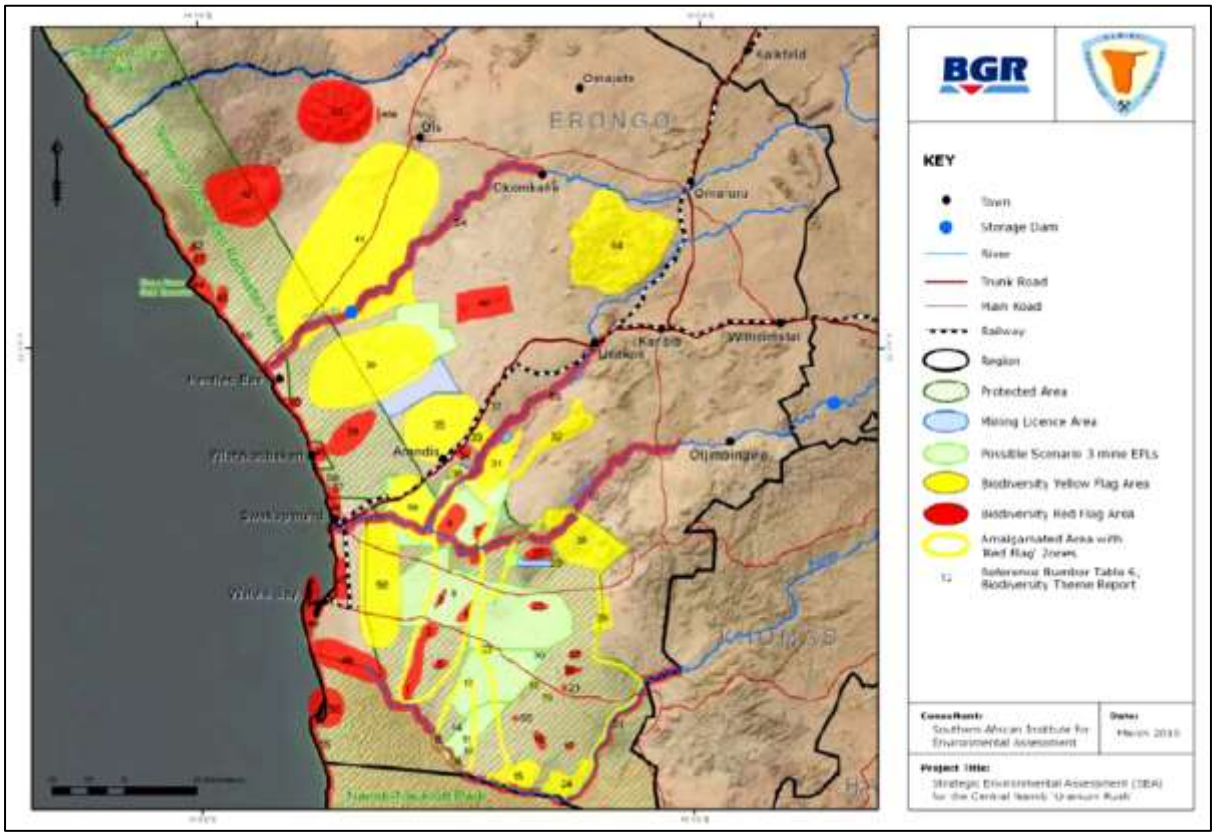


Figure 36: Red and Yellow Flag Biodiversity Areas

Indicator 8.1.1.2.	**The EIAs need to follow the mitigation hierarchy and incorporate offsets as an option.**
Data Source	**NERMU/NUA/MET**
Status:	

No new EIAs were carried out during the current reporting period.

Motivation of status: Because there were no new EIAs in 2016 the indicator was **NOT APPLICABLE**.

Indicator 8.1.1.3.	**GRN keeps a record of all decisions made regarding prospecting and mining applications so that applications denied on biodiversity grounds are not awarded in the future, unless alternative approaches are adopted to avoid impact, mitigate or offset the impact.**
Data Source	**NERMU/NUA/MET**
Status:	

The Ministry of Mines and Energy did not issue any new prospecting and mining licences during 2016. Whenever licences are considered records of decision are kept at the Mining Directorate of the Ministry of Mines and Energy. The grounds for rejection are recorded in the minutes of Mining Advisory Council meetings. The industry suggested that environmental studies should also be taken into account when licence renewals are considered. EPL areas could be reduced as per MME guidelines at the time of renewals.

Motivation of status: The indicator was **NOT APPLICABLE** because no new licences were issued.

Case Study – Biodiversity Conservation at Rössing Uranium

Rössing Uranium values its reputation as a responsible corporate citizen and aims to minimise its impact on biodiversity. For this reason, any area that is scheduled to undergo ground disturbance must first go through an approval process which involves consulting the mine's environmental section. When the company planned to expand the tailings facility they called in the National Botanical Research Institute to map the distribution of endemic plants in the extension area. The survey discovered a globally significant population of stone plant (*Lithops ruschiorum*) and a small number of elephant's foot (*Adenia pechuelii*). Rössing therefore decided to extend the tailings storage facility vertically rather than horizontally and to establish a "no-go area" where the plants were found. This action prevented the loss of more than half the total number of stone plants recorded in the mining licence area and almost 100 hectares of natural habitat.

Lithops ruschiorum

Photo: Atomic Plant Nursery via Google

Adenia pechuelii

Photo Guide to Plants of Southern Africa via Google

Indicator 8.1.1.4.	Mines have specific programmes and projects to actively avoid, mitigate, restore or offset their impacts, with impact avoidance predominating.			
Data Source	NERMU/NUA			
Status:			MET	

Operational mines indicated that avoidance is the preferred solution, but it is not always possible because large areas have to be disturbed to access and process the ore. Mining companies have specific programmes to actively avoid, mitigate, restore their impacts and these are documented in their EIAs, EMPs and company-internal policies.[89] Rössing Uranium reported that compliance with the Rio Tinto land disturbance control and rehabilitation standard is mandatory. The standard prescribes the implementation of a land use management plan, which provides an overall land management direction, including biodiversity management. Concepts such as avoidance, mitigation and rehabilitation are well embedded in Rössing's land use decisions (see Rössing case study).

Swakop Uranium focused on finalising the biodiversity and land use procedure in 2016. Based on the findings of the EIA, biodiversity can primarily be impacted upon by:

- Physical destruction of fauna and flora due to roads, infrastructure, mining, etc.
- General disturbance of fauna and flora by dust, noise, traffic, habitat fragmentation; and
- Reduction of water resources as an ecological driver through topography change, water abstraction, and altered surface water systems.

The Swakop Uranium biodiversity and land use procedure thus incorporates the following aspects in managing the abovementioned risks related to land use management:

- Identification and communication of No-Go areas (i.e. biodiversity or archaeological sites)
- The Environmental Section requires a Land Clearance & Disturbance Application Form to be completed before entering and/or disturbing any previously undisturbed areas. Pre-disturbance inspections identify important fauna, flora and/or archaeological artefacts. Information gathered determines whether activity may proceed or not
- Reuse/reassign disturbed areas rather than disturbing new land
- Monitor natural stormwater catchments and drainage systems
- Stockpile topsoil for rehabilitation and restoration activities in future

The company is developing a comprehensive Biodiversity Action Plan that will encompass a detailed set of objectives, schedules, responsibilities, and deliverables for the life of the mine. To manage water as an ecological driver Swakop Uranium monitors surface and ground water levels and quality, and monitors the health and vigour of riparian vegetation in the Swakop and Khan rivers and around the mine. Swakop Uranium has mapped the distribution of *Welwitschia mirabilis* within its mining licence and EPL areas and studied its biology in cooperation with conservation partners (see Swakop Uranium case study). All operating companies' internal environmental monitoring and rehabilitation initiatives continued in 2016 as part of their EMP and ISO 14001 compliance requirements.

Motivation of status: EIAs and EMPs of operational mines comply with the mitigation hierarchy as stipulated in the SEMP and MET's ECC application assessment process, the indicator was **MET**.

[89] NUA (2017): Input to 2016 Annual SEMP Report

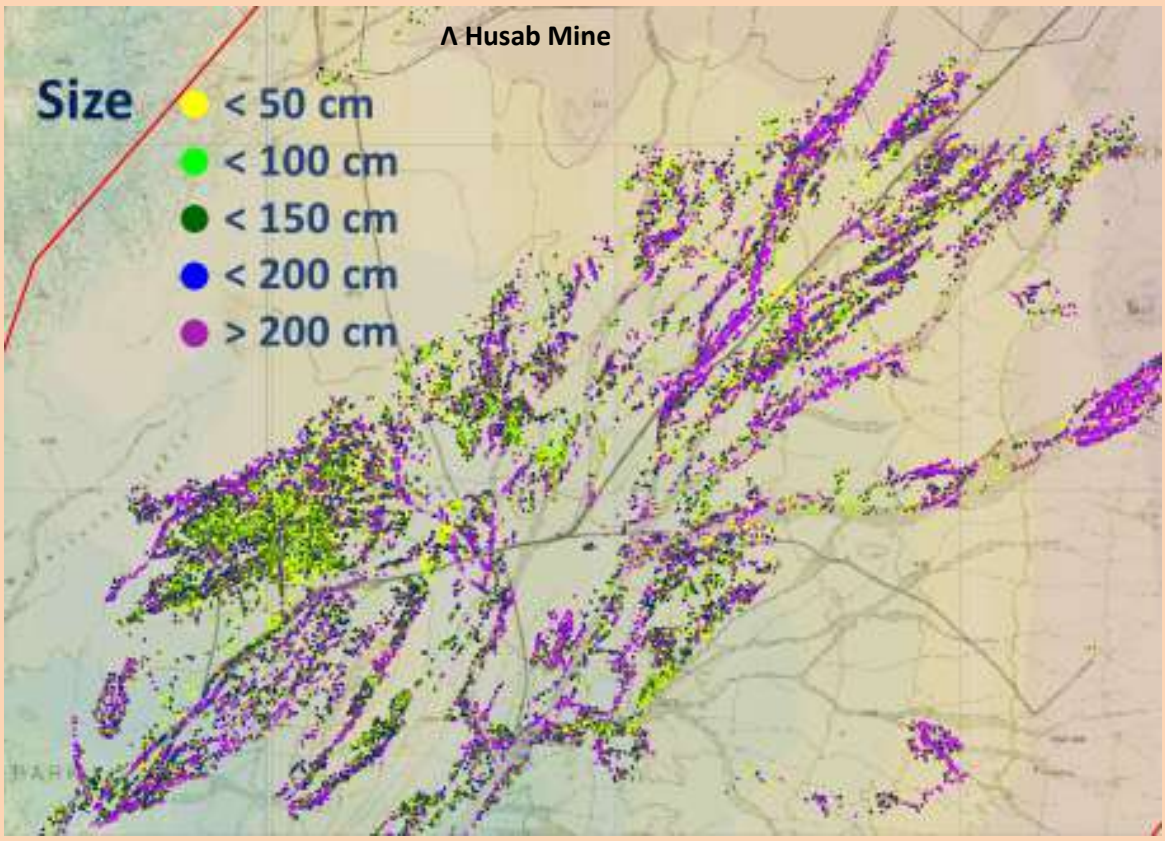
Case Study – Swakop Uranium *Welwitschia mirabilis* Census

Surprisingly, little is known about the extraordinary *Welwitschia mirabilis*, despite the fact that they are allegedly among the oldest living plants on Earth. This, coupled with the fact that Welwitschias occur in abundance in the Swakop Uranium exclusive prospecting licensing area, prompted the company to try and establish how they survive in the desert, such as where they get their water from, and whether any mining activities could adversely affect them.

Swakop Uranium proactively initiated the Welwitschia census during the project's exploration phase and by 2013 more than 52 000 individuals had been mapped. The survey data includes the actual position of the Welwitschia plants in the landscape, as well as their gender and relative size and health. This data has been made available to Gobabeb, connected scientists and students for analysis to obtain better scientific understanding of the unusual species.

Interestingly, not one Welwitschia seedling was mapped during the census as the seeds need a protracted wet period in order to successfully germinate and for the plant to establish itself. It is also evident from database maps that the Welwitschia size is related more to accessibility to water than age. The well-known Welwitschia Field plants are not as large or as healthy as those in the channels that feed the Big Welwitschia.

Various studies are underway to determine the source of water for the plants. Scientific excavations of some Welwitschia affected by the mine infrastructure revealed that the tap root is only about 2 m deep, and that the rather fragile root system is complex. As this information is collected it enables scientists to determine more about the plant, why it grows where it grows, what keeps it alive and what causes it to die.



Map indicating the size of some of the Welwitschia plants
(Map by Swakop Uranium)

Indicator 8.1.1.5.	**Sensitive areas are identified by mines and disturbance of these areas is minimized.**			
Data Source	**NERMU/NUA**			
Status:			**MET**	

All active mines have mapped sensitive areas within their mining licence areas and have programmes in place to minimize the size of their footprint on sensitive biodiversity. Because mining companies cannot always avoid causing disturbances they make provision for the rehabilitation of disturbed areas (see EQO 12).

Swakop Uranium has provided an example of measures taken to minimize the disturbance of sensitive areas in the NNNP. They have fenced off the mine site to keep mining activities and employees within the allowed area of disturbance. Security personnel are stationed at the main entrance points to manage access to the mine and the NNNP. Only the departments that work in exploration camps, linear infrastructure and monitoring sites are allowing into the park. Continuous environmental awareness training took place during 2016 and covered topics such as the NNNP permit, park rules and conditions, and the avoidance of secondary impacts such as poaching. The Environmental Section inspects the various off-site areas, investigates any unusual findings and reports them to the NNNP Warden and his team.

Motivation of status: The indicator was **MET** as all mines reported that they have mapped out sensitive habitats within their mining licence areas. Possible impacts are continuously monitored, assessed and mitigated according to the mitigation hierarchy.

Indicator 8.1.1.6.	**Infrastructure corridors are carefully planned to avoid ecologically sensitive areas, and demonstrate:** **- consideration of alternatives,** **- optimization of service provision; and** **- commitment to the 'green route'**			
Data Source	**NERMU/NUA**			
Status:				
Indicator 8.1.1.7.	**Mines share infrastructure as much as possible, thus minimizing infrastructure proliferation.**			
Data Source	**NERMU/NUA**			
Status:				

Indicator 8.1.1.8.	**Infrastructure planning and investment takes into account future demand, thus reducing the need for additional impacts.**
Data Source	**NERMU/NUA**
Status:	

There were no new large infrastructure projects in 2016 that could have resulted in the establishment of infrastructure corridors.

Motivation of status: The three indicators related to the development of infrastructure corridors were **NOT APPLICABLE**.

Desired Outcome 8.2.	**Mining industry becomes a conservation partner.**
Target 8.2.1.	**Mines and associated industries support conservation efforts in Namibia.**
Indicator 8.2.1.1.	**Mining companies (particularly those operating in the NNP) partner with conservation organisations to effectively manage their biodiversity impacts (both direct and indirect).**
Data Source	**NERMU/NUA/MET**
Status:	**MET**

AREVA Resources Namibia, Rössing Uranium and Swakop Uranium are working together with the NamPower/NNF Strategic Partnership to monitor the impact of power line corridors on birds such as Ludwig's bustards, korhaans, raptors and flamingos. Inspections at Swakop Uranium are conducted on a monthly basis on both internal and NamPower overhead power lines. The findings of these surveys have prompted NamPower to install mitigation measures to reduce bird collisions with power lines, e.g. where the power line to Husab mine crosses the Khan River. Two camera traps have been mounted on power line poles in the river to monitor the presence of larger birds. These cameras are maintained and armed by the Swakop Uranium. Langer Heinrich Mine took part in Gobabeb's GTRIP programme on restoration ecology (see case study). Bannerman Resources is partnering with TOSCO (Tourism Supporting Conservation) and in 2016 several areas were identified together with the Namib Naukluft Park Authority to put up 'no off-road driving' signs. Swakop Uranium is working with NERMU to monitor the health and vigour of riparian vegetation along the Ida Dome compartment of the Swakop River and in the Khan River. They also assist MET Parks & Wildlife with litter clearing at the Swakop River, Welwitschia and Big Welwitschia tourist sites.

Motivation of status: In 2016, mining companies partnered with conservation organisations as far as possible, considering the limitations imposed by the low uranium price. The indicator was **MET**.

Indicator 8.2.1.2.	**Mining companies commit to sustainable offset initiatives to ensure 'no net loss' to biodiversity as a result of their operations. This will involve partnering with long term conservation partners (GRN, NGOs and communities).**
Data Source	**NERMU/NUA/MET**
Status:	**NOT MET**

Multinational mining companies such as Rio Tinto have in the last few years reconsidered their commitment to "no net loss", mostly due to difficulties experienced in the implementation of offsets and the downturn in global commodity markets.[90] Companies would still consider biodiversity offsets if irreplaceable biodiversity was permanently lost and restoration was not possible.

In Namibia, there is an additional obstacle to the implementation of a 'no net loss' policy. Namibia does not have a legal framework for the establishment and protection of offsets as defined by Flora and Fauna International (FFI) and other international NGOs. Given the fact that mining is permitted in protected areas, it would not make sense to spend money on biodiversity offsets in areas that may be disturbed in future. Prerequisites for offsets are land use plans for the relevant regions and legislation to enforce the protection of conservation areas identified in land use plans, even if there are mineral resources underground. This information has been shared with MET's NBSAP2 steering committee, since biodiversity offsets are included as a target in the second National Biodiversity Strategy and Action Plan (NBSAP2). The mining industry, MME and NERMU are represented on the steering committee and engaging with MET on biodiversity offsets.

Motivation of status: Two main factors contributed to this indicator being classified as **NOT MET**: The mining industry's changed attitude towards offsets and the lack of a regulatory framework for the implementation of offsets.

Indicator 8.2.1.3.	**Additional conservation projects are supported (e.g. wetland bird counts, wildlife surveys, Namib Bird Route, coastal management, research, public awareness) as part of the companies' social responsibility programmes.**
Data Source	**NERMU/NUA/MET**
Status:	**MET**

Langer Heinrich Uranium continued its cooperation with DRFN's Gobabeb Training and Research Internship Programme (GTRIP) aimed at in-service training of (post)graduates (see case study). Rössing Uranium has been hosting annual BirdWatch events since 2000. This is considered a valuable additional conservation action and a means to engage stakeholders as each year some 70-100 school children participate in the event (Figure 37).[91]

[90] NUA 2016
[91] Rössing Uranium Limited (2017): Report to stakeholders 2016 – Taking the long-term view

Bannerman Mining Resources supported the joint venture between the Salambala Conservancy (Zambezi Region) and the Chobe River Lodge with funds to train young people of the conservancy and the Save The Rhino Trust during the Hospitality Association of Namibia's annual awards evening. Swakop Uranium is committed to ongoing contribution to the knowledge and conservation of the biodiversity in the NNNP, e.g. by contributing resources toward key species-related biodiversity studies such as *Welwitschia mirabilis* (refer to case under Indicator 8.1.1.5). NERMU has been appointed to develop a long-term biodiversity monitoring programme for the Husab mine.

