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Strategic Environmental Management Plan (SEMP) for the Central Namib Uranium Province 2012 Annual Report

May 2014

Prepared by

Geological Survey of Namibia

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Copies of this report and the Strategic Environmental Assessment report may be obtained from the Geological Survey of Namibia, Ministry of Mines and Energy. Electronic copies (pdf format) are available

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ABBREVIATIONS

AQG	Air Quality Guideline
DWAF	Department of Water Agriculture and Forestry
EIA	Environmental Impact Assessment
EMP	Environmental Management Plan
EQO	Environmental Quality Objective
HAN	Hospitality Association of Namibia
IAEA	International Atomic Energy Agency
ICPR	International Commission on Radiological Protection
MAWF	Ministry of Agriculture, Water & Forestry
MET	Ministry of Environment & Tourism
MME	Ministry of Mines & Energy
MoE	Ministry of Education
MoHSS	Ministry of Health & Social Services
NERMU	Namibia Ecological Restoration and Monitoring Unit
NAA	Neutron Activation Analysis
NMCF	Namibian Mine Closure Framework
NRPA	National Radiation Protection Authority
NTB	Namibia Tourism Board
PM10	Particulate Matter <10 µm
REEC	Radon Equilibrium Equivalent Concentration
SANS	South African National Standards
SEMP	Strategic Management Plan
UI	Uranium Institute
WBM	Walvis Bay Municipality
WHO	World Health Organization

Mining companies

Acronym	Full company name	Parent company	Mine/prospect site name(s)
ARN	AREVA Resources Namibia	AREVA (France)	Trekkopje
BMRN	Bannerman Mining Resources Namibia (Pty) Limited	Bannerman Mining Resources (Australia)	Etango, Ondjamba, Hyena
LHU	Langer Heinrich Uranium (Pty) Limited	Paladin Energy (Australia)	Langer Heinrich
MEN	Marenica Energy Namibia (Pty) Limited	Marenica (Australia)	Marenica
RUN	Reptile Uranium Namibia (Pty) Limited	Deep Yellow (Australia)	INCA, Omahola, Shiyela, Tubas
RUL	Rössing Uranium Limited	Rio Tinto (UK)	Rössing
VU	Valencia Uranium (Pty) Limited	Forsys Metals (Canada)	Norasa (formerly Valencia)
SU	Swakop Uranium (Pty) Limited	Taurus Minerals (China)	Husab
ZRN	Zhonghe Resources (Namibia) Development (Pty) Ltd	China Uranium Corporation (China)	Zhonghe

EXECUTIVE SUMMARY

The Strategic Environmental Management Plan (SEMP) for the central Namib Uranium province is an over-arching framework addressing cumulative impacts of existing and potential developments through monitoring and management. The SEMP arises from the Strategic Environmental Assessment (SEA) for the uranium province, an initiative that provides vision and generates a culture of collaboration within the mining industry, government, and the public. The 2012 SEA scenario for the uranium mining sector resembles Scenario 1 of the SEA (below expectations), as Rio Tinto's Rössing and Paladin's Langer Heinrich were the only two uranium mines in operation. About 4500 t U were produced in 2012 including 251 t from Areva Resources Namibia's pilot test at Trekkopjie. The construction of Swakop Uranium's Husab project commenced in October 2012. Environmental approval for Bannermann Resources Namibia was submitted in 2012. Like Reptile Uranium Namibia, Bannermann is waiting for a mining licence. Amongst the probably emerging mines is also Valencia, however, because of its low grade and unfavourable uranium prices, mining has not started. A mining licence was issued to Zonghe Resources in November 2012.

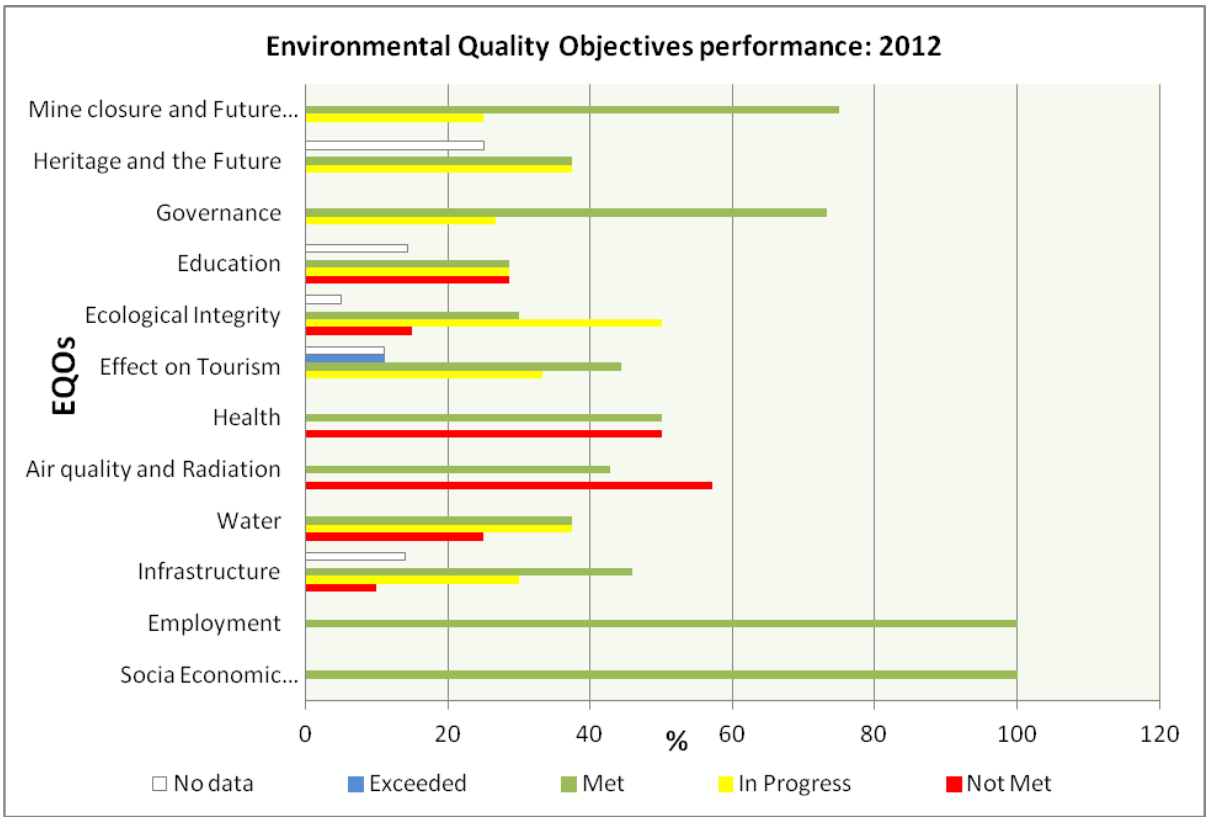
The SEMP office collates data, assesses indicators, and annually produces a SEMP report that provides a clear indication of what targets are being EXCEEDED, MET or NOT MET. Assessments of indicators are rated through their Environmental Quality Objectives (EQO), which define the limits of acceptable change due to the uranium mining in the region that can be tolerated. Each EQO articulates a specific goal and context with set standards. The SEMP operational plan currently comprises 38 desired outcomes, 46 targets, and 125 indicators spread across all EQOs. Indicators have been assessed according to the following colour-coded four-tiered system (see below).

The 2012 indicators performed as follows (2011 figures for comparison):

Status (%)	*NOT MET*	*IN PROGRESS*	*MET*	*EXCEEDED*
2012	*21 (16%)*	*37 (30%)*	*57 (46%)*	*1 (1%)*
2011	*14 (11%)*	*44 (33%)*	*64 (51%)*	*1 (1%)*

Evidently, mining is associated with positive synergies such as employment, infrastructures and various socio- economic benefits; however the potentially negative effects (e.g. air quality and radiation, effect on tourism) are amongst the major public concerns. Nonetheless, the central Namib still cremains a top destination for tourism and development. The 2012 assessment proves that land users within the region are collaborative and caring for the social, economic, and natural environment.

Compared to the 2011 report, the uranium activities have not significantly reduced the visual attractiveness of the Central Namib, and the respective indicator is even EXCEEDED. 46 percent of the total indicators of the total indicators are MET, with 100% MET attained in EQO 1(Socio-Economic Development) and EQO 2 (Employment). Governance (EQO10), Mine Closure and Future Land Use (EQ12) and Effect on Tourism (EQO7), Heritage and the Future (EQO11) are amongst the best performing EQOs; followed by the Infrastructure (EQO3), Water (EQO4) and the Effect on Tourism EQO (EQO7). The number of indicators that are in-progress has reduced from 33% in 2011 to 30% in 2012. Eight percent of the indicators did unfortunately not have sufficient data to be full assessed; therefore they are rated as no data. Sixteen percent of the indicators are NOT MET; and include some indicators the Education (EQO9), Ecological Integrity (EQO8), Infrastructure (EQO3) , Water (EQO4); with the Health (EQO6), and the Air quality and radiation (EQO5) making up most of it.



The 2nd annual SEMP report is expected to have a positive influence on the future performance of the uranium industry, government, other developers and wellbeing of the public. Its results and recommendations will hopefully create awareness and address the shortcomings that were identified. The aims of the SEMP to safeguard the environment of the Erongo Region while gaining maximum benefit from our natural resources can only be achieved by making every effort towards continued improvement. The desired outcome is that the development and utilization of Namibia´s uranium resources will contribute significantly to the goal of sustainable development for the Erongo Region and Namibia as a whole.

ACKNOWLEDGEMENTS

We would like to express our sincere gratitude to all those who have been involved with the SEA and the SEMP initiatives. We would like to thank the SEMP steering committee for its undivided devotion and guidance. Our appreciation also goes to the Uranium Institute and the Uranium Association for their continued support. We are obliged to the uranium industry through the uranium working group for always submitting data on time. Our greatest appreciation and thanks go to all the authors from the GSN-SEMP office, NERMU, and the individual contributors Sandra Müller of Areva and Dr Wotan Swiegers of the Uranium Institute, all ministerial offices, NGOs and other individuals who contributed to the compilation of this report.

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INTRODUCTION

SEMP Background

The world-wide first Strategic Environmental Assessment (SEA) for the uranium province was an initiative that provided vision and generates a culture of collaboration within the mining industry and between government, industry and the public. The SEA was driven by the concept of sustainability.

Article 100 of the Namibian constitution states that “Land, water and natural resources below and above the surface of the land and in the continental shelf and within the territorial waters and the exclusive economic zone of Namibia shall belong to the State if they are not otherwise lawfully owned.” Government allows companies to explore and mine in exchange for benefits to the country, such as taxes, investment, jobs, skills, and exports. Mining is associated with positive and negative synergies; hence Article 95 of the constitution emphasises the importance of environmental protection by stating that Namibia shall actively promote and maintain the welfare of the people by adopting policies aimed at the maintenance of ecosystems, essential ecological processes and biological diversity of Namibia and utilization of living natural resources on a sustainable basis for the benefits of all Namibians.

As a result of the SEA, the Strategic Environmental Management Plan (SEMP) was developed, and is an over-arching framework and roadmap for addressing the cumulative impacts of a suite of existing and potential developments. Its management and implementation requires decision makers at all levels to enter into meaningful partnerships with each other. Thus a broad-based steering committee is developed to oversee the functioning of the SEMP office. The Steering committee comprises of various stakeholders from governmental and non-governmental institutions (Figure 1). The SEMP is intended to guide both mining and other related industrial developments in the Erongo Region so that they do not compromise the natural, social, economic and physical environments. It provides an overall monitoring and management system for the “Uranium Province” in the Erongo Region.

Fundamental to the development of the SEMP was setting up the Environmental Quality Objectives (EQO) to try and define the limits of acceptable change that can be tolerated due to the uranium mining in the region (Table 1). The EQO’s each articulate a specific goal, provide a context, set standards and elaborate on a small number of key indicators that need to be monitored. Twelve (12) EQO’s have been identified, with 46 targets and 125 indicators. The SEMP office collates the data needed to assess the key indicators and compiles an annual SEMP report that provides a clear indication of what targets are being EXCEEDED, MET or NOT MET.

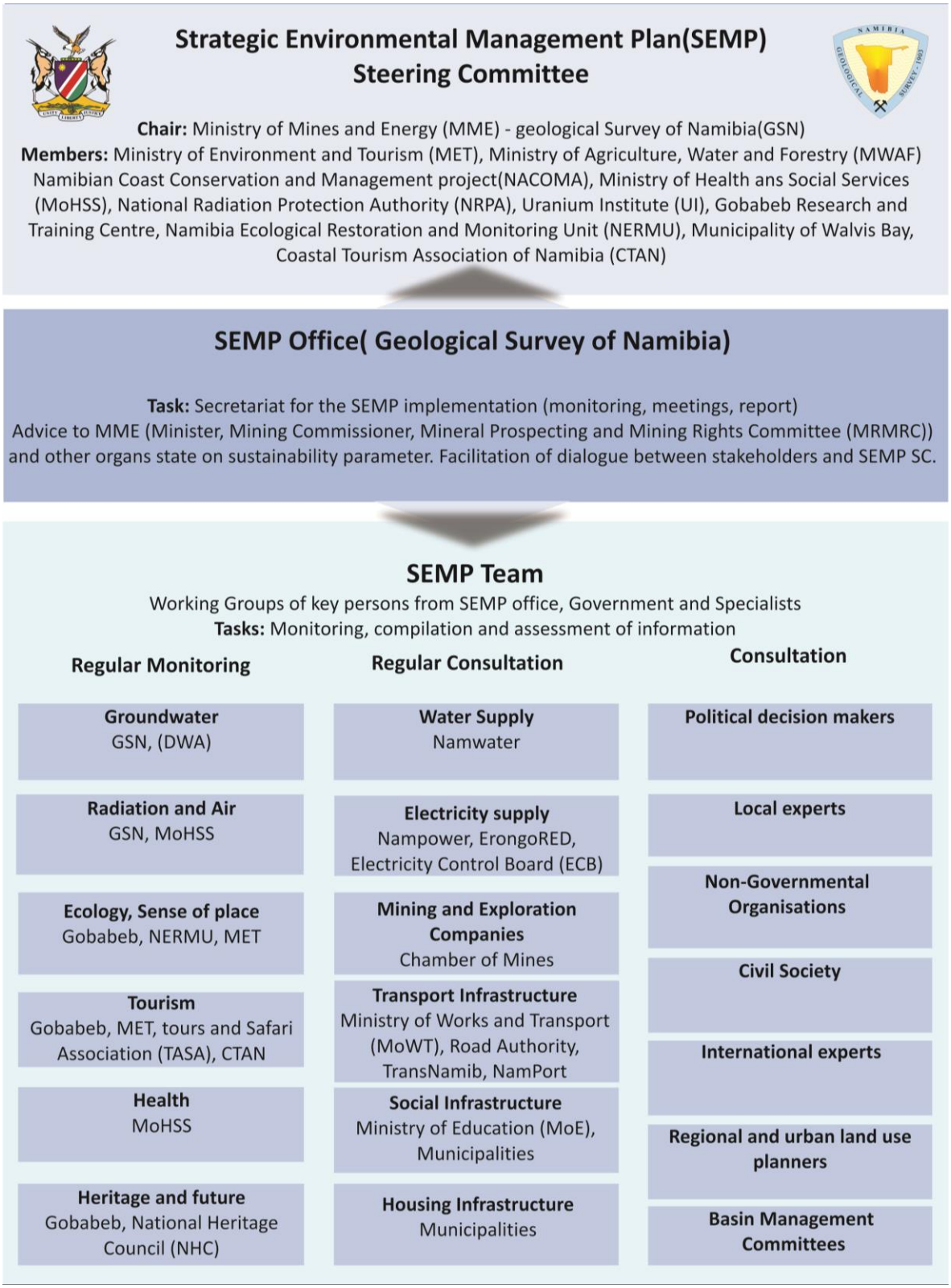

Figure 1: A diagram of the SEMP's Governance structure

Table 1: The Environmental Quality Objectives (EQO) of the SEMP Operational Plan

No.	EQO	Aims of EQO
1	Socio-Economic Development	The Uranium Rush improves Namibia and the Erongo region's sustainable socio-economic development and outlook without undermining the growth potential of other sectors.
2	Employment	Promote local employment and integration of society.
3	Infrastructure	Key infrastructure is adequate and well maintained, thus enabling economic development, public convenience and safety.
4	Water	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.
5	Air quality and radiation	Workers and the public do not suffer significant increased health risks as a result of radiation exposure from the Uranium Rush.
6	Health	Workers and the public do not suffer significant increased health risks from the Uranium Rush.
7	Effect on tourism	The natural beauty of the desert and its sense of place are not compromised unduly by the Uranium Rush; and to identify ways of avoiding conflicts between the tourism industry and prospecting/mining, so that both industries can coexist in the Central Namib. The Uranium Rush 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.
8	Ecological integrity	The ecological integrity and diversity of fauna and flora of the Central Namib is not compromised by the Uranium Rush. 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.
9	Education	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.
10	Governance	Institutions that are responsible for managing the Uranium Rush 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.
11	Heritage and future	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 heritage resources. Survey, assessment and mitigation will result in significant advances in knowledge of archaeological heritage resources, so that their conservation status is improved and their use in research, education and tourism is placed on a secure and sustainable footing
12	Mine closure and future land use	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.

Uranium mining and exploration in the Erongo region

Uranium was discovered in the Namib Desert in 1928, but it was not until intensive exploration got under way in the late 1950s that much interest was shown in Rössing. Rio Tinto discovered numerous uranium occurrences and in 1966 took the rights over the low-grade Rössing deposit, 65 km inland from Swakopmund. The first commercial uranium mine began operating here in 1976.

Two other significant calcrete-hosted uranium deposits found in early exploration were Trekkopje and Langer Heinrich; discovered in 1973. Numerous deposits such as Valencia, Etango, Omahola, Tubas, Marenica and Husab are amongst the latest discoveries. Namibia's identified uranium resources are about 5% of the world's known total uranium resources. A summary of all measured and inferred uranium resources is given in Table 2. To date, Namibia has two significant uranium mines providing 7.6% of world mining output, the Rössing and Langer Heinrich Mines (Table 3).

Table 2: Uranium resources of mines and exploration projects (WNA Market Report, 2013)

	Deposit type	**Known Resources**	
		Measured & indicated	Inferred
Rössing	Hard rock	52 700 t U @ 0.021% **	No data
Langer Heinrich	Palaeochannel	57 500 t U @ 0.055%	9 200 t U @ 0.06%
Trekkopje	Palaeochannel	26 000 t U @ <0.011%	3 000 t U @ 0.01%
Husab	Hard rock	137 700 t U @ 0.039%	50 000 t U @ 0.029%
Valencia-Namibplaas	Hard rock	36 190 t U @ 0.015%	7 100 t U @ 0.014%
Etango*	Hard rock	57 330 t U @ 0.019%	24 630 t U @ 0.016%
Marenica	Palaeochannel & hard rock	2 500 t U @ 0.010%	19 600 t U @ 0.008%
Omahola	Hard rock	10 400 t U @ 0.036%	6 950 t U @ 0.036%
Tubas-TRS	Aeolian	0	10 900 t U @ 0.0125%

** In addition to reserves, see table 3 below.
* Reserves are 46,000 t U at 0.0165% U

Table 3: Namibian uranium production - tonnes U per annum (WNA Market Report, 2013)

	2008	**2009**	**2010**	**2011**	**2012**
Rössing	3 449	3 519	3 083	2 641	**2 293**
Langer Heinrich	919	1 108	1 419	1 437	**1 960**
Trekkopje	0	0	0	0	**251**

About 64 percent of the world's production of uranium from mines is from Kazakhstan, Canada and Australia (Figure 2). Kazakhstan produces the largest share of uranium from mines (36.5% of world supply from mines in 2012), followed by Canada (15%) and Australia (12%) (Figure 2). Although there was a decline in production at the Rössing mine in 2012, the overall world production has increased.

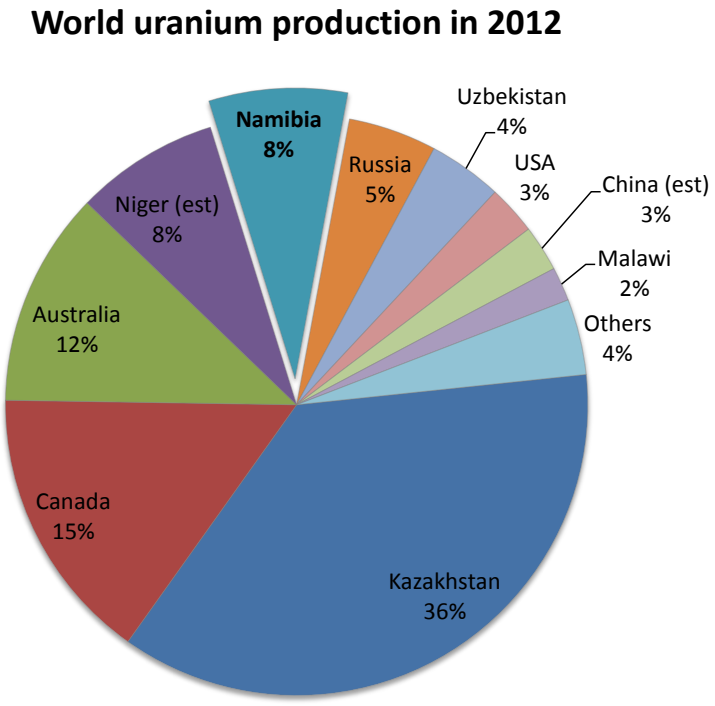

Figure 2: Namibian uranium production relative to world production in 2012 (WNA Market Report, 2013)

Uranium Legislative Framework

Uranium mining is regulated under various acts of which the major ones are the Minerals Act of 1992, the Atomic Energy Act of 2005, and the Environmental Management Act of 2007. Additionally, an Atomic Energy Board (AEB) has been established along with a National Radiation Protection Authority (NRPA). Finland's Radiation & Nuclear Safety Authority (STUK) is working with Namibian authorities to develop a uranium policy and a safeguards and non-proliferation regime, under a program funded by the Finnish Foreign Ministry. Furthermore, uranium is amongst the minerals which Cabinet has declared as strategic minerals.

Present Uranium Mining Scenario in Namibia

The 2012 SEMP assessment of the uranium mining sector most closely resembles Scenario 1 (below expectations) as defined in the SEA. In a brief summary the Chamber of Mines in Namibia (CoM, 2013) reports that the effects of the Fukushima tragedy are still being hard felt by the uranium industry. The uranium spot price has declined with the lowest records of U$41.50 a pound observed in November 2012 (Figure 33). This has caused mining companies to cut costs and defer capital projects. Investment decisions have been put on hold pending a recovery of the market.

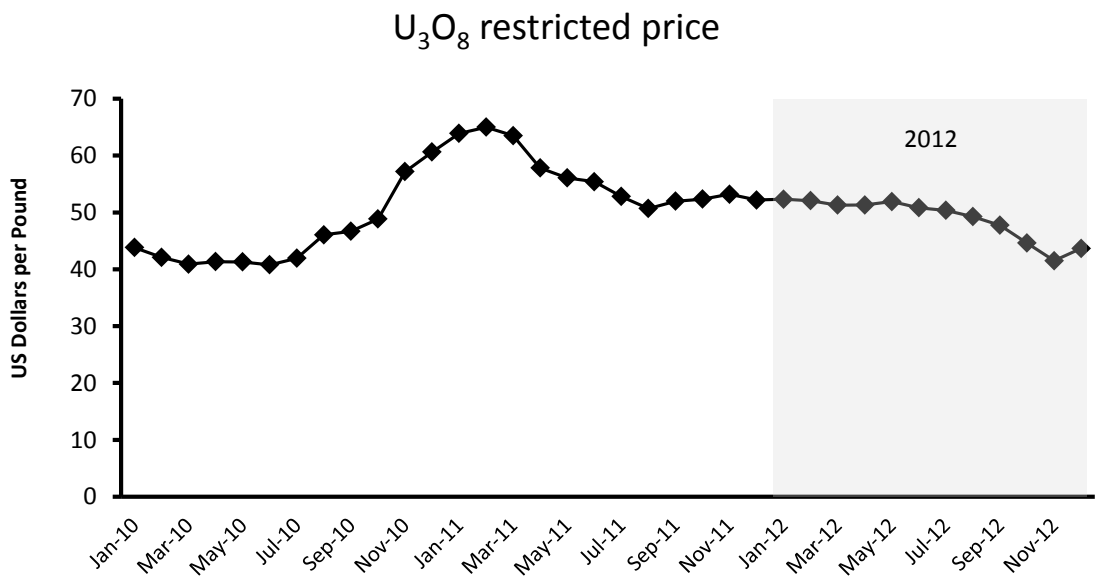

Figure 3: Uranium U3O8 restricted price, Nuexco exchange spot price in US$/lb (www.indexmundi.com/commodities/?commodity=uranium&months=60)

The expected expansion of uranium output has been delayed but not all together abandoned owing to the adverse effects of low uranium prices stemming from global financial uncertainty and the Fukushima incident (Chamber of Mines Annual Review 2012). The uranium industry nevertheless expects the current depressed situation to be temporary, because of new demand emerging from China, India and Russia. These countries want to increase their nuclear power capabilities significantly. In spite of the adverse market conditions, China's state-owned General Nuclear Power Corporation (CGNPC) announced the decision to forge ahead with the construction of the Husab Mine at an investment of N$ 20 billion. It is believed that the mine will become the second largest uranium mine in the world and Namibia is likely to become the second largest producer of uranium in the world, after Kazakhstan. The Husab mine will in future contribute 5% towards GDP with a potential life of mine of 20 years. The mine will also pay a 3% royalty to government once production commences.

Mining and exploration companies operating in the central Namib

Langer Heinrich Uranium

The Langer Heinrich Mine lies 50 km south-southeast of Rössing, in the Namib Naukluft Park, some 80 km from the coast. The open pit mine owned by Paladin Energy commenced operation late in 2006 with a 1000 t U/yr capacity and has since extended its capacity in two stages. Langer Heinrich successfully commissioned its stage three expansion and ramped up production to 1960 tonnes in 2012 which was equivalent to the plant's operating capacity. The stage 4 feasibility study was completed in May 2012 but the project was put on hold due to low uranium prices. Paladin's uranium is sold on the spot and contract market.

Rössing Uranium

Rio Tinto's Rössing Mine has a nominal capacity of 4 000 t U/yr and to the end of 2011 had supplied 101 123 t U. In 2012 it produced 2 293 t U. Its uranium is sold to power utilities in Central Europe,

North America and South-East Asia including China. Production by Rössing in 2012 was 10% less than budgeted for, resulting in continuous cash flow constraints. Rössing experienced operating losses for a third consecutive year, due to depressed uranium prices and high operating costs.

AREVA Resources Namibia-Trekkopje

AREVA's Trekkopje deposit lies about 70 km northeast of Swakopmund, and 35 km north of Rössing. The US$ 1 billion project has a shallow open-pit mine and has developed a sodium carbonate/bicarbonate heap leach process. About 80 percent of the ore occurs less than 15 metres deep, but is very low grade - 0.012-0.015%. Since 2010 water has been supplied from a coastal desalination plant set up by AREVA with has an output of about 55,000 m^3/day (20 million m^3/yr). Some of this water is available to other mines.

A substantial conversion of 'inferred' resources to reserves occurred as a result of drilling in 2006 and 2007, taking the Measured and Indicated Resource category to 42 000 t U in the main deposit. AREVA reported 45 600 t U resources in 2008, but then revised this to 26 000 t U in 2011 at lower grades, as it announced a massive EUR 1.8 billion write-down of its investment. Over 9 000 t of vanadium pentoxide as a by-product had been envisaged. The mine was intended to produce 3 200 t U/yr from 2013 onwards.

A mining licence was granted in June 2008, and the first concentrate from the pilot phase was produced in January 2011. The second stage pilot operation was commissioned in mid-2010 and produced 251 t U in 2012. The main ore stacking for the on-off alkaline heap leach operation was due to commence early in 2012. Considering both, the continued decrease of uranium prices coupled with the investments yet to be made on site, AREVA announced the postponement of the launch of the Trekkopje Mine and has placed the mine under a N$ 10 million/year care and maintenance plan from July 2013 onwards.

Bannerman Mining Resources Namibia - Etango

Bannerman Resources Ltd’s Etango project lies 30 km southwest of Rössing with an alaskite ore body comparable in composition to that at Rössing. The definitive feasibility study for the Etango project was completed in March 2012, confirming the viability of the project and putting its cost estimate at US$ 870 million. Some 80% of measured and indicated resources were converted to proven and probable reserves of 46 000 t U at 0.0165% U, supporting a minimum open pit life of 16 years. Production at 2 700 t U/yr following the heap leaching route is now envisaged, with production costs of US$ 41/lb U_3O_8 over the first five years. Environmental approval for development of the project was received in 2012. A mining licence is still awaited. Further inferred resources are at the adjacent Ondjamba and Hyena ore bodies.

Marenica Energy Namibia

In July 2008 West Australian Metals, now re-named Marenica Energy, announced a modest JORC-compliant inferred resource in the Marenica palaeochannel deposit 30 km north of AREVA's Trekkopje and similar to it. In December 2011 the company revised this to Indicated Resource of 2 500 t U at 0.01% U, and an Inferred Resource of 19 600 t U at 0.008% U, mostly in a palaeochannel but with some granite-alaskite basement rock down to 60 metres. Marenica Energy has an 80% interest in the project. Early in 2010 AREVA NC bought a 9.5% stake in the company from Polo Resources PLC, and in November 2010 China's Hanlong Energy Ltd, a subsidiary of privately-owned Sichuan Hanlong Group, bought a 5.82% share of the company and agreed to provide loan funding.

Reptile Uranium-Omahola, Tubas

Australia's Deep Yellow Ltd, through wholly-owned subsidiary Reptile Uranium Namibia, is focused on the Omahola Project. It includes the high-grade Inca primary uraniferous magnetite deposit at about 200 metres depth, the Ongolo Alaskite 10 km from Omahola, and the MS7 Alaskite in between and possibly connected.

Inca has 2 800 t U indicated and 2 400 t U inferred resources at about 0.04% U. Some 12 km northeast of Inca, the Ongolo Alaskite deposit was discovered in 2010, and has 2 600 t U measured, 3 000 t U indicated and 4 000 t U inferred resources at a grade of 0.032% and a strike length of up to 2 km (contiguous with Extract's Ida Dome). In between is the MS7 deposit with a 1 660 t U measured, 370 t U indicated and 500 t U inferred resource. It measures 600 m along strike and is 400 m wide.

In November 2011 the company submitted an environmental assessment report for Inca envisaging an open pit mine producing up to 2.5 Mt/yr of uranium and iron-bearing ore which could result in the production of up to 960 t U/yr. The company has also applied for a mining licence. Environmental assessment of Ongolo-MS7 was to be done in 2012, but it was postponed. First production could be in 2016 through a mill situated close to Ongolo.

The shallow aeolian Tubas Red Sand (TRS) deposit 10 km south of Inca and immediately south of the Tubas palaeochannel has indicated and inferred resources of 10 900 t U at 0.0125% U in carnotite, which can be readily upgraded to 0.05% using hydrocyclone technology. Reptile's Tubas-Tumas Palaeochannel Project takes in extensive secondary calcrete deposits and associated systems stretching over about 30 km south and southeast of Inca, and has a 2 350 t U inferred resource for the Tubas calcrete and 4 470 t U indicated for Tumas (25 km SE of Tubas) both at 0.03% U. Reptile's Aussinanis project, also a palaeo-channel deposit, near Gobabeb and about 60 km south of the others, has 6 976 t U indicated and inferred resources at about 0.02% U, and the hydrocyclone technology tested on TRS has a potential application here as well.

Deep Yellow Limited (Reptile Uranium) intend to establish their Shiyela Iron ore mine which, among other markets, is likely to supply iron ore to Rössing, which would be a further progression of the mining industry’s upstream value-addition chain.

Swakop Uranium-Husab Mine

The Husab Mine will exploit the ore body formerly known as Rössing South. The ore body lies about 5 kilometres south of the Rössing Mine forming part of the Rössing stratigraphy extension. The new owner of the project, Taurus Minerals operating as Swakop Uranium, a subsidiary of China’s CGNPC-Nuclear Fuel Co, planned to start development of the mine in October 2012, ramping up to 5770 t U/yr over 2015-17; evidently becoming the highest grade granite-hosted uranium deposit in Namibia.

A definitive feasibility study proving the technical and economic viability of mining Zones 1 & 2 was completed by Perth-based Extract Resources on the basis of a measured resource of 32,000 t U averaging 0.043% U, and an indicated resource of 105,500 t U at 0.037% U (JORC and NI 43-101-compliant). Inferred resources in Zones 1 to 5 are 50,000 t U averaging 0.029% U. This adds up to 188,000 t U averaging about 0.035% U proven to June 2011, all with 100 ppm cut-off. Construction of Swakop Uranium’s Husab project commenced in October 2012. Mining is expected to start late in 2015. This is certainly the most promising development the industry has seen for many years.

Valencia Uranium

Forsys Metals Corp. of Toronto is developing the Valencia uranium project. Environmental approval for an open pit mine was given in June 2008 and a mining licence was granted in August 2008 to Valencia Uranium P/L (a wholly owned subsidiary of Forsys). With its low grade and unfavourable U_3O_8 prices, mining has so far not commenced. Measured and indicated resources amount to 23 320 t U at 0.016% U with a 0.01% cut-off. This includes reserves of 19 000 t U at 0.0165% U with a 0.01% cut-off. The envisaged open pit is 1.6 km by 1 km and 375 m deep.

In September 2012 Valencia announced a NI 43-101 indicated resource of 12 870 t U at 0.013% U plus 4 250 t U inferred resources in the Namibplaas area, 7 km northeast of the Valencia project. Forsys is proposing a development involving both deposits to produce 1 900 t U/yr, starting in 2015, and plans a definitive feasibility study on this, which will also address the possibility of heap leaching. Forsys metals completed an updated resource estimate and is consolidating the 100% owned Valencia Uranium project with Namibplaas. The new project is now named Norasa Uranium.

Zhonghe Resources Namibia

Zhonghe Resources (Namibia) Development P/L is a Namibian registered company founded in 2008 by China Uranium Corporation Ltd (SinoU) (58%), a wholly owned subsidiary of China National Nuclear Corporation (CNNC), and a private company, Namibia-China Mineral Resources Investment and Development P/L (Nam-China) (42%). It was looking at alaskites northeast of Swakopmund, close to Rössing with a view to open pit mining and heap leaching a low-grade (0.02% U) uranium deposit to produce about 600 t U/yr. Resources are expected to be in the order of 6 000-12 000 t U. A mining licence was issued by the Ministry of Mines & Energy in November 2012, and the 2011 EIA was released in April 2013. Zhonghe Resources is likely to proceed with the mine in spite of depressed market conditions.

NARRATIVE REPORT ON EACH ENVIRONMENTAL QUALITY OBJECTIVE

EQO 1. Socio-Economic Development

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

Economic

The 2011 Fukushima event changed the nuclear industry worldwide and the "aftershocks" are still being felt today. The Uranium industry was negatively impacted by this event and was still recovering in 2012. Mineral commodity prices remained low with spot prices averaging around US$ 50/Ib for the second half of 2012, placing enormous operational pressures on the uranium sector of Namibia. The Fukushima disaster together with other international events also led to the suspension of some mining activities such as these of AREVA Resources Namibia, which recently put the completion of its Trekkopje project on hold. AREVA Resources Namibia did however produce some uranium from the Midi heap leach phase and exported it to France. Royalties amounting to N$ 4 738 million were paid to Government (Chamber of Mines, 2012). Royalties from Langer Heinrich and Rio Tinto Rössing amounted to N$ 53 990 million and N$ 110 183 million respectively. However, these companies did not pay any Corporate Taxes because they all incurred losses during the 2012 period.

Corporate Social Investment

Bannerman Resources

Bannerman Resources continued its Learner Assistance Scheme in the Erongo Region for the less privileged primary school children, and to date 850 learners have benefited from the scheme. Contributions to the Erongo Development Foundation have continued through 2012 with a focus towards education projects and this includes 7 young Erongo learners attending the NIMT to obtain their trade certificate.

Langer Heinrich Uranium

Langer Heinrich involves itself with a variety of community projects, including the Mondesa Youth Opportunities, annual sponsorship to the Maths Congress, and donations to coastal food schemes. A total of N$ 1.4 million was paid out to these projects during the 2012 period. The mine spent a total of N$ 2.013 million on goods and services. About 96 % of these goods and services were purchased locally (Chamber of Mines, 2012).

Rössing Uranium

Despite the losses incurred by the mine in 2012, it continued its Corporate Social Investment (CSI) activities. The Rössing Foundation supports the Arandis Town Council's sustainable development project. The company also introduced web-based information and a tracking system aiming to improve stakeholder and community relations. In terms of procurement, Rössing spent N$ 1.5 billion on local procurement.

AREVA Resources Namibia

AREVA supported the development of Small and Medium Enterprises (SME's) through participation in the Erongo Development Foundation's micro-finance scheme. During the year, various education initiatives and sports events in the Erongo region received funding. The company also donated hockey and soccer equipment to schools in the region.

Overall, the industry's performance was reasonably stable with all the indicators under the Socio-Economic Development EQO being MET.

Desired Outcome 1.1.	**Income and economic opportunities from the Uranium Rush 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**			
Status:			**MET**	

Mining royalties generally comprise a percentage of the export value of the uranium. Royalties are only levied on products sold. Even if the mining company is not making taxable profits but exports large quantities of product, royalties can still be a reliable source of revenue. The uranium royalty rate in 2012 for Rössing Uranium was 6% and for Langer Heinrich Uranium Ltd it was 3%. Valencia Uranium obtained their mining license (ML 149) in 2008, now operating under Norasa Uranium. Production has not commenced yet, as a result no royalties were paid for the 2012 period.

Only two uranium mines are in full production. Rössing Uranium has been paying royalties since 2009 and Langer Heinrich Mine has been paying royalties since start-up (Table 4). In 2012, AREVA Resources Namibia produced some uranium from the Midi heap leach phase and exported it to France. Royalties of N$4.74 million were paid on this product sold (Table 4).

Table 4: Royalties paid by uranium mining companies.

Company	Royalties paid in 2012 (N$)
AREVA Resources Namibia	4 738 739
Langer Heinrich Mine	53 990 032
Rio Tinto Rössing	110 183 000

Motivation of status: All the producing uranium mining companies have paid their royalties, hence this indicator is considered to be MET.

Indicator 1.1.1.2.	**Corporate taxes are paid in full by mines**			
Status:			**MET**	

No company paid corporate taxes in the 2012 financial year because none of them made a profit. Contributions to the national economy are however being made in terms of taxes paid on employees'and contractors' salaries and VAT on purchases.

Motivation of status: Although no mines paid corporate taxes, this was because they were not in a position to do so. However, all companies are paying VAT. The status of this indicator is therefore considered to be MET, although it is a great concern that mineral resources are being depleted while the benefits for the state are limited to royalties**.**

Indicator 1.1.1.3.	Increasingly, inputs that can be sourced locally are not imported.
Status:	MET

The data to assess whether the proportion of goods procured locally by all mines increases was not yet available. **Table** 5 provides an overview of local procurement in absolute terms, showing that there was an overall decline in local procurement by mining and exploration companies since 2010. This can be attributed to the fragile market conditions currently prevailing in the uranium industry. However, Rössing continues to support local suppliers, with N$ 1.5 billion out of N$ 2.3 billion (65%) spent on goods and services having been procured from Namibian registered suppliers (**Table** 5). This is 65% local input compared to 67 % in 2011(Geological Survey of Namibia, 2012). Many of the companies' local procurement declined, but Reptile, Bannerman and Langer Heinrich Mine increased their local procurement (the latter by more than 800%) (**Table** 5). An average of 96% of the procurement by Langer Heinrich was purchased locally (CoM report 2012).

Table 5: The value of local procurement by uranium mining companies.

Company	Local procurement (Millions N$)		
	2012 (% change from 2011)	2011	2010
AREVA Resources Namibia	449.5	774.7	636.4
Bannerman Mining Resources	52	21	14
Langer Heinrich Mine	529	54.1	21.8
Reptile Uranium Namibia	59.2	59.1	51.9
Rio Tinto Rössing	1,500	1,700	1,600
Swakop Uranium	No data	No data	No data
Valencia	10.7	31.0	25.0
Zhonghe	16.0	35.5	31.0
	1116.4	**975.4**	**780.1**

Motivation of status: There is an increase in local procurement from 2011 to 2012. The indicator can therefore be considered to be MET.

Indicator 1.1.1.4.	Processing companies connected to uranium mines are not granted EPZ status.
Status:	MET

Export Processing Zone (EPZ) status is granted to a manufacturer who derives an income from the export of goods manufactured or produced by it to another country and is entitled to an additional deduction of 25% of specified types of expenses. The decision to award EPZ status is made by the Ministry of Trade & Industry.

Motivation of status: The indicator is MET, because there are no new EPZs.

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Summary of performance: EQO 1					
Total no. indicators assessed	4				
	NOT MET	**IN PROGRESS**	**MET**	**EXCEEDED**	**NO DATA**
Number of indicators in class	0	0	4	0	0
Percentage of indicators in class	0	0	100	0	0

Like the performance of 2011, all of the indicators in the Socio-Economic Development EQO have been met.

EQO 2. Employment

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

The unemployment rate in Namibia has remained a debatable topic. The National Labour Force Survey 2012 calculated an unemployment rate of 27.4 %, much lower than the rate of 51.2 % reported in the previous survey (Table 6). However, the substantial increase in the number of persons employed and the consequent decrease in the unemployment rate is to a large extend due to an improved methodology that resulted in better capture of categories of employed people other than paid employees. One of the many goals for Vision 2030 is the reduction of unemployment from the current rate to less than 5% (NDP4, 2012). Namibia is classified as an upper middle income developing country with a population of 2.1 million people (MoLSW, 2013), which ranks among the lowest in the SADC region, almost on par with that of Botswana and Lesotho, and only larger than that of Mauritius, Seychelles and Swaziland. The current figure of mass unemployment in Namibia reflects the lack of alternative labour absorbed in various sectors. This is however a structural problem of the Namibian labour market which is at the top of policy priorities (see **Table** 6 for an overview of Namibian labour force statistics).

Table 6: Labour Force Survey 2012 at a glance.

Basic Indicators	**2012**
Population size	
Total	2 085 927
Female	1 084 845
Male	1 001 082
Population composition	
Under 15 years	770 265
Working age 15 + years	1 315 662
Economically active population	
Employed	630 094
Unemployed- broad	238 174
Labour force	868 268
Labour force participation rate – broad	66
Unemployment rate – broad	27.4
Economically active population by sex	
Female employed	300 390
Male employed	329 704
Female unemployed – broad	140 172
Female unemployment rate – broad	31.8
Male unemployed	98 002
Male unemployment rate – broad	22.9
Male labour force participation rate – broad	69.1
Female labour force participation rate – broad	63.2

The broad unemployment rate (people who are without work and available for work, no matter whether they actively seek for work or not) in the Erongo Region is above 20 % (MoLSW, 2013). With a total labour force of 20 203, this is approximately 8% of the country unemployment broad rate.

Namibia is the fourth largest exporter of non-fuel minerals in Africa and the world's fourth largest producer of uranium. With the Husab Mine becoming operational, the country will be amongst the top three exporters of uranium by 2015. Subsequently, an increase in employment within the uranium industry can be expected. Employment of locals to achieve equal opportunity in employment in accordance with Article 10 and Article 23 of the Namibian Constitution is the purpose of the Affirmative Action (Employment) Act, 1998 (Act 29 of 1998).

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).**			
Status:			**MET**	

All the statistics quoted in the section below are reported in Table 7 and Table 8.

AREVA Resources Namibia fully complies with the Employment Equity (Affirmative Action) Act, No. 29 of 1998 and has received an employment equity certificate for 2012 (O. Kanyangela, Employment Equity Commission, pers. comm). Of the 140 employees at Trekkopje Mine in 2012, 90% were Namibians. There were no retrenchments in 2012. Up to 1,800 contractors were working on site during peak construction in 2012 (pers. comm. AREVA, 2013). Most of the construction contracts ended in early 2013.

Bannerman Resources Namibia is 100% Namibian. The company has an approved Affirmative Action Plan and has received an employment equity certificate for 2012 (O. Kanyangela, Employment Equity Commission, pers. comm.)

Langer Heinrich Mine had a total of 328 permanent jobs, 47 temporary employees, 750 contactors and 14 expatriates in 2012. Their Affirmative Action Report for 2012 was submitted in June 2013, the mine is currently awaiting their certificate. Efforts to recruit persons with disabilities were unsuccessful.

As **Marenica** does not have a workforce of more than 25, they are not required to obtain a certificate (O. Kanyangela, Employment Equity Commission, pers. comm). However, the company reports that 3 Namibian employees were retrenched in 2012. At the same time the main office in Perth, Australia, reduced its staff from 4 fulltime to one full-time and one part-time during the year. In total, Marenica had to retrench 50 % of its workforce during 2012, due to high operating costs and the unfavourable uranium price (CoM, 2012).

Reptile Uranium has a workforce of 28 permanent employees, 10 temporary employees and approximately 100 employees of drilling and rehabilitation companies. The company complies with the Employment Equity (Affirmative Action) Act, No. 29 of 1998 and has received an employment equity certificate for 2012 (O. Kanyangela, Employment Equity Commission, pers. comm).

At the end of 2012, **Rössing Uranium Limited** employed 1 528 people with the average number of contractors at 780. This is a 6 % decline in employment. Eighteen temporary jobs were filled and nine expatriates were hired. The company has submitted its 2012 affirmative action report and was granted the certificate (O. Kanyangela, Employment Equity Commission, pers. comm).

Swakop Uranium had 44 permanent employees (including 22 expatriates) and 38 temporary employees in 2012. The construction phase of the mine has started, but employment levels have not

yet reached the full planned levels of some 8 000 temporary jobs during construction. It is estimated that 2 000 permanent jobs will be created once operations commence.

Valencia operated with a workforce of 29 permanent employees (including one expatriate), four temporary employees, and one contracting company. The company has also complied with the Act and was awarded a certificate (O. Kanyangela, Employment Equity Commission, pers. comm). During the year under review, one position became redundant and all criteria for retrenchment were applied.

Zhonghe Resources had employed 9 Namibians and 11 expatriates.

Out of all companies, only Rössing and Reptile each employed two persons with disabilities.

Table 7: Uranium Industry employment statistics for 2012, (sources: Uranium Institute, 2013).

Company	**Employment statistics 2012**					
	Total Men	Total women	Non-Namibian men	Non-Namibian women	Previously disadvantaged men	Previously disadvantaged women
AREVA	107	33	11	3	85	24
Bannerman	19	6	0	0	17	4
Langer Heinrich	273	64	8	2	238	58
Marenica	6	1	1	0	3	1
Reptile	27	7	1	0	21	6
Rössing	1313	215	22	1	1225	200
Swakop Uranium	68	14	19	2	45	8
Valencia	23	6	2	0	19	6
Zhonghe	17	3	10	1	0	0

Table 8: Uranium Industry employment statistics for 2011 (sources: Uranium Institute, 2013).

Company	**Employment statistics 2011**					
	Total Men	Total women	Non-Namibian men	Non-Namibian women	Previously disadvantaged men	Previously disadvantaged women
AREVA	124	41	17	3	89	30
Bannerman	22	7	1	0	19	4
Langer Hein.	257	56	10	2	217	50
Marenica	10	1	1	0	7	1
Reptile	40	11	0	0	35	8
Rössing	1411	226	25	1	1312	210
Swakop Uran.	77	10	2	0	73	8
Valencia	24	6	5	0	17	6
Zhonghe	35	2	25	0	0	0

Motivation of status: Because all mining companies which are required to have employment equity targets complied, the indicator is therefore MET.

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Summary of performance: EQO 2					
Total no. indicators assessed	1				
	NOT MET	IN PROGRESS	MET	EXCEEDED	NO DATA
Number of indicators in class	0	0	1	0	0
Percentage of indicators in class	0	0	100	0	0

Like in 2011, this indicator is fully MET. Certificates were awarded to Rössing, Valencia, Reptile Uranium Namibia, AREVA Resources Namibia, Bannerman Resources Namibia and Swakop Uranium. Langer Heinrich mine is awaiting for its certificate.

EQO 3. Infrastructure

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

Some of the potential benefits of uranium mining are that the physical infrastructure at the coast may be improved; this includes housing, transport infrastructures, electricity, port facilities as well as waste disposal facilities. The environmental quality objective relating to the EQO is to ensure that key infrastructure in the central Namib is adequate and well maintained, thus enabling economic development, public convenience and safety, whilst minimising impacts on habitats and ecosystem functioning.

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**			
Status:			**MET**	

Indicators 3.1.1.1 and 2 are related to towns, and are therefore discussed together. According to the UI (2013), employees of AREVA Resources Namibia, Bannerman Mining Resources Namibia, Marenica Energy, Reptile Uranium Namibia, Swakop Uranium and Zhonghe live, or will live, in existing towns and no company housing developments are planned (**Table** 9). There will be no on-site hostels during the operational phase of the mines (**Table** 9).

On the other hand, Valencia plans to provide operational staff with accommodation near site while they are on-shift only and then assist with transport to and from their homes during their off periods. No relocation of families is required. The Valencia operation will be treated as a remote site and will have an operations camp, referred to as the Valencia Village.

Table 9: Results of two Indicators in desired outcome 1, Infrastructure: Existing, proclaimed towns are supported.

Company	Employee housing in operational phase		
	Proclaimed towns	Mine township	Hostels on site
AREVA Resources Namibia	Yes	No	No
Bannerman Mining Resources	Yes	No	No
Langer Heinrich Mine (LHM)	Yes	No	No
Marenica	Yes	No	No
Reptile Uranium Namibia	Yes	No	No
Rio Tinto Rössing	Yes	No	No
Swakop Uranium	Yes	No	No
Valencia	Yes	NA	See remarks
Zhonghe	Yes	No	No

Motivation of status: The indicators 3.1.1.1 and 3.1.1.2 are both rated MET as no mine has created 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**

Status:		**IN PROGRESS**		

Roads Authority, who is responsible for answering this indicator, has not supplied the required data. Previously, this indicator was rated as IN PROGRESS as one mining company had indicated financial commitment toward grading the road. Bannerman Resources has engaged a contractor to grade the road between the D1991 and the D1941 leading to the Welwitschia Plain on a monthly basis as this is not a proclaimed road and not graded regularly by the Roads Authority.

Currently, Swakop Uranium maintains the Welwitschia road on a weekly basis to maintain existing road conditions. An old MET track was upgraded as a temporary access road to the project site. Valencia does not use any Roads Authority gravel roads, but constructed a private gravel road (28 km) from the B2 to the site. Part of the road is available to tourists into the Khan River valley at their own risk. Valencia maintains the road through regular grading and repairs following heavy rainstorms as required.

Motivation of status: Although the Roads Authority did not give data regarding the road conditions, the mining and exploration companies have made commitments in this regard. We therefore rate this indicator as IN PROGRESS.

Indicator 3.2.1.2.	**Un-surfaced roads carrying >250 vehicles per day, need to be tarred**

Status:		**IN PROGRESS**		

The SEMP office did not get information concerning traffic volumes on un-surfaced roads for 2012.

LHM has contributed to the cost of tarring parts of the road through the Namib Naukluft Park (NNP) to offset the impact of increased traffic to the mine. Swakop Uranium and Bannerman Resources also contributed towards the last section of road that was tarred.

Motivation of status: Without data on traffic volumes it was not possible to fully evaluate the status of this indicator, however, because the C14 is being upgraded, this indicator is rated as IN PROGRESS.

Indicator 3.2.1.3.	**The B2 tar road is free of pot-holes and crumbling verges**

Status:			**MET**	

Roads Authority conducts routine maintenance on their roads and the B2 road is well maintained and free of potholes (Roads Authority, pers. comm., 2013). The road is in good condition for the current traffic loads.

Motivation of status: Because the Roads Authority reports that the roads do not have pot holes and crumbling verges, the indicator is rated as MET.

Indicator 3.2.1.4.	**Road markings and signage are in place and in good condition**

Status:			**MET**	

Road markings and signage are in place and in good condition. The road signage is maintained by on-going routine maintenance programs (Roads Authority, pers. comm., 2013).

Motivation of status: Since there is an active maintenance program by Roads Authority and they report that signage and markings are in place and in good condition, this indicator is rated as MET.

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

The Feasibility Study to upgrade the Walvis Bay – Swakopmund road to Bitumen Standard is completed, the preliminary design of the road was finalised during April and May 2013, and the design is on-going.

Motivation of status: Because of progress in the project to upgrade the road in question, this indicator is rated as IN PROGRESS.

Indicator 3.2.1.6.	**90% of traffic on the B2 coastal road (Swakop-WB) is light vehicles**			
Status:		**IN PROGRESS**		

Once the D1984 (Swakopmund to Walvis-Bay east of dunes) is tarred, it will be possible to achieve 90% of traffic travelling on B2 road as light vehicles and have the heavy vehicles on the MR44 road.

Motivation of status: This indicator also depends on the MR44 (D1984) being upgraded, which is in progress, hence it is also rated as IN PROGRESS.

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

To ensure traffic safety on roads predominantly used by tourists the mines have agreed to maintain their vehicles in roadworthy condition, to abide by speed limits and to prevent off-road driving. These rules are communicated to all mine and contractor employees in their induction and repeated in toolbox/safety meetings. Compliance is monitored by installing satellite tracking systems that record speed and location of vehicles. Incident reports are issued in case of non-compliance with company and national park rules. As shown in Table 10, all companies comply with these rules for mine-owned vehicles. Contractors are not obliged to have satellite tracking, and speed cameras are therefore used to enforce their compliance, e.g. at AREVA and Reptile.

Table 10: Conditions for mine-owned vehicles driven on predominantly tourist roads.

Company	**Conditions for mine traffic**		
	Vehicles roadworthy, regularly serviced	Induction on site traffic rules	Observance of speed limits
AREVA Resources Namibia	Yes	Yes	Satellite tracking, speed camera
Bannerman Mining Resources	Yes	Yes	Satellite tracking
Langer Heinrich Mine	Yes	Yes	Satellite tracking
Marenica Energy	Yes	Yes	Satellite tracking of selected vehicles
Reptile Uranium Namibia	Yes	Yes	Satellite tracking, speed camera
Rio Tinto Rössing	Yes	Yes	Satellite tracking

Company	Conditions for mine traffic		
	Vehicles roadworthy, regularly serviced	Induction on site traffic rules	Observance of speed limits
Swakop Uranium	Yes	Yes	Satellite tracking
Valencia	Yes	Yes	Satellite tracking
Zhonghe	Yes	No	Satellite tracking

Motivation of status: Because the companies are clearly doing all they can to ensure safe road use that does also not negatively affect the safety of tourists, and have therefore met the agreed conditions, this indicator is rated as 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**
Status:	**MET**

Apart from Rössing, no other mining company transports its goods to the mine site by rail, although most have considered the use of rail as an option (Table 11). More than 80% of Rössing's bulk goods are transported by rail (Table 12). For mines further away from the existing railway track, construction of a new track proved to be prohibitively expensive.

Table 11: Use of rail transport by uranium mining companies.

Company	Tonnes by		Remarks on use of rail transport
	Rail	Road	
AREVA	0	18400	In the production phase bulk reagents will be transported by rail to Arandis and from there on a private road to the mine
Langer Heinrich	0	Not available	No existing railway nearby and new construction found to be prohibitively expensive
Reptile	0	0	During the production phase, bulk reagents and consumables to be transported to Swakopmund by rail and then by road to site as far as practically possible
Rössing	20763	2953	Uses rail for all bulk reagents and diesel
Swakop Uranium	0	0	No use of rail transport envisaged as terrain to Husab site from the north is too extreme for rail. All exploration and construction materials will be transported by road

Table 12: 88% of bulk goods to Rössing is transported by rail.

Product	Rail (t)	Road (t)
Acid	18000	0
Ammonia Nitrate	800	0
Ammonia Gas	120	0
Diesel	1843	0
Soda Ash	0	0
Caustic Lye	0	0
Solvent	0	33

Product	Rail (t)	Road (t)
Mn Oxide	0	1680
Iron Oxide	0	840
Flocculants	0	40
Total	20,763	2953

Motivation of status: Rössing is the only mine that is connected to the rail system. 80% of the bulk goods are transported that way and they indicator is therefore MET.

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:	**NOT MET**			
Indicator 3.4.1.2.	**Average waiting time for ships to obtain a berth is <12 hours**			
Status:	**NOT MET**			
Indicator 3.4.1.3.	**No oil/chemicals/contaminants/sewerage spills enter the Ramsar site**			
Status:	**NOT MET**			

Indicators 3.4.1.1-3 are related and therefore discussed together. No data were received from Namibia Ports Authority for this report.

Motivation of status: The SEMP office did not get data for these indicators hence rated as not MET.

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 the Uranium Rush**			
Indicator 3.5.1.1.	**No disruptions in electricity supply as a result of the uranium rush**			
Status:			**MET**	
Indicator 3.5.1.2.	**Industrial development is not delayed by electricity shortage**			
Status:			**MET**	
Indicator 3.5.1.3.	**No investment decision deferred because of electricity unavailability**			
Status:			**MET**	
Indicator 3.5.1.4.	**Electricity quality of supply meets ECB standard**			
Status:	**NOT MET**			
Indicator 3.5.1.5.	**Electricity provision does not compromise human health**			
Status:				

Indicators 3.5.1.1-5 are related and therefore discussed together.

According to the NamPower annual report for 2012, the grid did not experience any total system blackout during the year under review. However, one major system disturbance was recorded on 23 February 2012, when the Omburu-Ruacana 330kV line tripped during the commissioning of the

fourth unit at Ruacana. A new maximum demand of 534 MW was recorded on 18 June 2012. Scheduled system minute losses during the period under review were 584.2 compared to 420.6 in 2011. The higher scheduled minute losses can be attributed to system outages for maintenance, which are higher due to the growing network. On the other hand, unscheduled system minute losses have decreased from 420.6 to 361.6, demonstrating the results of the concerted efforts made to restore power supply in the shortest possible time and to practice preventative maintenance. Fault rates (that is faults/100 km) on our transmission network remained commendable on all voltage levels, with figures of 0.15, 0.02, 0.06 and 0.31 for the High Voltage Direct Current (HVDC), 400 kV, 330 kV and 220 kV lines respectively. The 132 kV transmission lines recorded an average of 0.7, while the 66 kV line recorded a rate of 1.4. The highest reduction in fault rates for the period under review was for the High Voltage Direct Current (HVDC) scheme, which showed a 40% reduction.

NamPower reports an increase in the number of customers from 2 738 in 2011 to 2 752 in 2012. The report does not state if any potential customers cancelled or deferred their investment due to unavailability of power supply. The electricity input into NamPower's system increased from 3 910 GWh in 2011 to 4 162 GWh in 2012 and there were no black-outs due to supply shortage. It would appear unlikely that industrial development was affected. The decision to go ahead with the Husab Mine, which will be a major power consumer, indicates confidence in the power supply.

The NamPower annual report does not refer to the quality of supply in relation to the ECB standard. It is also not stated in the ECB-SEA report what their requirements are. There are thus no data for this indicator.

Cognisant of the fact that generation, transmission and distribution of electricity could impact on the environment, NamPower has committed to performing comprehensive environmental impact assessments before undertaking any new project. EIAs were done for the following projects in Erongo: the Walmund-Rössing 220 kv line refurbishment; Erongo Coal Power Station and west coast transmission expansion projects. In 2012, no specific environmental incidences were recorded, indicating that NamPower manages its environmental programmes in accordance with the required standards (NamPower, 2012). EIAs also consider the impacts on human health. Power generation at Ruacana (hydropower) and the Van Eck coal-fired station made up 39% of Namibia's supply, while the rest was imported from neighbouring countries. Hydro-electric schemes are generally unlikely to affect human health, while burning coal can have an effect on the air quality in the vicinity of the power station. In the absence of an impact assessment for Van Eck it is not possible to draw conclusions on this indicator. The SEMP Steering Committee should discuss if and how this indicator can be measured.

Motivation of status: NamPower reported no disruptions in electricity supply as a result of the uranium rush. There was no evidence that industrial development was delayed by electricity shortage or that investment decisions were deferred because of electricity unavailability. Information on electricity quality of supply meeting the ECB standard and electricity provision not compromising human health was not available. The first three indicators are MET, indicator 3.5.1.4 was NOT MET and 3.5.1.5 could not be assessed. However, the desired overall outcome 3.5 "electricity is available and reliable" was achieved for 2012.

Indicator 3.5.1.6.	**Mines pursue renewable power supply options as far as possible.**			
Status:		**IN PROGRESS**		

75% of the uranium mining industry has considered renewable power (Table 13). Although the use of renewable power has proved not to be cost effective, some smaller operations utilize solar energy.

Table 13: Summary of renewable energy options considered by different companies.

Company	Renewable power supply options investigated
AREVA Resources Namibia	Study on alternative power supply options for Trekkopje concluded that solar power generation was technically feasible but currently not cost-effective. Mine uses evaporation coolers instead of air conditioners in some buildings.
Marenica Energy	Renewable energy is not yet consider at an exploration stage. But options will be investigated during the definitive feasibility study.
Bannerman Resources	Renewable power supply options have been considered in the Definitive Feasibility Study in areas like warm water for change houses and offices
Langer Heinrich Mine	A study conducted on the options to use renewable energy indicates that it is impractical and costly to implement for the entire operation. Smaller remote solar panels were installed in the following areas: remote access control gate; mine-site turnstiles; and lights at the entrance. Energy saving lights are installed in the Plant. Further renewable energy opportunities are investigated on an ongoing basis.
Reptile	Where technically feasible and cost-effective, renewable energy will be considered.
Rio Tinto Rössing	Studies on alternative power supply options at Rössing concluded that solar power generation is technically feasible but prohibitively expensive. Solar power generation is preferred and implemented in the case of some boreholes from which water is extracted, as well as to provide some environmental monitoring stations with power.
Swakop Uranium	Power regeneration on the haul truck trolley assist system is to be investigated. Solar panels will be used where appropriate, e.g. the construction camp.
Valencia	Nothing investigated at this stage regarding power generation. However, power conservation initiates like solar geysers and evaporative cooling systems are being considered.

Motivation of status: Because of efforts by mining companies to investigate renewable energy options, this indicator is rated as IN PROGRESS.

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 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**			
Status:			**MET**	

This indicator refers to sewage plants and waste sites that are used by the uranium industry or its contractors, or are situated in towns where the mines' employees reside. These currently include the sewage plants and domestic landfills at Arandis, Swakopmund and Walvis Bay, as well as the hazardous waste facility at Walvis Bay

Walvis Bay and Swakopmund have sufficient capacity in their waste sites (A Brummer, pers. comm., 2013). The Walvis Bay Municipality Sewage Works upgrade will be completed in 2013, giving a

capacity sufficient until at least 2016, and new separate sewerage works are being planned (A Brummer, pers. comm., 2013).