Motivation of status: The indicator was **MET** by supporting various additional conservation projects**.**

Case Study – GTRIP Project "Dealing with Radon at Langer Heinrich Uranium"

Langer Heinrich Uranium operates an open-pit uranium mine in the western part of Namibia. Uranium is a naturally occurring metal found in small quantities in most rocks and soils. The uranium 238 isotope forms a decay series that includes radon gas and its decay products, which have the potential to pose environmental hazards if not managed appropriately. This is why it is important to cover tailings storage facilities during mine closure and rehabilitation to minimise the transport of radon and radioactive tailings into the environment and to prevent erosion.

For this GTRIP study a literature review was done on the type and thickness of cover materials that have been used at other mines to cover tailings storage facilities, as well as the type of radon monitoring instruments available on the market to evaluate their pros and cons. Results from literature indicated that when covering tailings storage facilities, what matters most is the type of cover and not necessarily the cover thickness. A combination of cover materials was the most effective. The etched track detector, which is used at LHU, appeared to be a good instrument because it is passive, inexpensive and accurate. Lastly, a statistical data analysis was done on radon and wind data obtained from LHU for the duration of three months (January-March 2017).

Statistical methods such as One-way ANOVA and Tukey's Post Hoc Test were applied to find out if there was a difference in the average concentration of radon decay products between LHU's three monitoring stations. Most of the results showed a significant correlation between the entrance gate, eastern gate and the ROM pad. The results also indicated that the wind direction did not have an effect on the radon concentrations.

GTRIP Participant Ester Kayala holding a Radon Monitor

(Photo: Turkie Ellis)

Figure 37: Rössing Uranium BirdWatch Event 2016

Indicator 8.2.1.4.	**Protection and management of key biodiversity offset areas is supported (e.g. NW Kunene, Messum, Spitzkoppe, Brandberg and other special areas in Namibia).**
Data Source	**NERMU/NUA/MET**
Status:	**NOT MET**

To make progress with this indicator it will be necessary for Government to provide the legal framework for the protection and management of key biodiversity offset areas. As mentioned under Indicator 8.2.1.2, there was no progress with the Mining in Protected Areas Policy in 2016.

Motivation of status: The indicator was **NOT MET**.

Desired Outcome 8.3.	**No species become extinct because of uranium mining.**
Target 8.3.1.	**Authorisation to mine is denied if the extinction of a species is likely.**
Indicator 8.3.1.1.	**All EIAs and EMPs must consider national extinction possibility.**
Data Source	**NERMU/NUA/MET**
Status:	

See feedback under Indicator 8.3.1.2.

Indicator 8.3.1.2.	**Resources for a reasonable investigation are made available to manage species at risk of extinction**
Data Source	**NERMU/NUA/MET**
Status:	

There were no new EIAs or EMPs for projects that could affect species extinction conducted during the review period and thus no assessment of these two indicators could be made.

Motivation of status: The indicators were **NOT APPLICABLE**.

Desired Outcome 8.4.	**No secondary impacts occur**
Target 8.4.1.	**No secondary impacts occur**
Indicator 8.4.1.1.	**Off-road driving, poaching, illegal camping, littering by mine personnel, are explicitly prevented by mining and exploration personnel and their contractors.**
Data Source	**NERMU/NUA/MET**
Status:	**IN PROGRESS**

Bannerman Mining Resources have demarcated the roads leading to their Demonstration Plant and provided turn-around points every 400 metres to restrict the environmental footprint and prevent illegal off-road driving. Contractors and employees were inducted in the rules of the National Park and no night work is allowed. The company has continued to grade a section of the park road along the Moon Landscape towards the Big Welwitschia.

Langer Heinrich Uranium and Swakop Uranium distribute the park rules to all employees, contractors and visitors. All employees, visitors, contractors, suppliers and service providers are inducted in the park rules. The induction includes topics such as correct waste management practices, driving behaviour (including speed limits) and protection of local fauna and flora. Stringent access control measures are in place with daily security checks being carried out. Off-road driving is prohibited and only existing roads are used. Reptile Mineral Resources and Exploration employees and visitors also receive inductions in the NNNP rules before they are allowed to conduct any kind of exploration activities.

In spite of these measures Swakop Uranium recorded the following nonconformities in 2016: Some employees and visitors driving to the mine failed to produce a park permit upon request; Welwitschia plant leaves were slightly damaged by a vehicle at an exploration work site and a few animals were injured or killed by vehicles on access roads and in trenches.

Monitoring and compliance checks are the mandate of the Ministry of Environment and Tourism who continued to monitor, investigate and enforce the relevant remedial measures in 2016.

Motivation of status: The indicator requires that secondary impacts by mine personnel and contractors are prevented. Companies operating within the national park confirmed that they were doing everything possible to avoid secondary impacts. Incidents observed by the Ministry of Environment and Tourism could have been caused by persons not employed in the mining industry, but this could only be confirmed if the Ministry kept records of offenders' place of work. The indicator was regarded as **IN PROGRESS.**

Indicator 8.4.1.2.	**Improved vigilance and visibility of law enforcement personnel, with structured support from civil society (e.g. Honorary Wardens) reduces park/conservation transgressions.**			
Data Source	**NERMU/NUA/MET**			
Status:			**MET**	

The Ministry of Environment and Tourism reported that there has been improved vigilance and visibility of law enforcement with support from the mines, public and members of MET from other units. However, the Ministry of Environment and Tourism could not provide statistical data or information for assessment on the extent to which the situation has improved. On the matter of honorary wardens, MET responded that there is currently no legal provision[92] for this suggestion to be implemented, but this does not prevent the involvement of civil society in reporting transgressions.

Motivation of status: The Ministry of Environment and Tourism and mines in the NNNP have improved their vigilance, therefore the indicator was **MET**.

Desired Outcome 8.5.	**Water quality and quantity does not decrease to the extent that it negatively affects biodiversity.**			
Target 8.5.1.	**Water table levels, and water quality standards are described and ephemeral river ecosystems are monitored to ensure that these standards are not compromised.**			
Indicator 8.5.1.1.	**Regular monitoring of indicator species in relevant ephemeral rivers is in place to detect any impacts on wetlands, phreatophytes and riparian vegetation.**			
Data Source	**NERMU/NUA/MET**			
Status:		**IN PROGRESS**		

A study is in progress on the occurrence and vitality of large trees in the Swakop and Khan rivers and the factors that affect it. NERMU has carried out a baseline study on the health of riverine ecosys-

[92] Pers. comm. MET 2015

tems and potential impacts due to groundwater abstraction.[93] Follow-up surveys started in July 2016 in conjunction with a project for Swakop Uranium in the framework of a long-term biodiversity monitoring programme that includes the assessment of riparian tree health. The purpose of developing the monitoring programme is to identify tree health indicators (e.g. water stress) and collect data over a period under different conditions. Field campaigns were conducted in November-December 2013 and again in November-December 2016. Photosynthetic efficiency, water potential and growth measurements are some of the data collected.

Evaluation of the data is complicated by the length of time before effects in response to water table variations become apparent and the high variability among individual plants. These factors have to be taken into account in the design of a monitoring programme.

The general objective of the study is to understand if and how abstraction of groundwater affects tree mortality, how this effect presents itself and how the trees may be monitored effectively to timeously detect and prevent damage to the riparian forests.[94] Timeous detection is however a problem as explained in the comments under the next indicator.

Motivation of status: Surveys were conducted in 2016 to define the impact of water abstraction on the riverine vegetation which will eventually allow the identification of indicator species and the design of a regular monitoring programme. The indicator was rated **IN PROGRESS**.

Indicator 8.5.1.2.	**Results from monitoring are fed back to regulators and impacting companies so that negative impacts on riverine vegetation, springs and pans can be dealt with appropriately.**			
Data Source	**NERMU/NUA/MET**			
Status:			**MET**	

This indicator needs to be considered together with 8.5.1.1. As mentioned there, a monitoring programme that will be able to determine measurable effects of groundwater abstraction on the riverine vegetation is still being developed.

In the meantime, feedback to regulators for the purpose of impact prevention is taking place in form of the groundwater levels monitored by DWAF and reported in EQO 4, indicator 4.2.1.2 “Borehole levels fluctuate within existing norms”. Though the expression “existing norms” has not been clearly defined the interpretation given in EQO 4 could be used to identify unsustainable water abstraction. Additionally, companies that have an abstraction permit are required to submit quarterly returns to DWAF, which include the water levels of production and monitoring boreholes.

Until more information becomes available from NERMU, the intention of this indicator can be met if the Geohydrology Directorate evaluates the permit return data to detect any abnormal impact of groundwater abstraction on the water levels in Khan and Swakop rivers, and if DWAF as the relevant regulator instructs the impacting companies to take remedial action. Doing this will prevent irreversible damage to the vegetation or springs before it occurs.

[93] Wassenaar T., T. Shuuya & H. Mbura (2013): Baseline for the Development of a Central Namib River Vegetation Monitoring Programme for the SEMP, Attachment to 2013 SEMP Report
[94] Pers. comm. NERMU 2017

Motivation of status: This indicator was regarded as **MET** because the feedback in this SEMP report (Indicator 4.2.1.2) indicates that water level monitoring did not reveal any abnormal changes and no remedial action was required.

Target 8.5.2.	**Uranium mining does not compromise surface and groundwater availability.**			
Indicator 8.5.2.1.	**No unusual loss of wetland and riparian vegetation.**			
Data Source	**NERMU/NUA/MET**			
Status:		**IN PROGRESS**		

NERMU has appointed a researcher who is working on a series of papers about the occurrence and vitality of large trees in the Swakop and Khan rivers. It is expected that significant progress will be made in 2017. The results will hopefully show if there has been any unusual loss of wetland and riparian vegetation and identify the contributing factors.

Motivation of status: Seeing that results are expected in the near future the indicator was rated **IN PROGRESS**.

Indicator 8.5.2.2.	**No unusual loss of phreatophytes (deep-rooted plants dependent on water from the saturated zone of groundwater).**			
Data Source	**NERMU/NUA/MET**			
Status:			**MET**	

The Camelthorn (*Acacia erioloba*) is the most important phreatophyte (deep-rooted plant) in the ephemeral rivers and is therefore a good indicator of whether deep-rooted plants are affected by groundwater pumping. The baseline study conducted by NERMU did not show a clear link between tree stress and abstraction of water.[95] Follow-up studies are in progress. The groundwater levels in 2016 as shown in EQO 4 were well within the documented rooting depths of the Camelthorn, which can reach more than 50 metres.[96]

Motivation of status: The indicator was **MET** because groundwater levels in 2016 were within the reach of phreatophytes (see Indicator 4.2.1.2).

[95] Wassenaar T., T. Shuuya & H. Mbura (2013): Baseline for the Development of a Central Namib River Vegetation Monitoring Programme for the SEMP, Attachment to 2013 SEMP Report

[96] Schachtschneider, K. (2010) Water sourcing by riparian trees along ephemeral riverbeds. Unpublished PhD thesis, University of Cape Town

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Summary of performance: EQO 8

Total no. indicators assessed: 12 (8 were **NOT APPLICABLE**)

	NOT MET	IN PROGRESS	MET	EXCEEDED
Number of indicators in class	2	3	7	0
Percent of indicators in class	17%	25%	58%	0%

Overall performance: Six of the Ecological Integrity (EQO 8) indicators were **MET** in 2016. It was confirmed that mines have specific programmes and projects to actively avoid, mitigate, restore or offset their impacts according to the mitigation hierarchy, and that they have mapped out sensitive areas within their mining licence areas where impacts are monitored and mitigated accordingly. Mining companies have also partnered with conservation organisations and supported additional conservation projects, as far as currently possible. The Ministry of Environment and Tourism has made an effort towards improved visibility with the support of concerned stakeholders. Lastly, the indicator of groundwater levels being within the reach of phreatophytes was also **MET**.

Four indicators remained **IN PROGRESS**. One of these concerns the policy on mining in protected areas that is required to enforce the protection of important biodiversity areas and to create an enabling environment for biodiversity offsets. Other ongoing issues relate to secondary impacts in protected areas and studies being conducted to understand the impact of water abstraction on the riverine vegetation and to develop a regular monitoring programme for riverine vegetation, springs and wetlands.

The two indicators on biodiversity offsets were **NOT MET**. Mining companies are no longer committed to a "no net loss" policy, while the protection and management of key biodiversity offset areas cannot be implemented without enabling legislation.

Eight indicators were **NOT APPLICABLE** because 1) no new exploration or mining licences were issued, 2) no new EIAs for mining projects were carried out and 3) there were no new infrastructure projects in 2016.

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EQO 9.Education

Aims of this EQO: In the Erongo Learning Region, people continue to have affordable and improved access to basic, secondary and tertiary education, which enables them to develop and improve skills and take advantage of economic opportunities.

The education EQO keeps track of the evolution of the education sector in the Erongo region to ensure that school leavers will be well placed to find employment in the industry, either immediately after finishing school or when they have obtained a tertiary qualification. The Ministry of Education (MEAC) has introduced free primary education in 2013 and decided to provide free secondary education in 2016. This will address the aim of "affordable access" to education, but may influence the "improved" performance of the schools, depending on whether the government will be able to provide sufficient resources to sustain the quality of free education.

While much of the information for EQO 9 is kept by the Ministry of Education, the mining industry contributed the indicators related to bursaries and skills development programmes for employees. In addition to this, many companies support education as part of their social responsibility programmes. There is no SEMP indicator for this topic, but it is worth mentioning in this report. Rössing Uranium finances and implements numerous education initiatives through the Rössing Foundation. Project Safety W.I.S.E., which is a three-year safety awareness initiative, was implemented in partnership between AREVA Resources Namibia, Rössing Uranium and the Directorate of Education, Arts and Culture of the Erongo regional Council. The initiative supports the creation of a culture of safety among primary education learners in Arandis, Swakopmund and Walvis Bay. The initiative is built on the belief that if learners are exposed to safety awareness throughout their education, safety consciousness will become an integral part of their lives. The Rössing Foundation implements countrywide educational support programmes.

Bannerman Mining Resources continued its programme of donating school uniforms to primary schools in the Erongo region and making donations to various school funds that has benefited over 1700 needy primary school children to date. Working through the Erongo Development Foundation BMR assists under-privileged school leavers who want to obtain a trade certificate. In 2016 one student was sent to the Namibian Institute of Mining and Technology (NIMT), while another student went to the College of Cape Town to obtain an electrical engineering diploma.

Langer Heinrich provided additional support to education through donations and sponsorships to the value of N$2,030,000. This amount excludes contributions made towards the intake of NIMT students, Graduate Development Programme, staff development and contributions towards VET Levy. It includes the LHU Employee Education Assistance Programme and 6-month research internships for four post-graduate environmental students as part of the Gobabeb Training and Research Programme (GTRIP). School learners benefitted from the Mondesa Youth Opportunity Trust which provides after-school support for Grades 4-8 in maths, science, English, computer, music and life skills, and the ORISON after-school support programme for learners in Grades 8-12 enrolled in extended and higher level mathematics. In addition, the company provided employment skills training to unemployed youths in Swakopmund and donated four computers to a rural school.

Reptile Mineral Resources and Exploration entered into a joint programme with Bannerman Mining Resources to upgrade a small childcare centre at Utuseb (Kuiseb Topnaar village) with water infrastructure, paving and provision of shade netting for the playground. Zhonghe Resources has assisted almost 50 Namibian students to study civil engineering in China through the Namibia-China Loving Heart Organization (NCLHO). The shareholder of Zhonghe Resources (Namibia) Development has signed an agreement in this regard with the Namibia Students' Financial Assistance Fund (NSFAF). The total investment in these scholarships is N$1 million for 50 students.

Desired Outcome 9.1.	**Improved quality of school education.**
Target 9.1.1.	**Improved results.**
Indicator 9.1.1.1.	**75% of Grade 1 enrolments complete Grade 10.**
Data Source	**MEAC**
Status:	

The Ministry of Education, Arts and Culture (MEAC) does not have records of the data needed to assess this indicator on a regional basis. Many children move from one region to another between Grade 1 and Grade 10, so that statistics per region would not make much sense.

Motivation of status: It is not possible for the Ministry to provide this indicator on a regional basis. It will be rated **NOT APPLICABLE** and re-assessed by the SEMP Steering Committee.

Indicator 9.1.1.2.	**75% of Grade 12 graduates obtain 25 points in six subjects with at least a D in English.**
Data Source	**MEAC**
Status:	

The Ministry of Education, Arts and Culture does not have information for this indicator. The original intention of this indicator was to track how many learners completed school up to Grade 12. Nationwide, according to the NDP5 consultations by the National Planning Commission, only 19 082 or 29% of the 66 736 pupils who enrolled for Grade 1 in 2001 completed Grade 12.[97]

Motivation of status: The indicator was **NOT APPLICABLE** because it has to be replaced with a more appropriate indicator. The MEAC does not have the required data on a regional basis.

Indicator 9.1.1.3.	**National examination results in Grade 10 and 12 in maths, English and science are a D or better for more than 50% of learners from public (GRN) schools.**
Data Source	**MEAC**
Status:	**MET**

This indicator assesses the results of Grade 10 and Grade 12 ordinary and higher level together. The 2016 NSSC national examination results for Grade 12 in mathematics, science and English for the

[97] Article in The Namibian, 7 September 2016

Erongo region are presented in the graph below (Figure 38). Generally, learners performed well in English as a second language with over 70% obtaining a D symbol or better. The performance in mathematics and physical science was poor considering that just over 40% achieved a D. Even worse were biology and agriculture in which only 30% obtained a D.