The WBM waste site has a life span of at least another 30 years, with the hazardous waste site having at least another 8 years life span (A Brummer, pers. comm., 2013). The waste site at Arandis is too small and poorly managed; the town council is planning to create a new landfill (UI, 2013)). Mines in the vicinity (AREVA and Rössing) do not use the Arandis landfill (UI, 2013). The hazardous waste facility at Walvis Bay can accommodate the region's hazardous waste volumes and has space for further expansion (Brummer, pers. comm., 2013). Hazardous waste sites at Arandis or Swakopmund are therefore not required. The operating mines do not use the hazardous waste site in Windhoek (UI, 2013).

Swakopmund was building new sewerage works in 2012, to be completed in 2013 (C Lawrence, Swakopmund Municipality, pers. comm., 2013). The capacity of the sewage treatment plants at Walvis Bay and Arandis is still sufficient, but will be upgraded as the need arises (Geological Survey of Namibia, 2012).

Motivation of status: Because the larger municipalities all report a sufficient capacity for the foreseeable future, this indicator is rated as MET.

Indicator 3.6.1.2.	**Independent audits are undertaken for waste sites**			
Status:	**NOT MET**			

No audits are being conducted at Walvis Bay (A Brummer, pers. comm., 2013). No data were available from the Swakopmund Municipality.

Motivation of status: Because no audits are being conducted, this indicator is rated as NOT MET.

Indicator 3.6.1.3.	**All new waste sites undergo an EIA prior to construction and receive a licence to operate**			
Status:		**IN PROGRESS**		

All waste facilities currently used by the mining companies are listed in Table 14.

In terms of the Environmental Management Act, all new waste sites have to undergo an Environmental Impact Assessment prior to construction and commission. WBM has reported that they will conduct an EIA when a future site is required. However, at present there are no licenses required for a waste site.

Table 14: Waste facilities used by the mining companies in 2012.

Company	**Which waste facilities are used for:**		
	Domestic waste	**Hazardous waste**	**Radioactive waste**
AREVA Resources Namibia	Swakop, WB	Walvis Bay	On site
Bannerman Mining Resources	Swakopmund	Walvis Bay	Old Husab mine
Langer Heinrich Mine	Walvis Bay	Walvis Bay	On site
Marenica Energy	Henties Bay	Walvis Bay	On site
Reptile Uranium Namibia	Swakopmund	Walvis Bay, LHM	Langer Heinrich
Rio Tinto Rössing	Rössing landfill	Walvis Bay	On site
Swakop Uranium	Swakop, WB	Walvis Bay	On site
Valencia	On site	Walvis Bay	On site
Zhonghe	On site	N/A	On site

Bannerman Resources has approval from the Ministry of Environment & Tourism to disposes its drill samples at the old Husab Mine. Bannerman Resources has no other radioactive waste.

Reptile: Municipal waste collection, recyclables are separated and recycled.

RUL: In 2012, a total of 415 tonnes of domestic waste (mainly from bathrooms, change houses and lunch rooms) were disposed at the mine's own landfill site, while a total of 98 tonnes of hazardous waste was taken to the Walvis Bay hazardous waste site. 3,474 tonnes of low-level radioactive waste were disposed of at the demarcated site on the tailings facility.

Motivation of status: As the Environmental Management Act is now in place and there is therefore a certainty that new waste sites will undergo an EIA, it is rated as 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)**			
Status:			**MET**	

The Walvis Bay Municipality Hazardous Waste Inspector and Foreman for Solid Waste are trained and now attend annual conferences and seminars to keep track with solid and hazardous waste practices (A Brummer, pers. comm., 2013). The Swakopmund waste site managers are also trained (A Brummer, pers. comm., 2013).

Motivation of status: Relevant municipalities of Swakop and Walvis are training their site managers. This indicator is MET.

Indicator 3.7.1.2.	**Site manifests which record non-hazardous wastes, volumes and origins are kept**			
Status:			**MET**	

Records are kept at the utilised municipalities of Walvis Bay and Swakopmund (A Brummer, pers. comm., 2013).

Motivation of status: Swakopmund and Walvis Bay municipalities are the only sites that receive non-hazardous waste from the mines and since they keep records, the indicator is MET.

Indicator 3.7.1.3.	**Only hazardous waste classes for which the sites are licensed are accepted**			
Status:			**MET**	

Walvis Bay has the only hazardous waste facility in the region and keeps a record of hazardous waste deposited. The site is however not licensed to accept radioactive or toxic waste and therefore does not accept such waste (A Brummer, pers. comm., 2013)

Motivation of status: Because Walvis Bay hazardous waste facility accepts only those classes of hazardous waste for which it is permitted; this indicator is rated as MET.

Indicator 3.7.1.4.	Water and air quality monitoring data at waste disposal sites show no non-compliance readings
Status:	NOT MET

Municipalities do not monitor water and air quality at waste disposal sites, because there is no legal requirement to do so and no standards set, therefore it is impossible to identify non-compliance.

Motivation of status: Because no monitoring is taking place, this indicator is rated as NOT MET.

Indicator 3.7.1.5.	Municipal budgets are sufficient to comply with the site licence requirements relating to pollution control
Status:	IN PROGRESS

The municipalities of Walvis Bay and Swakopmund have a title in their budgets for compliance with the site license requirements in relation to pollution control, the other municipalities do not.

Motivation of status: Because the indicator is only partially MET, it is rated as IN PROGRESS

Indicator 3.7.1.6 has been replaced with the new target 3.7.2 and four indicators as per Steering Committee decision, April 2013 – see below

Target 3.7.2.	The management of mines' mineral waste sites (tailings and waste rock facilities) meets national standards
Indicator 3.7.2.1.	Mines comply with DWAF industrial effluent exemption permit conditions
Status:	IN PROGRESS
Indicator 3.7.2.2.	Complies with NRPA regulations
Status:	
Indicator 3.7.2.3.	Complies with approved EMP
Status:	
Indicator 3.7.2.4.	Complies with approved closure plan
Status:	

Target 3.7.2 and three new indicators have only been added after the SEMP Steering Committee meeting in April 2013. The information gathered for the 2012 SEMP report was based on the former indicator 3.7.1.6, which corresponds to the new indicator 3.7.2.1. Table 15 summarises the mines' feedback. The other indicators can only be assessed in the 2013 SEMP report, provided that all government agencies, and DWA in particular, carry out inspections to check if the mines comply with the national standards.

Table 15: Tailings management per mine. Source: (Uranium Institute, 2013)

Company	Tailings management in compliance with permit conditions
AREVA Resources Namibia	The Trekkopje industrial effluent exemption permit does not specify tailings management. Mine plan described in the ESIA envisages backfilling of the tailings into mined-out sections of the open pit to assist with ongoing rehabilitation. Tailings (leached ore) from the Mini and Midi pilot tests will be left on the pads until final disposal measures are confirmed to be in line with DWAF and NRPA requirements.

Company	Tailings management in compliance with permit conditions
Langer Heinrich Mine	In accordance with the permit conditions: i) accidental spillage is recorded *via* the incident reporting system; ii) samples are collected and analysed from the final effluent; iii) mined out pits are backfilled progressively; and iv) a groundwater monitoring programme is implemented.
Rio Tinto Rössing	In compliance with the industrial effluent exemption permit granted by the DWAF Rössing intercepts and returns tailings seepage for recycling and reuse in the processing plant to prevent contamination of the Khan River.

Motivation of status: Although mining is in compliance with tailings management conditions, no data was available from DWA to fully assess the indicator. The first indicator is therefore IN PROGRESS and the rest could not be assessed.

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**
Status:	**IN PROGRESS**

Walvis Bay, Swakopmund and Arandis have waste recycling depots for glass, paper and plastic. The other municipalities are currently not relevant to the mining industry. However, because recycling is a private enterprise dependent on other economic forces, and because recycling in Namibia is probably marginally profitable, the sustainability of the whole effort is in doubt.

Motivation of status: Because it is not clear if the waste recycling system will be sustainable, the indicator is rated as IN PROGRESS

Indicator 3.8.1.2.	**Waste recycling operators have sufficient capacity to collect, transport and recycle waste in a safe and responsible manner**
Status:	**IN PROGRESS**

There are four recycling operators with sufficient capacity in Walvis Bay, and one each in Swakopmund and Arandis (UI, 2013). In addition, the mines report that they are separating waste, some of which is also recycled under contract (Table 16). The capacity of the recycling operators to collect, transport and recycle waste is however threatened by high transport costs, low prices paid by recyclers in South Africa, and the consequent absence of a significant recycling industry in Namibia (A Brummer, pers. comm., 2013).

Table 16: Types of waste separated and recycled at mines.

Company	Is waste separated and recycled?
AREVA Resources Namibia	Certain recyclables are separated on site (metal, cardboard and paper). Domestic waste taken to Swakopmund and Walvis Bay landfills is recycled from there, e.g. plastic, glass. A shortcoming is the lack of weighing facilities and ability to issue certificates stating the mass or volume of waste recycled. Used printer cartridges are sent to Windhoek to be refilled. Electronic waste is removed by Trans world Cargo for responsible disposal or recycling.
Langer Heinrich Mine	Waste is separated according to the following categories: Domestic, hazardous, recyclable and contaminated. All waste (excluding radioactive contaminated waste) is disposed of at the Walvis Bay landfill and hazardous waste disposal facility. Certificates of safe disposal are issued for the disposal of hazardous waste. Used oil is stored in a waste oil tank and taken to

Company	Is waste separated and recycled?
	Walvis Bay for recycling.
Reptile	Non-radioactive recyclable material is sorted and collected by a recycling agent.
Rio Tinto Rössing	A contractor removes all recyclable waste (scrap metal, wood and paper, plastics and conveyor belting) from site.
Swakop Uranium	Waste is separated into primary recycle streams at the exploration camps.

Motivation of status: Because there are four recycling operators in the region, but it is not yet known whether all recyclable waste is indeed recycled, this indicator is considered to be IN PROGRESS.

Indicator 3.8.1.3.	**Volumes of waste disposed to landfill per capita decreases**			
Status:		**IN PROGRESS**		

Beside the recycling taking place at mines site, there is not recycling for general waste coming from the suburbs, therefore the waste volumes are still high (Brummer, PERS. COMM., 2013). Furthermore no information was received from the other municipalities. However, changes in volume of waste should take into account the population growth. This needs accurate waste data from the Municipalities and census figures, but these are only available every 10 years.

Motivation of status: The volumes of waste is still high at the Walvis Bay site, since the mining companies are doing recycling this indicator is rated as IN PROGRESS.

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Summary of performance: EQO 3

Total no. indicators assessed	34				
	NOT MET	**IN PROGRESS**	**MET**	**EXCEEDED**	**NO DATA**
Number of indicators in class	6	11	13	0	4
Percentage of indicators in class	10	30	46	0	14

The overall performance has slightly decreased compared to 2011. The Infrastructure EQO is made of 8 desired outcomes and 8 targets measured by 34 indicators. 46% of these indicators are MET. Eleven indicators (30%) are IN PROGRESS; six (10%) indicators are rated as NOT MET. Four indicators (14%) didn't have data to be assessed.

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.

The water Environmental Quality Objective (EQO 4) involves assuring the quality and quantity of water to the public in the Erongo Region (Uranium Province). Key stakeholders in this EQO are the Department of Water Affair (DWA) of the Ministry of Agriculture, Water and Forestry as the regulator, NamWater, as the distributor, and the mining industry as a major consumer.

Monitoring of groundwater in the uranium province is undertaken with the aid of 18 boreholes (as recommended by the SEA) along the Swakop and Khan Rivers. The Water EQO is evaluated through the sampling that has been undertaken annually by DWA as the custodian of the water resources in Namibia, and involves monitoring the quality and quantity of water resources in the region.

Water quality monitoring involves analysis of anions and cations of major and trace elements, and radionuclides (depending on expertise and finances available in the monitoring institution), which are compared to the Namibian guideline values. Water quantities are assessed through measurements of water level fluctuation in boreholes along the two rivers. Initially this indicator focused only on groundwater in the Khan and the Swakop River systems, however due to the fact that drinking water for the rural and urban communities in this region are not sourced from these two rivers, the indictor was modified to include drinking water which will be reported on in the next Annual Report (2013 SEMP Annual Report).

Desired Outcome 4.1.	**Water for urban and rural communities is of acceptable quality**
Target 4.1.1.	**Uranium Rush does not compromise community access to water of appropriate quality:** • **Urban users** • **Rural communities supplied by DWA** • **Commercial farmers (own supplier)** • **Lower Swakop River small holdings**
Indicator 4.1.1.1.	**Aesthetic/physical, inorganic, radio-nuclide and bacteriological determinants conform to minimum required quality as prescribed in the national water quality standards**
Status:	**NOT MET**

Urban users in the Erongo region are supplied by NamWater from the Kuiseb River (Walvis Bay) or Omaruru Delta (Swakopmund, Arandis, Henties Bay) with water of Group A (excellent) or B (good) quality according to the Namibian standard. Some rural communities are also supplied by NamWater (e.g. Usakos from the Khan River upstream of the mines), while other communal and commercial farmers have boreholes drilled into bedrock aquifers. None of these drinking water sources are affected by uranium mining. Smallholdings along the lower Swakop River obtain their drinking water from the NamWater pipeline to Rössing which is of the same quality as the supply to Swakopmund. They only use the saline Swakop River groundwater to irrigate certain crops and for commercial purposes.

However, the SEMP Steering Committee recommended in April 2013 that the Committee should carry out its own analyses and not rely on NamWater only. Municipalities should take random samples, analyse them and report back to the SEMP office. Alternatively the SEMP office should

contact DWA. This has not yet been put into practice because it is not clear who will be responsible for collecting the samples.

Motivation of status: Because a sufficient procedure of sampling and measurement is not yet in place, the indicator is rated as NOT 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**			
Status:			**MET**	

An additional indicator was required for the water quality in the Khan and Swakop rivers because Desired Outcome 4.1 only deals with the drinking water quality for the urban and rural communities. Target 4.1.2 was added at the 2013 Steering Committee meeting to focus on the monitored compartments of the Khan and Swakop rivers, which do not contain groundwater of potable quality.

The groundwater quality assessed by DWAF from 15 boreholes along the Khan and the Swakop Rivers indicated that the water from all boreholes sampled were of sodium-potassium-bicarbonate type (Figure 4). All boreholes, except SW1 at Swakop Uranium, have high concentration of Total Dissolved Solids (TDS), chloride, calcium and sodium above recommended guideline concentration for drinking water (N Masule, pers. Comm., 2013). However, this water is not for human consumption.

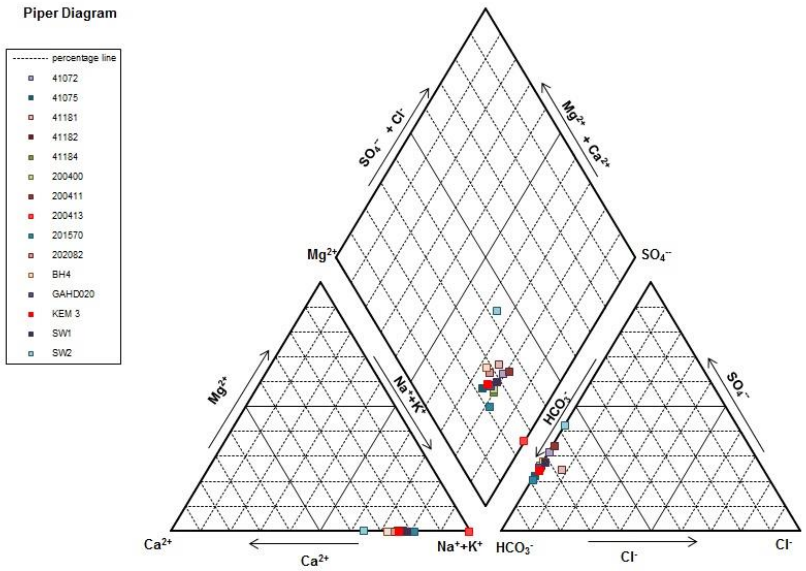


Figure 4: The Piper diagram indicating that the water from all boreholes sampled was of sodium-potassium-bicarbonate type.

The assessment of the radionuclide content is based on the concentration of uranium. Overall, groundwater quality in terms of the uranium content falls within Group A (U <1000 mg/l) of the Namibian Guideline Values for Drinking Water. Two possible sources of uranium contamination in groundwater are background geology as well as mine effluent. Figure 5 shows the relative location of mines, boreholes and the basic local geology of the region.

Uranium content of the groundwater is summarised as follows (Figure 5):

- Boreholes around the Swakop and Khan River confluence show higher average uranium content, with concentrations tapering off further downstream.

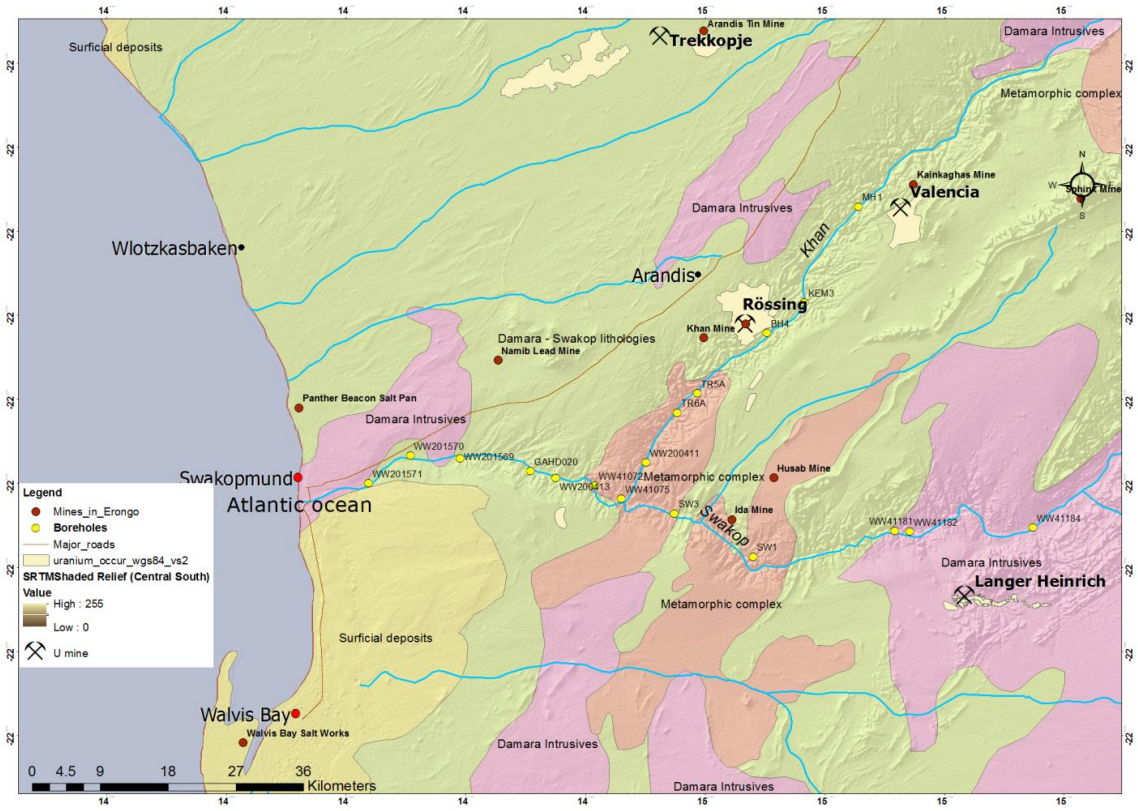
- A single borehole with the highest uranium content is a Khan River borehole (BH4) which is close to Rössing and recorded a uranium concentration of 160µg/l. This is, however, still in Group A of the Namibia Guideline Values of Drinking Water.
- BH4 has shown an increasing trend in uranium since the beginning of the SEMP sampling. In 2010, the concentration was – 43µg/l, in 2011 – 80µg/l, and 2012- 160µg/l.
- Three boreholes (WW 41181, 41182, and 41184) along the Swakop River which are close to the Langer Heinrich Mine showed a general decreasing trend of uranium over the past three years.
- Although the water quality in terms of the uranium content is of acceptable quality, the water is of low quality due to high salinity, which therefore makes it unsuitable for human consumption.

Some remarks about uranium monitoring in groundwater:

1) It is very difficult to analyse for low levels of U in the µg/l range and most methods are not very accurate. Each analysis result should be accompanied by the lower limit of detection of the method used and the confidence level, e.g. 80±25 µg/l.
2) Radionuclide concentrations have a very large natural range of variation (Dr Faanhof, NECSA, pers. Comm., 2013). Changes of 50-100% are quite normal.
3) There are genuine changes due to recharge from flood water (dilution), which explains the general reduction between 2010 and 2011. 2012 results are trending back towards the pre-flood concentrations.

Motivation of status: Because the water quality conforms to the national standards, this indicator is rated as MET.

a)



b)

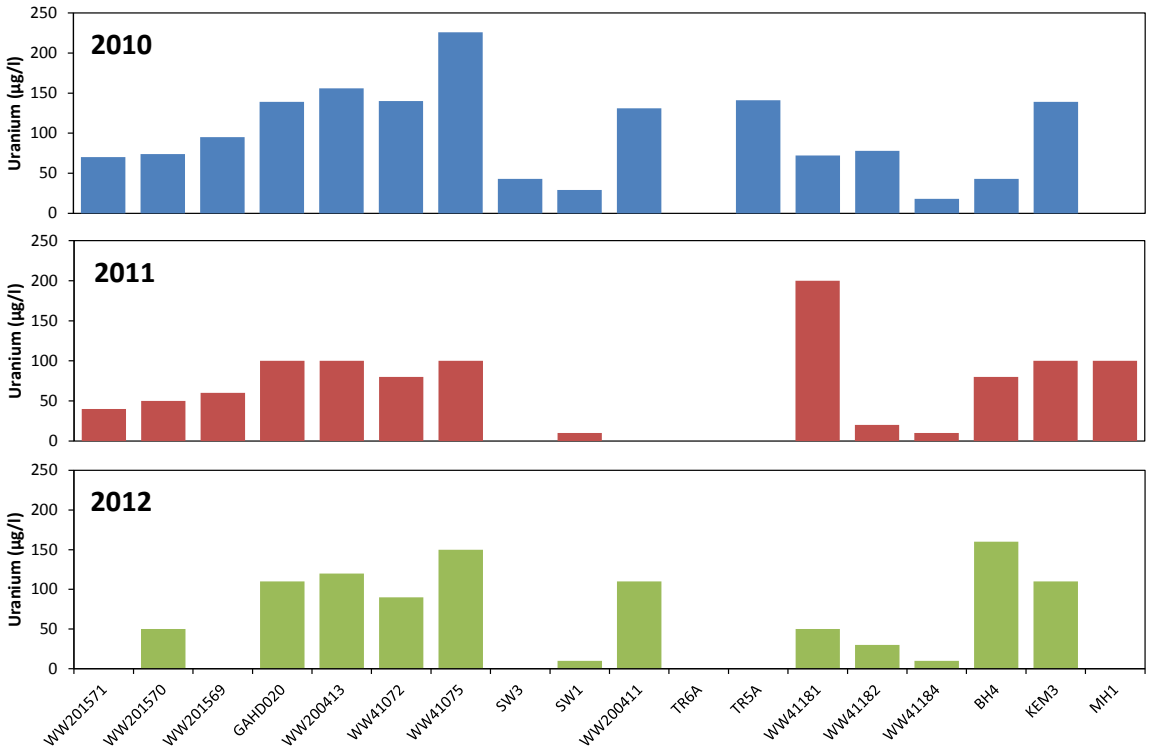


Figure 5: Borehole network in the Swakop and Khan Rivers relative to the simplified geology of the region (a), as well as the uranium levels in the boreholes in 2010, 2011, and 2012 (b). The uranium concentration in all boreholes is well below the Group A standard of the Namibian Guideline Values of Drinking Water (U < 1000 µg/L).

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**
Status:	**NOT MET**

The Steering Committee has changed the wording of Target 4.2.1 by deleting "movement and" because effects on groundwater movement would be hard to detect and monitor. The SC has added indicator 4.2.1.1 because it was concerned that water demand should not outstrip supply capacity. The former indicators 4.2.1.2 and 4.2.1.3 relating to the effect of pumping on wetlands and the riparian vegetation were moved to EQO 8 which deals with ecological integrity (Minutes of the Steering Committee meeting, April 2013). The remaining indicators were renumbered.

Indicator 4.2.1.1: In 2012, NamWater operated the Central Namib water supply scheme under a DWAF permit quota of 9 million cubic metres per annum (Mm^3/a) for Omdel, and 7 Mm^3/a for the Kuiseb River. The actual abstraction was 8.7 Mm^3/a from Omdel and 8.2 Mm^3/a from the Kuiseb River. The permit expired towards the end of 2013 and NamWater expected the quota for Omdel to be reduced to 4.5 Mm^3/a in the new permit. The shortfall would be made up with desalinated water.

Motivation of status: Because the abstraction from the Kuiseb River was higher than the amount given in the permit, the indicator was assessed as not being MET.

Indicator 4.2.1.2.	**Borehole levels fluctuate within existing norms**
Status:	**IN PROGRESS**

Assessments of groundwater level fluctuations were based on the monitoring results supplied by the UI (Uranium Institute, 2013) as no reporting was done on water levels by the DWA. The assessment of water levels occurs within a framework of continuous abstraction of water from wells before the reporting period, so the evaluation of fluctuations within "existing norms" has to take this into account. The best way to do this is to provide and evaluate the levels in the current reporting period against trends over a longer time (Figure 6) and compare this with flooding data. The latter was not available for this report. In general water levels measured by mining and exploration companies (Bannerman Resources, 2013) in the basement and palaeo-channel boreholes remained stable within the natural fluctuation range, whereas water levels in the Khan and Swakop River aquifers indicated a general decline in water levels. The Khan River boreholes (red dotted lines in Figure 6) show different trends. After having been re-charged during a significant flood event in 2000, BH1.10 and BH1.11 slowly declined over the years before stabilising, and showed no response to the large 2011 flood. In contrast, KEM3 and UK4B both experienced further significant re-charge events, most prominently in 2008/2009 and again in 2011. Curiously, the high flows of 2011 did not re-charge the Khan boreholes to the same extent as in the Swakop River boreholes (blue solid lines in Figure 6), which all showed a steep rise with a rapid decline in at least two of them starting before the reporting period and continuing into it. Bannerman Resources reported that the boreholes closer to the Swakop River confluence have shown decreased water levels with little response to recent recharge events.

Generally water levels in the boreholes rise when the aquifers are recharged during floods and from local runoff and fall as a result of evapotranspiration and drawdown due to pumping (where this takes place). It is important to note that water levels always decrease except during and just after floods. In the opinion of the mining industry, the Bannerman boreholes at Goanikontes (GAHD23 and GAHD24) are dropping faster because the farmers are pumping in this area.

Motivation of status: There are no defined existing norms and this need to be addressed by the SEMP steering committee. The indicator was therefore rated as IN PROGRESS.

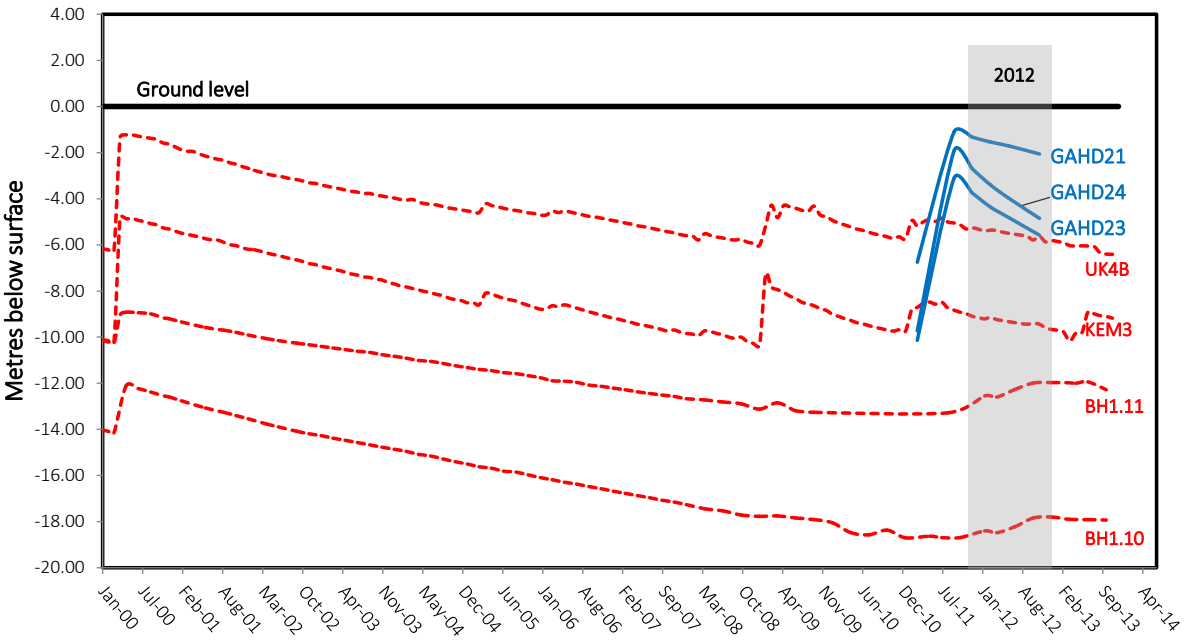


Figure 6: The change in the level of groundwater, measured as metres below river bed, in seven boreholes located at different points along the Swakop and Khan Rivers. Red dotted lines and text represent Khan River boreholes monitored by Rössing Uranium, while the solid blue lines and text represent boreholes that are being monitored by Bannermann, all of them below the confluence of the Khan and Swakop rivers. To provide some temporal context, an arbitrary starting date of 1 January 2000 was chosen for this particular graph. The reporting period – 2012 – is indicated as a grey band. Source: Uranium Institute, 2013.

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

To reduce the financial impact on domestic consumers aquifer water should be made available to domestic users at approved NamWater rates (as opposed to expensive desalinated water). The background to this indicator is that the coastal municipalities and the mines agreed in the past that NamWater would supply desalinated water to the mines and aquifer water (Kuiseb and Omaruru) to the towns. In practice the water from the desalination plant and the aquifers would be mixed, but only the mines would be charged the higher tariff, while the domestic users would enjoy the improved water quality at the normal tariff (Uranium Institute, 2013).There was some progress in this regard during 2012 (E Shiluama, NamWater, pers. comm., Omaruru Basin Management Committee, 28 Nov 2013).

No information was provided by DWA or NamWater regarding this initiative.

Motivation of status: Aquifer water will be available for domestic usage as the mines will be using desalinated water. The indicator is therefore MET.

Indicator 4.2.1.4.	**NamWater disaster management plans are in place a and implements them in case of flood damage to supply schemes**			
Status:			**MET**	

The wording of this indicator has been changed to focus on NamWater, because the mines' emergency plans for water supply are not of interest to the public (Steering Committee, April 2013).

Results: NamWater has disaster management plans and procedures are in place (Sirunda Johannes, NAMWATER, pers. comm., 2013). They did not have to be implemented in 2012 because there was no flood damage. In addition, the Kuiseb Basin Management Committee worked on a flood emergency plan to protect Walvis Bay's water supply.

Motivation of status: Because disaster management plans are in place, this indicator is rated as 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**			
Status:		**IN PROGRESS**		

Groundwater resources are inadequate to supply the demand of all the coastal customers, including industrial demand place (J.Sirunda, NAMWATER, pers. comm., 2013). Efforts are being made by the Government to develop a desalinated water source. Tenders for a desalination plant at mile 6 are currently being evaluated. In the interim, negotiations are on-going with AREVA and their subsidiary Erongo Desalination Company for supply of water from their plant place (J.Sirunda, NAMWATER, pers. comm., 2013).

Motivation of status: There is no report that investment was lost due insufficient water, on the contrary, Swakop Uranium decided to go ahead with its Husab Mine. Because of the efforts to provide desalinated water to industrial users, this indicator is rated as IN PROGRESS.

Indicator 4.3.1.2.	**Desalinated water meets mine demand**			
Status:		**IN PROGRESS**		

The SC decided to delete "by 2014" as the indicator can otherwise not be assessed in years prior to 2014. The capacity of the planned desalination plant will meet the envisaged water demand place (J.Sirunda, NAMWATER, pers. comm., 2013).

The UI highlighted that in 2012, only Trekkopje Mine used desalinated water and construction of a second desalination plant was planned by NamWater (Uranium Institute, 2013). The Erongo desalination plant has spare capacity and can be used to supply other mines, at least until NamWater's own plant is built. Negotiations between AREVA and NamWater continued throughout 2012 and into 2013.

Motivation of status: Since negotiations are underway to establish access for mines to desalinated water, this indicator is rated as IN PROGRESS

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Summary of performance: EQO 4

Total no. indicators assessed	8				
	NOT MET	**IN PROGRESS**	**MET**	**EXCEEDED**	**NO DATA**
Number of indicators in class	1	3	3	0	1
Percentage of indicators in class	13	38	38	0	13

The water EQO is made-up of 8 Indicators, of which all were assessed in the year under review. 38% (3) of the indicators were MET, while 13% (1) were NOT MET. 38% (3) indicators were assessed as in-progress. The performance of this EQO have decline in comparison to the 2011 performance.

EQO 5. Air quality and radiation

Aims of this EQO: Workers and the public do not suffer significant increased health risks as a result of radiation exposure from the Uranium Rush.

The Air Environmental Quality Objective (EQO 4) involves assuring the quality and quantity of the air quality and radiation EQO reports on nuisance dust and PM10 monitoring as well as radiation monitoring both in mines and settlements in the Erongo region. The SEMP office monitors and reports public exposure from dust, PM10, ambient concentration of radon at the three major coastal towns, as well as short lived progeny. The SEMP office thus has a PM10 E-Sampler at Swakopmund and three real time radon/radon progeny monitors at Arandis, Swakopmund and Walvis Bay. The National Radiation Protection Authority (NRPA) is a mandated Radiation Regulator in Namibia; therefore NRPA is the reporter responsible for occupational and public exposure to radiation. The mining and exploration companies' reports on the air quality and radiation exposures in their mining areas and operations are covered through the UI SEMP compliance report. The uranium industry in Erongo supports the SEMP office by monitoring of PM10 at Arandis (AREVA, Rössing) as well as management of Radon equipment (Bannerman Resources and UI).

The data collected includes PM10 concentrations, ambient temperature (AT), barometric pressure (Pa), wind speed (WS), relative humidity (RH), and wind direction (WD). The inhalable dust fraction monitoring is aimed at ensuring that ambient PM10 concentrations at public locations and mines do not exceed the required target/limit for both annual and 24-hour averages. The limit set is based on the World Health Organisation's (WHO) 24-hr International Threshold -3 of 75µg/m³. The dust fallout is collected by a dust buckets system and South African National Standards limits are used i.e. 600 mg/m²/day as permissible for residential and light commercial areas (may be exceeded up to three times within any year, but not in successive months), and for heavy commercial and industrial sites 1,200 mg/m²/day are permitted areas (may be exceeded up to three times within any year, but not in successive months).

The SEMP Steering Committee at its meeting in April 2013 found that all the indicators under 5.1 needed to be reworked, as they did not properly distinguish between exposure from a specific source and cumulative exposure. A working group was formed and the indicators were re-formulated.

Desired Outcome 5.1.	**Annual radiation exposures to the public via air are not significantly increased as a result of the uranium mining.**
Target 5.1.1.	**More accurate public dose assessments shall demonstrate that the cumulative radiation dose to members of the public does not exceed 1 mSv/a, or that the dose to members of the public does not exceed 0.25 mSv/a for contributions from any single operation.**
Indicator 5.1.1.1.	**Gross alpha/beta-analysis and determination of uranium and thorium within the inhalable (PM10) fraction of air filters.**
Status:	**NOT MET**

The gross alpha/beta-analyses and analyses of PM10 filters from the SEMP's PM10 air quality monitoring station at Swakopmund were not carried out during this reporting year 2012, as no funding was available. This indicator and 5.1.1.2 will be assessed when funds become available.

Motivation of status: There was no work carried out, therefore the Indicator is rated as NOT MET.

Indicator 5.1.1.2.	Gross alpha/beta-analysis and determination of uranium and thorium within dust fallout samples.
Status:	NOT MET

Gross alpha/beta-analysis of dust has not been done. However, in the course of 2012 some samples which were collected in 2009-2010 were analysed for thorium and uranium concentration (Shaduka, 2012). Figure 7 shows the localities where those samples were collected.

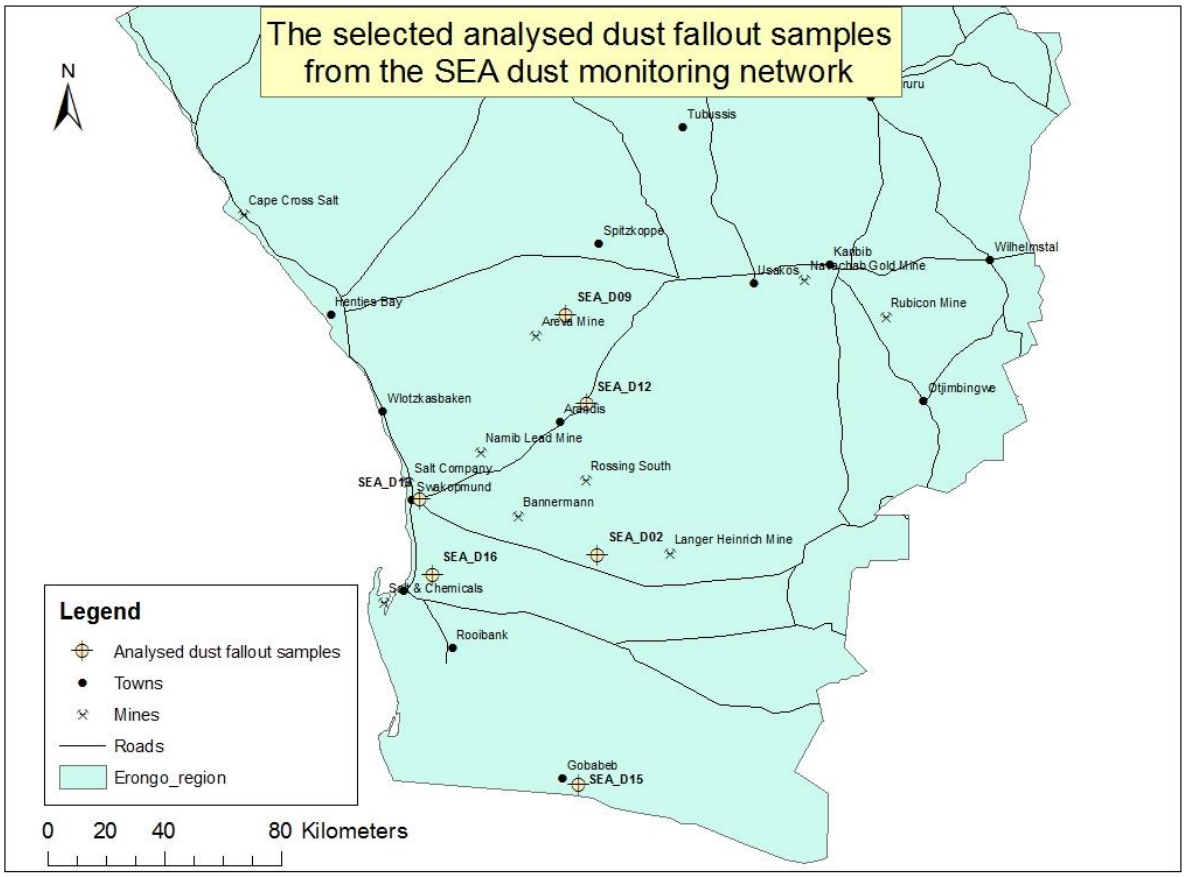

Figure 7: Locality map for samples analysed for U and Th using the SEA dust fallout samples (Shaduka, 2012).

The uranium concentrations in the dust fallout samples have higher values at sampling points SEAD12 and SEAD 09 (Arandis and Trekkopje) with 55.6 ppm and 100 ppm respectively, and with corresponding high values of thorium at same localities of 222.22 ppm and 400 ppm respectively. Thorium concentrations are always higher than uranium concentrations for all localities sampled although the ratio varies. See uranium and thorium in the graph as shown in Figure 8.

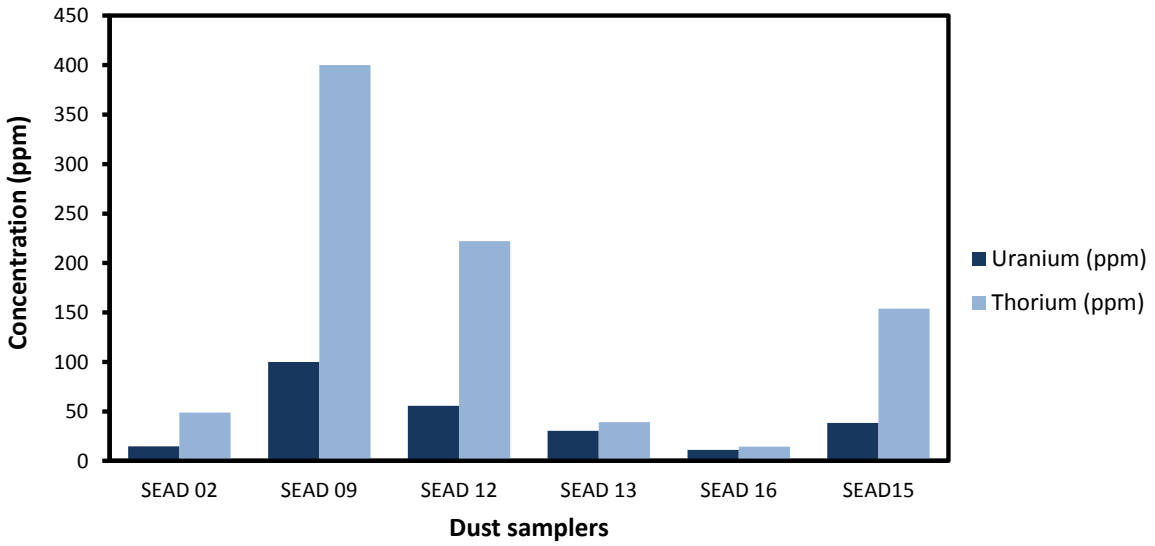

Figure 8: Uranium and Thorium concentration in dust fallout of the Erongo Region, SEMP-SEA project

Motivation of status: Although baseline work has been carried out, the annual determination of U and Th concentration for 2012 was not done. The Indicator is therefore considered to be NOT MET.

Indicator 5.1.1.3.	**Radon exhalation rates from ground through continuous monitoring by passive method**			
Status:	**NOT MET**			

The National Radiation Protection Authority (NRPA) has not measured radon exhalation rates for 2012.

Motivation of status: Because there is no continuous monitoring of radon exhalation rates, the Indicator is NOT MET.

Indicator 5.1.1.4.	**Monitoring of ambient concentrations of Radon (^{222}Rn) and its short-lived progeny (REEC) at the three major coastal towns is monitored**			
Status:			**MET**	

The SEMP Office has three operational real time ambient radon monitors in the Erongo Region at Arandis, Swakopmund and Walvis Bay. The ambient concentrations of Radon and Radon progeny are being monitored continuously, although all three monitors experienced significant downtime in both years of operation (Figure 9, Figure 10).

Although the current report focuses on the 2012 calendar year, the data for 2011 are also provided here because it has not been published before. In 2011, the highest ambient concentration of radon was recorded at Arandis with a peak up to 446 Bq/m^3 (Figure 9). At Swakopmund in the same year the highest recorded value was 80.5 Bq/m^3, while at Walvis Bay it was 126 Bq/m^3 (Figure 9). These values dropped in 2012, with the three towns recording highs of 190, 68.5 and 78 Bq/m^3 respectively (Figure 9). There is a common unusual elevation of radon concentration at all the three stations. The reason for the common pattern is not known, but it could be due to seasonal weather phenomena such as predominant wind speed and direction combined with unusual artificial or natural events. All

three towns had lower levels of REEC overall in 2012 than in 2011, but Arandis was still relatively high (Figure 10).

There are no international limits or standards for ambient radon concentration or its progeny. The exposure dose is roughly estimated according to the fact that 20 mSv corresponds to a radon gas concentration of 3000 Bq/m^3 (IAEA, 2003) thus maximum exposure dose due to radon concentration at Arandis, Walvis Bay and Swakopmund was 3 mSv, 0.8 mSv and 0.5 mSv respectively. The average dose was not calculated, because there were down times at the measuring stations. Radiation protection is required if long-term 222Rn exposure is more than 1000 Bq/m^3 (ICRP, 1993) hence the three towns inhabitants will not need the protection measures.

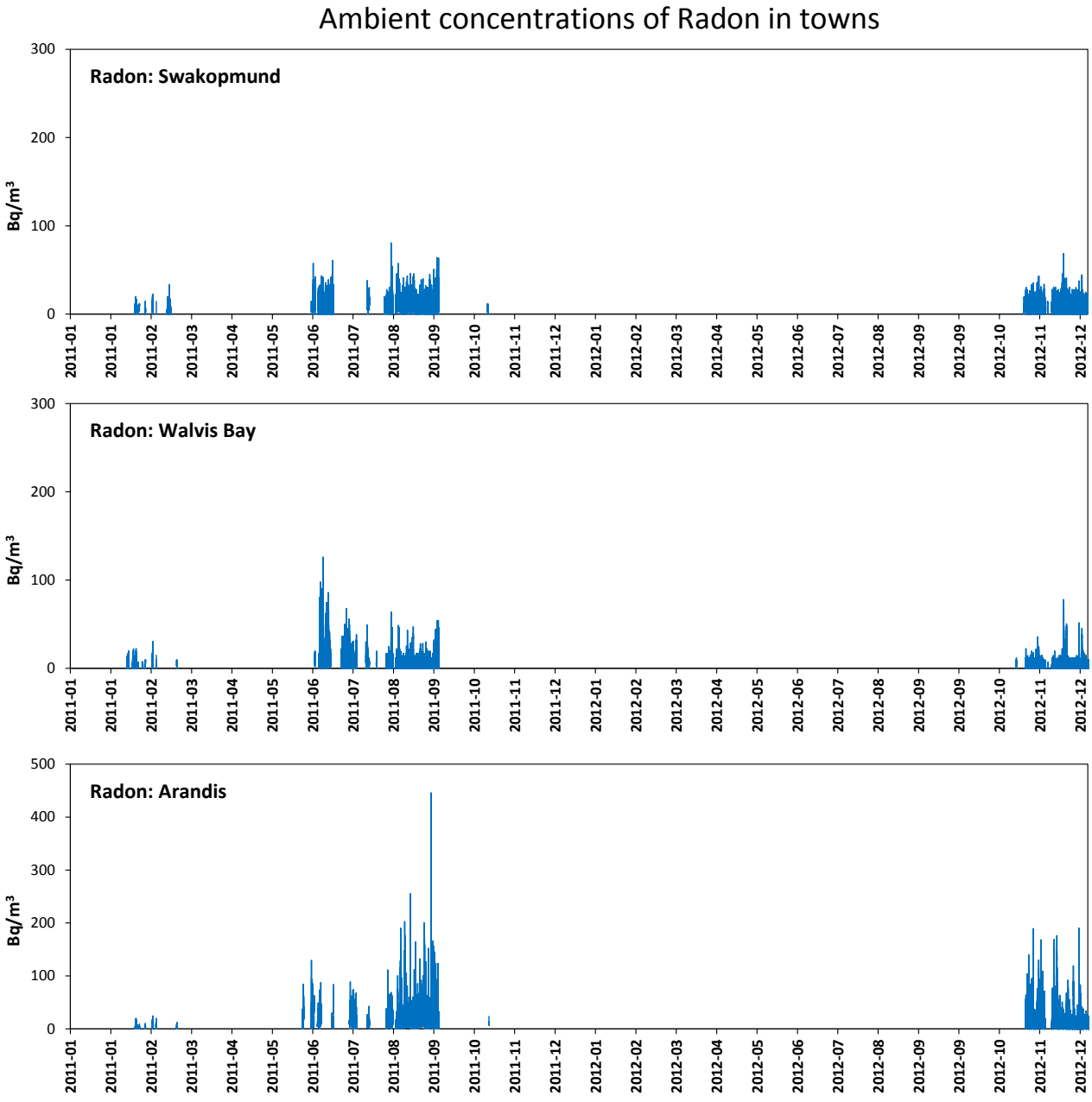

Figure 9: Monitoring results of ambient concentrations of radon at the three major coastal towns Swakopmund, Walvis Bay and Arandis for the 2011 and 2012 calendar years. Periods with no data represent those periods during which the monitors were not functioning correctly. Note that the Y-axes of the graphs are not drawn to the same scale.

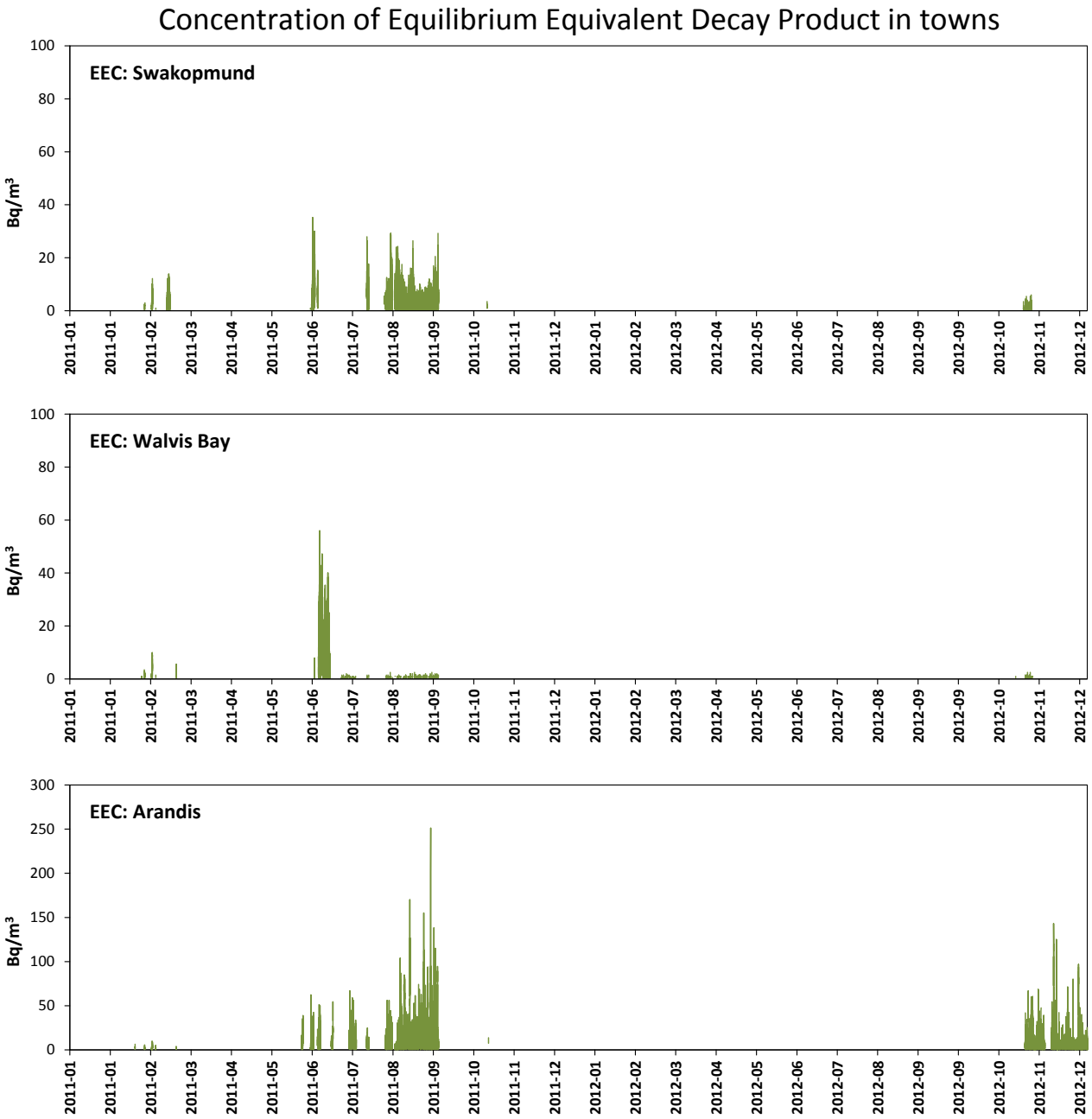

Figure 10: Monitoring results of short-lived progeny (REEC) at the three major coastal towns Swakopmund, Walvis Bay and Arandis for the 2011 and 2012 calendar years. Periods with no data represent those periods during which the monitors were not functioning correctly. Note that the scale of the Y-axis differs between the graphs.

Motivation of status: Because the ambient concentrations of radon and REEC are being monitored, this indicator is rated as MET, although there have been significant periods of data loss in the reporting year. It is clear that the monitors need to be maintained and serviced regularly, to prevent long periods of data loss.

Desired Outcome 5.2.	**Annual human exposures to particulate concentrations are acceptable (IFC Standard).**
Target 5.2.1.	**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 5.2.1.1.	**Ambient PM_{10} monitoring (µg/m³) at Swakopmund**
Status:	**MET**

PM10 is being monitored at Swakopmund and Arandis, although 2012 experienced interruptions due to technical problems (Figure 11). At Arandis data is available for parts of the year and at Swakopmund data is available for the months August to October 2012, with the gap in data due to overwriting of the earlier months since the data was not downloaded before this period.

The ambient PM10 at both stations is well within the WHO IT-3 limit (Figure 11).

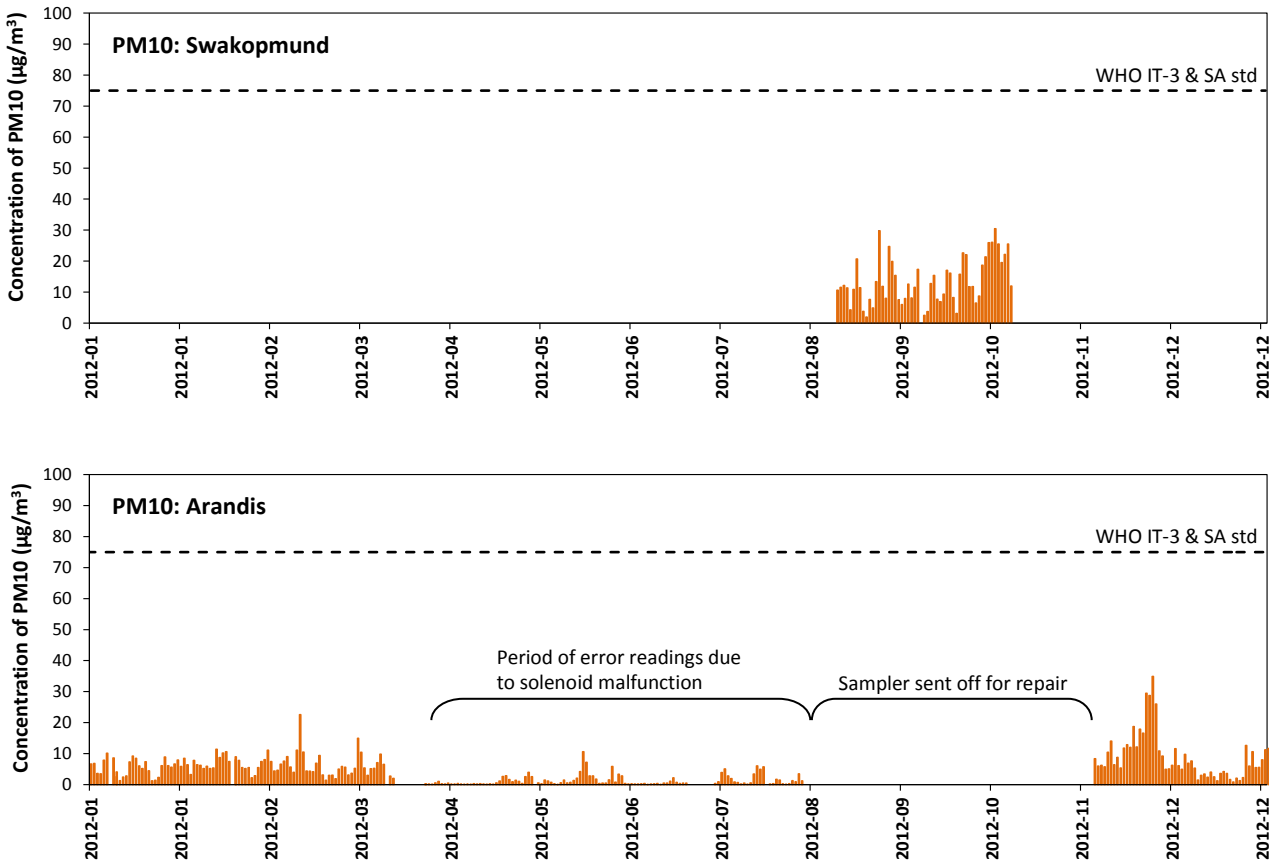

Figure 11: Average daily concentrations of PM10 at Swakopmund and Arandis. For Swakopmund, periods with no data represent those periods during which the downloading of data from the PM10 sampler was not functioning properly. For Arandis specific malfunction periods are indicated (S Müller, UI, pers. comm., 2013). The horizontal dotted line indicates the level of the WHO IT-3 limit and SA standard.

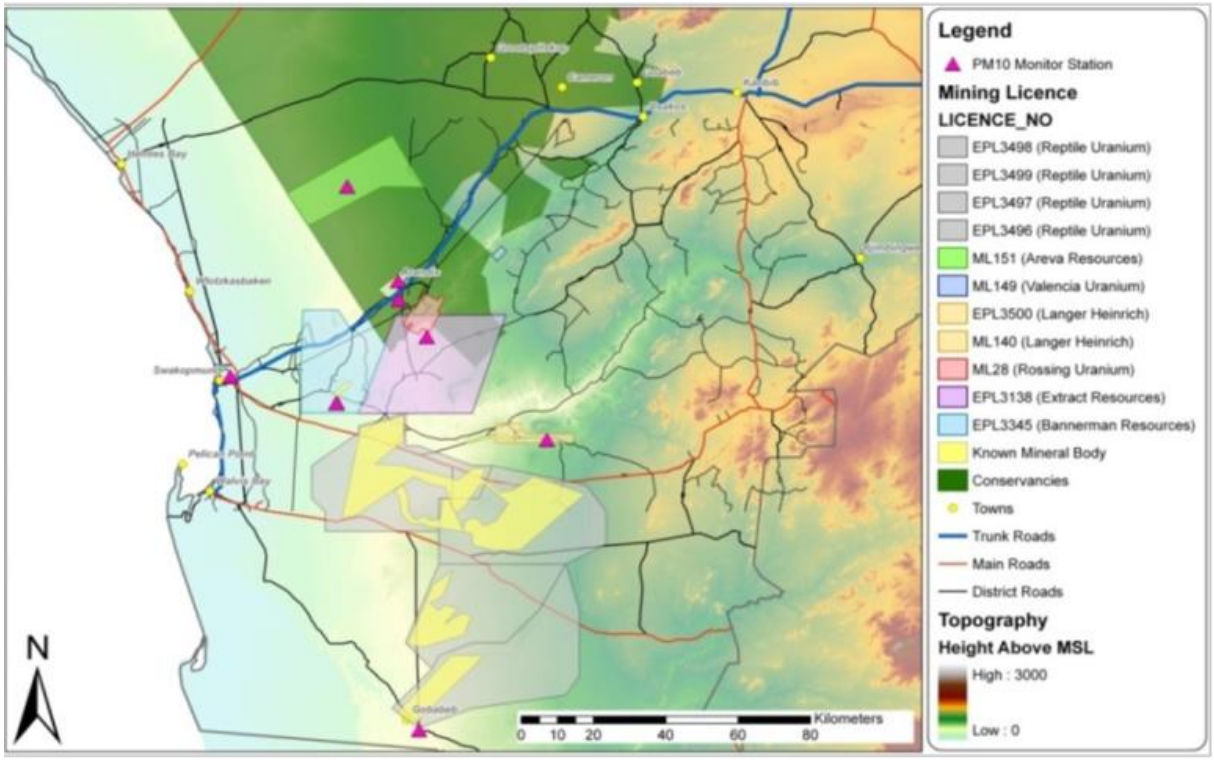

Figure 12: Location of PM10 monitoring stations in the western Erongo Region. The station at Gobabeb ceased to operate in 2011

Motivation of status: In spite of past gaps in the data, ambient PM10 monitoring has occurred at Swakopmund as well as Arandis. This indicator is therefore considered to be MET.

During the steering committee meeting in April 2013, it was decide that **Indicator 5.2.1.2** must be removed as it was not very significant to the desired outcome.

Desired Outcome 5.3.	**Nuisance dust resulting from the Uranium Rush is within acceptable thresholds.**
Target 5.3.1.	**Dust fallout levels at residences in towns should not exceed the recommended limit of 600 mg/m^2/day.**
Indicator 5.3.1.1.	**Continuous dust fallout measurements (mg/m^2/day) on a regional scale e.g. maintain existing SEA dust fallout network.**
Status:	**NOT MET**

The SEA dust fallout network has not been maintained thus there is no data of dust fallout recorded for the reporting year 2012. It was discussed at the Steering Committee meeting in April 2013 that fallout dust settles close to its source and that monitoring of public health impacts should rather focus on inhalable dust (PM10). The SC asked the working group mentioned in 5.1.1.1 to come up with a new and cost-effective method to complement the one PM10 station at Swakopmund.

Motivation of status: Because there is not currently an independent regional network to monitor nuisance dust, this indicator is rated as NOT MET.

Target 5.3.2.	**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 5.3.2.1.	**Mines must implement a dust fallout network, measuring dust fallout at main dust generating sources and mine license boundaries.**
Status:	**MET**

A comprehensive dust fallout monitoring network is implemented by all active uranium mines. Dust fall out is measured in milligrams/square meter/day, (mg/m^2/day) and the South African Dust fallout standard SANS (2005) of 1200 mg/m^2/day is adopted for reference on industrial limits.

AREVA (Trekkopje) mine- The highest dust fallout was measured at Arandis (DM19) where the dust bucket is situated next to an unpaved road (Figure 13). On the mine, low to moderate dust levels of 87 to 283 mg/m^2/day were recorded at the Maxi pad construction sites, DM20-DM27. The next lower range of dust fallout values from 30 to 62 mg/m^2/day was associated with traffic on gravel roads, while the lowest dust fallout of 11 to 29 mg/m^2/day was found at background monitoring sites and places on the mine where there was very little traffic or other activity (Figure 13). All the dust fallout locations are well below the South African Dust fallout standards SANS (2005) of 1200 mg/m^2/day adopted for reference on industrial limits (Figure 13). The low dust fallout at AREVA is explained by the fact that there were no mining activities during 2012.