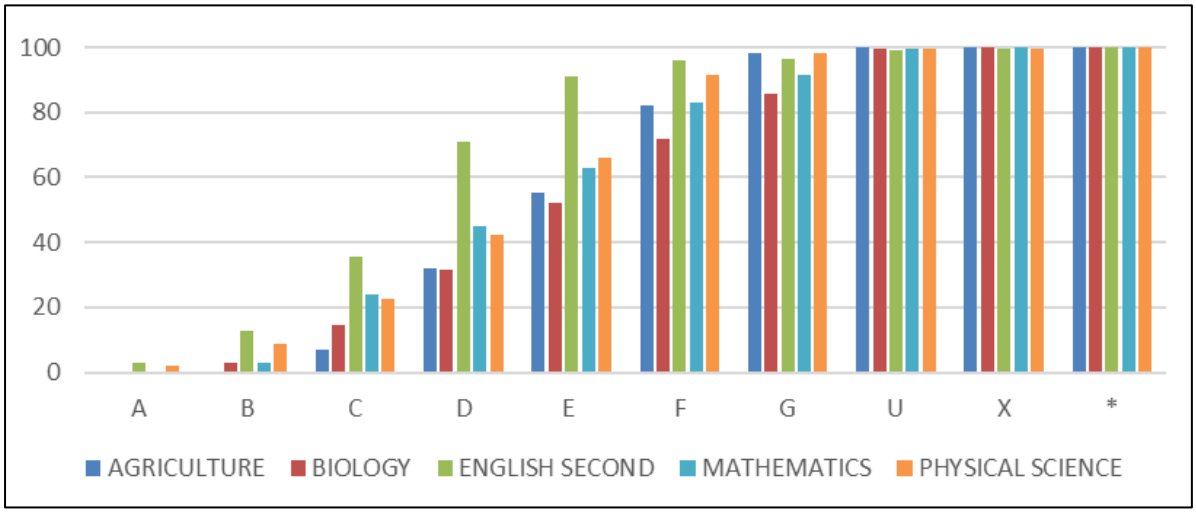

Figure 38: Cumulative Grade 12 NSSC Results for the Erongo Region

Motivation of status: The indicator requires more than 50% of the learners to achieve at least a D symbol in English, science and maths in their NSSC examinations. Taking the average of the three percentages results in an overall score of 52%, so that the indicator was **MET**.

Indicator 9.1.1.4.	**Region improves performance in reading and mathematics.**			
Data Source	**MEAC**			
Status:		**IN PROGRESS**		

To assess this indicator the SEMP would normally use the Namibian National Standardised Achievement Tests (NNSAT). These tests are annual assessments that are administered mainly to provide stakeholders with diagnostic information regarding learners' achievement of key learning competencies in the curriculum at Grades 5 and 7. However in 2016, the MEAC suspended the NNSAT in order to re-align the analysis and reporting programme to the revised syllabi, as a result of the national curriculum reform. As of 2016, the Ministry is implementing a new curriculum from Grade 1 to Grade 7, and it is therefore required from the Directorate of National Examinations and Assessment (DNEA) to diligently re-establish the NNSAT for Grades 5 and 7 in line with the revised syllabi and the scheme of assessment for English second language, mathematics and natural science which emanated from the national curriculum review.[98]

Motivation of status: NNSAT used to rate this indicator were suspended for 2016 due to the curriculum reform and the programme will continue with a new curriculum in 2017. The indicator was rated **IN PROGRESS**.

[98] Article in The Namibian of 30 Oct 2016; http://thepatriot.com.na/index.php/2016/10/30/education-ministry-suspends-grade-5-and-7-standardised-tests/

Desired Outcome 9.2.	**Increased availability of technical skills in Erongo.**			
Target 9.2.1.	**More qualified artisans, technicians, geologists, accountants and engineers.**			
Indicator 9.2.1.1.	**Increasing number of graduates from NIMT, Polytechnic of Namibia (now National University of Science and Technology, NUST), proposed VTC facility in Walvis Bay and UNAM.**			
Data Source	**SEMP Office/UNAM/NUST/VTC/NIMT**			
Status:			**MET**	

Qualified artisans, technicians, geologists and engineers are needed in the uranium mining industry. Indicator 9.2.1.1 assumes that an increasing number of graduates from the institutions listed above will ensure that the necessary skills are available to the mining industry. Since 2011, UNAM and NUST have each produced around 2500-3000 graduates per annum with a slight increasing trend over time (Figure 39). At NIMT around 300-500 artisans complete their training every year. The Vocational College at Walvis Bay is not relevant to this indicator because its courses mainly focus on computer skills, safety and accounting.[99] The mining industry contributed to vocational training by paying the VET levy in 2016 and by supporting a total of 150 apprentices at NIMT. Langer Heinrich subsidised 132 of these apprentices.

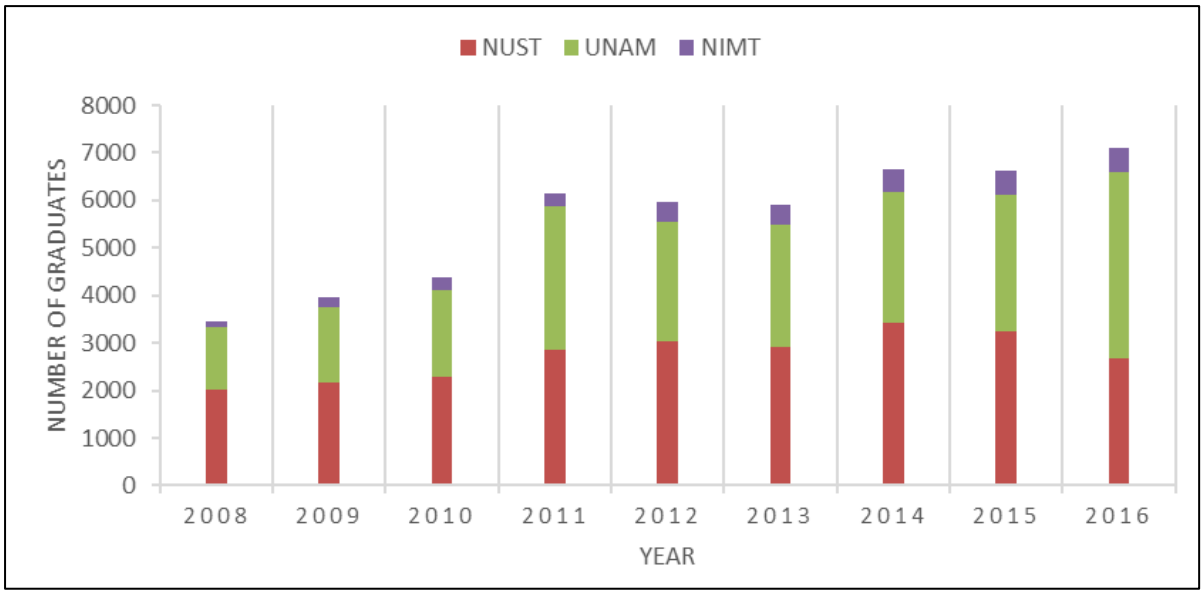

Figure 39: Number of Graduates from NIMT, UNAM and NUST

Motivation of status: The indicator was rated as **MET** because there was an increase in the number of graduates from the relevant institutions over the last ten years.

[99] Walvis Bay Vocational College website

Indicator 9.2.1.2.	**Every mine has or funds a skills development programme for employees (3% of wage cost).**			
Data Source	**NUA**			
Status:				**EXCEEDED**

This indicator only applies to operating mines (Langer Heinrich Uranium and Rössing Uranium), other companies are included in Table 15 for information only. The percentage of wage cost allocated to skills development varied from 6.7% at Langer Heinrich Uranium to 12% at Rössing Uranium. Both companies by far exceeded the 3% target. AREVA Resources Namibia and Bannerman Mining Resources contributed 1.2% and 7% of wage cost to skills development programmes.

Langer Heinrich's percentage of wage cost allocated to skills development increased from 4% in 2015 to 6.7% in 2016. This figure refers to internal and external training, job attachment salaries and VET levy contributions. It excludes skills development through the Community Support Programme which amounted to N$2,030,000 (see comments in the introduction to EQ0 9).

Table 30: The Mining Industry's Contribution to Skills Development in 2016

Company	**Skills development in 2016 (internal and external)**			
Number of:	NIMT apprentices	Work permits	Bursary holders	% of wage cost
AREVA	5	0	2	1.2%
Bannerman	1	0	2	7%
Langer Heinrich	109	15	3 bursaries, 9 employee education assistance	6.7%
Rössing Uranium	10	5	11 bursaries, 11 empl. assist., 26 empl. dependents	12%

Motivation of status: The two operating mines **EXCEEDED** the requirement of this indicator by spending 6.7% and 12% on skills development.

Indicator 9.2.1.3.	**Each mine has 10% more bursary holders than work-permit holders.**			
Data Source	**NUA**			
Status:	**NOT MET**			

Of the two operating mines, only Rössing Uranium met this target in 2016. The number of work-permit holders at Langer Heinrich Uranium decreased from 38 in 2015 to 15 in 2016 while external bursaries reduced from 4 to 3, plus nine internal students. The company continued to experience a high staff turnover rate and struggled to attract the required skills from within Namibia. Due to financial constraints it was impossible to increase the number of bursaries in line with the indicator. Langer Heinrich Uranium complies with the requirements of the Employment Equity Act and has understudies in place for all non-Namibian employees. The company also offered job attachments to

students in the fields of mechanical engineering, mine surveying and metallurgy. Furthermore apprenticeships were offered to students in the trades of fitter & turner, boilermaker, electrician, control & instrumentation technician and diesel mechanic.

In 2016, 11 students received bursaries from Rössing Uranium; seven of these were new bursaries in the fields of chemical, mining and mechanical engineering and chemistry in line with the mine's operational requirements. The Rössing dependent scholarship scheme supported 26 students at tertiary level and 11 employees pursued part-time and full-time studies. The mine also offered 10 trade-related job attachments and one apprenticeship. Five employees pursued limited contact studies and seven employees took part in the graduate development programme.

AREVA Resources Namibia continued supporting two students who had received bursaries in 2015. Bannerman Mining Resources also supported two bursary holders in 2016. Swakop Uranium awarded two new bursaries, while five bursary holders completed their studies in 2016. They did not report the number of work permit holders.

Motivation of status: While Rössing Uranium exceeded this indicator, Langer Heinrich Uranium had slightly more work-permit holders than bursary holders. As the indicator requires each mine to have 10% more bursary holders than work-permit holders was **NOT MET** for 2016.

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Summary of performance: EQO 9

Total no. indicators assessed	5 (2 were **NOT APPLICABLE**)			
	NOT MET	**IN PROGRESS**	**MET**	**EXCEEDED**
Number of indicators in class	1	1	2	1
Percent of indicators in class	20%	20%	40%	20%

Overall performance: The first two indicators were rated **NOT APPLICABLE** because the Ministry of Education does not collect the required data on a regional basis. Of the two indicators regarding the Grade 10 and 12 results one was **MET** and one was **IN PROGRESS** because there were no statistics for 2016 but they will be provided again in 2017. There was an increase in the number of graduates from the relevant training institutions, meaning that this indicator was **MET**. The two operating mines **EXCEEDED** the requirement of spending 3% of total wage cost on training by actually allocating 6.7% and 12% to skills development. The indicator that requires each mine to have 10% more bursary holders than work-permit holders was however **NOT MET**.

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EQO 10.Governance

Aims of this EQO: Institutions that are responsible for managing uranium mining provide effective governance through good leadership, oversight and facilitation, so that all legal requirements are met by all parties involved, either directly or indirectly, in prospecting and mining of uranium.

Uranium exploration and mining activities occur in the Central Namib, an ecologically-sensitive area containing parts of the Namib Naukluft National Park and the Dorob National Park. Namibia is probably unique in the world for allowing mining in national parks, though a Policy on Prospecting and Mining in Protected Areas has been drafted to prohibit prospecting and mining in sensitive areas of high biodiversity, heritage or tourism value and to set conditions under which mining and prospecting will be permitted in other park areas. The areas where mining-related activities will be prohibited can be equated to the 'red flag' areas of the SEA; there are no 'yellow flag' areas with a lesser degree of protection. As mentioned under EQO 7 and EQO 8 the policy does not cover all the areas recommended in the SEA and it has still to be ratified. Mining is also regulated under the Minerals Act of 1992, the Atomic Energy Act of 2005 and the Environmental Management Act of 2007.

Desired Outcome 10.1.	**Prospecting and mining avoids environmentally high value, sensitive areas.**
Target 10.1.1.	**Sensitive areas in need of protection are not generally available for prospecting or mining.**
Indicator 10.1.1.1.	**Declared 'red flag' areas undergo the required high level of scrutiny before mineral licenses are considered.**
Data Source	**SEMP Office/MME/MET**
Status:	
Indicator 10.1.1.2.	**Where possible, red flag areas remain undisturbed by mining or other developments that have high impacts on biodiversity, heritage and/or sense of place.**
Status:	
Indicator 10.1.1.3.	**If development (especially mining) is to take place in a yellow flag area, strict conditions are attached with the approval certificate.**
Data Source	**SEMP Office/MME/MET**
Status:	

The moratorium on new EPLs for nuclear fuels remained in place in 2016 and no new mining licences were issued for existing projects, it was therefore not possible to assess these three indicators.

Motivation of status: The indicators for red and yellow flagged areas were **NOT APPLICABLE**.

Indicator 10.1.1.4.	**No new power lines, pipelines or roads linked to uranium mining are routed through red flag areas, and preferably also not through yellow flag areas, nor interfere with ecological processes (such as migration routes for example)**			
Data Source	**SEMP Office/MET/NUA**			
Status:			**MET**	

Swakop Uranium conducted an EIA in 2016 for the addition of a new 33 kV overhead line from the B2 staging area to the existing Erongo RED 22 kV power line. The EIA incorporated specialist studies by Africa Conservation Services and was approved by MET in September 2016. The affected area is however not in a red or yellow-flagged zone.

A new power line was built through the 'yellow flag' area between Arandis and Trekkopje, which was described as a "relatively undisturbed gravel plain with wildlife concentrations" in the SEA report. This was part of NamPower's West coast 220 kV strengthening project that was completed in the 2016/17 financial year. A new transmission line was built mostly parallel to the existing power line, except for some straightening in the area of Arandis (indicated by an arrow in Figure 40).[100] The power line route crosses the more disturbed part of the yellow flag area close to Arandis. The Lithops 220/132/33 kV transmission station does not seem to be situated in a red or yellow flag area.

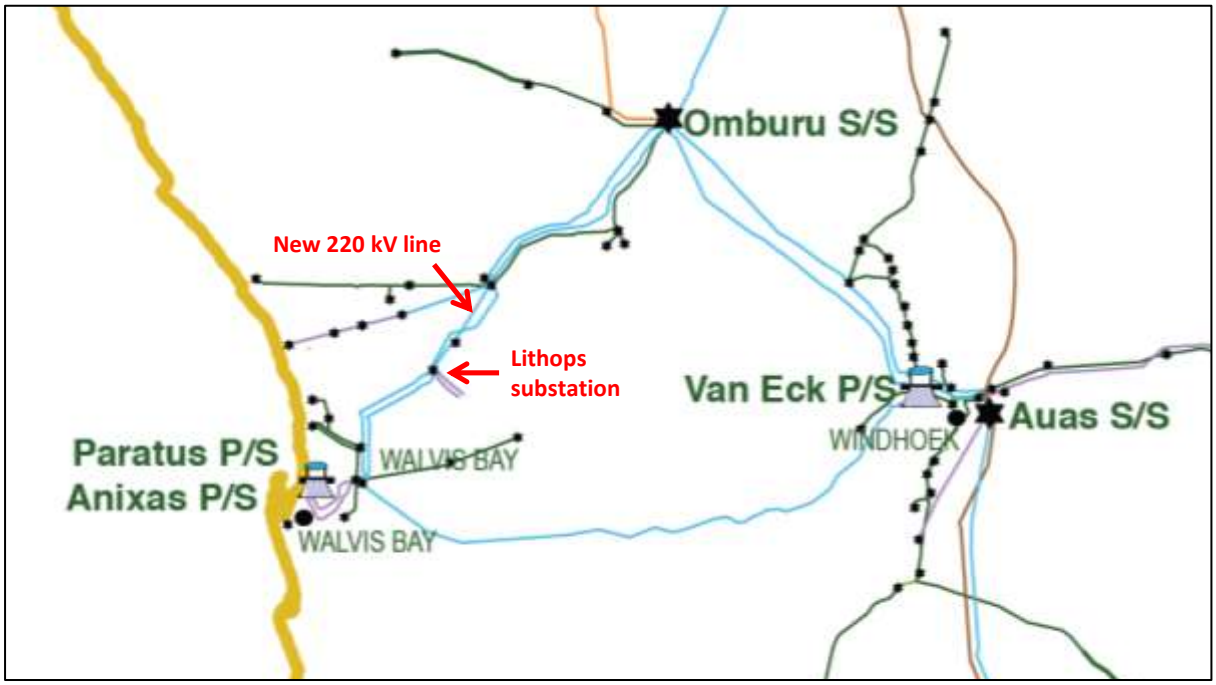

Figure 40: New NamPower Line and Lithops Substation near Arandis

Motivation of status: The indicator is difficult to assess because of the wording "preferably also not through yellow flag areas". A new power line was built through a yellow flag area, but it crosses a

[100] Map from NamPower EIA report

relatively disturbed zone where wildlife is scarce, and NamPower did obtain an environmental clearance. One could therefore say the indicator was **MET**.

Desired Outcome 10.2.	**Good governance is maintained in the issuing of mineral licenses.**
Target 10.2.1.	**The defined process is always followed in the allocation of all kinds of mineral licenses and the establishment of supporting infrastructure.**
Indicator 10.2.1.1.	**Mineral licenses are given only after full consultation of, and consensus within, the Mineral Rights Committee and the relevant status of areas in question (red and yellow flag areas).**
Data Source	**SEMP Office/MME/MET**
Status:	

Mineral licences are issued to applicants after consulting the Mineral Prospecting and Mining Rights Committee (MPMRAC) and obtaining an Environmental Clearance Certificate.[101] Marenica Energy obtained a mineral deposit retention licence (MDRL) for their existing EPL, but no new licences were issued in 2016.

Motivation of status: This indicator was **NOT APPLICABLE**.

Indicator 10.2.1.2.	**No evidence of corruption in the allocation of mineral licences.**
Data Source	**SEMP Office/MME**
Status:	

Seeing that no new mineral licenses were issued in 2016, it was not possible to assess this indicator. The review of media reports under EQO 11 did not reveal any allegations of corruption related to pending or existing uranium mining licences. The industry recommended that the issue of corruption should also be considered when granting or declining licence renewals.

Motivation of status: Since no new licences were issued in 2016 this indicator was **NOT APPLICABLE**.

[101] Pers. comm. MME Directorate of Mines, 2016

Indicator 10.2.1.3.	**No prospecting, mining or major infrastructure projects are permitted (anywhere) before full EIAs are completed and approved. Minimum EIA standards as in the EMA and regulations, are adhered to, including:** **- Clear TORs** **- Use of independent consultants** **- Public consultation** **- Specialist studies** **- Consideration of alternatives** **- Avoid and/or minimise adverse impacts** **- Include an EMP and closure and restoration plan** **- Professional review of EIAs and EMPs**
Data Source	**SEMP Office/MME/MET**
Status:	

This indicator could not be assessed because no new projects received permission (environmental clearance) in 2016. NUA members suggested that the indicator should not just apply to new licences, but also existing licences where the scope of project work has changed. For example, environmental clearance might have been given for standard exploration activities (drilling, soil sampling, trenching), but companies then start bulk sampling or trial mining, which is allowed under MME's conditions for EPLs. Development of support infrastructure is also allowed on EPLs, but may not be explicitly included in EIA studies.

Motivation of status: The indicator was **NOT APPLICABLE**.