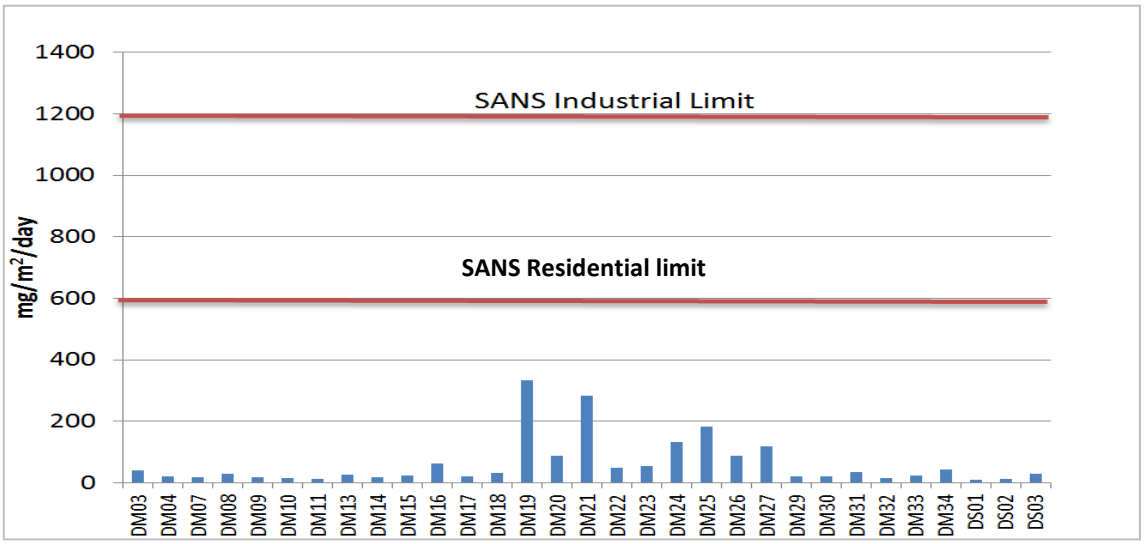

Figure 13: AREVA (Trekkopje) mine dust monitoring results.

Langer Heinrich Uranium mine (LHU) – Reports high dust fallout within the borders of its mining license, some dust fallout results fall below the South African National Standards limit of 1200 mg/m^2/day with some others exceeding it. The sampling point that records the highest dust fallout way above the limit is Valley, South CCD due to its proximity to the crushers and ROM (run on mine) Pad. See the locality map of the four directional and single dust buckets (Figure 14) and the graph for results (Figure 15) below.

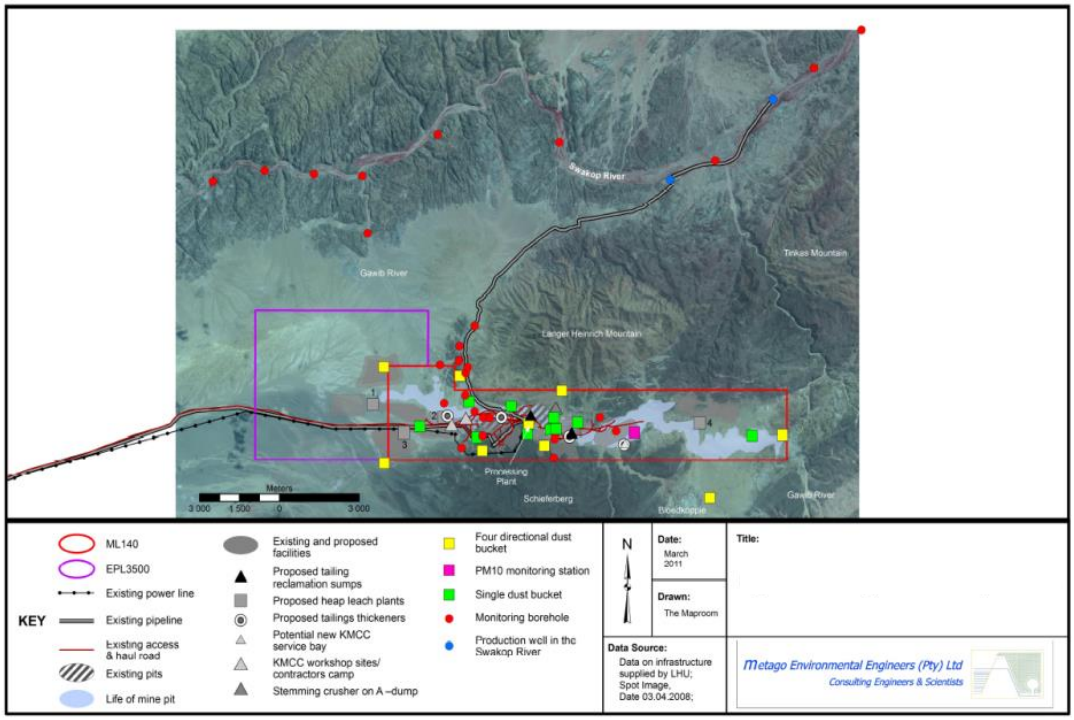

Figure 14: Langer Heinrich water and dust monitoring localities.

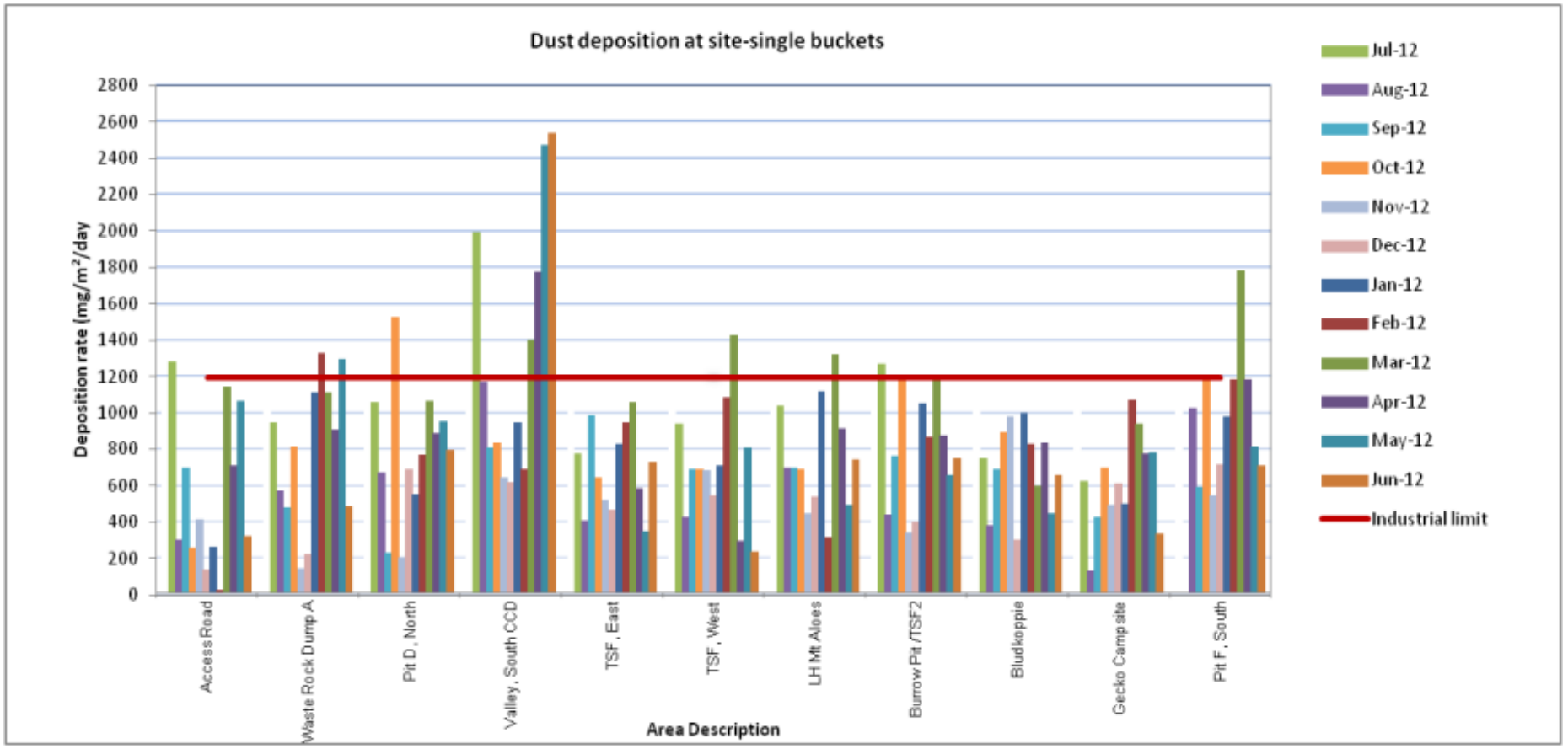

Figure 15: Langer Heinrich mine dust fallout monitoring results

Rössing – The dust fallout monitoring sites at Rössing uranium mine are five in total, mainly around the tailings and two sites at the waste dump and coarse ore stockpile (Figure 16). This network is not considered to be meeting the criteria set by the indicator (measuring dust fallout at main dust generating sources and mine license boundaries). The dust monitoring is not comprehensive since the mine has only five sites at one side of the mining license, and none at the south, west and east boundaries of the Rössing mine license (Figure 16). Rössing is close to Arandis town and neighbour to other mines such as Husab and Valencia, thus it is vital to have multi-directional dust buckets at all sides of the mining license boundaries.

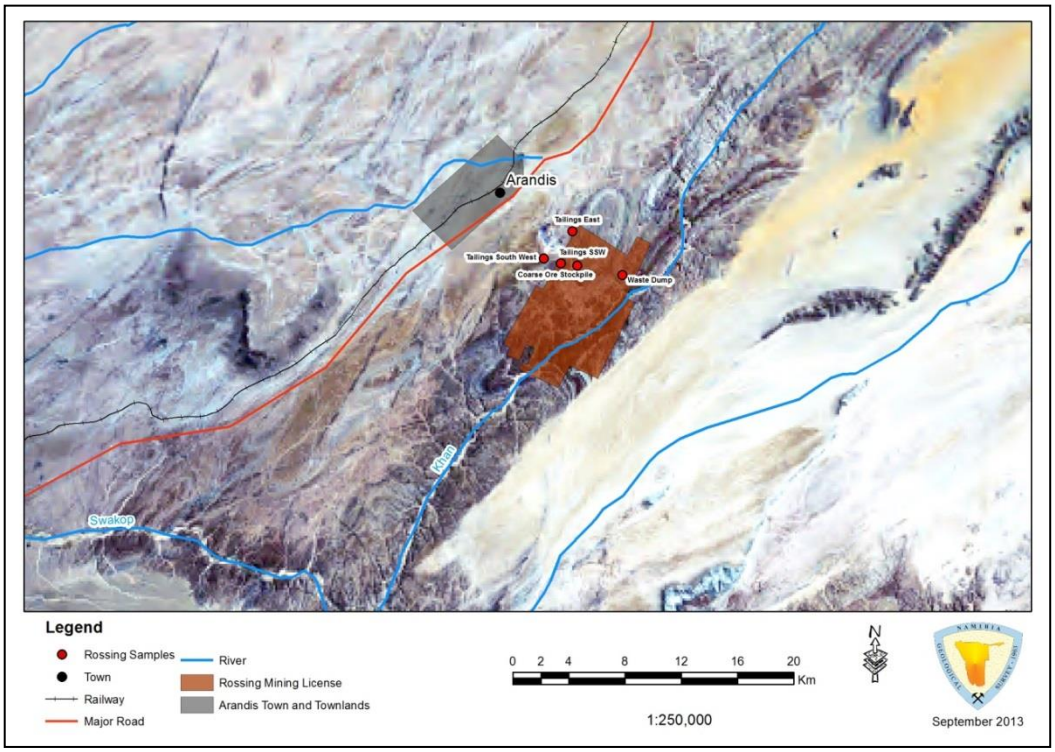

Figure 16: Rössing uranium mine dust fallout monitoring sites

The dust monitoring results at Rössing fall well within the South African National Standards industrial limit of 1200 mg/m2/day (Figure 17). The highest dust fallout is recorded at the coarse ore stockpile for most of the months with 764.75 mg/m2/day recorded in February 2012. This site is located at the north-western border of Rössing Mine where Arandis town is located. This site dust fallout is a concern since it is not clear where the border of Arandis town is situated (Figure 16). Thus the dust fallout at the coarse ore stockpile could result in non-compliance if the plume crosses into the south-eastern town boundaries.

However, fallout dust is heavy and does not travel very far. The shape of the dust plume depends on the wind direction, which is mainly south-west in summer and north-east in winter. For the plume to reach Arandis the wind would have to come from the south-east. Weather records show that this happens very seldom.

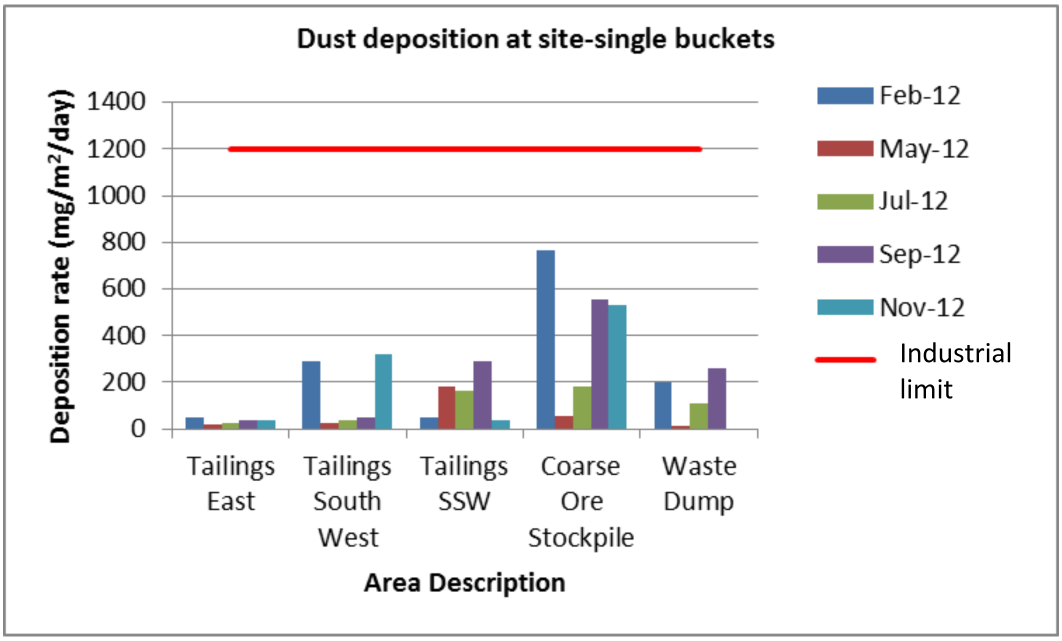

Figure 17: Rössing uranium mine dust fallout monitoring results.

Valencia: No data available for the reporting year 2012.

Bannerman Resources: No drilling and active exploration took place at the Bannerman Resources exploration licenses, thus no dust fallout monitoring was done during the reporting year 2012.

Motivation of status: With few minor exceptions, all active mines have dust fallout monitoring networks in place, measuring dust at dust generating sources and in their ML. This indicator is therefore rated as MET.

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Summary of performance: EQO 5

Total no. indicators assessed 7

	NOT MET	IN PROGRESS	MET	EXCEEDED	NO DATA
Number of indicators in class	4	0	3	0	0
Percentage of indicators in class	57	0	43	0	0

The EQO performance has improved during the 2012 reporting year compared to the previous year because of the improved results from research projects and successful installation of the Radon and Radon progeny equipment at the three major coastal towns. The EQO has 7 indicators and recorded a 43 % (3/7) MET status, 14 % (1/7) no data status and 43 % (3/7) NOT MET status

EQO 6. Health

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

One of the core foundations for economic growth and development is a healthy population. Vision 2030 aims for a healthy nation in which all preventable, infectious and parasitic diseases are under secure control and people have access to quality health services. Uncontrolled uranium mining and recovery has been associated with adverse health effects, especially associated with lung diseases such as lung cancer (GSN, 2012). The Namibian uranium industry is amongst some of the top industries that are health vigilant.

Health is a basic employment right and the health, safety and wellness of employees is a priority. All the uranium mines in Namibia have Occupational Health Management Programmes on industrial Hygiene (safety, dust, noise), Risk Assessment, as well as Occupational Medicine programmes (medical screening, wellness, stop smoking campaigns, and HIV management)(Annual report of the Uranium Institute). The UI prescribes Standards and Guidelines for the promotion and maintenance of the physical, mental and social well-being of workers, the prevention of direct and indirect illnesses amongst workers caused by their working conditions, the protection of workers from risks resulting from factors adverse to health, and the placement and maintenance of workers in an occupational environment that is adapted to their physiological and psychological capabilities (Rössing Mine, 2013). The standards (HERSS Standards) are available on the website of the UI.

Safety is the number one priority for the Namibian mining industry and for the Chamber of Mines, and the Namibian mining industry strives to meet the highest international standards of mine safety.

Additionally, the UI has entered into partnerships with various service providers to develop a suite of training courses to cater for the needs of the uranium industry in Namibia. The UI offers the popular “Introduction to Radiation and Uranium” courses for the public every three months. This is now augmented with the course “Introduction to the Namib Environment” and information lectures. The primary purpose of the UI training programme is to promote learning and to build capacity in specialized skills in the fields of health, environmental management and radiation safety. Furthermore, the Director of the UI acts as the joint Chief Medical Officer for the UI’s member companies providing advice, clinical support and coordinates the development of medical facilities.

As the uranium industry grows it will require an extension of occupational medical facilities at the coastal towns. The extension of these facilities has been achieved, at least in the private sector.

Although the permanent uranium workforce and their direct families have medical aid coverage through their respective companies, improved health services in the Erongo Region and Namibia at large remain relatively inadequate.

Desired Outcome 6.1.	**Disease rates amongst the public and employees of the mining are not increased as a result of the 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 mine project**
Status:	**MET**

The question of interest to the public is how much additional radiation will be released through uranium mining and processing activities. There is no straightforward answer based on direct measurements because instruments cannot distinguish between natural background radiation and radiation released by mines. The preferred approach is a radiological public dose assessment. This is based on air dispersion models for air-borne dust and radon gas, and on consumption and uptake factors for radioactivity in food and water. Modelling predicts the exposure of members of the public at sites closest to the mines. People living at these sites are known as 'critical groups' because it is critical that their exposure dose does not exceed the legal limit. Model results can be verified by monitoring to see if the actual data match the predicted results.

The NRPA may require operating mines and exploration companies to carry out public dose assessments as part of their Radiation Management Plan. Table 17 shows companies which have done an assessment, what the predicted doses to the critical groups were and where these groups were situated.

Table 17: Public Dose Assessments from mining and exploration companies.

Company	Public dose assessment results (mSv/a)			
	Assessment done	Additional dose at mine boundary	Dose to critical group(s)	Critical group location
AREVA	Yes	0.15	0.00	Arandis
Bannerman*	No	Not requires	Not required	Moonlandscape view point
Langer Heinrich	No	Not available	Not available	Bloedkoppie
Marenica*	No	Not required	Not required	
Reptile*	Yes	No data	No data	Swakopmund
Rössing	Yes	0.020 (E-Camp)	0.049	Arandis
Swakop Uranium	Yes		0.06	Constr. camp
Valencia*	Yes	0.00	0.00	Swakopmund

* Exploration companies are not required to carry out public dose assessments

AREVA's assessment predicted no additional dose to the nearest critical group at Arandis.

To date, **Bannerman Resources Namibia** (BRN) has not done any public dose assessments (Table 17: **Public Dose Assessments from mining and exploration companies.**) but plans have been put in place to start with such assessments as from March 2013. The critical group location will be the nearest Moon Landscape view point to the Etango Project area which is frequented by tourists. Bannerman's Exposure Group 2 (EG2) - employees and contractors who are occasionally exposed to

sources of radiation as a result of BRN's activities, have to date been taken as a 'proxy' for public dose assessments. The dose for EG2 in 2012 was 0.02 mSv/a above background.

Langer Heinrich Mine reported that no dose assessment has been carried out. The mine is far from permanent settlements, so that the only relevant critical group would be tourists camping at Bloedkoppie, but since this is outside their Mining Licence, they are not required to collect data there (I Shaduka, NRPA, pers. comm., 2013).

Marenica is still in the early exploration phase and has not yet done any dose assessment; the critical group assessment will be made if they decide to go ahead with the operation.

Reptile carried out a public dose assessment (Table 17: **Public Dose Assessments from mining and exploration companies.**) on its office premises at Hidipo Hamutenya Street, Swakopmund and determined an additional dose of 0.090 mSv/a; calculated on the (theoretical) assumption that a person spends 2000 hours per year at the office. The dose for the critical group at Café Rosso, which is next door to Reptile Uranium, was 0.090 mSv/a. The public maximum allowable exposure is 1 mSv/year above the natural background.

Rössing Mine's dose assessment predicted an additional dose of 0.049 mSv/a to the critical group at Arandis (Table 17: **Public Dose Assessments from mining and exploration companies.**).

Swakop Uranium: Husab's EIA Amendment baseline radiation public dose assessment report identified 14 critical groups. The highest additional dose of 0.06 mSv/a was modelled for the construction camp on the mine site (UI, 2013).

Valencia's EIA/EMP baseline radiation report was part of an ongoing monitoring programme that included neighbouring farms, the exploration camp located outside the licence area, and the town of Swakopmund.

Motivation of status: Excluding Rössing Mine, most operations are very far from the critical group(s). Overall the public dose is well below 1mSv/a, therefore the indicator is MET.

Target 6.1.2.	**The cumulative radiation dose to members of the public and designated 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 (designated radiation workers)**
Status:	**MET**

The legal limit for designated radiation workers is a maximum of 50 mSv/a, provided that the average dose over five years does not exceed 20 mSv/a. Table 18 shows the available data. Note that the figures for AREVA, Langer Heinrich, Marenica and Swakop Uranium include the background dose, while Bannerman and Reptile report the additional dose without the background dose. Rössing Mine's average dose from gamma radiation for radiation workers only is 1.63 mSv/a for 2012. Valencia did not have designated radiation workers in 2012.

Table 18: Summary of radiation doses to designated radiation workers

Company	**Radiation dose to designated radiation workers (mSv/a)**	
	Average dose	Number of workers exposed to >20 mSv
AREVA Resources Namibia	2.6 ± 2.7	0
Bannerman Mining Resources	0.09	0
Langer Heinrich Mine	2.4	0
Marenica	1.3	0
Reptile Uranium Namibia	0.19	0

Company	Radiation dose to designated radiation workers (mSv/a)	
	Average dose	Number of workers exposed to >20 mSv
Rio Tinto Rössing	1.63	1
Swakop Uranium	2.05	0

Motivation of status: Except for Rössing, none of the workers were exposed to a > 20mSv/a radiation dose. The average dose is also well below the legal limit. The indicator is therefore MET.

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** • **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.**
Status:	**MET**

Table 19 summarises the industrial diseases findings from 2007 to 2012 (UI, 2014). In the year under review, two case cases of dermatitis where identified. This where however not related to radiation but as personally allergic reaction to the safety rubber gloves worn in the mining operation.

Table 19: Summary of industrial diseases for radiation workers at mines

Key Performance Indicators	2007	2008	2009	2010	2011	2012	Change
Employees							
Number of Medical Examinations	1175	1307	1415	7523	10251	9920*	- 2728
Production							
Tonnes of Uranium oxide produced	3046	4108	4150	3628	2137	**4915**	**+ 2778**
Health Safety and Environment							
Number of personal annual radiation exposures >20 mSv	0	0	0	0	0	0	0
New cases of Pneumoconiosis	1	0	0	0	0	0	0
New cases of Dermatitis	0	0	0	1	1	2	+ 1
New cases of Noise Induced Hearing Loss	0	0	0	0	0	0	0
New cases of Occupational Chronic Bronchitis						0	
All injury frequency rate (AIFR)	0.71	0.91	0.73	0.89	0.81	**0.86**	**+ 0.05**
Number of Lost Time Injuries (LTI)	9	8	6	14	11	**10**	**- 1**

* Including contractors

Motivation of status: The uranium industry continues to make enormous investments for the purpose of safe and healthy mining operations. Nonetheless two cases of dermatitis where reported

in 2012, although not directly related to uranium mining. The AIFR has increased marginally, however the number of LTI was reduced by one. This indicator is therefore rated as 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**			
Status:	**NOT MET**			

The uranium mining industry monitors diseases that are scientifically attributed to radiation amongst uranium workers. The public health falls under the jurisdiction of NRPA. Currently, NRPA have not done studies to measure these diseases that are scientifically attributed to radiation. This is due to the reason that background radiation from the ore bodies is low, and that recipients (public and health personnel) reside far from the mining sites and thus have little chance to be expose to high dosage.

Motivation of status: There is not sufficient data to assess the indicator, hence it is NOT MET.

Target 6.1.4.	**No increase in road accidents directly attributable to uranium mining and its support industries.**			
Indicator 6.1.4.1.	**Measured change in the number of fatal road accidents per road user over 1 year**			
Status:			**MET**	

There was no road accident that could be attributed to uranium mining.

Motivation of status: The indicator is MET, there was no road accident attributed to the uranium industry. However it was decided that this indicator will be discontinued.

Desired Outcome 6.2.	**Improved Healthcare Facilities and Services are able to meet the increased demand for healthcare resulting from the 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**			
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**			
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.**			
Status:	**NOT MET**			

Indicators 6.2.1.1, 6.2.2.1 and 6.2.3.1 are all related, and hence are assessed as a whole. The only available data in the form of an annual report of the Ministry of Health is for 2009/10 and the data was used for the 2011 SEMP report.

Motivation of status: Because of the lack of data, these three indicators are all considered to be NOT MET.

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Summary of performance: EQO 6

Total no. indicators assessed	8				
	NOT MET	**IN PROGRESS**	**MET**	**EXCEEDED**	**NO DATA**
Number of indicators in class	4	0	4	0	0
Percentage of indicators in class	50	0	50	0	0

The performance of the health EQO has dropped. 50% of the indicators are NOT MET, however this was due to the fact that the Ministry of Health did not compile their data, and not necessary because the health situation on ground has deteriorated. Half of the indicators are MET.

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 the Uranium Rush; and to identify ways of avoiding conflicts between the tourism industry and prospecting/mining, so that both industries can coexist in the Central Namib.**
- **The Uranium Rush 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.**

Residents and tourists to the central Namibian coast define their quality of life as being enhanced by opportunities for sport, exploring the desert by vehicle, relaxing on the beach and living in tranquil towns, angling or adventure activities. Tourism products in the Central Namib include adventure tourism (e.g. parachuting and quad biking), business tourism (e.g. workshops and conferences), consumptive tourism (e.g. hunting and fishing) and ecotourism (excursions into the desert). Although the tourism sector in Namibia has been deeply affected by the global financial crisis that started in 2008, it remains of considerable importance to the Namibian economy, contributing 15.7% to the GDP in terms of direct and indirect impacts (NTB 2013). The coastal region has always been a major draw-card for tourists, with bed occupancies consistently higher than the national average, even though the financial crisis (HAN 2012). For example, in 2012 bed occupancy in the coastal region was 47.1% compared to only 36.2% nationally (HAN 2012).

The key concerns with regard to the impacts on tourism are concerns or perceptions over public health due to radiation exposure; decreased sense of place as a result of visual impacts and noise; actual or perceived loss of unique biodiversity; and reduced accessibility to sites of tourism importance. The SEMP strives to monitor the effects of impacts on inter alia the four key concerns expressed above.

Desired Outcome 7.1.	**Central Namib is accessible to the public (within the regulations of the National Park)**			
Target 7.1.1.	**Uranium Rush 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, Kuiseb and Swakop 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.**			
Status:		**IN PROGRESS**		

The "red" and "yellow" tourism zones for tourism identified by the SEA are still relevant as is. Although these areas have been declared as such in the SEA, there is not currently a legal mechanism to ensure that their status is used in the decision-making process around land-use rights. Because a large component of the tourism zones overlap with areas of biodiversity value (but see exceptions and the resulting conundrum below), the development of the National Policy on Prospecting and Mining in Protected Areas (NPPMPA) remains key to effectively enforcing these zones for tourism as well. In its draft form, the NPPMPA identified the strong link between biodiversity and tourism value and used this to justify the need for a policy that will ensure that

conservation values are being met while economic opportunities are maximised. Until such time as this policy is finalised, neither the MET nor the MME can enforce these principles and adherence to these zones remains voluntary.

Additionally, areas such as the Khan River valley (a yellow flag tourism zone, a red flag biodiversity zone [SAIEA, 2010] host valuable uranium deposits, which means that this area is currently, and will most probably in the future be affected by exploration and mining activities. Swakop Uranium is currently constructing the Husab Mine on the edge of the Khan River Valley and in sight of the area around the Giant Welwitschia and Welwitschia Plains Campsite (both important tourist areas). Arguably, the tourism value of this area has consequently changed to a large extent (e.g. the "wilderness" value of the Welwitschia Plain has declined, even though the plants themselves have not yet been significantly affected), which may lead to tourist operators adapting their products. Tour operators have not yet experienced significant decline in the value of this area, although the increase in traffic as the Husab mine construction gets underway will likely have some impact (G Kolb, CTAN, pers. comm., 2013).

As before, MET and MME are still cooperating to address the issue of red and yellow flag areas. No maps have been received from MET, but these maps are in the draft version of the NPPMPA and will be included in the final one.

Important issues to consider for the future are:

- There is some justified feeling that the issue of zones is duplicated because the principle is repeated in EQO8 (where the biodiversity zones are discussed). There is indeed some overlap in the tourism and biodiversity zones, but overall the tourism zones as identified in the SEA reflect the value of scenic and other attractions to the tourism industry. The Draft NPPMPA explicitly identifies the way in which tourism value (in terms of areas that are aesthetically intact and/or that have the potential to be developed into economically viable tourist or other compatible operations and/or have high recreational value or potential) should influence zoning of parts of protected areas to exclude mining and exploration. Additionally, archaeological, historic and cultural value will play a role in identifying these zones. The NPPMPA will therefore be a major determinant for both ministries in deciding over prospecting and mining rights within protected areas, and the two separate indicators may be collapsed into one in the future.
- However, many of the currently identified high-value tourism areas fall outside protected areas as such, so it is unclear how the decision-making process around mining and prospecting rights will be influenced by the red and yellow tourism zones as identified in the SEA without an official policy in this regard.

Motivation of status: Because the main role players are actively engaging this issue and the decision-making process is being developed, but the NPPMPA is still in draft form and there is not yet clarity how areas outside protected areas will be approached, the status of this indicator is considered to remain IN PROGRESS.