Desired Outcome 10.3.	**Prospecting and mining activities are properly monitored.**
Target 10.3.1.	**Post-implementation monitoring is regular, efficient and outcomes-based.**
Indicator 10.3.1.1.	**GRN agencies (notably MME, MET, MAWF, MHSS) inspect active mines at least once per annum, and closed mines at least once every 3 years.**
Data Source	**SEMP Office/MME/MET/MAWF/MHSS**
Status:	**IN PROGRESS**

Various government institutions are responsible for the implementation of this EQO. In the Ministry of Mines and Energy (MME), the Division of Engineering and Environmental Geology (DEEG) in the Geological Survey of Namibia (GSN) and the Mines Inspectorate in the Directorate of Mines are mandated to monitor current and abandoned mine sites. Abandoned mines are monitored according to the risk they pose. Those classified as "mining environmental liability" are regularly monitored and precautionary measures are taken where necessary.

MET's Directorate of Environmental Assessment (DEA) requires regular reports on the status of the environment to assess the mines' compliance with their environmental management plans and does site inspections from time to time. MAWF's Directorate of Resource Management (DRM) inspects mines for compliance with groundwater abstraction permits and industrial and domestic wastewater discharge permits. They occasionally collect water samples for independent analysis. The Ministry of Health and Social Services (MHSS) inspects and licences health-care personnel and facilities at mines, e.g. first-aid stations or clinics. The National Radiation Protection Authority (NRPA), which resorts under MHSS, conducts inspections for compliance with the relevant legislation and the mines' radiation management plans. The Ministry of Labour, Industrial Relations and Employment Creation (MLIREC) is also involved, particularly in inspecting working conditions. Table 31 lists the government inspections conducted at mines and exploration sites in 2016.

Table 31: Government Inspections of Uranium Mines and Projects in 2016

Company	Government Agencies
Langer Heinrich	• February 2016 - DWAF Geohydrology section visited to verify and gather technical information for application/renewal of abstraction permit • February 2016 - DWAF Law Division checked compliance with water management plan, sampling, reporting and data management, as well as tailings storage facilities and sewerage treatment plant • April 2016 - Meeting with MET to discuss park-related issues, e.g. hand-over date of eco-toilets and Bloedkoppie waste management to MET, construction of a waterhole to keep wildlife away from the mine • November 2016 - Compliance audit by MET and DWAF on tailings storage facility management and fauna deaths. An amendment was made to the wastewater and effluent permit to include fencing of the TSF • February 2016 - NRPA safety assessment • September 2016 - NRPA safety assessment
Rio Tinto Rössing	National Radiation Protection Authority (NRPA), MHSS
Swakop Uranium	• DWAF conducted a compliance inspection and site visit on 16 February 2016 and were satisfied with Swakop Uranium's compliance • NRPA site visit on 24-25 February 2016 included presentations and site visits; a repeat site visit was conducted later in the year • The NNNP Park Warden Mr Arnold Uwu-Khaeb visited Husab Mine on 7 March 2016 for an update on the progress of activities • Environmental Department Assistants attended/participated in the SLR/DWAF SEMP sampling activities in the Khan River in June 2016 • Regular inspections by the Inspector of Mines (MME)
AREVA Namibia	MHSS inspected first aid station, no other inspections due to care and maintenance status
Bannerman	Inspection by MET staff in May 2016
Marenica	No inspections (no activities on EPL)
Reptile MR&E	NRPA inspection, no findings

Motivation of status: Some government agencies, notably DWAF, MHSS and NRPA, are carrying out annual inspections at active mines, while others prefer to do spot checks on the information that mining companies present in their (bi)annual reports. Since the indicator defines "proper monitoring" as an inspection at least once per annum, it would be preferable if all relevant ministries conducted regular site inspections at active mines. Closed mines, at least those posing an environmental risk, should be inspected at least once every three years. Because there is room for improvement the indicator was considered to be **IN PROGRESS**.

Indicator 10.3.1.2.	**Honorary conservators are appointed by MET to assist with monitoring, including of unauthorized secondary (off-mine) activities such as off-road driving, poaching and littering.**			
Data Source	**SEMP Office/MME/MET**			
Status:	**NOT MET**			

The Ministry of Environment reported that there was no legal framework for the appointment of honorary conservators.[102] It remains to be seen whether this option will be taken up in future revisions of the Namibian nature conservation legislation. Swakop Uranium has taken the initiative of reporting to MET: Parks & Wildlife when they come across indications of poaching activities in the NNNP, DNP or associated river systems. It is suggested that all interested stakeholders, whether they are members of the public or mine employees could play a role in monitoring and reporting secondary impacts by contacting the NNNP Wardens directly.

Motivation of status: Since it is currently impossible for the Ministry to appoint honorary conservators, this indicator will be regarded as **NOT MET** until the required legislation is in place.

Indicator 10.3.1.3.	**International agencies regularly inspect mines and provide independent opinion on their performance.**			
Data Source	**SEMP Office/MME**			
Status:			**MET**	

The International Atomic Energy Association (IAEA) is the designated international agency mandated to inspect uranium mines under the Nuclear Safeguards Agreement concluded with the Namibian government.[103] The IAEA Safeguards are a system of inspection and verification of the peaceful uses of nuclear materials as part of the nuclear non-proliferation treaty (NPT). The IAEA safeguards nuclear material and activities under agreements with more than 140 states.[104]

Matters such as the mines' environmental performance or sustainable development issues are beyond the scope of the Safeguards Agreement. These aspects are covered by the Equator Principles established by the International Finance Corporation (IFC). The Equator Principles are a risk management framework, adopted by financial institutions, for determining, assessing and managing en-

[102] Pers. comm. Ministry of Environment and Tourism, 2016
[103] Pers. comm. Dr. W. Swiegers, Chairman of the Atomic Energy Board, 2016
[104] https://www.iaea.org/publications/factsheets/iaea-safeguards-overview

vironmental and social risk in project finance.[105] Financial institutions in 35 countries have officially adopted the Equator Principles, meaning that mining companies wanting to access international project finance in emerging markets are required to abide by the principles. Mining companies will state in their EIAs and EMPs that these documents were developed in compliance with the Equator Principles. Compliance is independently audited, for instance as part of the annual ISO14001 environmental management system audits at operating mines.

Another relevant international agency is the World Nuclear Association (WNA). Though the WNA will not inspect Namibian uranium mines it has issued a very comprehensive self-assessment reporting tool that companies are encouraged to complete in order to demonstrate compliance with the International Council on Mining and Metals (ICMM) sustainable development principles, the Global Reporting Initiative (GRI) and other international best practice standards.[106] Table 32 summarises the sections of the WNA checklist. Each section has a list of up to 14 requirements that should be met and for which supporting documentation has to be attached. The checklist is useful for audits, e.g. by the mines' customers, as it summarises the most of the documentation required by auditors.

Motivation of status: The current level of international oversight by the IAEA and the mining industry's voluntary compliance with the Equator Principles, ICMM sustainable development principles, GRI and WNA requirements is regarded as sufficient to rate the indicator as **MET**.

Table 32: Summary of WNA Checklist

Section	Requirements
1: Adherence to Sustainable Development	Conduct all aspects of uranium mining and processing with full adherence to the principles of sustainable development as set forth by the International Council on Mining and Metals. Apply these principles with emphasis on excellence in professional skills, transparency in operations, accountability of management, and an overarching recognition of the congruency of good business and sound environmental practices
2: Management System	Employ a recognized quality management system, including the quality-assurance steps of Plan, Do, Check and Act, in administering the management of all activities pertinent to radiation, health and safety, waste and the environment
3: Compliance	Support the establishment of a suitable legal framework and relevant infrastructure for the management and control of radiation, occupational and public health and safety, waste and the environment. Ensure that all activities are authorized by relevant authorities and conducted in full compliance with applicable conventions, laws, regulations and requirements, including in particular the Safety Standard Principles of the International Atomic Energy Agency (IAEA). Do so with careful consideration to the applicable IAEA Safety Standards. In recognition that effective interaction of operators (including contractors) and the appropriate regulatory authorities is essential to safety, ensure that operators and contractors are licensed, having met the requirement of relevant authorities

[105] International Finance Corporation "Equator Principles"

[106] World Nuclear Association (2015): Internationally Standardized Reporting (Checklist) on the Sustainable Development Performance of Uranium Mining and Processing Sites

Section	Requirements
4: Health, Safety and Environmental Protection	In all management practices, ensure adequate protection of employees, contractors, communities, general public, and the environment relative to mining safety, occupational health & safety, radiation safety, personal protective equipment, ventilation, water quality and environmental protection
5: Social Responsibility/ Stakeholder Engagement	At all stages of uranium mining and processing, properly inform – and seek, gain and maintain support from – all potentially affected stakeholders, including employees, contractors, host communities, and the general public. Establish an open dialogue with affected stakeholders, carefully consider their views, and provide feedback as to how their concerns are addressed
6: Management of Hazardous Materials	Manage and dispose of all hazardous materials (radioactive or non-radioactive), including products, residues, wastes and contaminated materials, in a manner that is safe, secure and compliant with laws and regulations
7: Accidents and Emergency	Identify, characterize and assess the potential for incidents and accidents, and apply controls to minimize the likelihood of occurrence. Develop, implement and periodically test emergency preparedness and response plans. Ensure the availability of mechanisms for reporting and investigating all incidents and accidents to identify "root causes" and facilitate corrective actions
8: Transport of Hazardous Materials	Package and transport all hazardous materials (radioactive and non-radioactive) – including products, residues, wastes, and contaminated materials – safely, securely, and in compliance with laws and regulations. With radioactive materials, adhere to IAEA Regulations for the Safe Transport of Radioactive Material, relevant IAEA Safety Guides, applicable international conventions, and local legislation
9: Systematic Approach to Training	In each area of risk, provide systematic training to all site personnel (employees and contractors) to ensure competence and qualification; include in such training the handling of non-routine responsibilities. Extend such training, where appropriate, to visitors and relevant persons in communities potentially affected by these risks. Regularly review and update this training
10: Security of Sealed Radioactive Sources and Nuclear Substances	Ensure the security of sealed radioactive sources and nuclear substances, using the chain-of-custody approach where practicable and effective. Comply with applicable laws, international conventions and treaties, and agreements entered into with stakeholders on the security of sources
11: Decommissioning and Site Closure	In designing any installation, plan for future site decommissioning, remediation, closure and land re-use as an integral and necessary part of original project development. Maximize remedial actions concurrent with production. Ensure that the long-term plan includes socio-economic considerations, including the welfare of workers and host communities, and clear provisions for the accumulation of resources adequate to implement the plan. Periodically review and update the plan in light of new circumstances and in consultation with affected stakeholders. At the cessation of operations, establish a decommissioning organization to implement the plan and safely restore the site for re-use to the fullest extent practicable. Engage in no activities – or acts of omission – that could result in the abandonment of a site without plans and resources for full and effective decommissioning or that would pose a burden or threat to future generations

Indicator 10.3.1.4.	**Results of monitoring improve practice and are disclosed to the public through existing channels and in an annual SEMP report, or more regularly.**			
Data Source	**SEMP Office**			
Status:			**MET**	

The annual SEMP report covers all the various monitoring aspects related to uranium mining. The reports are freely available to the public through the SEMP office (on the MME website) and from the NUA. More regular results are currently not available and probably not required in the "below expectation" scenario of mine development.

Motivation of status: Seeing that annual SEMP reports are freely available to the public the indicator was **MET**.

Desired Outcome 10.4.	**Non-compliance is rectified.**			
Target 10.4.1.	**Transgressions are noted and acted upon timeously.**			
Indicator 10.4.1.1.	**The activities of proponents / developers / service providers, who have caused unauthorised negative impacts, are suspended, and they are forced to remedy impacts.**			
Status:			**MET**	

Indicator 10.4.1.2.	**If impacts are not remedied, the operation is closed and the project authorisation is cancelled.**			
Status:			**MET**	

Indicators 10.4.1.1 and 10.4.1.2 are assessed together as they are similar. In case of environmental transgressions MET issues compliance orders to parties that do not comply. They are given 21 days to achieve compliance before their clearance is revoked. When a compliance order is issued all activities must stop until the case has been cleared. No cases of compliance orders or clearances being revoked were reported in 2016. [107]

Motivation of status: The two indicators were **MET**.

[107] Pers. comm. Ministry of Environment and Tourism, 2017

Indicator 10.4.1.3.	Fines are issued for non-compliance.
Data Source	SEMP Office/MME/MET
Status:	IN PROGRESS

Currently, the Environmental Management Act (Act No. 7 of 2007) does not empower the Ministry of Environment and Tourism to issue fines; hence none have been issued so far.[108] The regulations to the Environmental Management Act, which are currently in draft form, will however make provision for fines and other penalties for environmental offences.

Motivation of status: The indicator was **IN PROGRESS** because the proposed regulations to the EMA will make provision for fines.

Indicator 10.4.1.4.	All incidences of non-compliance are publicised through the media and noted in the annual SEMP report.
Data Source	SEMP Office
Status:	

As mentioned under Target 10.4.1, the Ministry of Environment & Tourism did not issue any compliance orders to uranium mines in 2016. The indicator will probably be difficult to meet because the draft amendment to the Environmental Management Act (Act No. 7 of 2007) does not make provision for the reporting of non-compliance cases in the media. The Ministry of Environment and Tourism will however report any relevant transgressions in its contribution to the annual SEMP reports.

Motivation of status: This indicator could not be assessed because no compliance orders were issued in 2016 (**NOT APPLICABLE**).

[108] Pers. comm. Ministry of Environment and Tourism, 2017

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Summary of performance: EQO 10

Total no. indicators assessed	8 (7 were **NOT APPLICABLE**)			
	NOT MET	**IN PROGRESS**	**MET**	**EXCEEDED**
Number of indicators in class	1	2	5	0
Percent of indicators in class	12.5%	25%	62.5%	0%

Overall performance: The five EQO 10 indicators that were **MET** (62.5%) relate to the protection of red and yellow flag areas, the availability of monitoring results in annual SEMP reports, action taken to address EMP non-compliance and international checks on the uranium industry's performance. Two indicators were **IN PROGRESS** (25%) because firstly, many GRN agencies postponed their annual inspections at active mines or three-yearly inspections at closed mines and secondly, the regulations under the EMA that will enable the Ministry of Environment & Tourism to issue fines for environmental offences were still pending. One indicator was **NOT MET** because a lack of legislation made it impossible for the Ministry to appoint honorary conservators. Seven EQO 10 indicators were **NOT APPLICABLE** because no new licences for uranium prospecting and mining were issued in 2016, no EIAs were conducted and no compliance orders were issued.

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EQO 11.Heritage and Future

Aims of this EQO:

- **Namibia's international image is maintained and enhanced, as the 'Namib Uranium Province' builds a good international reputation as a result of generally reliable, ethical, trustworthy and responsible practices/behaviour and more specifically, because of environmentally, socially and financially responsible uranium mining operations.**
- **Uranium exploration and mining - and all related infrastructure developments - will have the least possible negative impact on archaeological and paleontological heritage resources.**
- **Survey, assessment and mitigation will result in significant advances in knowledge of archaeological and paleontological heritage resources, so that their conservation status is improved and their use in research, education and tourism is placed on secure and sustainable footing.**

The Heritage and Future EQO has two distinct components. The first two targets concern the future of Namibia's uranium industry, which can only be safeguarded if all stakeholders subscribe to an ethical conduct and internationally accepted social, environmental and economic standards. International nuclear power utilities free to choose where they purchase uranium and their best practice standards require them to buy from responsible mining companies. The industry's international reputation is assessed by reviewing the national and international online media to find any critical reports that may influence key international stakeholders.

Desired Outcome 11.1.	**Namibian uranium is regarded as a 'green' product.**			
Target 11.1.1.	**The 'Namib uranium province' is regarded internationally as an area where reliable, trustworthy, ethical, and environmentally, socially and financially responsible companies prospect and mine uranium.**			
Indicator 11.1.1.1.	**<10% critical international voices about the operations and performance of the Namib Uranium Province among any key international stakeholders (other than those international stakeholders opposed to uranium mining and/or nuclear power anyway, in principle/on ideological grounds).**			
Data Source	**SEMP Office**			
Status:			**MET**	

A Google search for the key words "Namibia uranium impact" was used to access relevant online listings. A review of the most results showed that apart from official websites of mining companies, NUA and other organisations, the publications fell into three main groupings:

- Publications for the mining industry (trade journals), such as Mining Journal, www.mining.com, www.miningweekly.com, etc. whose articles provide facts about new mine developments, projects, appointments, consultants and products, and who are by nature pro-mining.

- Newspaper articles or online news about government moves related to uranium mining or industry developments such as new mines, developments at existing mines and projects, etc. that are based on facts and therefore mostly neutral (neither positive nor negative).
- Critical reports about social, environmental, health or economic conditions at Namibian uranium mines by international organisations that are opposed to uranium mining and/or nuclear power in principle.

In the latter category a scan of the articles from 2016 turned up one Earthlife Namibia posting related to the publication of an EJOLT report from March 2015:

Earthlife Namibia (earthlife.org.za), 12 January 2016 "EJOLT Report 22: Evaluation of Nuclear Legislation - The issue of rehabilitation of uranium mine sites in Namibia" by T Tsipa. *This document deals with the still unsolved issue of proper rehabilitation of uranium mine sites after closing down operations. Namibia has large uranium deposits, many of them located in national parks of the Namib Desert. It is therefore the Namibian challenge to find solutions in terms of how nature conservation and future and present mining and exploration can coexist while meeting the requirements of sustainable development. It is against this backdrop that the Namibian government earmarked the issue of rehabilitation as one of the most pressing and is currently in the process of updating the relevant legislation in order to establish adequate laws and regulations that are applicable to mine closure. This report aims to contribute to the ongoing discourse among political decision makers, scientists and in public, analysing the current status and providing recommendations tailored to the Namibian situation.*

A controversial issue was Swakop Uranium's use of groundwater from the Swakop River, which was reported as follows:

The Namibian, 19 January 2016 "Hands off our water, farmers tell Husab mine" by Adam Hartman: *Farmers and residents along the Swakop River have told Swakop Uranium to leave the precious underground water and use desalinated water for its Husab mining processes instead. The mine recently installed pumps in the Swakop River's course to pump 500 000 cubic metres of water, for which it got clearance from government. The water is allegedly only going to be used for flushing the mine's plant as part of the pre-production phase. They have not started pumping yet. Once the mine goes into full production, it will leave the Swakop River underground water untouched and move over to desalinated water, an environmental officer of the mine said. The only reason they are using the underground water now is because they do not have enough water to do the flushing. They have been using Rössing water to date, while the pipeline from the Erongo desalination pipeline to the mine is being laid. The underground water is only to supplement the periodic shortfall, the mine's environmental officer said. Farmers and residents do not trust the mine, accusing it of using its political ties to bulldoze the exploitation of the scarce resource for its own benefit at the expense of the farmers' well-being, the downstream environment and the local economy. A public meeting held at Swakopmund on Thursday was attended by farmers, residents, mine representatives, environmental and hydrological consultants, tour companies and environmental activists. Explanations by hydrological experts were not tolerated for long as they were said to merely contain jargon and questionable and irrelevant statistics and facts which left more questions than answers for the concerned group. The meeting became so heated that it had to be stopped short after opposing parties refused to see eye to eye.*

Wikipedia, which is always near the top of Google search results and probably trusted by many members of the public, had this to say under "Uranium mining in Namibia": *The environmental impact of uranium mining in Namibia has raised concerns amongst environmentalists, especially as many mining activities are conducted within the Namib-Naukluft National Park. The highly acidic tailings dams found at Namibia's uranium mines are an environmental concern. Monitoring activi-*

ties include: air, water, and dust quality; biodiversity; medical surveillance; occupational hazards; and radiation protection.