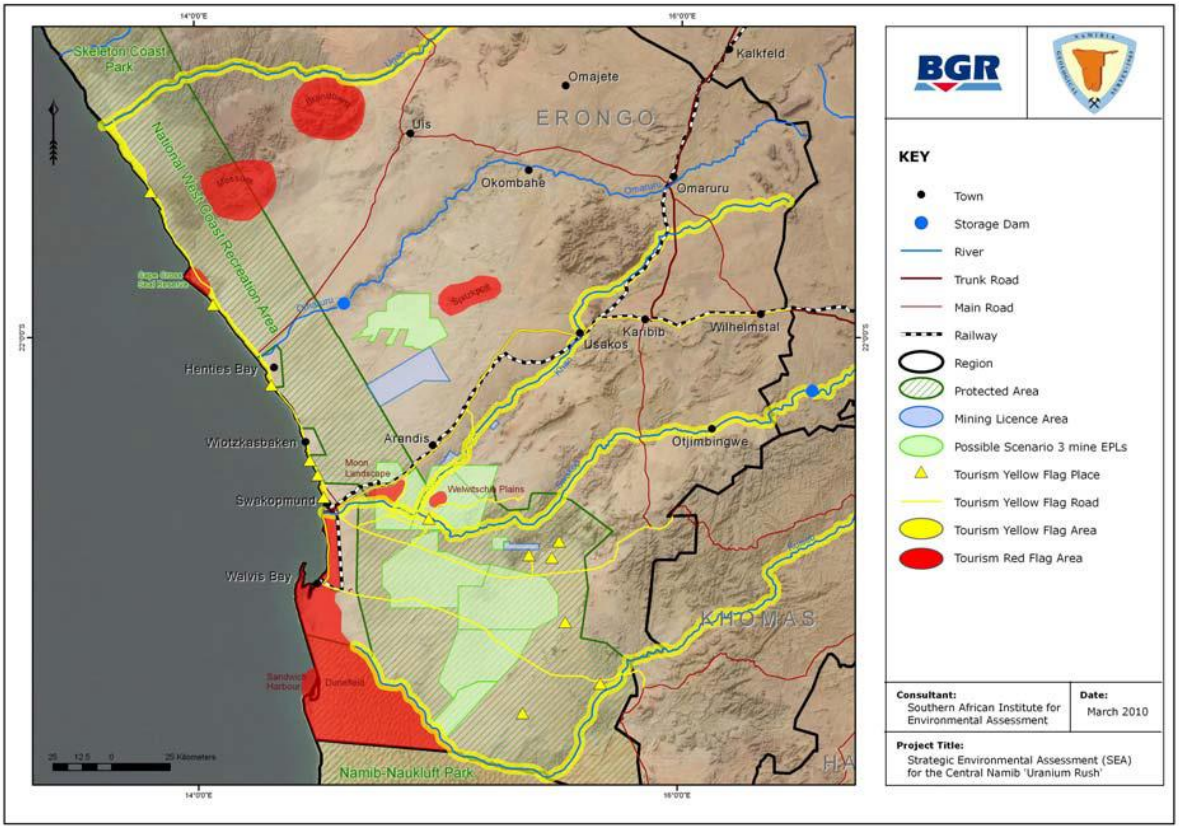

Figure 18. Red and yellow flag zones for tourism as identified in the SEA for the Uranium Rush (SAIEA 2010).

Indicator 7.1.1.2.	**EIAs for all new listed mineral developments address the issue of public access**			
Status:			**MET**	

Note that the term "public access" was interpreted to mean that people must be able to gain physical access to all areas.

Since the previous SEMP Report, only two listed activities have taken place, namely the Z20 Mining Project of Rössing Uranium Limited (which published a scoping report); and Swakop Uranium's Husab Mine for which an amendment was made on their existing EIA after significant changes to the mine plan. Although the Z20 report is technically not an EIA yet, it is the precursor to a full EIA (for which specialist studies were indeed started in 2012). The Husab Amendment EIA committed to offsetting their visual impact by providing alternative access to tourist sites such as the Giant Welwitschia and to maintaining gravel roads that are also used by tourists. From all perspectives this is indeed an assessment of public access.

The EIA report for Zhonghe Resources (Namibia) Development (PTY) Ltd (Zhonghe) was published in 2011, but was not available at the time of writing the 2011 report. It is therefore included here. The EIA for Zhonghe included a Visual Impact Assessment that also assessed the impacts of proximity to visual viewpoints. The latter is interpreted as public access in a broad sense.

Additionally, AREVA reports that although the Trekkopje area was not used for personal recreation on a regular basis before mining started (G Wagner, UraMin, pers. comm., 2013), currently only the 4x4 track past the Annaberg mine to Spitzkoppe is used occasionally by Namibians and tourists.

Access to this track remains open, though AREVA has a security gate in the vicinity of the Trekkopje farm house. A second manned gate controls access along the private road next to the desalinated water pipeline. The mining area is currently off limits to the public for reasons of safety and security.

Motivation of status: Given the positive addressing of the issue in the Husab Amendment EIA, this indicator is considered to be MET.

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

A number of exploration projects have been closed in the reporting period: Bannerman Resources closed and rehabilitated all tracks and drill pads in EPL3346, Reptile Uranium closed their Oryx drilling project area and Rössing have closed some exploration areas. Both Langer Heinrich Mine and Swakop Uranium report that their rehabilitation work is ongoing.

In response to a question put to them by NERMU, mining companies have reported in the following way:

- AREVA envisages that public access will be restored after mine closure and rehabilitation, with the possible exception of areas with remaining radioactivity.
- Langer Heinrich Mine and Rössing report that public access is addressed in their closure plans, but Swakop Uranium reports that this is not the case for Husab Mine.
- Concerning the exploration companies, Bannerman Resources acknowledge that the Etango Pit will close off part of the Welwitschia Drive, but an alternative route has been planned so that tourists can continue to drive in a loop from Swakopmund via the Moon Landscape to the Welwitschia Plain and back to Swakopmund. The route re-location is necessary because the pit will not be backfilled to re-establish the current route.
- Marenica Energy has not progressed to that stage of the project yet, but both Reptile and Valencia have included public access needs in their closure plans.

Motivation of status: Given that no mining projects have been fully closed or decommissioned in the reporting period, that the exploration projects that have been closed did consider public access, and that the majority of mining and exploration companies have considered public access in their closure plans, we consider the status of this indicator to be MET.

Desired Outcome 7.2.	**Uranium Rush does not significantly reduce the visual attractiveness of the Central Namib.**
Target 7.2.1.	**Direct and indirect visual scarring from the Uranium Rush 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.**
Status:	

The pilot survey conducted by NERMU for the previous SEMP report (see GSN 2012) was used to refine the questionnaire used for a repeat study. The results of the repeat study are reported in **Error! Reference source not found.**. The sample size for the current survey was highly curtailed due to a lack of time and human resources. With only three respondents out of five Operators

approached by NERMU answering the key question, the results for this survey are therefore as yet highly uncertain. Although 19 of a total of 21 scores made by the three respondents (=90%) were rated 3 or higher across all categories (indicating that the operators still consider the particular attractions as significant or highly significant components of their tour packages) it is therefore very difficult to judge whether this was a general phenomenon or not.

Motivation of status: Because the low sample size for tour operators prevented confident conclusions, this indicator is rated as No data

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.**			
Status:				**EXCEEDED**

The pilot survey conducted by NERMU for the previous SEMP report (see GSN 2012) was used to refine the questionnaire used for a repeat study. The results of the repeat study are reported in **Error! Reference source not found.**. In summary, of a total of 271 scores (by 55 respondents) across six aspects defining visitors' experiences in the Namib, 93% were 3 (met expectations) or higher (exceeded expectations). For the single aspect of "Scenic quality", 96% scored it 3 or higher. The pattern of scores produced by all respondents (foreign and Namibian-based) was matched by respondents based in Namibia, with 88% of scores across all aspects being 3 or higher, and 92% in the aspect "Scenic quality".

Motivation of status: Given that the target here was 80%, this indicator is considered to be EXCEEDED.

Indicator 7.2.1.3.	**All EIAs for mine development address visual impacts and sense of place**			
Status:			**MET**	

This indicator was assessed only for those projects that published EIAs in the reporting period, as well as for the Zhonghe Project (which was published in 2011 but was not previously available).

Of the two projects assessed here (Husab Amendment EIA and Zhonghe (Namibia) Resources), two (100%) assessed visual impacts and impacts on sense of place.

In addition to the above, all currently active mining and exploration companies reported that they have indeed assessed visual impacts and impacts on sense of place.

Motivation of status: Because the EIA studies conducted in the reporting period all met the criteria of the indicator, it is rated as MET.

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. These include:** **- Coastal strip,** **- Major dunefields,** **- Moon Landscape,** **- Spitzkoppe,** **- Brandberg,** **- Messum crater,** **- Sandwich harbour,** **- westward flowing rivers (notably Khan, Swakop and Kuiseb)**
Status:	**IN PROGRESS**

Indicator 7.3.1.2.	**MME recognizes and respects 'yellow flag' status for areas regarded as being scenically attractive. These include:** **- Gravel plains,** **- Inselbergs (other than those listed above),** **- River washes (other than rivers listed above),** **- Lichen fields.**
Status:	**IN PROGRESS**

Indicators 7.3.1.1 and 7.3.1.2 are related and therefore discussed together here. These indicators have to be assessed in the context of the bigger drive towards a more strategic use of land that explicitly includes tourism and biodiversity values in the decision-making process. The active work on this process, as well as the issue of the draft status of the key legal instrument (the National Policy on Mining and Prospecting in Protected Areas) for this was discussed above (Indicator 7.1.1.1). No change has occurred in any of the conditions since the previous report. However, although the MME does not currently have a formal policy whereby red flag areas can be recognized it has very clearly indicated a willingness to accept scientifically well-justified arguments for such zoning of Protected Areas (G Schneider, MME, pers. comm., 2012).

Motivation of status: Because of the in-principle acceptance of the concept of red and yellow flag areas by the relevant Ministry, but because the policy on mining and exploration in protected areas, which will formalise these areas, has not yet been finalised, both these indicators are considered to be IN PROGRESS

Indicator 7.3.1.3.	**No new mines and prospecting licenses are awarded in the red and yellow flag areas as identified by the SEA**
Status:	**MET**

A moratorium currently exists on all new prospecting licenses in the area of relevance to the SEMP, and without these, new mines will therefore only develop in areas where EPLs were previously granted (G Schneider, MME, pers. comm., 2012). In the reporting period two projects in the focal region were granted Mining Licences:

1. Zhonghe Resources Namibia (Pty) Ltd.: Mining Licence for Nuclear Fuel, issued 30/11/12 valid until 29/11/31, and

2. Shiyela Iron (Pty) Ltd.: Mining Licence for Base and Rare Metals, Industrial Minerals and Precious Metals, Issued 06/12/12/ valid until 15/12/27

Zhonghe falls outside a Protected Area, while Shiyela is not a nuclear fuel licence and is therefore not relevant to this assessment. In addition, Bannerman has returned EPL 3346 and 50% of EPL 3345 back to the ministry and due to the moratorium, no new EPL has been issued in this protected area (W Ewald, Bannerman Resources, pers. comm., 2013).

Motivation of status: Because no new licences were awarded in red or yellow flag areas, the indicator is considered to be MET.

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Summary of performance: EQO 7

Total no. indicators assessed	9				
	NOT MET	**IN PROGRESS**	**MET**	**EXCEEDED**	**NO DATA**
Number of indicators in class	0	3	4	1	1
Percentage of indicators in class	0	33%	44%	11%	11%

Of the nine indicators in this EQO, 44% has been MET, which is an improvement of 11% over the previous year. The number of indicators NOT MET dropped from 3 (33%) to none this year. The number of indicators rated as IN PROGRESS is 33% and the exceeded indicators remained the same. The one indicator assessing the experience of tour operators could not be assessed because the response rate in a structured survey was too low (only five respondents).

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 the Uranium Rush. 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.

The Central Namib might appear to be a barren environment, but its climatic variations superimposed on diverse landscapes and substrates support a great variety of living creatures. The most impressive diversity is found in those groups which normally are cryptic or go unnoticed, namely reptiles and invertebrate groups such as insects and arachnids, and they display many remarkable adaptations for survival in the Namib. The area is known as a hotspot of species diversity in these groups; most particularly in geckos and sand lizards, beetles, scorpions and solifuges. Some of these species, as well as other more conspicuous mammals and birds, are conservation priorities on the basis of endemicity and rarity, and almost all desert species are specialized to live in arid conditions of some sort.

The SEMP addresses concerns about the likely impacts on biodiversity by monitoring the protection of critical habitats and processes (including areas flagged as being especially important for biodiversity, e.g. the riverine ecosystems), the extent of direct impacts and the measures put in place to ensure persistence of all species.

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.**			
Status:		**IN PROGRESS**		

The Ministry of Environment and Tourism is an integral part of the committee that assesses license application. However the policy on mining and exploration in protected areas, which will formalise these areas, has not yet been finalised.

Motivation of status: Because of the outstanding but almost complete policy, the indicator is considered as being IN PROGRESS.

Indicator 8.1.1.2.	**The EIAs need to follow the mitigation hierarchy and incorporate offsets as an option.**			
Status:		**IN PROGRESS**		

All EIAs conducted in the reporting period followed the mitigation hierarchy. As before, the issue of incorporating offsets is tied up with the lack of a regulatory framework for this. In the previous report the results from the so-called LLA project (MET 2012) were discussed. This is a robust decision-support tool and database that allows a more direct determination of areas of critical biodiversity value. The MET has released but not yet distributed the LLA report.

Motivation of status: Because the processes and tools required to decide on offsets have commenced, but are only partially complete, the indicator is considered to be IN PROGRESS.

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.
Status:	MET

The MME keeps records in the form of minutes of the MPMRAC. The Mining Commissioner´s office furthermore keeps a record of licenses granted and refused. A list of licenses granted and pending is also on MME's webpage (all G Schneider, MME, pers. comm., 2012). The issue of whether any subsequent applications for licences in the same area has been influenced by a previous decision is not, at the moment, possible to determine, because it will require very careful scrutiny of the Mining Commissioner's records. However, as a moratorium on granting exploration licenses for nuclear fuels is in place, no new licenses can be granted at present in the same area where such have been previously refused on the basis of biodiversity issues.

Motivation of status: Because records of all decisions are kept and there is a moratorium on granting new nuclear fuel exploration licences in place, the Indicator is considered to be MET.

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

Some aspects of this indicator cannot yet be measured, because it expects a process that cannot yet occur (offsets). However, the intent of this indicator is interpreted to be an assessment of whether there is an emphasis on avoiding impacts, rather than pushing the problem down the line to offsets. Avoidance is good practice and has a secure and predictable outcome, while all other options, and especially offsets, require a large number of variables and criteria to be met and outcomes are more uncertain.

Although it cannot be explicitly determined whether avoidance predominates (all mining companies responding to a question from NERMU reported that it does, but it is difficult to verify this independently). All EIAs for projects conducted in the reporting period are following the basics of the mitigation hierarchy and a balanced mix of mitigation types were committed to.

Motivation of status: Because the mitigation hierarchy forms the backbone of all EIAs conducted in the reporting year, the indicator is considered to be MET.

Indicator 8.1.1.5.	Sensitive areas are identified by mines and disturbance of these areas is minimized.
Status:	MET

All mines have identified biologically sensitive areas (as reported in their respective and various EIA reports, available upon request). All active mines (Trekkopje, Husab and LHM) except Rössing report that they explicitly attempted to minimize the size of their footprint effect on sensitive biodiversity (Uranium Institute 2013). Rössing was designed in the 1970s when the concept of footprint minimization was not applied. An alternative and/or complementary option to minimizing disturbance of sensitive areas is to restore their ecological and biological properties after disturbance, with rehabilitation being the first step towards restoration. Table 19 shows the size of

the mining footprint, already rehabilitated areas and areas protected by the mine, e.g. as potential future offset.

Table 20: Sizes of different components of the biodiversity footprint of different mining and exploration companies in the region.

Company	Disturbed area (ha)	Rehabilitated area (ha)	Protected area (ha)	% rehabilitated (ha)
AREVA Namibia	1,818	26	4,941	1.4%
Bannerman	198	176	No data	89%
Langer Heinrich	626	0	0.82	0%
Marenica	No data	No data	No data	-
Reptile	15,900	2,100	0	13%
Rössing Uranium	2,438	93	0	4%
Swakop Uranium	5.6	No data	No data	-
Valencia	130	40	0	31%
Zhonghe	No data	No data	No data	-

From this table it is clear that at least one exploration company (Bannerman Resources) have significantly decreased their biodiversity footprint by rehabilitating almost 90% of the area that they disturbed, with only those tracks used to access boreholes and possible future exploration drilling areas remaining open. Valencia has rehabilitated almost a third of their disturbed area and Reptile, who reports that areas disturbed in 2012 were cleaned and partially rehabilitated, but that they keep many tracks open for future drilling, have rehabilitated about 13%. Valencia is already planning an extremely confined footprint due to surface rights limitations and topography. Rehabilitated areas consist mainly of the borrow pits and service roads used during construction. Both RUL and AREVA have rehabilitated less than 5% of their disturbed areas, because the disturbed areas are still in use. No (or not enough) data were available for Zhonghe, Marenica and Swakop Uranium. Swakop Uranium reported that exploration tracks not in the footprint of the mine pits or related infrastructure are rehabilitated, but that the area of these tracks is unknown. The actual mine and plant areas are to be fenced out of the remainder of the Mining Licence area, which would in theory form a protected area within their mining licence (although this will not necessarily protect the highest diversity of fauna and flora, it will include much of the population of Welwitschia mirabilis.

Important disclaimer: this assessment only records the total areas that were treated, but does not provide any indication of actual recovery of biodiversity properties. This topic is the subject of an ongoing study by NERMU. It must also be noted that the actual disturbed area is only a part of the total biodiversity footprint, because many impacts affect functional ecological processes and system properties that are not bound to area. It is essentially impossible to measure this in a consistent and fair manner across different habitats and diversities. There is not an immediately apparent solution to this dilemma because it will be so site-specific, but it should be noted that the concept of a functional biodiversity footprint needs a lot more attention in specialist studies for EIAs than it currently receives. In addition, this indicator does not allow an evaluation of how cumulative biodiversity footprints are assessed, which is a critical aspect that the SEMP was designed to address.

Motivation of status: Although not all mines have explicitly minimised the disturbance of sensitive areas, most mines report positively that they attempted to minimize their biodiversity footprints and rehabilitation is being done. This indicator is therefore considered to be MET

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'
Status:	**IN PROGRESS**

Most active mines except Rössing (which was designed in the 1970s before these concepts of corridors and minimizing of footprints existed) report that they actively tried to minimise their footprint impact through linear infrastructure as part of the EA and management process. For instance, the EIA for linear infrastructure at AREVA resulted in the desalinated water pipeline route being shifted south to avoid the Wlotzkasbaken lichen field. However, Swakop Uranium points out that although they have attempted to minimize their linear biodiversity footprint, the linear routes can unfortunately not avoid all red or yellow flag biodiversity zones. The Husab Amendment EIA made some minor changes to the planned routes, so the previous assessment stands. Zhonghe did not report on this aspect and also did not assess impacts of linear infrastructure in their EIA.

Motivation of status: Although not all mines have planned their linear infrastructure to avoid sensitive areas, the two most relevant ones (AREVA's Trekkopje and LHM) did and the only other developing mine (Husab) could not avoid crossing sensitive areas by force of location. Overall we therefore consider this indicator to remain IN PROGRESS.

Indicator 8.1.1.7.	Mines share infrastructure as much as possible, thus minimizing infrastructure proliferation.
Status:	**NOT MET**

In terms of the reporting period, the Husab Amendment EIA makes no reference to the sharing of linear or other infrastructure with other mines, and neither does the Zhonghe EIA. Swakop Uranium furthermore explicitly avoided placing linear infrastructure too close to that of Rössing, although their permanent pipeline does partly share the route of the Langer Heinrich Mine pipeline.

Motivation of status: Because the only currently developing projects do not share infrastructure, the indicator is considered to be NOT MET.

Indicator 8.1.1.8.	Infrastructure planning and investment takes into account future demand, thus reducing the need for additional impacts (e.g. 1 pipeline, not 3).
Status:	**MET**

AREVA and Langer Heinrich Mine report that their power lines and pipelines were planned to allow for additional users, but Rössing was designed in the early 1970s when the concept of footprint minimization was not applied. Swakop Uranium was a key participant in the southern Swakop water supply scheme designed with the intention of building one pipeline to service several mines. In addition, they preferred to construct their linear infrastructure across the Khan River from the north rather than through the Namib Naukluft National Park. The Husab Amendment EIA made no changes to this.

Motivation of status: Although one mine was not planned with future demands in mind, their planning period pre-dates the SEMP with many decades. The other mines are considered to have done enough to meet the expectations of this criteria and assign its status as MET**.**

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).**

Status:			**MET**	

Partnerships have been established by LHM with independent parties (e.g. Gobabeb) to assist with some research activities in the Namib Naukluft Park. Bannerman Resources is working with the Gobabeb Research Station to monitor the effectiveness of the rehabilitation on the micro-organisms e.g. hypolithic cyanobacteria. Swakop Uranium actively engages with the Directorate of Parks and Wildlife, both in the Namib Naukluft National Park and at corporate level. Rössing has partnerships with Birdlife International and Fauna & Flora International (FFI) and cooperates with local conservation organisations such as Coastal Environmental Trust of Namibia, the Millennium Seed Bank Project (MSBP) and the National Botanical Research Institute (NBRI). The objective of the partnership with FFI is to support the development of a biodiversity action plan and to support the identification and implementation of offset opportunities. Langer Heinrich, Trekkopje and Valencia also work with the NBRI and MSBP, while AREVA's head office has partnered with FFI (further possibilities will be explored in future should the mine come into full operation). Langer Heinrich Mine and Swakop Uranium cooperate with NERMU on biodiversity and rehabilitation projects.

Motivation of status: All mining companies are involved, in some form or another, in projects and partnerships to mitigate their impacts on biodiversity. For that reason the indicator is rated as MET.

Indicator 8.2.1.2.	**Mining companies commit to sustainable offset initiatives to ensure a 'no net loss' to biodiversity as a result of their operations. This will involve partnering with long term conservation partners (GRN, NGOs and communities).**

Status:		**IN PROGRESS**		

Since there is no official policy on biodiversity offsets in Namibia as yet, operating mines are holding back on a firm commitment to offsets and partnerships. Swakop Uranium considers offsets to be the last option, once the mitigation hierarchy has been implemented (but in principle they therefore do support a no net loss policy). Rössing and AREVA have a "no net loss" policy. Langer Heinrich Mine has committed to investigating the option of a biodiversity offset if irreplaceable biodiversity will be permanently lost and restoration is not possible. Rössing, following the stated biodiversity strategy of all Rio Tinto operations, is currently busy with an initiative that will directly result in the quantification and identification of biodiversity offset areas. Discussion of offsets has started with FFI being the link between the mining industry and government. However, there is little movement to engage meaningfully with all role players and to come to grips with the issue (which can be complex), nor do any of the companies' partnerships with NGOs and conservation organizations involve offsets. This lack of real action may very well be the result of a lack of clear policy on this, but there is no real reason to expect that government will take the lead on identifying potential offsets or developing a mechanism through which buy-in can be obtained across a multitude of stakeholders, hence the onus could be considered to be on the mining companies.

Motivation of status: Considering the fact that mining companies are engaging with the concept on a number of levels (in spite of a lack of policy), but with no commitments yet on the table, the status of this indicator is considered to remain IN PROGRESS.

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.
Status:	IN PROGRESS

The range of projects that can be counted as conservation is large. However, a balanced portfolio of support of strict conservation projects (such as measures to protect the Damara Tern) and studies into biodiversity conservation principles and issues was looked for. AREVA Namibia has provided logistical support to the annual wildlife counts in the #Gaingu Conservancy since 2008 and has supported NACOMA's environmental week (including beach clean-up events) since 2010. Power line surveys are conducted monthly as a contribution to the NamPower/NNF Strategic Partnership's project on bird interactions. Several biodiversity research projects were conducted at Trekkopje Mine and are described in more detail in their annual stakeholder reports. At Langer Heinrich Mine only public awareness projects have been undertaken (not specified), and soil and zebra studies as in the past. Rössing supports and funded the protection of the Damara Tern project between 1992 and 2012. Other, informal, understandings with institutions such as NBRI (plant surveys and annual monitoring of some species) and NACOMA (annual Coastal Environmental Week) exist. Rössing supports and sponsors the annual BirdWatch event through the Rio Tinto / BirdLife International partnership. Rössing is a member and sponsor of the Namibian Environmental and Wildlife Society (NEWS). Swakop Uranium is supporting research into *Welwitschia mirabilis* and other iconic species of the area, but do not yet support specific conservation projects.

Motivation of status: Support to conservation projects seem to be growing slowly despite trying financial conditions. However there is not yet a balanced portfolio of conservation projects and research into biodiversity impacts/issues. Although all mines are considered to be committed to biodiversity conservation in their own way, the status of this indicator has to remain IN PROGRESS.

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).
Status:	IN PROGRESS

The lack of a clear national policy on biodiversity offsets still hampers progress in this area. AREVA states that its support towards protection and management of key biodiversity offset areas will depend on future government requirements (e.g. legislation) or industry-wide projects that have Government approval. All other mines are still at the initial stages of planning for this aspect.

Only Rössing Uranium is currently busy with an initiative that will directly result in the quantification and identification of biodiversity offset areas.

One of the outcomes of the Landscape Level Assessment project (MET 2012) may be the definition of potential offset areas based on data that support a robust ecological framework. However, the process of actually identifying "like-for-like" surrogates is still in its infancy.

Motivation of status: Although the process is still in its initial phases, because of several positive initiatives and firm commitment by the mines, this indicator is considered to be IN PROGRESS.

Desired Outcome 8.3.	**No species become extinct because of the Uranium Rush.**			
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.**			
Status:			**MET**	

In the previous report a fairly rigid and conservative criterion was used: the indicator was considered as being met by a specific mine's EIA if there is a clear statement about risk of extinction for a single species or a group of species. This means that the consideration of red data status of a species would only be the first step on the road to gauging extinction risk, because it is a national-level assessment of risk, which needs to be refined for the site itself. Such risk need not be completely quantitative but if it is to be prevented from happening, it is important to phrase it in terms of probability of loss of all individuals from a geographically defined site or a region. Few projects do this explicitly, so the indicator is almost guaranteed not to be met. From this perspective considering the two relevant EIAs: Husab Amendment EIA (published in 2012) and the Zhonghe Resources (Namibia) EIA, published in 2011 (but not previously available), the Husab Amendment EIA did explicitly consider extinction possibility, but the Zhonghe EIA did not even mention the word extinction.

However, recognizing that there is a whole range of approaches to managing extinction risk, of which the Red Data status of a species is the most widely accepted one, the manner in which the mining and exploration companies have gauged and managed extinction risk is reported in Table 21.

Table 21: Strategies employed by mining and exploration companies to assess risks to and avoid extinction of species. Source: Uranium Institute 2013.

Company	Species extinction		
	Was considered in EIA (year)	Endangered species identified	Measures taken
AREVA Resources Namibia	Yes, 2007	None	Not applicable
Bannerman Mining Resources[1]	Yes, 2012	Yes	See remarks
Langer Heinrich Mine	Yes, 2012	None	Not applicable
Marenica Energy	Yes, in PEA 2007	None	Not applicable
Reptile Uranium Namibia	Yes, 2006, 2010	None	Not applicable
Rio Tinto Rössing[2, 4]	Yes, 2010 and 2012	Yes	See remarks
Swakop Uranium[3]	Yes, 2010, '11, '13	Yes	See remarks
Valencia[4]	Yes, 2008	None	Not applicable
Zhonghe	Yes, 2011[5]	None	Not applicable

[1] A new *Pachydactylus* gecko species was identified and current knowledge suggests that about 10% of its habitat would be affected by the Etango mine. As mitigation measure, more studies will be done both to understand its habitat and to obtain a more confident assessment of its range.

[2] Eighteen invertebrate species were recorded in the mid 1980s of which only two were recorded again. Four spider species fall in the critical priority. In 2011 a total of nineteen new invertebrates were recorded in addition, and not recorded again. Two reptile species (lizards) are high priority species, two bird species and two mammals are of a threatened status. A total of 253 plant species occur. A total of 68 plant species are of conservation value, which includes near-endemics and rare plants and one of a near-threatened status. Invertebrate species surveys in prioritised habitats take place annually. The mitigation hierarchy (avoid, minimize, rehabilitate, offset) is applied in the assessment of impacts.

[3] Though there were endangered species found at Husab they are not threatened by extinction. For example, spatial distribution studies indicated that the Husab Sand Lizard had a wider distribution outside the Husab mine sphere of influence. Protected plant species were identified, and areas

where they grew were subsequently avoided, or plants were relocated if directly affected. More studies are also being undertaken on some of these species.

[4] Rössing and Valencia were both concerned about their possible impact on the endemic species *Lithops ruschiorum* and *Adenia pechuelli*. The NBRI was subsequently commissioned to map the distribution of these species on the mine sites and in the surrounding area and showed that both species had a fairly wide distribution and healthy populations, even within the Rössing mining area.

[5] Note that the Zhonghe EIA, contrary to their own assessment in the Table above, does not provide evidence of assessing extinction risk, apart from providing lists of species of different conservation concern.

Motivation of status: Because of the proven efforts and approaches by all companies to consider extinction this indicator as considered to be MET.

Indicator 8.3.1.2.	**Resources for a reasonable investigation are made available to manage species at risk of extinction**
Status:	

All older EIAs and existing EMPs were assessed for the previous report. No EMPs were updated in the intervening period. Therefore all evaluations for the previous period (which was accorded Not Met) still stand. Considering for the moment only those EIAs relevant to the reporting period, the only EIA that did consider extinction risk (Husab Amendment) considered the risk to be low. Consequently there was no need to either install management procedures or allocate resources to avoid extinction of species.

Motivation of status: Because risk of extinction was not applicable in this reporting period, this indicator was not assessed.

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.**
Status:	**IN PROGRESS**

The mining and exploration companies have instigated a number of procedures to prevent secondary impacts (Table 22).

Table 22: Procedures instigated by mining and exploration companies in the region to prevent secondary impacts.

Company	Measures taken to avoid secondary impacts
AREVA Namibia	All AREVA employees, contractors and visitors are given an environmental site induction which includes the prohibition of off-road driving, poaching, illegal camping and littering. Inspections are carried out to identify transgressions and corrective action is taken.
Bannerman	All employees, contractors and consultants receive inductions in this regard. Bannerman Resources has rehabilitated old off-road driving tracks in the National Park and erected additional signage and barricades with the approval of the MET to reduce this type of behaviour.
Langer Heinrich	The park rules are distributed to all employees, contractors and visitors during environmental inductions. Strict waste management practices are applied in the Mining Licence area. Off-road driving is not allowed – only existing roads are used

Company	Measures taken to avoid secondary impacts
	and access roads required for mining-related activities are addressed during the EIA process and controlled as part of the mine planning function.
Marenica Energy	Site inductions to personnel and visitors.
Reptile Uranium	Constant tight control on all sites by ECOs and supported by all personnel; reporting to MET after investigation; incident reporting with mitigation actions; refresher inductions and toolbox meetings to improve awareness.
Rio Tinto Rössing	The undesirability of off-road driving, poaching, illegal camping, littering by mine personnel, etc. is part of the induction modules (to recruits and contractors, for example). Furthermore signage and fences limit off-road driving.
Swakop Uranium	Swakop Uranium is cognisant of the potential temporary impact on tourism along the Welwitschia Drive toward the Husab site. SU engages regularly with the Costal Tourism Association of Namibia and the directorate of Parks and Wildlife in this regard. Stringent measures are being implemented to manage construction related traffic including driver training, driver awareness campaigns etc. Swakop Uranium has provided new recycle bins at the NNNP campsites near the Husab mine and removes rubbish from these bins on a regular basis.
Valencia	Inductions done on-site to all site personnel and contractors to highlight these issues, ongoing monitoring and site inspections done, security check point.
Zhonghe	No information provided.

Although the measures as defined in Table 22 appear to be fairly comprehensive, the MET reports that they have experienced a general increase in all of the illicit activities as listed in the indicator. In at least one poaching incident a number of clues pointed to the involvement of employees of an exploration company or other persons with access to their vehicles (R Solomon, MET, pers. comm., 2013). Overall, the MET perceives a “serious increase” in poaching incidents (200% in the last five years; M Le Roux, MET, pers. comm., 2013). For instance, they have lost a numerous gemsbok, two giraffes and have recently discovered two zebra heads. In their opinion, poachers make use of the opportunity created by all the mining activities to hunt in [mining] areas. It is therefore desirable that employees of mining companies should wear an ID document at all times.

In the opinion of Park Managers (M Le Roux, MET, pers. comm., 2013), exploration companies are responsible for the perceived increase in off-road driving as they are the main road users. The quality of rehabilitation in this regard could have a positive impact e.g. at Bannerman and Swakop Uranium.

A related issue, although not listed as part of this indicator, is the perceived increase in road kills, with springbok, black-backed jackal and even Cape fox being killed on access road/s. The MET also perceives an increase in littering (and ascribes this mostly to truck drivers), but illegal camping does not appear to be a problem. Illegal collecting of species and artefacts is difficult to monitor and to catch trespassers on the spot, so it is not possible to evaluate.

Overall the MET park management is of the opinion that road users don’t adhere to speed limits, with especially truck drivers driving too fast for these roads. Road traffic on permit-access roads has also definitely increased, mostly because of increased usage by trucks.

Nevertheless, it needs to be noted that this assessment relies on opinions given by MET officials, and no proof that exploration and/or mining companies are responsible for the transgressions was provided. Since it is clear that the mining and exploration companies are committed to be responsible Park residents, it is advisable that the MET and mining companies enter into more frequent communication, perhaps in the form of a regular forum, where most of these issues can be resolved. The MET suggested that this could start with the direct Park heads to meet quarterly with mine representatives to reinforce communication and best practices (e.g. what to do when mines are aware of possible poaching at night; what are best actions to take (M Le Roux, MET, pers.

comm., 2013)). However, this would also depend on the MET providing data on all incidents that they consider to be mining-related to allow the companies to respond appropriately.

Motivation of status: The measures put in place by mining companies are in the opinion of the MET not effective at decreasing the incidence of illicit activities and impacts. However, MET could also not prove that the illicit activities detected were directly related to mining or exploration companies. It is concluded that this indicator is 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.**			
Status:	**NOT MET**			

Improved vigilance is not possible, because capacity of wardens remains a problem, as does a shortage in human resources with only one warden at Ganab. Wardens are often transferred to more popular stations as per demand by visitors´ numbers during high season. A related issue is actions undertaken by MET to improve capacity through training. In this regard they report that they have attended EIA and other workshops organized by NACOMA.

NACOMA has received 9 applications for Honorary Wardens, and these are currently being submitted to the MET. There has been no reaction by the MET on the topic of Honorary Wardens since 2006 when the concept was initiated. NERMU also queried the MET on their resources and regulation process in terms of law enforcement. In this regard, the MET reports that their resource base has effectively shrunk over the last 5 year budget cycle and that there have been no new regulations, patrolling patterns, permits and fines implemented to enhance law enforcement in general (M Le Roux, MET, pers. comm., 2013). One positive development is that new park regulations have been approved, but are now waiting to be gazetted. These regulations make provision, inter alia, for a 100% increase in fines for transgressions of park rules.

Some general comments by MET (M Le Roux, MET, pers. comm., 2013):

- Mines should get actively involved with Parks in general. For instance, Swakop Uranium donated a 2-way radio to assist with law enforcement. Similar small donations and targeted help may have a major positive impact.
- Road kills could be drastically decreased by organizing information (training) sessions for truck drivers and others.
- Park Management suspect impacts on wildlife due to drilling, e.g. impacts of drilling machinery on foxes and earth wolves (Ganab has currently the highest population of earth wolves in the world). These issues should be studied further and solutions sought.
- Lack of communication between mining companies and the MET seems to be a persistent problem (see also Indicator 8.4.1.1). A specific example is:
    - Park Management's perception is that Langer Heinrich Mine has destroyed numerous plants in the Gawib River valley, including camel thorn trees and succulents. They have not been informed whether these actions were done with permission or guidance from the NBRI.

Motivation of status: Because there was still not much progress in the appointment of Honorary Wardens, the MET's capacity has not increased coincident with the increased activities in the Park and there are evidently a number of perceived problems from the perspective of the MET, this indicator has to be considered as NOT 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
Status:	**IN PROGRESS**

Indicator 8.5.1.1 has been revised to make the task clearer and more manageable by specifying monitoring of indicator species.

There are no formal initiatives by the MET or other regulatory bodies to monitor the health of riverine ecosystems. NERMU's mandate includes the monitoring of impacts on biodiversity by mining, but these monitoring programmes are still being developed. One clear focus is on the riverine systems for which progress includes fieldwork for pilot and comprehensive baseline studies, data capturing and data quality control. Data analysis is underway and a progress report, including preliminary results, has been appended to the current report (**Error! Reference source not found.**).

Motivation of status: Because regular monitoring is not yet being conducted, but there is progress in the development of such a monitoring programme for at least two of the ephemeral rivers, the indicator is considered to be 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.**
Status:	**IN PROGRESS**

Progress with this indicator depends on the development of an established monitoring programme (which is in progress) and some follow-up surveys.

Issues to resolve: It was never made clear who should be responsible for a monitoring programme. At the moment NERMU is designing and implementing a baseline study and will take the lead in designing the monitoring programme on that basis. However, there is not yet a mechanism in place to sustainably fund such a programme over the period that is required. In addition, the MET should ideally play a large role in this programme, and this issue needs to be raised with them as soon as possible.

Motivation of status: Because the process of developing a regular Monitoring Programme is still in progress, this indicator's status is considered to be the same. The indicator is therefore IN PROGRESS.

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**
Status:	**IN PROGRESS**

Mines that abstract water from the rivers do so within the given permits (Langer Heinrich, Rio Tinto Rössing, Swakop Uranium), conduct groundwater monitoring, and report to DWA on a regular basis. No loss of wetland and riparian vegetation has been reported by the mining companies themselves (Uranium Institute, 2013); with at least part of this conclusion being based on a survey by Rössing (more details are presented in **Error! Reference source not found.**). However, preliminary results from an independent survey by NERMU showed significantly higher mortality of Ana trees in the

Langer Heinrich compartment of the Swakop River than in any other compartments or rivers investigated (**Error! Reference source not found.**). With only preliminary analysis completed, it is not yet possible to ascribe this to any particular cause. It could therefore be both the result of abstraction or of lower re-charge because of flood prevention by the Swakoppoort Dam. However, there are also indications that tree health is affected by proximity to production boreholes, with trees closer to the hole being less healthy than those further away. Abstraction could therefore in theory cause losses in riparian vegetation, but more analysis needs to be done and more data collected before confident conclusions can be drawn. NERMU is currently busy collecting more data and doing further analyses.

Motivation of status: Because more data and analysis is needed to confirm preliminary results from a broad survey that trees may be negatively affected by water abstraction, this indicator is rated as IN PROGRESS.

Indicator 8.5.2.2.	**No unusual loss of phreatophytes (deep-rooted plants dependent on water from the saturated zone of groundwater)**			
Status:		**IN PROGRESS**		

No unusual loss of phreatophytes was reported by mining companies (Uranium Institute, 2013). A vegetation survey carried out by Rio Tinto Rössing in the Khan River in March and September 2012 showed that most of the trees at the monitored transects were in a satisfactory condition except for Transects 3, 6 and KEM 16 away from the mine which are in poor condition. The Uranium Institute (2013) report suggests that this confirms a long-observed trend related to the generally low recharge received from runoff in this part of the river, but the evidence for this remains circumstantial. More details are presented in Appendix 3.

Preliminary results from an independent survey carried out by NERMU in the Khan, Swakop and Kuiseb rivers found no unusual mortality patterns of *Acacia erioloba*, the most important phreatophyte in the ephemeral rivers (Appendix 4)

Even though there is a declining trend in the water levels measured in five monitoring boreholes, the water table was relatively shallow (see Figure 6 in EQO 4) and remained well above the documented rooting depths (Schachtschneider, 2010) of *Acacia erioloba*.

Motivation of status: Because groundwater levels are in theory still well within the reach of phreatophytes, and there are no reports of unusual loss of phreatophyte species, this indicator is rated as MET.

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	Summary of performance: EQO 8					
Total no. indicators assessed	**20**					
	NOT MET	**IN PROGRESS**	**MET**	**EXCEEDED**	**NO DATA**	**N/A**
Number of indicators in class	3	10	6	0	0	1
Percentage of indicators in class	15%	50%	30%	0	0	5%

Overall performance in this indicator has improved somewhat. Of 18 indicators, the majority (50%) are IN PROGRESS, down from 11 in the previous report. However, there were slightly fewer that were NOT MET (three compared to four previously) and slightly more (five compared to three previously) that were MET. One indicator in the current assessment was not applicable.

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 SEA states that the expansion of the uranium mining in the Erongo Region is accompanied by a high public expectation that many new jobs will be created, directly and indirectly, that the investment will relieve poverty and reduce inequality, and that new skills will be acquired by Namibians. The Uranium Rush and associated industries and developments are expected to result in a number of impacts and skills in the Erongo Region and nationally.

The Key issues are:

- Increased demand for skilled human resources
- Access to education for school-aged children; and
- Quality of the education

In-migration has placed considerable pressure on schools and the education authorities in the Erongo Region, especially the coastal areas. No other region has experienced such consistent growth in education demand. Thus the quality of education in the region requires monitoring to assure that standards are met and quality education is being given to the learners. This EQO keeps track of the evolution of the education sector in the Erongo region, to ensure that the learners and the industry receive quality products.

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.**
Status:	**NOT MET**

The statistics for this indicator where obtained from the Education Management Information System (EMIS) report of 2012, which at the time of the compilation of this report was not publicly released yet (MoE, 2012).

Motivation of status: The National Survival rate to grade 11 is 41% and the Erongo region is always placed amongst the top three**.** However, in view of the low national survival rate the status of the indicator is considered to be NOT MET.

Indicator 9.1.1.2.	**75% of grade 10 graduates obtain a NSSC.**
Status:	

The Ministry of Education, which is the data source, does not have records for this indicator (D. Nieuwoudt, MoE, pers.comm., 2013). The objective of the indicator is improved quality of education, however obtaining a NSSC does not imply a pass.

Motivation of status: The indicator is currently not measurable until reformulated; therefore the indicator was not assessed.

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.
Status:	NOT MET

For this indicator the national performance of grade 12's and 10's for the year of 2012 is summarized below (Table 23).

The NSSC Ordinary Level National results of the full-time candidates compared to 2011 show that the percentage of graded entries decreased from 93.6% in 2011 to 93.1% in 2012. In summary the full-time candidates performed better at Grades A* and A, with a slightly poorer performance from B to G. In the rank order of the thirteen educational regions on their overall performance in the subjects entered by the full-time candidates Erongo Region ranked first in 2011 and in 2012.

In 2012, 95.4% of all candidates having entered for NSSC Higher Level subjects obtained a grade 4 or better when compared to 96.2% in 2011. A grade 3 or better symbol is required in a NSSC Higher Level subject for entry to Universities. 67.2% of the subject entries in 2012 have met this minimum requirement compared to 68.7% in 2011. The percentage of candidates having obtained a grade 3 and better in 2012 represents a decrease of 1.5% when compared to 2011.

The number of full-time Grade 10 candidates who wrote the Junior Secondary Certificate examinations stood at 33 428. The ministry noted a decrease of 2 212 (6%) candidates compared to the 2011 enrolment figures. Regional rankings show that the Erongo Region is in fourth place

Table 23: National Results for Science, Mathematics, and English for Grade 10 and 12 in 2012 (Grades from A - G). Source: MoE (2012a)

National results for science, mathematics and English subjects	Status
Grade 10	
Mathematics: 44.5% learners obtain a D or better symbol	Not Met
Physical Science: 51.8% learners obtain a D or better symbol	Met
Life Science: 46.8% learners obtain a D or better symbol	Not Met
English as a Second Language: 42.9% learners obtain a D or better symbol	Not Met
Grade 12	
NSSC Ordinary Level of 2012 (Grades from A* - G)	
English as a Second Language: 29.2% learners obtain a D or better symbol	Not Met
Biology: 29.3% learners obtain a D or better symbol	Not Met
Physical Science: 45.3% learners obtain a D or better symbol	Not Met
Mathematics: 41.8% learners obtain a D or better symbol	Not Met
NSSC Higher Level of 2012 (Grades from 1 - 4)	
English as a Second Language: 84.1% learners obtain a 3 or better symbol	Met
Biology: 77.8% learners obtain a 3 or better symbol	Met
Physical Science: 72.8% learners obtain a 3 or better symbol	Met
Mathematics: 77.2% learners obtain a 3 or better symbol	Met

The grade symbol defined as D or better applies to grade 10 (junior secondary certificate) and grade 12 ordinary level examination results, and is regarded here as being equivalent to a grade 3 or better with reference to grade 12 higher level examination results. Percentages for the grade symbol(s) of

the subject groups defined in indicator 3 are expressed as the total number of students who sat for the specific exam. The Table above showcases the percentages in symbols obtained by learners nationally for 2012. Both grades 12 and 10 performed better in English than in the Science subjects.

Motivation of status: Only 5 out of a total of 12 subjects (41.7%) met the indicated requirement and 7 out of a total 12 subjects (58.3%) did not meet the requirement. Therefore the indicator is NOT MET.

Indicator 9.1.1.4.	**Region improves performance in reading and mathematics.**			
Status:			**MET**	

The following data was obtained from the latest SAQMEC III (Southern and Eastern African Consortium for Monitoring Educational Quality) report of September 2007 (Table 24). Even though the study does not cover 2012, it gives a very good baseline and is relevant for this indicator. This report shows a study of the conditions of schooling and the quality of primary education in Namibia. One of the most important and exciting features of the SACMEQ research program has been that the Ministry of Education has been able to scientifically assess trends over time in the reading and mathematics achievement levels of grade 6 learners and also to make valid comparisons of Namibian performance to other education systems in Southern and Eastern Africa.

Reading and mathematics achievement levels of grade 6 learners across the 13 regions of Namibia are presented in the table below for the SACMEQ project II (2000) and the SACMEQ III project (2007).

In the Erongo region the reading score improved from 527.4 in 2000 to 579.5 in 2007 and the score for mathematics increased from 494.3 in 2000 to 523.3 in 2007. This indicates that there was an improvement in the reading and mathematics skills in the region. Between 2000 and 2007 almost all Namibian regions experienced improvements in the average reading and mathematics performances of Grade 6 learners. The only exceptions were Hardap and Khomas regions – which both lost ground especially Hardap in the area of mathematics.

Motivation of status: Using the statistics for the grade 6 learners of the Erongo Region it can be concluded that the indicator is MET.

Table 24: Reading and mathematics test scores of learners and teachers (SACMEQ II and III).

Region	SACMEQ II								SACMEQ III							
	LEARNERS				TEACHERS				LEARNERS				TEACHERS			
	Reading		Mathematics		Reading		Mathematics		Reading		Mathematics		Reading		Mathematics	
	Mean	SE	Mean	SE	Mean	SE	Mean	SE	Mean	SE	Mean	SE	Mean	SE	Mean	SE
Caprivi	417.0	4.68	405.0	4.00	700.3	19.89	680.8	23.43	488.5	15.94	457.9	10.40	738.7	12.87	737.6	16.39
Erongo	**527.4**	**24.18**	**494.3**	**21.22**	**770.8**	**23.80**	**777.0**	**37.11**	**579.5**	**15.01**	**523.3**	**12.19**	**764.8**	**13.92**	**786.6**	**18.04**
Hardap	518.6	20.33	498.9	17.93	811.4	28.45	819.6	30.61	509.4	18.27	483.1	13.24	773.6	23.60	818.8	30.61
Karas	510.3	19.13	482.6	17.92	778.2	22.85	853.6	39.71	548.0	15.76	510.3	14.94	774.5	25.37	799.8	26.37
Kavango	431.3	4.99	418.8	4.97	697.9	12.00	684.5	14.32	481.7	10.14	455.6	7.60	709.1	12.38	750.5	15.09
Khomas	567.1	18.79	530.5	19.06	796.9	17.02	831.2	26.10	574.9	12.54	522.7	11.55	751.3	14.82	760.0	21.42
Kunene	448.0	13.42	445.2	14.30	702.4	21.82	809.1	35.97	501.6	15.77	478.2	13.71	786.3	31.63	760.2	33.15
Ohangwena	416.5	3.66	398.5	2.65	726.1	11.22	718.2	21.46	463.5	5.22	447.8	4.86	744.2	15.57	785.0	14.07
Omaheke	434.2	8.28	426.2	5.14	656.6	53.87	811.8	48.03	494.5	8.98	468.3	6.19	779.0	20.13	818.7	27.84
Omusati	423.7	3.92	409.8	3.82	705.5	10.38	703.0	11.11	462.1	4.65	450.2	3.96	729.3	14.79	768.5	16.58
Oshikoto	428.0	13.39	419.8	13.51	728.3	12.91	703.4	20.33	471.1	10.48	457.2	9.27	744.3	11.58	771.7	18.48
Otjozondjupa	468.7	21.39	458.6	17.02	742.3	24.15	789.7	31.17	526.5	9.91	488.6	8.14	731.1	19.78	797.6	23.06
Oshana	429.6	7.63	402.1	6.74	715.0	11.30	704.3	16.17	500.9	10.53	474.8	8.99	704.6	9.62	743.1	19.37
NAMIBIA	**448.8**	**3.13**	**430.9**	**2.94**	**727.9**	**4.70**	**734.8**	**6.66**	**496.9**	**2.99**	**471.0**	**2.51**	**738.6**	**4.78**	**771.1**	**5.87**

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, proposed VTC facility in Walvis Bay and UNAM.**
Status:	**MET**

Data used in the assessment of this indicator originates from annual reports of the University of Namibia (UNAM) and was received from representatives from the Polytechnic of Namibia and NIMT. The assessment is based on the graduation statistics of the tertiary institutions as a whole. The target is MET for this indicator for all 3 institutions represented in the bar graphs below, which is reflecting growth in the number of graduates each year. The number of graduates from NIMT increased from 282 in 2011 to 406 in 2012. Data for UNAM and the Polytechnic will only be available in their 2013 annual report as their graduations are held months after the year of completion. Data from other Vocational Training Centres was not available. There is a proposal to establish a VTC in Walvis Bay, however plans are still underway.

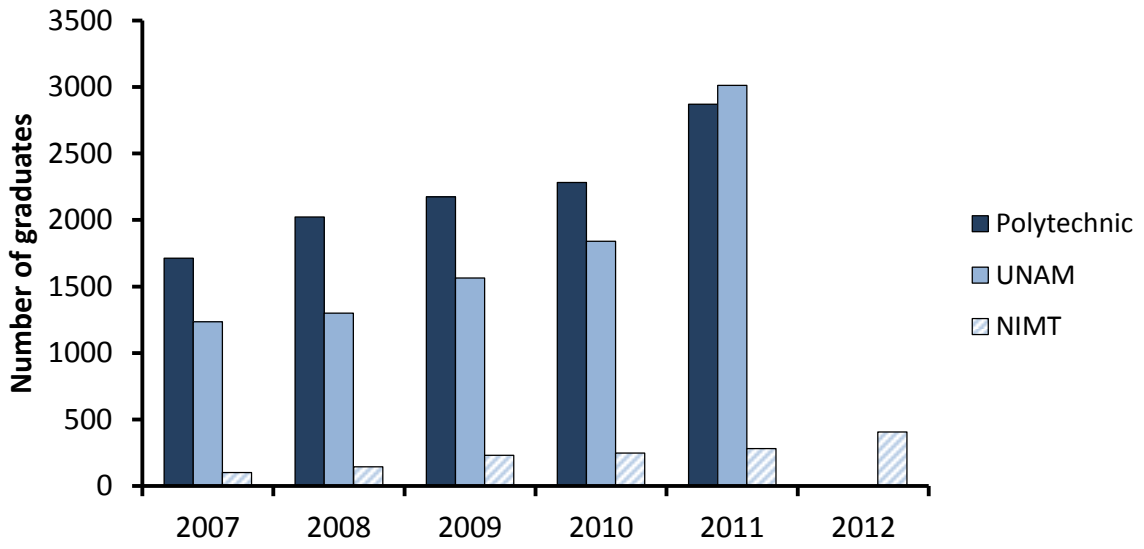

Figure 19. Total number of graduates from NIMT, UNAM and the Polytechnic of Namibia.

Motivation of status: Since there is a clear and consistent increase in the number of graduates in at least three of the four institutions over the last five years, the indicator is rated as MET. However, this should be re-considered for the next report when data for the actual reporting period are available.

Indicator 9.2.1.2.	**Every mine has funds/ a skills development programme for employees (3% of wage cost).**
Status:	**IN PROGRESS**

Indicator 9.2.1.3.	Each mine has 10% more bursary holders than work-permit holders.			
Status:		IN PROGRESS		

Indicators 9.2.1.2 and 9.2.1.3 are related and assessed together based on the data obtained from the annual reports of the Chamber of Mines, the Uranium Institute, and the respective mining and exploration companies. This indicator mainly focuses on mining companies, but data from companies that are in the developing stage are also included.

AREVA Resources Namibia

In addition to the eight bursary holders (who are not AREVA employees) study assistance was provided to five employees as part of their career development (Table 26). The company also assisted 21 employees to complete their Grade 12 exams or better their results at NAMCOL. The company spent 3.4% of its wage bill on training. Support was extended to government schools in the Erongo region as part of the company's social responsibility programme.

Bannerman Resources Namibia

Bannerman Resources implemented a three-year Learner Assistance Scheme in 2011, whereby school clothes are donated to needy learners in the Erongo Region, and the company also paid their school development fund fees. To date 850 less-privileged learners have been assisted across the Erongo region in this way. Bannerman Resources assisted the Erongo Development Foundation to obtain funding from the Australian government to fund the trade tests for seven less-privileged students in the Erongo region at NIMT (Table 26).

Langer Heinrich Uranium

The Langer Heinrich Mine sponsored 41 NIMT apprentices and 5 bursary holders (Table 26). Indirect cost of internal training is not reflected in the above percentage of wage cost for skills development (1.93%). The SEMP report of 2011 reported that Langer Heinrich Uranium provides extensive internal and external training, as part of employees' capacity development. The company also has a management development programme (through the University of Stellenbosch) into which 5 employees (supervisory and middle management) are registered annually.

Reptile Uranium

Reptile has sponsored one student for a M.Sc. in Geophysics (Table 26). There is a Namibian understudy appointed for the one work permit holder. Based on the statistics given in Table 25 the target is IN PROGRESS for Reptile.

Rössing Uranium

Table 26 shows that Rössing Uranium sponsored 88 NIMT apprentices and the mine contributes 3% of wage costs to skill development programmes. Rössing mine also sponsored 29 bursaries for the year 2012. Table 25 below shows the total training cost for Rössing for the year 2012.

Table 25: Training costs for Rössing Mine during 2012, compared to 2011.

Costs and number of Participants in training and development programmes	2011	2012
Total participants: Bursaries, job attachments, apprentices, correspondence programmes, and development programmes etc….	426	246
Training costs (N$)	15,529 707.00	8,110 937.00

Valencia Uranium

As stated in Table 26 Valencia mine spent 0.5% of their annual wage bill on training. A total of N$ 146 248 was utilized on bursaries. Valencia reported having more bursary holders than work-permit holders (M. Krohne, pers. comm., 2013).

Table 26: The contribution of mining companies to training of Namibian students (Uranium Institute, 2013)

Company	Skills development in 2012			
	NIMT apprentices	% of wage cost	Bursary holders	Work permits
AREVA Namibia	4	3.4%	8	14
Bannerman	7	1.0%	3	0
Langer Heinrich	41	1.93%	5	5
Marenica	0	No data	13	0
Reptile Uranium	0	0.44%	1	1
Rio Tinto Rössing	88	3%	29	11
Swakop Uranium	0	2.68%	5	21
Valencia	0	0.5%	4	1
Zhonghe	0	0	0	0

Motivation of status: For Indicator 9.2.1.2, only two of the four mining companies met or exceeded the 3% of wage bill target. It is therefore considered to be IN PROGRESS. In terms of Indicator 9.2.1.3, two of the four companies have met or exceeded the 10% target. It is therefore also considered to be IN PROGRESS.

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Summary of performance: EQO 9					
Total no. indicators assessed	7				
	NOT MET	IN PROGRESS	MET	EXCEEDED	NO DATA
Number of indicators in class	2	2	2	0	1
Percentage of indicators in class	29%	29%	29%	0%	13%

One of the indicators (13%) could not be assessed as it did not answer to the desired outcome and therefore it needs reformulation. The rest of the indicators either MET (29%), are IN PROGRESS (29%) or NOT MET (29%). However, in comparison to 2011, the overall performance for EQO 9 has declined.

EQO 10. Governance

Aims of this EQO: Institutions that are responsible for managing the Uranium Rush 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.

The aim of this EQO is that the institutions administering the Uranium Rush provide good oversight and insure that all parties involved meet the legal requirements of prospecting for and mining uranium. The Ministry of Mines & Energy, the Ministry of Environment and Tourism, and the Uranium Industry together with all other relevant stakeholders continue to work towards improved protection of the beauty of the Namib.

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**			
Status:		**IN PROGRESS**		

Through its Strengthening the Protected Areas Network (SPAN) programme, MET commissioned Fauna and Flora International (FFI), in collaboration with international and local specialists, to undertake a Landscape Level Assessment (LLA) of key biodiversity, vulnerability and land-use within the uranium province in the Central Namib. This includes a landscape assessment of biodiversity in the Erongo region and the identification of biodiversity priority areas in the landscape. The LLA employed a systematic conservation planning approach to develop a decision support tool that identified priority areas for biodiversity and ecosystem services in the Central Namib, based on defensible data and a robust methodology, and will support decision-makers and stakeholders in evaluating the cumulative impacts of mining and other land-uses on biodiversity and ecosystem services.

The LLA produced a series of maps and data sets that will help to better understand the impacts of uranium mining and other developments for the environment and identify where conservation priorities and other land uses may be found within the landscape. The planning tool is complemented by an economic valuation of different land uses and natural assets in terms of direct use values (MET, 2012).

While the current red and yellow flag areas used in the SEA study are being refined, MET has acknowledged their existence and together with MME had a conference on "Mining in Protected areas" to facilitate dialogue between the various stakeholders. MET is also drafting a policy aligned with the Environmental Management Act, which together with the results of the LLA, would ensure that prospecting and mining avoids environmentally high value and sensitive areas.

The designated red and yellow flag areas will have to be redefined now that the study by Fauna and Flora International is completed. MET and MME are currently drafting a policy for mining in protected areas and are considering red and yellow flag areas.

Motivation of status: The outcome of FFI's landscape level assessment will be used to clearly define red flag areas, and a policy for exploration and mining in protected areas is being drafted. The status is therefore IN PROGRESS.

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:	**IN PROGRESS**
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.**
Status:	**IN PROGRESS**

Indicators 10.1.1.2. and 10.1.1.3. are related and are therefore discussed together here. MET and MME are currently drafting a Policy for Exploration and Mining in Protected Areas. Although Husab mine was currently awarded a mining license in a protected area, environmental conditions are attached to their EIA.

Motivation of status: The government is in process of formulating the policy for exploration and mining in protected area. MET provides environmental regulation to exploration and mining projects, however the Environmental Act does not fully accommodate the protection of yellow and red flagged areas. This indicator is therefore IN PROGRESS.

Indicator 10.1.1.4.	**No new power lines, pipelines or roads linked to the 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)**
Status:	**MET**

No new power lines, pipelines or roads where constructed in 2012.

Motivation of status: There was no new infrastructure developed. The indicator is therefore 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 infrastructures.**
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).**
Status:	**MET**

Swakop Uranium has been granted a mining license in a red flag area. Infrastructure to access the mine site will have to go through red and yellow flag areas.

Motivation of status: The indicators in this desired outcome have been given a MET status because the required decision making process has been followed and the mining licence has been awarded to Swakop Uranium with the relevant conditions.

Indicator 10.2.1.2.	**No evidence of corruption in the allocation of mineral licenses.**
Status:	**MET**

A most challenging aspect is the ability to detect if any corruption has occurred during the allocation of mining /exploration licenses, but there were no reports of such a nature.

Motivation of status: Because there have been no reports about corruption, this indicator is considered to be MET.

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 EIA and EMP.s**
Status:	**MET**

The commencement of the Environmental Management Act and its associated regulations which describe the above EIA process were gazetted in February 2012. Prior to this, the uranium industry followed the 1995 Environmental Assessment Policy which includes similar provisions.

During the reporting period, Swakop Uranium's Husab Mine has been granted a mining license in a red flag area. Full EIAs for the Husab Mine and for the associated linear infrastructure have been submitted to MET, and Environmental Clearance Certificates have been awarded for both.

Motivation of status: The status can therefore be considered as MET.

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, MoHSS) inspect active mines at least once per annum, and closed mines at least once every 3 years.**
Status:	**MET**

The Division of Environmental Geology in the Geological Survey of Namibia and the Mines Inspectorate in the Directorate of Mines, both Ministry of Mines and Energy, are mandated to monitor current and abandoned mine sites. Active and abandoned mine site monitoring took place (Table 27), as well as training for stakeholders from various agencies. A manual for the assessment of abandoned mine sites was developed. DWAF's Directorate of Resource Management (DRM) inspects mines for compliance with groundwater abstraction permits and industrial and domestic wastewater discharge permits. They collect water samples for independent analysis. MET requires regular reports on the status of the environment and does spot checks. The MoHSS inspects and licences health-care personnel and facilities at mines, e.g. first-aid stations or clinics. The National Radiation Protection Authority (NRPA) conducts inspections for compliance with the relevant legislation and the mines' radiation management plans. The Ministry of Labour is also involved, particularly in inspecting working conditions.

Table 27: Summary of government inspections of mines in 2012.

Company	Government inspections in 2012
AREVA Namibia	DWAF DRM in May 12 (water samples taken), NRPA in Oct 12 (radiation readings taken), Min Labour inspected Maxi construction area several times
Bannerman	No inspections done – no active mine yet
Langer Heinrich	National Radiation Protection Authority (January and October 2012)
Marenica Energy	None – no active mine yet
Reptile Uranium	All EPLs in current and good standing with relevant authorities. All statutory reports completed and submitted as prescribed. Rehabilitation signed off after inspection by MET and NACOMA personnel, inspections of MET staff to drill sites, regular interaction with NNP park wardens
Rio Tinto Rössing	Most agencies visit the mine once a year which is according to prior arrangements. Some take measurements of certain parameters but the consistency is varying.
Swakop Uranium	MME soil sampling, DWAF groundwater monitoring and regular SU abstraction permit reporting. Exploration EMP biannual audits provided to MET. Radiation Management Plan for exploration reporting
Valencia	None– no active mine yet
Zhonghe	Yes

Motivation of status: Because active inspection is taking place, the indicator is considered to be MET.

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.**
Status:	**IN PROGRESS**

NACOMA has received 9 applications for Honorary Wardens, and these have been submitted to the MET. However, there has been no reaction by MET on the topic of Honorary Wardens since 2006 when the concept was initiated.