Other articles throughout the year were in the mostly neutral category. They are recorded here in chronological order with verbatim quotes of the most relevant statements, so that readers can form their own opinion. In case of several reports about the same topic only the English version was selected, mostly from The Namibian because it has a functioning archive.

The Namibian, 3 March 2016 "MUN fights for recognition at Langer Heinrich" by Adam Hartman: *Workers at the Langer Heinrich Uranium mine in Erongo held a peaceful demonstration on Monday, in which they handed over a petition to the mine's management. They had given the mine until yesterday (Wednesday) to respond to their grievances, or face further action from the workers and the Mineworkers Union of Namibia (MUN). Issues included the setting of a date agreeable to the union and the company for the signing of a recognition and procedural agreement.*

The Namibian, 16 March 2016 "Rössing health study to target 12 000 workers" by Chamwe Kaira: *A health study announced last month by Rio Tinto's Rössing Uranium aims to reach 12 000 current and former workers, managing director Werner Duvenhage told The Namibian this week. All former and current workers who started work between 1976 and 2010 and who have worked at the mine for more than one full year stand a chance of being included in the study. The outcome of the study called 'An Epidemiological Study of Uranium Mineworkers' will not be influenced by Rössing, Duvenhage assured yesterday. The study is being conducted by the University of Manchester and has been approved by the Ministry of Health and Social Services while the Namibian Cancer Registry has agreed to provide support, he said. "An external advisory committee will regularly oversee the progress of the research. It will consist of Asser Kapere, Dr Wotan Swiegers, Ismael Kasuto, Willem van Rooyen, as well as a nominee from each of the health and social services and mines and energy ministries," he said.*

Mining.com, 27 March 2016 "Namibia's uranium production to triple by 2017": *Uranium production in Namibia is expected to triple by 2017 with the ramp-up of the massive Husab mine, states a senior government official. "We are of the opinion that, in spite of weak commodity prices and relatively slow growth in external demand, the coming into operation of large-scale mining projects will support decent levels of economic growth. Namibia's output of uranium in 2017, for example, is projected to be more than three times the volume produced in 2015, thanks in large part to the Husab uranium mine," Calle Schlettwein, Namibia's finance minister, said recently in parliament.*

Informanté, 31 March 2016 "Mining sheds jobs": *Rössing Uranium managing director, Werner Duvenhage said the global mining slump was expected to last for many years and the industry just needs to adjust. "The recovery of the industry is not coming very soon. Although it is beneficial for the industry now that the local currency has depreciated against the US Dollar, the currency depreciation should not move up too fast," Duvenhage said.*

The Namibian, 12 May 2016 "Bannerman not delisting from NSX" by Chamwe Kaira: *Bannerman Resources says it has no plans to delist from the Namibia Stock Exchange despite announcing this week that it was delisting from the Toronto Stock Exchange in Canada. Chief executive officer, Brandon Munro told The Namibian yesterday that the company had decided to delist from TSX to cut costs, particularly given the limited trading on TSX over a sustained period of time. The regulatory and other costs associated with maintaining the TSX listing could not be justified," said Munro in response to a question whether delisting in Canada means the company would do the same in Namibia.*

The Namibian, 17 May 2016 "Namibia appreciates nuclear benefits" by Ndama Nakashole: *Deputy Prime Minister Netumbo Nandi-Ndaitwah says as a uranium-producing country, Namibia cannot shy away from the benefits of nuclear energy. She said this yesterday whilst officially welcoming the di-*

rector general of the International Atomic Energy Agency, Yukiya Amano, to Windhoek. According to Nandi-Ndaitwah, Namibia is a major uranium-producing country and since uranium is a natural gift, it can be put to good use. "It is a natural gift, but when people talk of nuclear, some people react with agitation," she said. As a member of the International Atomic Energy Agency (IAEA) and a member of its board of governors, Namibia cooperates with the IAEA in various areas of the three pillars of the nuclear non-proliferation treaty. These are the peaceful uses of nuclear technology, nuclear disarmament and the non-proliferation of nuclear weapons. Nandi-Ndaitwah further expressed appreciation for what the IAEA has done for Namibia.

The Namibian, 2 June 2016 "Pension surplus decision falls" by Werner Menges: *Former employees of Namibia's first uranium mining company, Rössing Uranium, yesterday emerged as the winners from a legal battle over the distribution of a surplus of hundreds of millions of dollars in the Rössing Pension Fund. The ex-employees, who are also former members of the Rössing Pension Fund, scored a victory over the pension fund and Rössing Uranium when Judge Shafimana Ueitele set aside a decision to distribute the surplus in the fund to former members of the fund, current members and Rössing Uranium. Judge Ueitele also ordered the fund and the company to pay the former pension fund members' legal costs in the case. The fate of the actuarial surplus of more than N$450 million in the Rössing Pension Fund is now set to be back in the hands of the trustees of the fund.*

Mail & Guardian, 7 June 2017 "Uranium miner offers desalination plant to government": *Namibian uranium miner AREVA Resources Namibia has offered to sell its private 26 million cubic metres water plant to the Namibian government to mitigate a nationwide water crisis that has hit cities and the mining industry hard. AREVA Resources Namibia Managing Director Hilifa Mbako told journalists that the company has offered to sell the Erongo Desalination Plant (EDP) to government. Mbako said the company was aware of the serious water crisis facing the country and only needed to recoup the capital costs incurred in the construction of the plant since its investment portfolio does not include the water sales business. Presently, the company sells water to State entity Nam Water in terms of a contract. Namibian Deputy Minister of Information and Communication Technology Stanley Simaata told Namibian newspaper "The Villager" that the government plans to negotiate with AREVA before deciding on whether to purchase the plant or not.*

BTVi (www.btvi.in), 17 June 2016 "Namibia-India iron out issues over uranium supply": *India and Namibia today decided to iron out issues which are impeding supply of uranium from this resource-rich African country as President Pranab Mukherjee held talks with his Namibian counterpart. India will send a joint technical team of atomic energy experts to Namibia to resolve issues which are impeding supply of uranium to India from Namibia, the world's fourth largest producer of uranium. The issue came up for discussion during bilateral talks between Mukherjee and Namibian President Hage G Geingob. One of the suggestions given by the Namibian side was to let an Indian company mine the fuel but it is yet to be evaluated. Namibia despite being one of the largest producer of uranium and having a treaty with India for peaceful use of nuclear use does not supply the fuel to India because of the Pelindaba treaty among African Union countries which bars exports of the element to non-NPT signatories.*

African Business Magazine, 22 June 2016 "Down but not out": *The uranium mining industry's contribution to economies such as Namibia is significant. Robert Grant, senior partner at the audit, tax and advisory services provider KPMG Namibia, says that in 2011/12 the country earned more than $1bn in foreign direct investments in the mining sector alone. Uranium production accounts for as much as 15% of the country's GDP.*

The Namibian, 6 July 2016 "Appeal filed over Rössing pension surplus" by Adam Hartman: *The Rössing Pension Fund has decided to appeal against a High Court judgement in which a decision about the distribution of a surplus of more than N$450 million in the fund was set aside. In a statement issued by the chairperson of the fund, lawyer Ruth Chun, she said a notice of appeal against the*

High Court's decision was filed on Wednesday last week, and that the effect of it was that the High Court's decision would be put on hold. The date for the appeal hearing will be set by the Supreme Court. In the meantime, Chun encouraged former members of the pension fund, who are said to number about 10 000, to register with the fund. Former members are previous members of the fund - also including Rössing Uranium's former pension fund - who meet the criteria set by the trustees and are allocated a surplus amount in terms of the fund's scheme for the distribution of the surplus.

The Namibian, 25 July 2016 "Langer Heinrich to sell 24% stake" by Chamwe Kaira: *The owner of the Langer Heinrich uranium mine in the Erongo region, Paladin Energy, is hoping to raise about US$200 million (about N$2,84 billion) through selling stakes in its mines, including a 24% stake in Langer Heinrich. "If it proceeds on its current terms, the sale is expected to raise US$175 million cash for the company, and be accompanied by long-term arrangements for uranium off-take," the company said.*

The Namibian, 3 August 2016 "Husab demonstrates readiness to PM" by Adam Hartman: *Swakop Uranium's Husab mine in Erongo is a few months away from becoming the single-largest uranium mine in the world, making Namibia the third-biggest uranium producer globally and boosting the country's GDP by 5%. Prime Minister Saara Kuugongelwa-Amadhila last Friday was shown a presentation by Swakop Uranium's CEO Zheng Keping of the mine's accomplishments to date, and what it means for Namibia in terms of socio-economic development. According to Keping, construction of the mine plant is already 99.53% complete, as a ramp-up to full-scale operations is set to start early next year. It took about N$27 billion (current US$/N$ exchange rate) to build the mine; one of the biggest single investments in the country's history.*

The Namibian, 24 August 2016 "Rössing gets desalination lifeline" by Shinovene Immanuel: *A plan by Rössing Uranium to build a water desalination plant at the coast received the green light from the environment ministry, but the mining company needs another clearance from the agriculture ministry – the same portfolio which blocked the plan last year. Details about the approval comes around a year after environmental commissioner Teofilus Nghitila blocked plans by Rössing Uranium to build a N$200 million plant to supply water for their mining operations. Nghitila stopped Rössing from going ahead with their desalination dreams because the agriculture ministry objected to the plans, but the mining company appealed that decision last year. Environment minister Pohamba Shifeta instructed Nghitila to approve Rössing's application on 21 June 2016, directing him to issue the environmental clearance with a set of conditions as appropriate for Rössing.*

The Namibian, 29 August 2016 "Rössing from foe to true investment in 40 years" by Adam Hartman: *President Hage Geingob said that he and other liberation fighters fought against Rössing Uranium coming to Namibia (as a colonial element) in the 1970s, but has seen how this mine was ultimately a true investment to the country's economic development. "We fought a battle against them then, but when we started seeing how the towns of Swakopmund and Arandis had grown over the years because of Rössing, we see the positive impact they have had in our lives and economy," said Geingob at the mine's 40th anniversary celebration held last Thursday. Besides the input into the local economy, Geingob commended Rössing for the investments it made into skills development of Namibians, who also later have found work on the mine, or elsewhere in specialised fields. A group of graduates was introduced at the event. "We do not eat uranium, but others can use it for their specific reasons. What we can do is partner with such investors and ensure a conducive environment is available for them to invest in and so plough back into our economy to the benefit of our people," said Geingob.*

The Namibian, 5 September 2016 "Government turns down AREVA offer" by Adam Hartman: *Cabinet has declined to buy the AREVA desalination plant near Wlotzkasbaken in the Erongo region four years after negotiations started. Agriculture minister John Mutorwa met with public officials, bulk water consumers and the water supply utility yesterday to discuss water supply to the coast, as well as to communicate government's plans and strategies. Mutorwa said after much consultations and research, Cabinet decided against the purchase of the desalination plant because of the cost. The*

managing director of AREVA Resources Namibia, Hilifa Mbako, in May said government still had to decide whether it wanted to buy the plant at AREVA's price tag of US$200 million (N$3 billion). The selling price was the amount AREVA initially invested in the construction of the desalination plant.

The Namibian, 7 September 2016 "Langer Heinrich plans to slow production" by Chamwe Kaira: *Langer Heinrich is planning to slow down production due to low uranium prices on the international market. At this stage, it is not clear what impact the planned slowdown will have on the workforce. "Details haven't been finalised yet, so we are not in a position to answer the questions," said Andrew Mirco, general manager of corporate development and investor relations at Paladin Energy, the parent company of Langer Heinrich. Paladin said in the report that it is working on a proposed mine plan adjustment, involving reduced mining material movements, combined with processing plant feed coming from stockpiled low and medium grade ores. The revised mine plan effectively shifts higher grade ore processing into later years when uranium prices are expected to be higher.*

World Nuclear News (world-nuclear-news.org), 16 September 2017 "Uranium suppliers dig in for long haul": *Speaking at the World Nuclear Association's 41st Annual Symposium in London, Swakop Uranium's CEO Zheng KePing said the company's Husab project in Namibia has been ten years in the making. Mining began in 2014 and the first stage of the processing plant was commissioned in July this year. The mine's own sulphuric acid plant, capable of producing up to 1500 tonnes per day, began operation on 6 September. First production is expected in the coming weeks with the plant ramping up to nameplate over the next year, ultimately producing 15 million pounds U_3O_8 (5770 t U) per year. … Paladin Energy intends to remain a sustainable long-term supplier and is adapting to the downturn in uranium, its CEO Alexander Molyneux said. The Langer Heinrich mine in Namibia is a "strategic tier 1 mine", he said, and the company aims to maximise cash flow through optimisation, without breaching the integrity of its long-term mining plan. A major step in the optimisation process has been the installation of a bicarbonate recovery facility: a nanofiltration plant. This separates bicarbonate after the leaching phase, allowing the reagent to be recycled. While the company has the scope to cut costs further, changes to the business plan mean that some capabilities have been lost, Molyneux said.*

The Namibian, 22 September 2016 "Langer Heinrich workers stage protest" by Adam Hartman: *Langer Heinrich uranium mineworkers staged a protest at their employer's head office at Swakopmund, where they handed over a petition on overtime claims and other matters involving their salaries. The protest was organised by the Mineworkers Union of Namibia (MUN). They are accusing their employer of "injustices" dating back to 2007. The workers said the company admitted making a mistake then, and even suggested a "fresh new policy" before blaming the errors and irregularities on the payroll system.*

The Namibian, 5 October 2016 "NaCC sees nothing wrong with AREVA water price" by Chamwe Kaira: *The Namibian Competition Commission said yesterday that it decided not to investigate a complaint by NamWater over the price of water supplied by AREVA in the Erongo region because international lending institutions have different rates, compared to local ones. The plant was funded by international lenders. Dina-Tina Gowases, corporate communications officer at the commission, said yesterday that the loan was based in US dollars because the plant was intended for internal purposes to support the Trekkopje mine, since the production from the mine is sold in US dollars. "The difference between the costs incurred by AREVA in supplying water reveals a reasonable profit margin. AREVA's profit margin does not seem to imply an unreasonable variation between the costs incurred and the selling price, and there is therefore no evidence that indicates that the price that AREVA charges NamWater constitutes an abuse of a dominant position," she said. Gowases said NamWater had told the commission that the price charged by AREVA for the supply of its desalinated water was excessive and constituted an abuse of dominance.*

Windhoek Observer, 16 December 2016 "Uranium price headache for Namibia": *The Bank of Namibia (BoN) has warned that the continued decline of global uranium prices could negatively impact on the mining sector, as well as the domestic economy as a whole. This comes as the uranium spot price touched a 13-year low at the beginning of this month, trading at around US$17.75 per pound. Namibia, one of the world top producers of uranium, has been betting on the commodity's recovery to spur the country's economic growth, which is projected to slow down to 2.5 percent this year from 5.3 percent last year. "2017 is expected to look better than 2016, but this depends on a lot of factors, such as drought and commodity prices, especially uranium, but it seems things will become worse for Namibia, with prices now at US$18 per pound," BoN Governor Ipumbu Shiimi warned in a recent interview.*

In summary it can be concluded from these articles that most reporting in 2016 was neither for nor against uranium mining. The prevailing topics related to the uranium market outlook, developments at specific companies and the Erongo desalination plant. Positive voices included the Deputy Prime Minister's appreciation for the IAEA, the President's speech at Rössing and the Prime Minister's visit to Husab mine, as well as talks with the Indian president about uranium supply. More negative views of the Swakop farmers, MUN and former Rössing pension fund members were also reported factually.

Motivation of status: Within the limitations of the survey method the indicator was **MET** because there were hardly any critical voices (<10% of all articles).

Indicator 11.1.1.2.	**There is <10% evidence of unreliable, unethical and/or environmentally, socially and financially irresponsible conduct by operating uranium mines or prospecting activities.**			
Data Source	**SEMP Office**			
Status:			**MET**	

Assessment of this indicator is based on the media review described above. Some of the cited articles contained allegations of unethical and/or socially or financially irresponsible conduct by uranium mining companies. The issues ranged from workers union demands at Langer Heinrich to the pension fund surplus distribution dispute at Rössing. The former issues have been resolved, while the High Court decided against the Rössing Pension Fund in 2016.[109] This could have turned into a case of socially or financially irresponsible conduct, but then the Rössing Pension Fund appealed and the Supreme Court upheld the appeal in July 2017, stating that the former fund members failed to prove that the trustees and the mine had acted outside the rules of the fund. Nor did they establish any breach of the duty of the mine to act in good faith as employer. The 2016 order of the High Court was set aside.[110]

Motivation of status: The indicator was **MET** because there was <10% evidence of unethical conduct

[109] Article in The Namibian of 6 July 2016
[110] Article in New Era of 3 July 2017

The SEA identified the heritage part of EQO 11 as a measure to protect the archaeological sites in the uranium province and to ensure significant advances in scientific knowledge. The Central Namib is home to some of Namibia's key heritage resources with an archaeological history dating back more than a million years. Significant human evolutionary development and specific adaptations to extreme aridity and environmental uncertainty are evident. Some of the archaeological sites are obvious to any observer, such as rock art or historical mines. Others, such as pre-colonial stone features or surface scatters of stone artefacts are virtually invisible to the untrained eye. This means that archaeological sites have to be located and identified before the start of mining projects to avoid damage. Consequently, it has become regular practice to carry out archaeological surveys and assessments at the earliest possible stage of exploration, mine development or expansion.

Desired Outcome 11.2.	**The integrity of archaeological and paleontological heritage resources is not unduly compromised by uranium mining.**
Target 11.2.1.	**Mining industry and associated service providers avoid impacts to archaeological resources, and where impacts are unavoidable, mitigation, restoration and /or offsetting are achieved.**
Indicator 11.2.1.1.	**All mining and related developments are subject to archaeological and paleontological assessment** **No unauthorised impact occurs**
Data Source	**NERMU/MET/NUA**
Status:	

Indicator 11.2.1.2.	Mining companies adhere to local and international standards of archaeological assessment**.**
Data Source	**NERMU/MET/NUA**
Status:	

All new projects at mines are subject to the EIA or scoping process during which the need for archaeological assessments is identified. During mine operation, any unexpected finds are safeguarded and relevant specialists consulted on the way forward. No archaeological assessments for new projects or existing mines were carried out in 2016; it was therefore not possible to assess these two indicators.

Motivation of status: The indicators were **NOT APPLICABLE**.

Desired Outcome 11.3.	**Integration of archaeological and environmental knowledge in a balanced working model of Namib Desert environmental processes.**
Target 11.3.1.	**Development of a general research framework to identify gaps in scientific knowledge.**
Indicator 11.3.1.1.	**Research in progress.**
Data Source	**NERMU/MET**
Status:	

Indicator 11.3.1.2.	**Working model of Namib Desert developed.**
Status:	

Indicator 11.3.1.3.	**Model providing information to guide decision making about development in the Namib desert.**
Status:	

Indicator 11.3.1.4.	**Model providing information to guide decision making about development in the Namib desert.**
Status:	

Indicator 11.3.1.5.	**Development of diachronic models to determine the effects of climatic and other environmental changes.**
Data Source	**NERMU/MET/NUA**
Status:	

When the SEA report and the SEMP were compiled it was expected that continuing mine development would be accompanied by further archaeological research. However, under the current mining scenario there is no ongoing research and all these indicators were therefore rated as **NOT APPLICABLE**.

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Summary of performance: EQO 11

Total no. indicators assessed	2 (7 were **NOT APPLICABLE**)			
	NOT MET	**IN PROGRESS**	**MET**	**EXCEEDED**
Number of indicators in class	0	0	2	0
Percentage of indicators in class	0%	0%	100%	0%

Overall performance: Both indicators in the "future" part of EQO 11 were **MET** (100%), meaning that there were <10% critical international voices about the operations and performance of the Namib uranium industry <10% evidence of unreliable, unethical and/or environmentally, socially and financially irresponsible conduct. A qualitative assessment of internet search results for "Namibian uranium mining" revealed that the number of positive industry publications will probably always outweigh the critical voices, especially if anti-nuclear organisations are excluded from the count. The "heritage" indicators referring to archaeological research were **NOT APPLICABLE** because no archaeological assessments for new projects or existing mines were carried out in 2016.

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EQO 12.Mine Closure and Future Land Use

Aims of this EQO: To maximize the sustainable contribution mines can make post closure to society and the region, and to minimize the social, economic and biophysical impacts of mine closure.

The EQO aims to maximize the sustainable contribution that mines can make to society and the region post-mining. Mine closure is one of the mining industry's hardest sustainable development challenges because it is necessary to incorporate socio-economic aspects, along with infrastructure and biophysical aspects into the closure planning process. Closure plans should be drawn up as early as possible and be an integral part of the mining plan. If the shape of the ore body and open pit allow this option, rehabilitation should be undertaken progressively during the life of the mine. Sufficient personnel and financial resources must be allocated during and after mining to enable (progressive) rehabilitation and decommissioning of mine structures at final closure. Even though mining companies may not have sole responsibility for addressing the socio-economic impacts of mine closure, they are key players with significant power, influence and resources.

Namibia currently does not have legislation governing mine closure, although the Ministry of Environment and Tourism has started drafting a document in 2016. To fill this gap the Chamber of Mines of Namibia (CoM) has issued the Namibian Mine Closure Framework in 2010 with the primary aim of providing guidance for the Namibian mining industry on how to develop relevant, practical and cost-effective closure plans and to lay down minimum requirements for all Chamber members. Thus at the end of mine life, government agencies know what to expect, while companies are well prepared and have the necessary resources to implement the closure plan, ensuring that negative social, economic and biophysical impacts are minimized.

Desired Outcome 12.1.	**Companies have approved closure plans in place which ensure that there are no significant post-closure long term negative socio-economic, health and biodiversity effects from the mine. These plans should address planned as well as premature closure.**
Target 12.1.1.	• **The planning process is initiated early (in the feasibility study stage) to ensure that reasonable opportunities for post closure development are not prevented by inappropriate mine design and operations.** • **Mine closure plans need to be based both on expert and stakeholders input, and consider site-specific risks, opportunities and threats as well as cumulative issues. These must include socioeconomic opportunities for nearby communities and the workforce, demolition and rehabilitation and post closure monitoring and maintenance.** • **The plan needs to contain accepted and agreed objectives, indicators and implementation targets.** • **The plan needs to be subjected to periodic critical internal and external reviewed, must have written GRN approval.**

Indicator 12.1.1.1.	**The contents of the plan are consistent with the IAEA guidelines, Namibian regulations and policies and the Namibian Mine Closure Framework.**			
Data Source	**SEMP Office/CoM/MME**			
Status:			**MET**	

It is current practice in Namibia that operational mines have formal closure plans, while exploration companies only need a plan and financial provisions for items such as site rehabilitation and re-trenchments. All operational mines reported that the contents of their plans were consistent with the Namibian Mine Closure Framework that was developed based on International Atomic Energy Agency (IAEA) guidelines and international good practice, e.g. the West Australian Closure Standard that is regarded as leading practice (items 9 and 11 in Table 33).

Mine closure legislation will be incorporated in the regulations under the Environmental Management Act of 2007. Once these regulations have been promulgated, certain EIAs will have to be accompanied by a rehabilitation, closure and aftercare plan. The regulations will also specify the details to be contained in the plan and the financial guarantee for rehabilitation. Because these regulations are still under discussion item 10 was mostly marked not applicable (N/A). Companies that answered "yes" have received an ECC for a closure plan that was included in their EMP.

Table 33 also contains feedback on the items listed under the bullet points of Target 12.1.1. Regarding item 1, Rössing's feasibility study was completed in the early 1970s when closure planning was not considered in mine development. All other companies started the closure planning process at the feasibility study stage. Item 2: The plans were generally based on expert input and, if included in EMPs, also on public consultation or other stakeholder input. Y/N for item 7 in Table 33 means yes for expert input and no for stakeholder input.

Item 3: Most plans considered site risks, opportunities and threats, whereas cumulative issues (several mines closing at the same time) were not always taken into account (Y/N). Socioeconomic opportunities for communities and the workforce (item 4) were included in all available plans. Most companies have looked at demolition, rehabilitation and post closure monitoring and maintenance (item 5).

The next three points should be considered together, starting with item 8 that requires written GRN approval. A formal process to obtain approval is not yet in place because Namibian policies and regulations specific to mine closure are still being drafted. The companies that responded "yes" to item 8 are referring to closure plans included in their EMPs and as such approved by MET as part of the environmental clearance process. Accepted and agreed objectives, indicators and targets (item 6) can only be developed once specific regulations are provided by GRN. Item 7: At this stage companies rely on corporate head offices, EIA consultants and/or ISO 14001 auditors to review the closure plans as there are no external reviews by government agencies.

Motivation of status: The two operating mines have closure plans consistent with the Namibian Mine Closure Framework and IAEA guidelines. The indicator was **MET**.

Table 33: Feedback from Mines Regarding Compliance with Closure Planning Requirements

Closure plan requirements	AREVA Namibia	Bannerman	Langer Heinrich	Rössing Uranium	Swakop Uranium	Valencia Uranium
1) Planning process started at feasibility study stage	Yes	Yes	Yes	No	Yes	Yes
2) Was based on expert and stakeholders input	Y/N	No	Yes	No	Yes	Yes
3) Considers site risks, opportunities, threats, and cumulative issues	Y/N	Yes	Yes	Yes	Yes	Yes
4) Socioeconomic opportunities for communities and workforce	Yes	Yes	Yes	Yes	Yes	Yes
5) Demolition, rehabilitation and post closure monitoring, maintenance	Yes	Yes	Yes	Yes	Yes	Yes
6) Contains accepted and agreed objectives, indicators and targets	No	No	Yes	Partly	Partly	No
7) Subjected to internal and external review	Yes	No	Yes	Yes	Yes	Yes
8) Written GRN approval	No	No	Yes	No	Yes	Yes
9) Consistent with IAEA guidelines	Yes	No	Yes	Yes	No	Yes
10) Namibian regulations and policies	N/A	N/A	Yes	Yes	Yes	N/A
11) Namibian Mine Closure Framework	Yes	Yes	Yes	Yes	Yes	Yes

Desired Outcome 12.2.	**Mines have adequate financial resources to close operations responsibly and to maintain adequate aftercare.**
Target 12.2.1.	**The financial provision for mine closure needs to be based on cost calculations including:** • **employee costs (retrenchment provision, new employment opportunities, re-training costs);** • **social aspects (sustainability of associated communities), an exit strategy (that is, the process by which mines cease to support initiatives), social transition (that is, communities receiving support for transition to new economic activities);** • **demolition and rehabilitation costs (infrastructure breakdown, salvage and/or disposal at the site or transition to end uses), ecosystem rehabilitation costs of the site;** • **post closure monitoring and maintenance; and** • **project management (administration and management costs during the decommissioning period).** **Companies, in conjunction with regulators, need to establish an independent fund to provide adequate financial resources to fully implement closure.**
Indicator 12.2.1.1.	**Closure cost estimations contained in the closure plan.**
Status:	**MET**

Indicator 12.2.1.2.	**Financial sureties are available.**
Data Source	**SEMP Office/CoM/MME**
Status:	**MET**

Closure cost estimates are contained in the closure plans of operating mines and include the aspects listed in Target 12.2.1 as shown in Table 34. Financial sureties to be placed in an independent fund will be addressed in the upcoming regulations under the EMA. Exploration companies and mines under construction are not required to comply with these two indicators (Bannerman Mining Resources, Reptile Mineral Resources and Exploration, Swakop Uranium), but some have provided information to indicate the status of their plans. Swakop Uranium's full closure plan is still being developed; currently financial provision has only been made for decommissioning and rehabilitation and no financial surety has been provided.

Motivation of status: All mines operating in 2016 had closure cost estimations in their plans and provided financial sureties as per current practice. The two indicators have therefore been **MET.**

Table 34: Feedback from Mines Regarding Compliance with Closure Cost Provisions

Closure financing requirements	AREVA Namibia	Bannerman	Langer Heinrich	Rössing Uranium	Swakop Uranium
Includes employee costs	Yes	Yes	Yes	Yes	Yes
Social aspects, exit strategy	Yes	Yes	Yes	Yes	No*
Demolition and rehabilitation costs	Yes	Yes	Yes	Yes	Yes
Post-closure monitoring and maintenance	Yes	Yes	Yes	Yes	Yes
Project management	Yes	Yes	Yes	Yes	Yes
Closure cost estimations contained in the plan	Yes	Yes	Yes	Yes	Yes
Financial sureties are available	Yes	Yes	Yes	Yes	N/A*

Desired Outcome 12.3.	**The Government has appropriate mechanisms in place to approve mine closure plans, financial instruments chosen for implementation and to effect relinquishment back to the state.**			
Target 12.3.1.	**Adequate regulations applicable to mine closure are contained in the relevant legislation.**			
Indicator 12.3.1.1.	**Mine closure regulations are adequate to govern:** • **review and approval of mine closure plans;** • **financial guarantees and sureties;** • **implementation review,** • **Relinquishment and transfer of liabilities to the subsequent land owner.**			
Data Source	**SEMP Office/CoM/MME/Ministry of Environment and Tourism**			
Status:		**IN PROGRESS**		

As mentioned above Government is in the process of compiling regulations under the Environmental Management Act to establish adequate governance of mine closure. The proposed closure legislation is expected to cover the review and approval of mine closure plans, financial guarantees and sureties, implementation review, as well as relinquishment and transfer of liabilities to the subsequent land owner. The Ministry of Environment and Tourism as the responsible authority will have to ensure that they have the required capacity and expertise to review closure plans.

Motivation of status: The indicator was **IN PROGRESS** because Government is working on the mine closure regulations in order to establish adequate legislation.

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Summary of performance: EQO 12

Total no. indicators assessed 4

	NOT MET	IN PROGRESS	MET	EXCEEDED
Number of indicators in class	0	1	3	0
Percent of indicators in class	0%	25%	75%	0%

Overall performance: The first three indicators were **MET** (75%) because the two operating mines had closure plans that were consistent with the Namibian Mine Closure Framework and IAEA guidelines, as well as closure cost estimations and financial sureties. The fourth indicator requires adequate mine closure regulations to govern the review and approval of mine closure plans at all stages of the closure and relinquishment process. It was rated **IN PROGRESS** (25%) because Government has started working on the relevant legislation. The overall EQO performance was the same as in the previous SEMP report.

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SUMMARY OF RESULTS

Indicators of Socioeconomic Development in EQO 1 are related to the payment of royalties and taxes, local procurement and EPZ status for processing companies. The four indicators have all been **MET** (100%) in 2016 and previous years.

The only indicator of Employment (EQO 2) has always been **MET** because the majority of the permanent workers and contractors at uranium mines are Namibian citizens.

The infrastructure EQO 3 covers housing, transportation including roads, railways and harbour, electricity supply and renewable energy, as well as waste management and recycling. The two housing indicators continued to be **MET** because mining companies do not intend to establish on-site hostels or mine-only townships. Four indicators referring to road condition and maintenance were **IN PROGRESS**, while two were **MET**. The indicator for the reduction of heavy traffic on the B2 between Swakopmund and Walvis Bay was **NOT APPLICABLE**. As in the 2015 report, the indicator of rail use for bulk goods was **MET**, while Namport's three efficiency indicators were **EXCEEDED, MET** and **IN PROGRESS**, respectively. The indicators concerning the quantity and quality of electricity supply to the region and the implementation of renewable energy projects at mines were mostly **MET**, only the indicator on the health impact of local electricity generation was **IN PROGRESS**. Eight waste management indicators were **MET** and eight were **IN PROGRESS**. Among these, all four indicators that check the uranium mines' compliance with regulatory requirements for the management of mineral waste were **MET**.

Six of the eight Water-related indicators in EQO 4 were **MET** (88%), while the two indicators related to the availability of desalinated water changed from MET in 2015 to **NOT MET** in 2016 (13%). The comprehensive sampling and disaster management indicators that were in progress in 2015 have now been **MET**. Contrary to fears expressed in the SEA process uranium mining did not compromise the water quality or lower the water table in the rivers. The water tariff for domestic users did not increase to the level required to cover the cost of desalinated water. Negative developments in 2016 related to reports of industrial investors being lost due to water unavailability and an insufficient supply of desalinated water to meet the mines' demand.

The Air Quality performance in EQO 5 did not change from the 2015 report as all three indicators continued to be **MET** (100%). Progress towards the long-awaited regional air quality standard was made when the advanced air quality study started in the last quarter of 2016. The consultants have set up a new regional monitoring system that will be handed over to GRN after the study.

In EQO 6 (Health) two indicators were **MET** (25%): The radiation dose to workers at mines did not exceed the legal limit and the incidence of occupational diseases did not increase. Three indicators **IN PROGRESS** (37.5%) related to public dose assessments that will be re-assessed as part of the advanced air quality study and the Rössing Uranium epidemiological study. The three indicators measuring the ratio of healthcare professionals and facilities per number of population were rated **NOT MET** (37.5%) because it appears unlikely that MHSS will be able to meet them by the year 2020.

The Tourism EQO 7 has five indicators related to EIAs and new licences issued by MME that could not be assessed because there were no new developments in 2016 (**NOT APPLICABLE**). Of the remaining four indicators, the one about tourists' expectations was again **EXCEEDED** (25%) and two indicators were **MET** (50%), showing that tourism operators and mining industry manage to coexist in the Central Namib. It seems that conflict between the need for public access and mining has so far been avoided and uranium mining did not prevent the public from visiting the usually accessible areas in the Central Namib for personal recreation and enjoyment. One indicator concerning the Policy on Prospecting and Mining in Protected Areas was still **IN PROGRESS** (25%).

Six of the Ecological Integrity (EQO 8) indicators were **MET** in 2016. It was confirmed that mines have specific programmes and projects to actively avoid, mitigate, restore or offset their impacts according to the mitigation hierarchy, and that they have mapped out sensitive areas within their mining licence areas where impacts are monitored and mitigated accordingly. Mining companies have also partnered with conservation organisations and supported additional conservation projects, as far as currently possible. The Ministry of Environment and Tourism has made an effort towards improved visibility with the support of concerned stakeholders. Lastly, the indicator of groundwater levels being within the reach of phreatophytes was also **MET**. Four indicators remained **IN PROGRESS**. One of these concerns the policy on mining in protected areas that is required to enforce the protection of important biodiversity areas and to create an enabling environment for biodiversity offsets. Other ongoing issues relate to secondary impacts in protected areas and studies being conducted to understand the impact of water abstraction on the riverine vegetation and to develop a regular monitoring programme for riverine vegetation, springs and wetlands. The two indicators on biodiversity offsets were **NOT MET**. Mining companies are no longer committed to a "no net loss" policy, while the protection and management of key biodiversity offset areas cannot be implemented without enabling legislation. Eight indicators were **NOT APPLICABLE** because 1) no new exploration or mining licences were issued, 2) no new EIAs for mining projects were carried out and 3) there were no new infrastructure projects in 2016.

The first two Education (EQO 9) indicators were rated **NOT APPLICABLE** because the Ministry of Education, Arts and Culture does not collect the required data on a regional basis. Of the two indicators regarding the Grade 10 and 12 results one was **MET** and one was **IN PROGRESS** because there were no statistics for 2016 but they will be provided again in 2017. There was an increase in the number of graduates from the relevant training institutions, meaning that this indicator was **MET**. The two operating mines **EXCEEDED** the requirement of spending 3% of total wage cost on training by actually allocating 6.7% and 12% to skills development. The indicator that requires each mine to have 10% more bursary holders than work-permit holders was however **NOT MET**.

The five EQO 10 (Governance) indicators that were **MET** (62.5%) relate to the protection of red and yellow flag areas, the availability of monitoring results in annual SEMP reports, action taken to address EMP non-compliance and international checks on the uranium industry's performance. Two indicators were **IN PROGRESS** (25%) because firstly, many GRN agencies postponed their annual inspections at active mines or three-yearly inspections at closed mines and secondly, the regulations under the EMA that will enable the Ministry of Environment & Tourism to issue fines for environmental offences were still pending. One indicator was **NOT MET** because a lack of legislation made it impossible for the Ministry to appoint honorary conservators. Seven EQO 10 indicators were **NOT APPLICABLE** because no new licences for uranium prospecting and mining were issued in 2016, no EIAs were conducted and no compliance orders were issued.

The "future" part of EQO 11 tries to gauge the international reputation of the Namibian uranium brand. Both indicators in this part were **MET** (100%), meaning that there were <10% critical international voices about the operations and performance of the Namib uranium industry <10% evidence of unreliable, unethical and/or environmentally, socially and financially irresponsible conduct. A qualitative assessment of internet search results for "Namibian uranium mining" revealed that the number of positive industry publications will probably always outweigh the critical voices, especially if anti-nuclear organisations are excluded from the count. The "heritage" indicators referring to archaeological research were **NOT APPLICABLE** because no archaeological assessments for new projects or existing mines were carried out in 2016

The performance of EQO 12 on Mine Closure and Future Land Use was the same as in the previous report. The first three indicators were **MET** (75%) because the two operating mines had closure plans that were consistent with the Namibian Mine Closure Framework and IAEA guidelines, as well as closure cost estimations and financial sureties. The fourth indicator requires adequate mine clo-

sure regulations to govern the review and approval of mine closure plans at all stages of the closure and relinquishment process. It was rated **IN PROGRESS** (25%) because Government has started working on the relevant legislation. The overall EQO performance was the same as in the previous SEMP report.

The overall performance of the 2016 SEMP showed a reduction in the number of indicators being **MET** (47%) compared to previous years, while three indicators were again **EXCEEDED** (2%). The percentage of indicators that were **NOT MET** increased to 9%, while the indicators **IN PROGRESS** dropped to 23% (Table 35). In 2016, 30 indicators were rated **NOT APPLICABLE** because the relevant activity did not take place (25%).

Table 35: EQO Performance in 2016 Compared to Previous Years

Status (%)	NOT MET	IN PROGRESS	MET	EXCEEDED
2016	9 (7%)	23 (19%)	57 (47%)	3 (2%)
2015	3 (3%)	34 (34%)	61 (60%)	3 (3%)
2014	8 (7%)	40 (33%)	71 (58%)	3 (2%)
2013	12 (10%)	36 (30%)	70 (59%)	1 (1%)
2012	21 (18%)	37 (32%)	57 (49%)	1 (1%)
2011	14 (11%)	44 (36%)	64 (52%)	1 (1%)

Figure 41 displays the performance for each EQO, which can be summarised as follows:

- The Socioeconomic Development (EQO 1), Employment (EQO 2) and Air Quality (EQO 6) objectives were 100% **MET**. The two applicable indicators in Heritage and the Future (EQO 11) were also **MET**.
- The indicators that were rated as **EXCEEDED** were in the Infrastructure EQO (average waiting time for ships to obtain a berth at Namport was much lower than 12 hours), in Effect on Tourism (tourists' expectations of their visual experience in the Central Namib were mostly exceeded) and in the Education EQO (percentage of wage cost allocated to skills development exceeded the 3% target at operating mines).
- The objectives for Infrastructure (EQO 3), Effect on Tourism (EQO 7)and Mine Closure and Future Land Use (EQO 12) were mostly **MET** with some indicators **IN PROGRESS** or **EXCEEDED**.
- Mixed results ranging from **MET** to **NOT MET** were obtained in the following EQOs: Water (EQO 4), Ecological Integrity (EQO 8), Education (EQO 9) and Governance (EQO 10).
- In the Health EQO (6) the number of indicators **IN PROGRESS** or **NOT MET** was higher than the ones that were **MET**, mostly because it appears unlikely that the stipulated ratio of healthcare professionals and facilities per number of population will be achieved by 2020.
- Other indicators that were **NOT MET** relate to the availability of desalinated water in EQO 4 and biodiversity offsets in EQO 8. One EQO 10 indicator was **NOT MET** because there is no legislation that would allow the Ministry of Environment & Tourism to appoint honorary conservators.

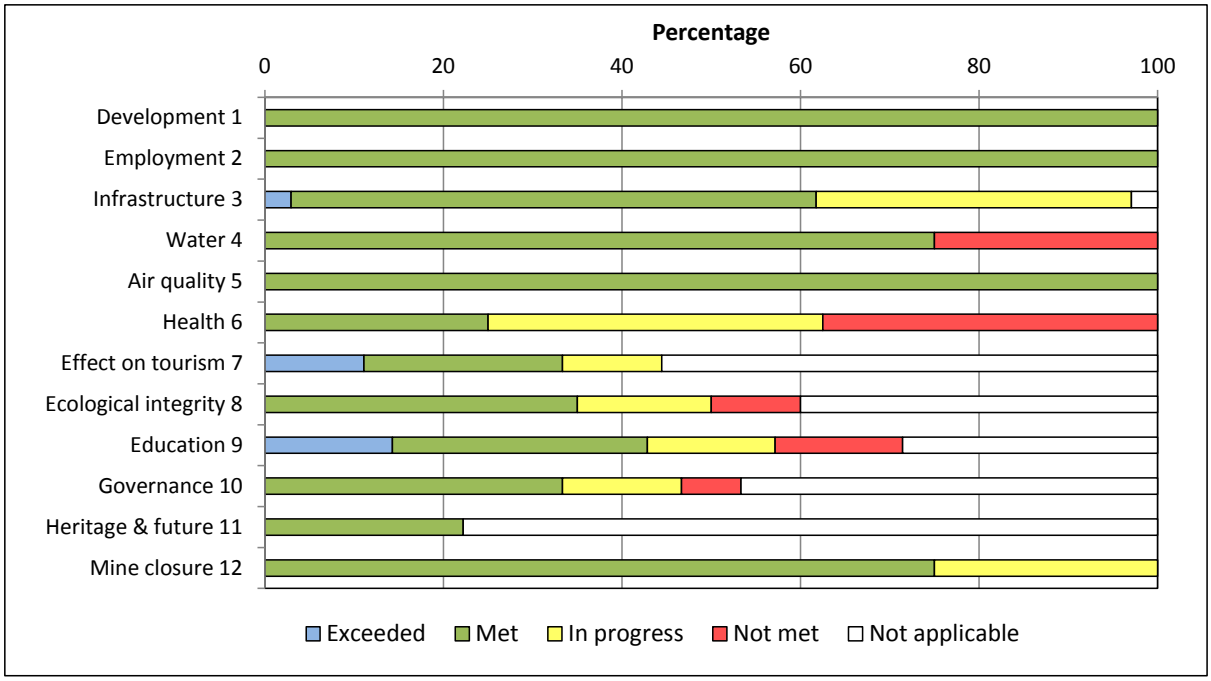

Figure 41: Performance per EQO in 2016

The gradual improvement in performance that was observed in 2013-2015 was reversed in 2016 (Figure 42). The number of indicators that were **NOT MET** has increased and the objectives that were **MET** have declined to the lowest level since 2012. It is worth noting that in 2012 the **NOT MET** rating was also applied to indicators for which the responsible parties did not provide data. The ratings in 2015 were probably too lenient, tending to give stakeholders the benefit of the doubt. It has now become clear that more resources and effort will be needed if the desired outcome of the SEMP is to be achieved.

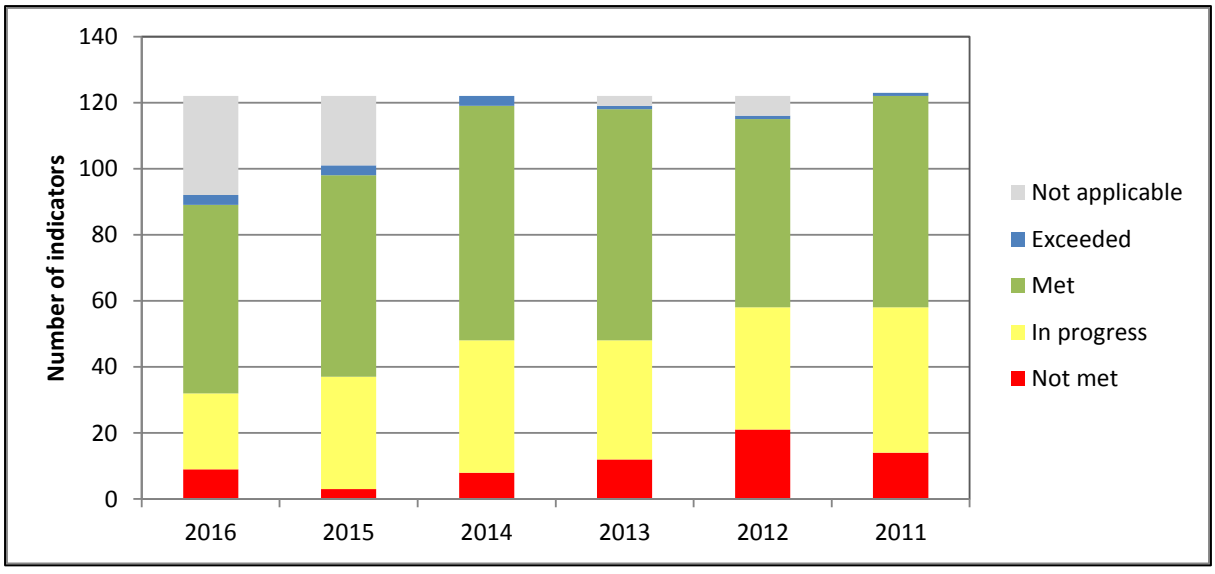

Figure 42: EQO Performance Trends over Time

INDICATORS FOR DISCUSSION

Some indicators have already been changed in previous reports to make the wording clearer or more appropriate. Nevertheless, some new problems or questions came up during the current evaluation. The following indicators are highlighted mainly for the attention of the SEMP steering committee, though it also shows all readers that the evaluation of some indicators is not straightforward. The SEMP has to be seen as a living document that may be amended where required.

Wording of indicator 3.6.1.2: "Independent audits are undertaken for waste sites." Will the intention of the indicator be MET if audits are carried out or would it be more to the point if the municipalities are required to implement remedial measures to address the findings of such audits?

Indicator 4.1.1.1: "Aesthetic/physical, inorganic, radionuclide and bacteriological determinants conform to minimum required quality as prescribed in the national water quality standards." Considering the high background salinity does it make sense to evaluate Khan and Swakop groundwater against the standard for drinking water?

Wording of indicator 5.2.1.1 "Continuous dust fallout measurements (mg/m^2/day) on a regional scale e.g. maintain existing SEA dust fallout network" should be changed in accordance with target 5.2.1. Suggested indicator: "Dust fallout levels in relevant towns should be monitored and not exceed the recommended limit of 600 mg/m^2/day."

Indicator 9.1.1.1: "75% of grade 1 enrolments complete grade 10" and 9.1.1.2: "75% of grade 12 graduates obtain 25 points in six subjects with a D in English." The Ministry of Education has confirmed several times that it is not possible for them to provide these two indicators on a regional basis. The Steering Committee needs to either rephrase or delete the indicators.

Indicator 10.3.1.2: MET cannot appoint honorary conservators because there is no enabling legislation and the creation of such is not being considered. SEMP Steering Committee to re-assess if honorary wardens are required or if it is sufficient that any interested member of the public may report transgressions in parks to MET Parks and Wildlife department.

Indicators 11.3.1.1-11.3.1.5: It is proposed that these indicators under the desired outcome "integration of archaeological and environmental knowledge in a balanced working model of Namib Desert environmental processes" are not applicable in the current mining scenario in which there is a scarcity of new exploration companies conducting EIAs that would include archaeological surveys in the central Namib.

ACTIONS ARISING FROM THIS REVIEW

The implementation of EQO targets is essential to ensure that the region is well positioned for future uranium mining projects. Table 36 summarises the most important actions to address the shortcomings identified in this report. Responsible agencies should take note that the review covers the year 2016 and the report was completed at the end of 2017. The urgency of most actions has increased in the meantime; it would thus be advantageous if some progress could be documented in the next report.

Table 36: SEMP Action Plan

Target / Indicator	Deficiency	Actions	Agency
3.2.1: Roads are well maintained, traffic frequency is acceptable for tourism / other road users and traffic is safe	Traffic on the B2 has increased to the extent that the road is unsafe	• Upgrade the road to double lanes or create passing lanes at least up to Arandis	Roads Authority
3.2.1.1: All key gravel roads are graded timeously to avoid deterioration	Drivers complained about the condition of the Welwitschia Drive	• Tourists' positive impression of the region is important, key tourist roads should always be well maintained	Roads Authority, Mines
3.2.1.2: Unsurfaced roads carrying >250 vehicles per day need to be tarred	To reach Sossusvlei most tourists use the C14 (MR 36) which is in poor condition	• The very busy C14 should be tarred as a matter of priority	Roads Authority
3.2.1.4: Road markings and signs are present and in good condition	Visibility on the B2 at night should be improved, some signs are corroded	• Install cat's eyes for better visibility in the fog zone • Replace corroded road signs	Roads Authority
3.3.1: Most bulk goods are transported by rail	Bulk goods such as fuel are transported on the B2	• Upgrade the railway line so that bulk freight can be transported more efficiently	Transnamib
3.5.1.5: Electricity provision does not compromise human health	Study carried out on Van Eck emissions did not come to firm conclusions	• Determine if emissions from Van Eck power station comply with the air quality guidelines	NamPower
3.6.1.3: All new waste sites undergo an EIA prior to construction and receive a licence to operate	Municipalities completed EIAs for new sites, licencing in progress	• Comply with conditions so that environmental clearance certificates (licences) are issued	Swakopmund and Walvis Bay Mun.
3.7.1.1: Waste site managers are adequately trained	Contractors at Walvis Bay were not fully trained	• Train newly appointed contractors	WB Municipality
3.7.1.2: Site manifests which record non-hazardous waste volumes and origins are kept	Not all the required records are kept	• Swakopmund waste site needs a weighbridge • Improve record-keeping	Swakop, WB Municipalities

Target / Indicator	Deficiency	Actions	Agency
3.7.1.4: Water and air quality monitoring data at waste sites show no non-compliance readings	Air quality is monitored at Swakopmund and Walvis Bay, but not water quality	• Monitor water quality to see if there is hydrocarbon or other hazardous pollution	Swakop, WB Municipalities
3.8.1.3: Volume of waste disposed to landfill per capita decreases	No records of waste volumes from Swakopmund Municipality	• Provide the required data to assess this indicator	Swakop, Municipality
4.3.1.1: Industrial investors are not lost because of water unavailability	Reports of lost investment opportunities due to water unavailability	• Provide sufficient desalinated water at a competitive tariff	Nam-Water
4.3.1.2: Desalinated water meets mine demand	Water supply disruptions due to desalination plant maintenance and delays in upgrading	• Communicate with bulk water users about their expected demand • Inform Erongo desalination plant of increases in demand well ahead	Nam-Water
6.1.1.1: Public dose assessments produced by each new mine project include the cumulative impact of other operating mines	Cumulative impact of other operating mines has not been considered	• Impact will be determined in the advanced air quality study that is currently in progress	MME
6.1.3.2: Measured change in the incidence rate of diseases scientifically attributed to radiation amongst members of the public and uranium mine workers	Incidence rate of diseases scientifically attributed to radiation in the Erongo region is unknown	• Rössing Uranium commissioned an independent study to determine if there is an excess, work-related cancer risk for uranium miners	Mines (RUL)
6.2.1: An increase in qualified health workers available to all in the Erongo region to 2.5 per 1000 of the population by 2020	Number of healthcare professionals in the region is below the envisaged target ratios	• Employ the number of healthcare professionals identified in the 2015 WISN study	MHSS
6.2.2: An increase in registered healthcare facilities in Erongo, reaching 2.5 acute care beds per 1000 population and 0.5 chronic care beds per 1000 population by 2020	Number of healthcare facilities in the region is below the envisaged targets	• Construct additional healthcare facilities	MHSS
6.2.3: An increase in ambulances in Erongo, reaching 1 per 20,000 by 2020	Number of ambulances in the region is below target	• Get additional ambulances (and qualified drivers)	MHSS
7.1.1.1: Areas of importance for recreation that are not yet alienated	The Walvis-Swakop dunes, Messum Crater, Klein Spitzkoppe, Swakop and	• Ensure that these areas remain accessible for	MME

Target / Indicator	Deficiency	Actions	Agency
by mining or prospecting are declared 'red flag' for prospecting or mining	Khan rivers, Welwitschia Drive and Park campsites are not declared 'red flag'	tourism and recreation	
8.1.1.1: Important biodiversity areas [red or yellow flag areas] are taken into consideration when adjudicating prospecting and mining applications	Some red and yellow flag areas are not included in the Policy on Prospecting and Mining in Protected Areas	• Consider the status of these areas before granting mining or exploration licences	MME
8.2.1.2: Mining companies commit to sustainable offset initiatives to ensure 'no net loss' to biodiversity as a result of their operations	Implementation of offsets hampered by lack of procedure and regulations	• Endorse policy to create offsets for irreversible damage to important biodiversity areas	Mines
8.2.1.4: Protection and management of key biodiversity offset areas is supported	There is no legislation for the lasting protection of offset areas	• Create legislation	MET
8.4.1.1: Off-road driving, poaching, illegal camping, littering by mine personnel, are explicitly prevented by mining and exploration personnel and their contractors	MET reported transgressions but could not say if they were committed by mining personnel or members of the public	• Give offender names to NUA so that mines can take action • Continue to prevent and monitor secondary impacts	MET Mines
8.5.1.1: Regular monitoring of indicator species in relevant ephemeral rivers is in place to detect any impacts on wetlands, phreatophytes and riparian vegetation	Monitoring system not yet in place, but studies ongoing	• Identify indicators, design and implement a monitoring system	NERMU
8.5.2.1: No unusual loss of wetland and riparian vegetation	This will form part of the monitoring system mentioned above	• Identify indicators, design and implement a monitoring system	NERMU
9.1.1.4: Region improves performance in reading and mathematics	Standardised Achievement Tests (SAT) not done in 2016, therefore no data	• Carry out SAT in 2017 to measure performance	MEAC
9.2.1.3: Each mine has 10% more bursary holders than work-permit holders	One company exceeded the target, while another failed to meet it	• Allocate more bursaries or reduce number of work-permit holders	Mines
10.3.1.1: GRN agencies inspect active mines at least once per annum, and closed mines at least once every 3 years	Not all agencies inspected each of the mines as required in 2016	• Inspect operating mines every year • Inspect closed mines every 3 years	MME MET MAWF MHSS

Target / Indicator	Deficiency	Actions	Agency
10.3.1.2: Honorary conservators are appointed by MET to assist with monitoring, including of unauthorized secondary (off-mine) activities such as off-road driving, poaching and littering	Currently no legal basis for the appointment of honorary conservators	• Create the necessary regulations, or • Ensure that any member of the public can report transgressions in the parks (e.g. have a central contact number)	MET
10.4.1.3: Fines are issued for non-compliance	Currently no legal basis for the issuing of fines	• Create regulations that include fines	MET
12.3.1.1: Mine closure regulations are adequate to govern: Review and approval of mine closure plans; financial guarantees; implementation review; relinquishment and transfer of liabilities to the subsequent land owner	Namibia does not have mine closure regulations, only a Mine Closure Framework proposed by the industry	• Create the necessary regulations	MME

CONCLUSIONS

The 2016 SEMP report is the sixth annual report since the inception of the process. The report format has reached a certain level of maturity, with the contents improving over time, though many areas could still be optimised. It has become clear over the years that many objectives and indicators were formulated under the assumption that the "uranium rush" that triggered the SEA would lead to the development of a number of new mines. This prediction did not materialise due to the lower demand for uranium following the Fukushima disaster. In the absence of new developments there were 30 indicators that could not be measured because the related activities did not take place anymore.

The SEMP has established itself as a long-term monitoring and decision-making tool through which potential impacts are highlighted so that measures can be introduced to avoid unnecessary impacts or mitigate unavoidable impacts. A continuing aim of the SEMP process is to increase the commitment of key government institutions, the uranium industry and NGOs to undertake whatever actions will take the Erongo region towards the desired future state where communities and industry are able to co-exist in harmony.

The SEMP Office conducted a roadshow in 2015 to inform stakeholders such as government and parastatal institutions that are involved in data collection or monitoring and the implementation of particular targets about the objectives of the SEMP and the importance of their contributions. Some stakeholders were visited again during the data collection process in 2017. Personal interaction was found to be most effective in building productive relationships. The SEMP Office hopes to continue and expand on this stakeholder engagement process in future.

In view of the cyclical nature of commodity markets it is expected that the demand for uranium will increase in future. The implementation of EQO targets according to the action plan in this report, as well as the ongoing monitoring and reporting on achievements and shortcomings is essential to ensure that the region is well positioned for future uranium mining projects.

APPENDIX

Table 37: Namibian Water Quality Guidelines and Standards for Potable Water (MAWF)

Determinants with Aesthetic/Physical Implications

DETERMINANTS	UNITS	LIMITS FOR GROUPS			
		A	B	C	D*
Colour	mg/l Pt**	20			
Conductivity	mS/m 25 C	150	300	400	400
	25/ALT + 248/C				
Total hardness	mg/l $CaCO_3$	300	650	1300	1300
Turbidity	N.T.U***	1	5	10	10
Chloride	mg/l Cl	250	600	1200	1200
Chlorine (free)	mg/l Cl	0,1- 5,0	0,1 – 5,0	0,1 – 5,0	5,0
Fluoride	mg/l F	1,5	2,0	3,0	3,0
Sulphate	mg/l SO_4	200	600	1200	1200
Copper	µg/l Cu	500	1000	2000	2000
Nitrate	mg/l N	10	20	40	40
Hydrogen Sulphide	µg/l H_2S	100	300	600	600
Iron	µg/l Fe	100	1000	2000	2000
Manganese	µg/l Mn	50	1000	2000	2000
PH****	pH-unit	6,0 – 9,0	5,5 – 9,5	4,0 – 11,0	4,0 – 11,0

All values greater than the figure indicated. ** Pt = Platinum Units Nephelometric Turbidity Units****The pH limits of each group exclude the limits of the previous group**

Bacteriological Determinants

DETERMINANTS	LIMITS FOR GROUPS			
	A**	B**	C	D*
Standard plate counts per 1 ml	100	1000	10000	10000
Total coliform counts per 100 ml	0	10	100	100
Faecal coliform counts per 100 ml	0	5	50	50
E. coli counts per 100 ml	0	0	10	10

Inorganic Determinants

DETERMINANTS	UNITS	LIMITS FOR GROUPS			
		A	B	C	D*
Aluminium	µg/l Al	150	500	1000	1000
Ammonia	mg/l N	1	2	4	4
Antimonia	µg/l Sb	50	100	200	200
Arsenic	µg/l As	100	300	600	600
Barium	µg/l Ba	500	1000	2000	2000
Beryllium	µg/l Be	2	5	10	10
Bismuth	µg/l Bi	250	500	1000	1000
Boron	µg/l B	500	2000	4000	4000
Bromine	µg/l Br	1000	3000	6000	6000
Cadmium	µg/l Cd	10	20	40	40
Calcium	µg/l Ca	150	200	400	400
Calcium	µg/l $CaCO_3$	375	500	1000	1000
Cerium	µg/l Ce	1000	2000	4000	4000
Chromium	µg/l Cr	100	200	400	400
Cobalt	µg/l Co	250	500	1000	1000
Cyanide (free)	µg/l CN	200	300	600	600
Gold	µg/l Au	2	5	10	10
Iodine	µg/l I	500	1000	2000	2000
Lead	µg/l Pb	50	100	200	200
Lithium	µg/l Li	2500	5000	10000	10000
Magnesium	mg/l Mg	70	100	200	200
Magnesium	mg/l $CaCO_3$	290	420	840	840
Mercury	µg/l Hg	5	10	20	20
Molybdenum	µg/l Mo	50	100	200	200
Nickel	µg/l Ni	250	500	1000	1000
Potassium	µg/l K	200	400	800	800
Selenium	µg/l Se	20	50	100	100
Silver	µg/l Ag	20	50	100	100
Sodium	µg/l Na	100	400	800	800
Tellurium	µg/l Te	2	5	10	10
Thallium	µg/l Tl	5	10	20	20
Tin	µg/l Sn	100	200	400	400
Titanium	µg/l Ti	100	500	1000	1000
Tungsten	µg/l W	100	500	1000	1000
Uranium	µg/l U	1000	4000	8000	8000
Vanadium	µg/l V	250	500	1000	1000

EQO4 – Interpretation of Swakop and Khan Groundwater Quality Analyses

The Namibian water quality standards (Table 37) classify water for human consumption according to an ideal guideline value and an acceptable standard. The standard is a firm limit, while the guideline shows the values that a water supply should aspire to meet if this is technically and economically possible. As mentioned under Indicator 4.2.2.1, the standard is just used as a benchmark for comparison because the salinity renders the water unsuitable for human consumption. The complete 2016 analysis reports for Khan and Swakop groundwater can be found in the SLR report[111].

It is clear that from the analysis results that the water is unsuitable for human consumption due to its high salinity. It is however used for livestock farming and horticulture. DWAF collected samples from the SEMP boreholes in January and October 2013, September 2014 and in June 2016. This report compares the earlier analyses in 2013 and 2014 with the new results of 2016. To assist with the data interpretation graphs were compiled to show the concentrations of the main indicators, i.e. total dissolved solids (TDS), chloride, sodium and sulphate (in milligrams per litre, mg/L). These graphs depict some noteworthy trends related to recharge from floods in 2011 and a slow return to the "normal" salinity as measured before the floods.

For instance in the Rössing area, the groundwater at boreholes BH4 and WW200411 was diluted with flood water and the resulting TDS of 4000-5000 mg/L slowly rose back to the level of 5000-6500 mg/L that is typical for this area (Figure 43). Borehole WW202082 did not improve much after the 2011 floods because the deep water table in the lower Khan compartment, more than 15 metres below the surface, is not easily reached by infiltrating flood water.

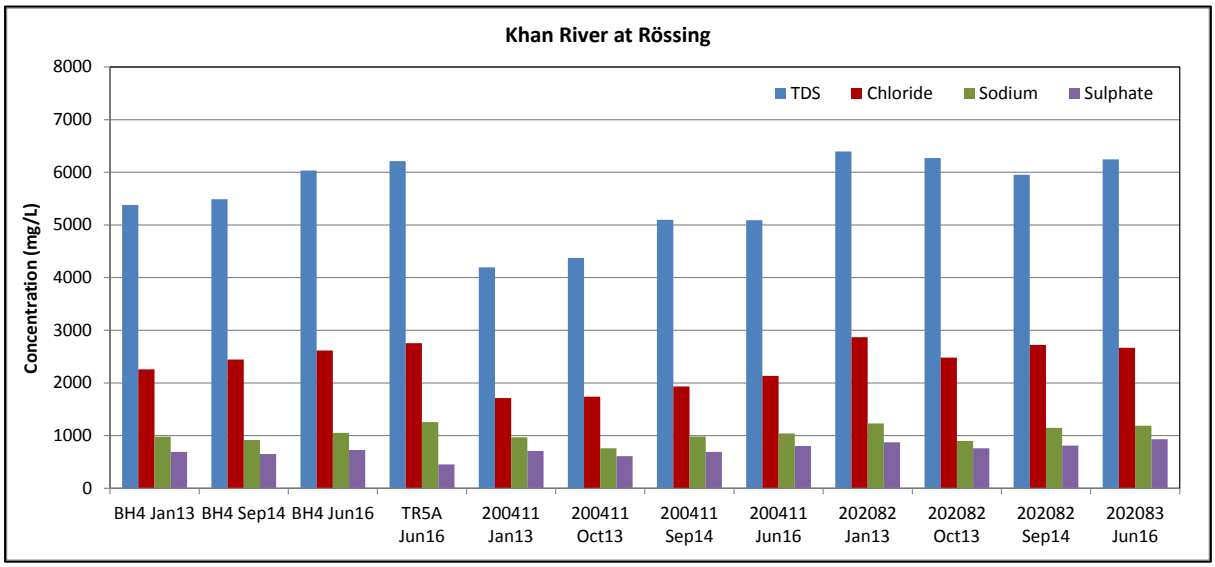

Figure 43: Water Quality Indicators for the Khan River at Rössing Mine

Figure 44 for the Swakop River in the Langer Heinrich area shows the upstream borehole WW41184 on the right, followed by the two sites downstream of the mine in the Husabberg compartment, WW41182 and WW 41181. The water quality at WW41184 improved after the 2011 recharge to a minimum of 3000 mg/L TDS in 2016. The opposite trend was observed at WW41182, where a quality improvement was already visible in January 2013 and which returned to pre-flood salinity concentrations in 2016. WW41181 fluctuated a little in 2013 and 2014 before rising to over 7000 mg/L in

[111] SLR (2017): Central Namib Uranium Province, Specialised Groundwater Monitoring and Training in the Swakop/Khan River for the Strategic Environmental Management Plan (SEMP). SLR Project No. 733.07042.00001, Report No. 2016-WG31 submitted to Geological Survey of Namibia, MME, Windhoek

2016. The higher salinity in the Husabberg compartment is caused by evapotranspiration from a wetland at the compartment boundary. Only water evaporates in the wetland or is taken up by plants, while the dissolved salts remain behind and are relatively enriched.

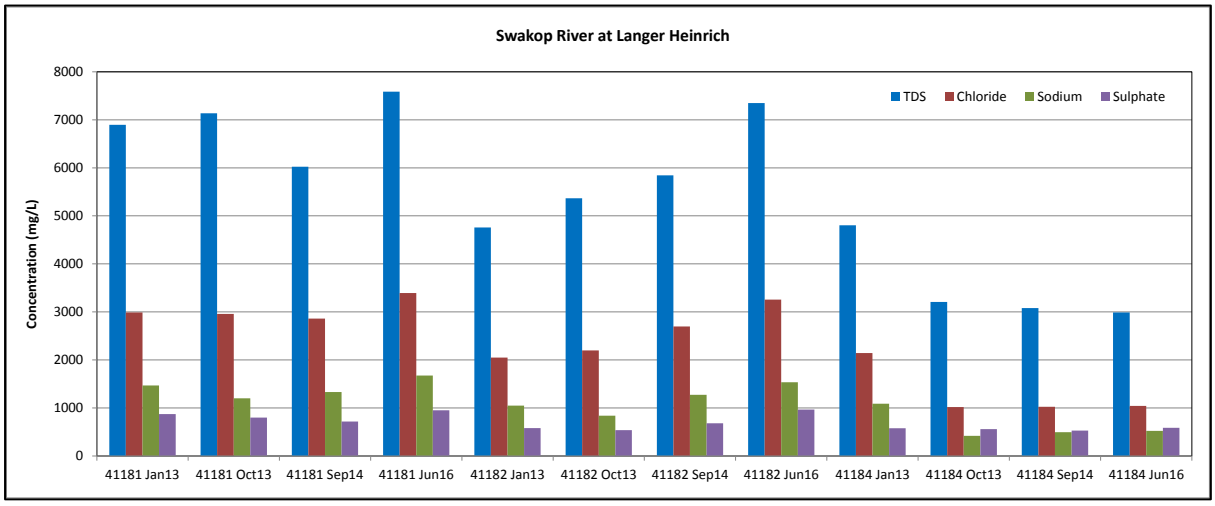

Figure 44: Water Quality Indicators for the Swakop River at Langer Heinrich Mine

Swakop Uranium's boreholes in the Ida Dome compartment are characterised by relatively low salinities of 3000-4000 mg/L TDS (Figure 45). This trend continues at farm Palmenhorst which lies at the downstream boundary of the Ida Dome compartment (borehole 41075 in Figure 46). An interesting anomaly is the high sulphate concentration at SW2, while most other sites have lower sulphate than chloride levels. Borehole SW1 could not be sampled in 2016 because it had collapsed.

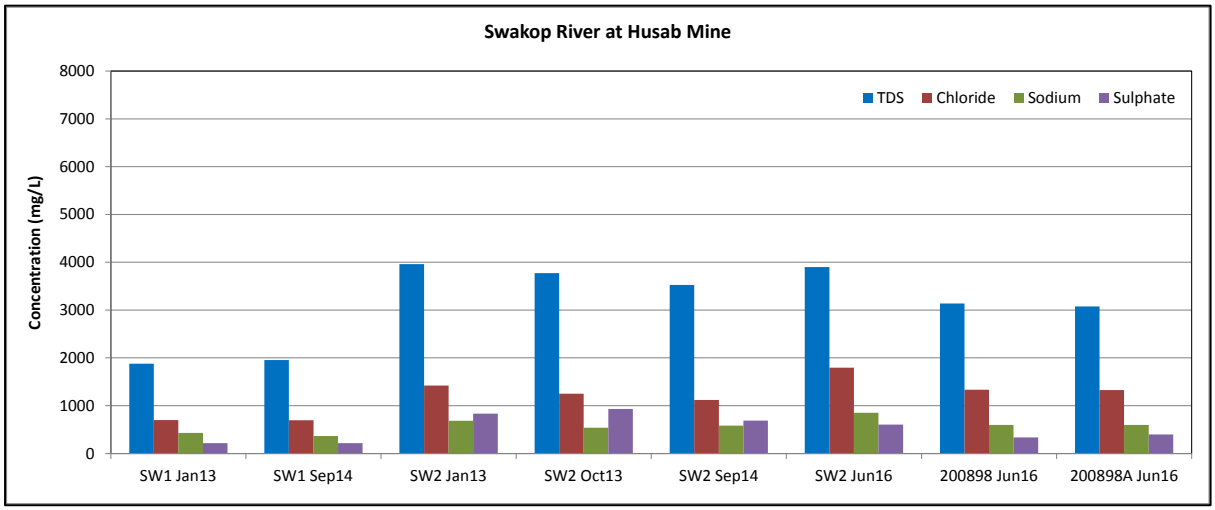

Figure 45: Water Quality Indicators for the Swakop River at Husab Mine

The lower reaches of the Swakop River from the Khan confluence to the coast are characterised by an increase in salinity to a maximum of 18,000 mg/L in the vicinity of the Rossmund golf course. Bannerman's boreholes WW41072 and WW41075 upstream of Goanikontes display salinities around 5000-7000 mg/L similar to the Khan River. There is a step change downstream of Goanikontes to TDS levels of 9000-11,000 mg/L at boreholes WW200413 and GAHD020, and a further increase in the area of the smallholdings (WW201569-201571 in Figure 47). These analyses show that the run-off in 2011, even though it persisted for several months, did not lead to a significant improvement of the water quality in the farming area.

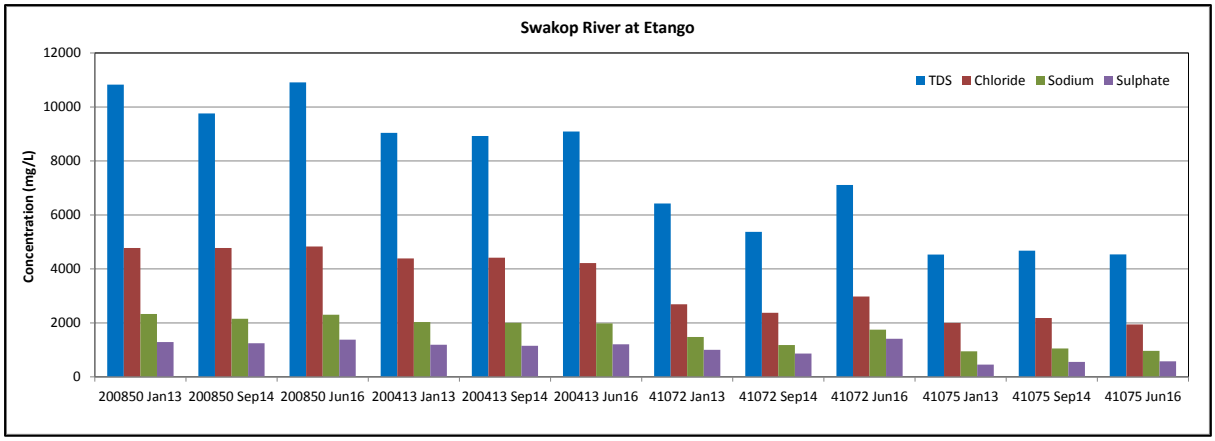

Figure 46: Water Quality Indicators for the Swakop River at Etango (Goanikontes)

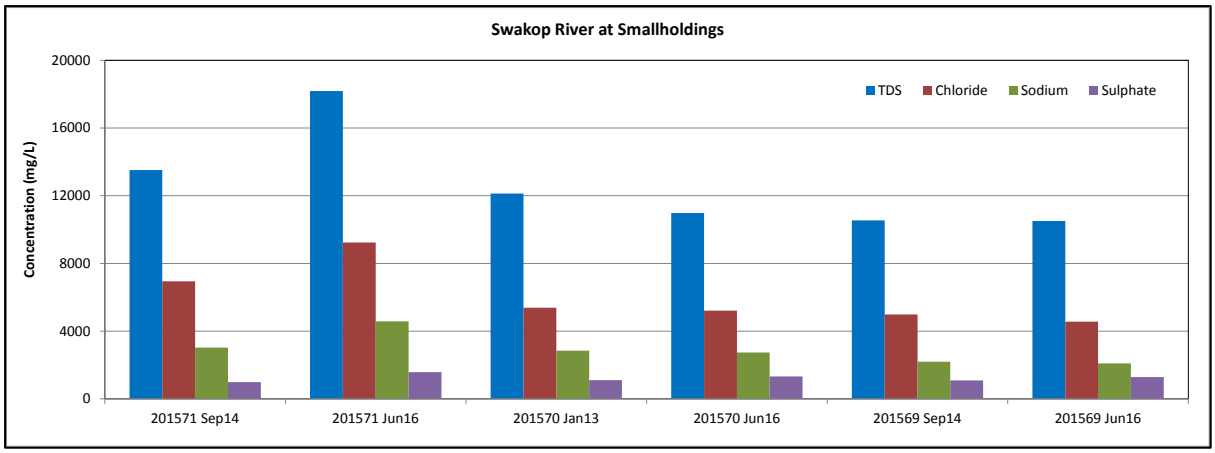

Figure 47: Water Quality Indicators for the Swakop River in the Farming Area

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