Motivation of status: Because applications for Honorary Wardens have been submitted to MET, this indicator is considered to be IN PROGRESS

Indicator 10.3.1.3.	**Honorary conservators and MET take accurate and consistent measurements of key indicators.**

As decided in the Meeting of the Steering Committee in April 2013, this indicator will no longer be assessed because it is not possible to evaluate it at present.

Indicator 10.3.1.4.	**International agencies regularly inspect mines and provide independent opinion on their performance**
Status:	**MET**

In 1983 Namibia became a member state of the International Atomic Energy Agency (IAEA), and thus committed itself to mandatory inspections. The IAEA carries out different types of on-site inspections and visits under comprehensive safeguards agreements and at 4 years intervals. The activities performed by IAEA inspectors during and in connection with on-site inspections or visits at facilities may include auditing the facility´s accounting and operating records and comparing these records with the State´s accounting reports for the agency; verifying the nuclear material inventory

and inventory changes; taking environmental samples; and applying containment and surveillance measures (e.g., seal application, installation of surveillance equipment) (IAEA Safeguards, 2012).

Motivation of status: Because IAEA carries out regular inspections; this indicator is considered to be MET.

Indicator 10.3.1.5.	**Results of monitoring improve practice and are disclosed to the public through existing channels and in an annual SEMP report, or more regularly.**			
Status:			**MET**	

Currently, the only existing channels for mining companies to disclose results of monitoring are their annual reports, their different EIA reports, public participation meetings, the Annual and Quarterly reports of the Chamber of Mines, and the annual SEMP Report. With the exception of the SEMP Report, the different reporting channels are not designed to specifically report on the various monitoring aspects. However, the annual SEMP Report covers all these aspects and is freely available.

Motivation of status: Because the annual SEMP Reports are freely available to the public, the indicator is considered to be MET.

Indicator 10.3.1.6.	**Where appropriate, the public are able to participate in physical monitoring.**

As decided in the Meeting of the Steering Committee held in April 2013, this indicator will no longer be assessed because it is impractical.

Indicator 10.3.1.7.	**Through existing channels and /or the SEMP office, the public can report observations of illegal activities or unwanted impacts.**

As decided in the Meeting of the Steering Committee held in April 2013, this indicator will no longer be assessed because it is impractical.

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**	
Indicator 10.4.1.3.	**Fines are issued for non-compliance.**			
Status:			**MET**	

Indicators 10.4.1.1., 10.4.1.2., and 10.4.1.3., are related and therefore discussed together here. No unauthorised negative impacts occurred during the reporting period (H. Itamba, MME, pers.comm., 2013).

Motivation of status: Because no unauthorised impacts have occurred in the reporting period, the indicators are all considered to be MET.

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

The issues of non-compliance if they do occur are dealt with by the Ministry of Mines and Energy and the Ministry of Environment and Tourism.

- Annual License Fees: A number of companies do not comply with annual fee payments. Once this is detected at the Mining Commissioner's office, the company or companies are required to pay a penalty. It is calculated at one-third of one percent per day of delay on the outstanding fee.
- Technical Expertise and Training: EPL renewals are put on hold unless companies submit proof of employment of expertise and training, preference to be given to Namibians in terms of Section 50 (b) & (c) of the Minerals Act, No. 33 of 1992.
- Environmental Issues (Environmental Management Plan (EMP), Environmental Contract (EC), and Environmental & Social Impact Assessment Report (ESIA): All exploration companies are required to submit EMPs for approval before activities commence; once approved they are issued with an EC. All mining companies are required to submit ESIA for approval before activities commence, once approved they are issued with an EC. All the uranium exploration companies have complied.

All companies do comply with health and safety requirements. No non-compliance has been reported to the Mining Commissioner for the 2012 period.

Motivation of status: Non-compliance with license requirements has been reported, and the indicator is therefore MET.

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Summary of performance: EQO 10

Total no. indicators assessed	15				
	NOT MET	**IN PROGRESS**	**MET**	**EXCEEDED**	**NO DATA**
Number of indicators in class	0	4	11	0	0
Percentage of indicators in class	0%	27%	73%	0%	0%

73% (11) of the indicators are MET while 27% (4) are still IN PROGRESS. The governance EQO has a significant improved performance relating to 2011.

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 palaeontological heritage resources.**
- **Survey, assessment and mitigation will result in significant advances in knowledge of archaeological and palaeontological heritage resources, so that their conservation status is improved and their use in research, education and tourism is placed on a secure and sustainable footing.**

The Erongo Region has an archaeological record spanning more than one million years, including evidences of significant human evolutionary and technological advances, as well as specific adaptations to extreme aridity and environmental uncertainty. This forms the material basis of knowledge about the occupation of the Namib during the Pleistocene and Holocene periods. Some of the archeological sites are obvious to any observer, such as rock art or historical mines; however others are quite ambiguous and might appear less significant than they are, such as pre-colonial stone features; and yet others, such as surface scatters of stone artefacts are virtually invisible to the untrained eye. This means that it is very difficult for mining projects to avoid damage to archaeological heritage sites if they have not been located, identified and made known to company personnel. Consequently, it has become an increasingly regular practice to carry out archaeological surveys and assessments of mining areas at the earliest possible stage of exploration and during mine expansion.

The Chamber of Mines of Namibia has establish a Uranium Stewardship Committee (USC) This was done with due regards to the rapidly growing uranium industry in the country in response to the world's demand for uranium in the generation of clean energy. Almost all uranium mines and exploration companies are members. The USC is the representative body which both articulates the national and global interest associated with Namibian uranium exploration, mining and export, as well as advocating the industry's views to government and the community.

Desired Outcome 11.1.	**Namib 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 for 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).**
Status:	**MET**

Google News and other relevant media were the primary sources of data. This service has its flaws but covers hundreds of national and international news sources. The websites of the IAEA and World Nuclear News (the reporting arm of the World Nuclear Association) were also searched. The sources conducted had no negative information on Namibia's uranium. It is therefore clear that that the positive image and good reputation for the mining industry and the government.

Motivation of status: On the international level, no negative information related to this indicator was found. Based on this, the indicator is considered MET.

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.**
Status:	**MET**

Mining and exploration operations function within the framework of the laws and regulations of Namibia. These laws define the procedures needed to be followed by the operations. Under the reporting year, the regulatory authorities (e.g MME, MET) did not encounter any environmentally, socially or financial irresponsibility's conducted by the uranium industry.

Motivation for Status: The Uranium Mines and exploration companies are truly compatible with the concept of sustainability; no irresponsible conduct has been witnessed during the 2012 period. The indicator is therefore considered MET.

Desired Outcome 11.2.	**The integrity of archaeological and palaeontological heritage resources is not unduly compromised by the U-rush.**
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 palaeontological assessment** **No unauthorised impact occurs**
Status:	**IN PROGRESS**

Both the EIA report for the Husab Amendment and the Zhonghe Project EIA (although this was published in 2011, it was not previously available) have included archaeological assessments; however they are rather poor when it comes to palaeontology.

Motivation of status: Because all EIAs conducted in the reporting period included archaeological assessments, but lacked palaeontology, the indicator is IN PROGRESS.

Indicator 11.2.1.2.	**Mining companies adhere to local and international standards of archaeological assessment.**			
Status:			**MET**	

The NHC also published a policy document entitled "POLICIES AND GUIDELINES OF ARCHAEOLOGICAL RESEARCH IN NAMIBIA" in 2012. This document includes comprehensive guidelines for how archaeological studies should be conducted, and this will include specialist studies for EIAs in mining. Mining companies are largely adhering to such standards and best practice (A Nankela, NHC, pers. comm., 2012).

Motivation of status: Based on evidence from NHC, the indicator is considered to be MET.

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.**			
Status:			**MET**	

Active research is taking place by Dr John Kinahan of Quaternary Research Services (J Kinahan, QRS, pers. comm., 2013) and Alma Nankela of the NHC (A Nankela, NHC, pers. comm., 2012), as well as by Dr Ted Marks of the University of Iowa (T Marks, University of Iowa, pers. comm., 2013).

Motivation of status: Because active research has been taking place, the indicator is considered to be MET.

Indicator 11.3.1.2.	**Working model of Namib Desert developed.**			
Status:		**IN PROGRESS**		
Indicator 11.3.1.3.	**Model providing information to guide decision making about development in the Namib desert.**			
Status:		**IN PROGRESS**		
Indicator 11.3.1.4.	**Development of diachronic models to determine the effects of climatic and other environmental changes.**			
Status:		**IN PROGRESS**		

Indicators 11.3.1.2., 11.3.1.3. and 11.3.1.4 are related and therefore discussed together here. At the time of the previous report, Dr Kinahan reported that his ongoing work will lead to the development of a diachronic model to determine the effects of climatic and other environmental changes (J Kinahan, QRS, pers. comm., 2012).

Motivation of status: Since the models have not yet been developed, but the work is still IN PROGRESS, the status of all three indicators is IN PROGRESS.

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Summary of performance: EQO 11					
Total no. indicators assessed	8				
	NOT MET	**IN PROGRESS**	**MET**	**EXCEEDED**	**NO DATA**
Number of indicators in class	0	4	4	0	0
Percentage of indicators in class	0%	50%	50%	0%	0%
50% of the indicators are MET and the other half is IN PROGRESS.					

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.

This EQO aims to maximize the sustainable contribution that mines can make to society and the region post mining. Furthermore the Namibian Mine Closure Framework that was finalized by the Chamber of Mines of Namibia (CoM) in May 2010 has the primary purpose 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 members of the CoM bound by the Chamber's Code of Conduct and Ethics (COC) (CoM, 2010). Thus at the end of mine life, companies and the government are well prepared and have the necessary resources to carry out the mine closure plan; ensuring that the negative social, economic and biophysical impacts of mine closure 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.**
Status:	**MET**

While legislation on mine closure is not yet in place in Namibia, most companies are guided by the Namibian Mine Closure Framework which was developed in accordance with the IAEA guidelines. Most mines do not have written government approval for their closure plans because there are no regulations that specify the competent authority and approval process. Conceptual closure plans form part of the EIA/EMP and are thus approved by MET when a clearance is issued. Relevant aspects of the closure plan for each mine are summarised in Table 28.

The AREVA Resources Namibia closure plan updated in 2012 contains expert input and stakeholders will be consulted once the mine is in operation. Site-specific risks, opportunities and threats were considered, but alternative scenarios and cumulative issues have not yet been assessed. Socioeconomic opportunities for nearby communities are provided during the operation of the mine and the exit strategy aims to leave them in a sustainable condition before the mine closes. The next

update of the plan will be presented to government to obtain written approval of the objectives, indicators and implementation targets.

The Bannerman Resources mine closure planning has been done at a high level at this stage. It was done with input from consultants and items such as ongoing groundwater monitoring, fencing and berming of excavations, covering of the leached or residue pad have all been taken into consideration. Once approval to develop the mine is obtained, a more detailed closure plan will be developed

The Marenica project has not yet progressed to the point where a closure plan will be required. Rehabilitation measures for exploration sites are included in the Environmental Management Plan.

Rössing's feasibility study was done in the early 1970s when closure planning was not considered in mine development; otherwise the company complies with most of the requirements (Uranium Institute, 2013).

The Valencia closure plan within the EIA/EMP was approved as part of the Environmental Clearance granted in 2008. The closure plan itself will be reviewed following detailed design and commencement of construction to ensure that the plan is more relevant at the start of operations.

Motivation of status: Given the fact that all the mines have closure plans that have been approved at some stage by the MET (thus most likely meeting the requirements of Namibian regulations and policies), and that the closure plans all follow the Namibian Mince Closure Framework, the indicator is considered to be MET.

Table 28: Closure plan compliance per mine.

Closure plan requirements:	AREVA	Bannerman	LHM	Reptile	Rössing	Swakop U	Valencia
Planning process started at feasibility study stage	Yes	Yes	Yes	Yes, on-going	No, done in 1970s	Yes, financial aspects considered	Yes
Was based on expert and stakeholders input	Experts only	Experts only	Yes	Yes, on-going	Yes	Not yet	Yes
Considers site risks, opportunities, threats, and cumulative issues	Yes, except for cumulative	Yes, except for cumulative	Yes	Yes on-going	Yes	Not yet	Yes
Socioeconomic opportunities for communities and workforce	Yes	Yes	Yes	Yes on-going	Yes	Not yet	Yes
Demolition, rehabilitation and post closure monitoring, maintenance	Yes	Yes	Yes	No not yet	Yes	Yes	Yes
Contains accepted and agreed objectives, indicators and targets	No	No	Yes	Yes on-going	No	Some	No
Subjected to internal and external review	Yes	Yes	Yes	No, not yet	Yes	Not yet	Yes
Written GRN approval	No	No	No	No	No	No	Yes*
Consistent with IAEA guidelines	Yes	Yes	Yes	Yes on-going	Yes	?	Yes
Namibian regulations and policies*	N/A	N/A	N/A	Yes on-going	Yes	N/A	N/A
Namibian Mine Closure Framework	Yes	Yes	Yes	No not yet	Yes	Used as a guide	Yes

*Valencia refers to MET's clearance issued for their EIA and EMP

**Most companies understood this to refer to new closure-specific legislation that is not yet in place, therefore N/A

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 break-down, 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.**
Status:	**MET**

Indicators 12.2.1.1 and 12.2.1.2 are related and are therefore discussed together. Financial surety provisions per mine are summarised in

Table 29. Exploration companies are not required to have complete financing for the closure of their planned mine developments. AREVA Resources Namibia has included adequate financial resources in its budget. The establishment of an independent fund depends on new mining legislation and requirements of the regulator. The annual closure cost estimates were audited by Deloitte & Touche and confirmed to be in compliance with financial reporting standards. All mining companies (not exploration companies) have included closure costs into their closure plans and financial sureties are available for all.

Bannerman Resources' closure costs have not yet been estimated, but the risk assessments do take into account the social aspects and post-closure monitoring and maintenance.

Swakop Uranium has committed in its EMP to the development and regular review of mine closure plans (Uranium Institute, 2013).

Table 29: Mine closure financing per mine (Source UI).

Closure financing	AREVA	Banner man	LHM	Reptile	Rössing	Swakop Uranium	Valencia
Includes employee costs	Yes	N/A	Yes	N/A	Yes	No	Yes
Social aspects, exit strategy	Yes	N/A	Yes	N/A	Yes	No	Yes
Demolition and rehabilitation costs	Yes	N/A	Yes	N/A	Yes	Yes	Yes
Post-closure monitoring and maintenance	Yes	N/A	Yes	N/A	Yes	Yes	Yes

Closure financing	AREVA	Banner man	LHM	Reptile	Rössing	Swakop Uranium	Valencia
Project management	Yes	N/A	Yes	N/A	Yes	No	Yes
Closure cost estimations contained in the plan	Yes	N/A	Yes	N/A	Yes	Yes	Yes
Financial sureties are available	Yes	N/A	Yes	N/A	Yes	Not yet	Yes

Motivation of status: Because all mining companies (not exploration companies) have included closure costs into their closure plans and financial sureties are available for all except Swakop Uranium (which is still in construction phase), both these indicators are MET.

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.**
Status:	**IN PROGRESS**

The government is in the process of updating the relevant legislation in order to establish adequate regulations applicable to mine closure. The mining industry needs closure regulations that are adequate to govern 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 (Uranium Institute, 2013).

Motivation of status: Because current legislation is being updated to establish adequate regulations, this indicator is considered to be IN PROGRESS.

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Summary of performance: EQO 12

Total no. indicators assessed	4				
	NOT MET	IN PROGRESS	MET	EXCEEDED	NO DATA
Number of indicators in class	0	1	3	0	0
Percentage of indicators in class	0%	25%	75%	0%	0%

75% of the indicators are MET while the remaining 25% are IN PROGRESS. The performance for this EQO is the same as it was in 2011.

LIMITATIONS AND CONSTRAINTS

General Comments

There are a number of limitations and constraints that have become apparent during the compilation and writing of this report such as:

- Problems with interpretation of indicators, mainly relating to ambiguities in how indicators have been defined.
- Obtaining reliable, complete and referenced data.
- Vague responses.
- Some responses from the data sources did generally provide good information however not always answering or not wholly answering to the indicator(s)

Below are suggestions that arise from some EQOs:

EQO 3:

- As suggested in the 2011 SEMP report, reporting on Indicators 3.6.1.2 and 3.6.1.3 is postponed until the appropriate legislation is promulgated. The D1984 gravel road between Walvis Bay and Swakopmund east of the dunes has changed to MR44 (Roads Authority, 2013)
- Satellite tracking shows the whereabouts of mine vehicles and is used to ensure that no unauthorised trips are undertaken. Unfortunately, most contractors' vehicles are not equipped with the tracking devices. It is therefore being recommended that mining companies should consider making this a contract condition.
- Difficulties encountered were due to lack of information from Municipalities such as Swakopmund, Henties Bay, and Arandis as well as from NAMPORT, NAMPOWER and Roads Authority.

EQO 4:

- There is a lack of commitment by DWA in terms of compilation of the Water EQO. The DWA contribution was the major limitation encountered in putting together the EQO, as it comprised of one sentence only, and did not answer to questions regarding radionuclides, and bacteriological determinants as per indicator 4.1.1.1. Similarly there was also no narrative on the water quantities within the Swakop and Khan Rivers.

EQO 5:

- There is a need for the SEMP steering committee to adopt internationally recognised standards in the cases were Namibia has not yet developed standards, this will encourage consistent and similar reporting by all stakeholders in future.
- The SEMP Steering Committee should initiate and support research studies and scientific papers on data interpretations to support various EQOs of the SEMP including the Air Quality and Radiation EQOs.

EQO 6:

- Indicator 6.1.1.1.: There is Discrepancy between target and indicator, which should ask whether the public dose is exceeding the target value and therefore it should read “Public dose assessment produced by each mine must not exceed 1 mSv /a above background”
- Indicator 6.1.2.1: The indicator should read “Measured change in absorbed radiation dose of uranium mine workers and medical professionals (designated radiation workers) must not exceed 50 mSv/a provided that the average dose over five years does not exceed 20 mSv/a.”
- It is very likely that changes in the following indicators 6.2.1.1, 6.2.2.1 and 6.2.3.1 will not be noticeable every year. What we are measuring is highly tied with national plans with 2020 as the target year; but progress usually takes time. It is however suggested that these indicators will only be assess every five years.

EQO 7:

- The Tourism EQO needs an additional indicator that will assess whether uranium mining projects are doing visual rehabilitation of surface scars. This will be decided in the next steering committee meeting.

EQO 8:

- No suggestions

EQO 9:

- Indicator 9.1.1.2 has no data, its status could therefore not be determined. It was stated by MoE that there are no statistics that supported the indicator as there was no way of correctly calculating it, and the number would therefore be non-representative of the real situation. It is recommended that the indicator should therefore be to measure the number of students who are able to obtain the minimum of 25 points in 5 subjects in both higher and ordinary level. This is the minimum requirement for entry at UNAM. The statistics can then be used to assess the number of grade 12 learners that can qualify for tertiary education in Namibia.

EQO 10:

- The most challenging aspect is the ability to detect if any corruption has occurred during the allocation of mining /exploration licenses, but there were no reports of such.

DISCUSSION

The SEMP operational table for 2012 consists of 125 indicators, 46 targets and 38 desired outcomes, distributed amongst 12 Environmental Quality objectives (EQOs). The results are however short of 3 indicators. Indicator 10.3.1.3: Honorary conservators and MET take accurate and consistent measurements of key indicators, indicator 10.3.1.6: Where appropriate, the public are able to participate in physical monitoring and, indicator 10.3.1.7: Through existing channels and /or the SEMP office, the public can report observations of illegal activities or unwanted impacts where deleted from the plan as they are unpractical to measure.

The EQO's performances of 2011 seem better than the 2012 (Table 30 and Figure 20). However, some of the indicators where under-assessed in annual report of 2011. Like the SEA for the central Namib Uranium Province, the 2011 SEMP annual report was the first Environmental Management Plan ever taken on. Thus, performances where unintentionally overlooked. In the 2012 annual SEMP compilation, assessments are improved. As a result, it has affected the ideal trend of an improving sustainable development. Nevertheless, the declined performances do therefore not imply low performance of the uranium industry, but rather better assessment techniques.

In the year under review, the uranium province has not significantly reduced the visual attractiveness of the Central Namib. A questionnaire study was conducted and tourists' expectations are still 'met or exceeded' regarding their visual experience in the Central Namib, therefore constituting the 1% of the indicator that is exceeded (Table 30 and Figure 20). The same performance was achieved in 2011 report (Table 30). 46 percent of the total indicators are MET, with the 100% MET attained in EQO 1(Socio-Economic Development) and EQO 2 (Employment) (Table 30 and Figure 20). In addition, the Governance (EQO10), Mine closure and future land use (EQ12) and Effect on Tourism (EQO7), Heritage and the future (EQO11) are amongst the best EQO performers (Figure 20). They are then followed by the Infrastructure (EQO3), Water (EQO4) and the Effect on Tourism EQO (EQO7) (Figure 20).

The performance of indicators that are in-progress has reduced from 33% in 2011 to 30% in 2012 (Table 30). Although the reduction signals a positive shift of less IN PROGRESS and more of the MET indicators, the 2011 assessment found that most of the indicators that where rated as IN PROGRESS in 2011, actually did not have sufficient data to be full assessed. Hence they were regarded as no data, constituting 8% (Figure 20).

Other indicators that are IN PROGRESS are related to the ecological integrity of the central Namib. Although the uranium industry live by stringent rules of operating in an environmental sensitive area, the Ministry of Environment and Tourism (MET) has observe incidences of off-road driving, speeding and animals killed on the road which they suspect is associated with the industry. However, there is no proof that these are causes of the uranium mining industry. It is advisable that MET and mining companies enter into more frequent communications, perhaps in the form of a regular forum to reinforce best practices.

Sixteen percent of the indicators are NOT MET, they are distributed between the Education (EQO9), Ecological Integrity (EQO8), Infrastructure (EQO3) , Water (EQO4), with the Health (EQO6), and the Air quality and radiation (EQO5) making up most of it (Figure 20).

As Namibia does not have regulations on environmental monitoring of waste sites, none of the sites in Erongo Region conducts effluent, soil and dust sampling; nor do they have audits. Therefore Indicator 3.5.1.2 and 3.7.1.4 are NOT MET. Indicators 5.1.1.2, 5.1.1.3 and 5.3.1.1. that are NOT MET under EQO 5 are a result of insufficient resources within the responsible regulatory authorities. The SEMP dust monitoring network was discontinued due to financial difficulties. On the other hand NRPA has committed to conduct continuous dust fallout monitoring and radon monitoring. However

the monitoring was not conducted during the reporting period. Hence, the 50% of the indicators under the Health EQO (6.2.1.1, 6.2.2.1 and 6.2.3.1) where rated as NOT MET.

Indicator 9.1.1.1 and 9.1.1.3 will be reformulated as they currently do no serve the desired outcome of the education EQO.

Table 30: Status performance for 2012

Status (%)	*NOT MET*	*IN PROGRESS*	*MET*	*EXCEEDED*
2012	*21 (16%)*	*37 (30%)*	*57 (46%)*	*1 (1%)*
2011	*14 (11%)*	*44 (33%)*	*64 (51%)*	*1 (1%)*

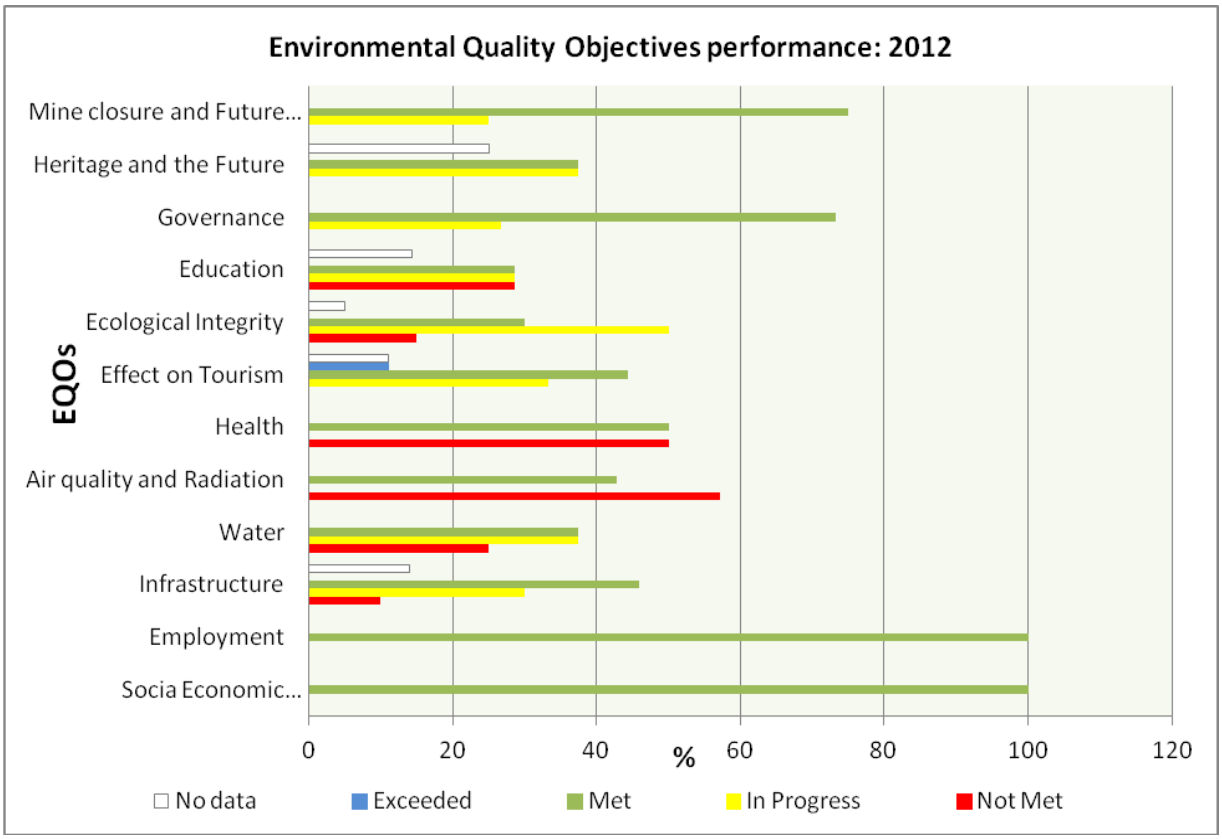

Figure 20: Environmental Quality Objective Performance for 2012

Individual EQOs are discussed below.

EQO 1. Socio-Economic Development

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

All of the Indicators under the Socio-Economic Development EQO have been MET. The uranium mines operating in the Erongo region are paying royalties and corporate taxes to state coffers. These companies, including the exploration projects, continue to source goods and services locally wherever possible. Bannerman, Reptile and Langer Heinrich Mine are good examples of companies promoting import substitution for goods and services required in the uranium production and exploration process. No EPZ status has been granted to a potential project in 2012

EQO 2. Employment

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

All mining companies with more than 25 employees have been awarded their Affirmative Action certificates for 2012. The indicator is fully MET.

EQO 3. Infrastructure

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

The Infrastructure EQO is made of 8 desired outcomes and 8 targets measured by 34 indicators. Half (50%) of these indicators are met due to the reasons that none of the mines plan to have on-site accommodation; the B2 road is free of potholes and all roads have markings. Additionally, the mining companies highly respect the tourist roads. The only mine that uses the rail for good transportation, fully utilises this service. Electricity is available for the mining companies and the public. Waste sites are managed, their volumes are kept and they do comply with all regulators. Ten indicators (29.4 %) are IN PROGRESS. Although most of the gravel roads are in good condition, not all are upgraded timeously. The D1984 road is not yet tarred, however there are plans that also include reducing heavy traffic from light weight traffic roads. Most mines and exploration companies have considered renewable energy, however it is not economical sustainable. Other indicators that are IN PROGRESS include the insufficient waste site budgets and minimal recycling within the region. As there are no audits and monitoring of air and water effluents for waste sites, these two (5.9 %) indicators are rated as NOT MET. Five indicators (14.7 %) did not have data to be assessed. The overall performance has slightly decreased compared to 2011

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.

The water EQO is made-up of 8 Indicators, of which all were assessed in the year under review. 50% (4) of the indicators were MET. Besides by farmers, water in the Swakop and Khan is not used by the majority of the communities due to its salinity. Moreover, the mining industry is now moving to the usage of desalinated water. In case of a disaster, NamWater has management plans. 38% (3)

indicators were assessed as in-progress, this includes the borehole level fluctuation that the mining industry considers to be within norms. However, DWA has done no monitoring to confirm the levels. There are ongoing negotiations for a second desalination plant, which will provide the mining industry and the public with water.

One indicator (13%) was not assessed as there is no data from DWA to confirm if the water abstraction is within sustainable yields. The performance of this EQO has declined in comparison to 2011.

EQO 5. Air quality and radiation

Aims of this EQO: Workers and the public do not suffer significant increased health risks as a result of radiation exposure from the Uranium Rush.

The EQO performance has improved during the 2012 reporting year compared to the previous year, because of the improved results from research projects and successful installation of the Radon and Radon progeny equipments at the three major coastal towns. However, there has been an observed lack of support by crucial stakeholders such as the National Radiation Regulator (NRPA). It was necessary to change some indicators to accept available data sets such as meteorological data from any station in the region. There was also a need to change the indicators to accept results from available technology in Namibia, such as to determine the gross and alpha radiation of the dust and PM10 by swipe counter instead of Neutron Activation Analysis (NAA).

- Since the discontinuation of the SEA/SEMP dust fallout network, no dust monitoring data is available, except at Arandis, where one point is monitored by AREVA Resources and reported to be lower than the SANS residential limit. The SANS limits are 600 mg/m²/day as permissible for residential areas.
- Dust fallout at the mining and exploration sites falls well within the SANS industrial limit of 600 mg/m^2/day, except at the Langer Heinrich Mine site, where the SANS industrial limit of 600 mg/m^2/day was exceeded more than three times and in sequential months. Langer Heinrich Mine thus needed to initiate major measures on dust suppression methods to reduce the dust fallout. The very low dust fallout at AREVA mining area is related to the fact that no mining activities were carried out at the AREVA mine site during 2012.
- Ambient radon concentration is higher at Arandis and lower at Swakopmund (100 Bq/M^3) with the estimated exposure due to Radon being 3 mSv (Arandis), 0.8 mSv (Walvis Bay) and 0.5 mSv (Swakopmund). There has been a elevated Rradon concentration at Arandis in August 2011 and December 2012, as well at the other towns, but at different times. The cause of the elevation and trend is not clear, however the scientific research proposed by Ignatius Shaduka (Geological Survey of Namibia) and Michael Schubert (UFZ Leipzig, Germany) and entitled "Large Scale / Long Term Monitoring of the Dissemination of Radon and its Short-Lived Progeny from a Major Uranium Mining Area" will attempt to study the trends and suggest possible causes.
- The PM10 concentrations were low, and below WHO AQG IT-3 standard (75 µg/m³) in Arandis during 2012, while Swakopmund records moderate to high PM10 concentrations with few measurements exceeding the WHO AQG IT-3 standard (75 µg/m³) during the period of August – November 2011.
- At present, these PM10 concentrations and dust fallout cannot be pinned to a particular source, thus it is fair to assume that the recorded concentrations are due to different sources such as mining and all associated activities, as well as vehicle movement on paved and unpaved roads. Although a fingerprinting attempt was made by Shaduka (2012), no feasible results were achieved due to lack of funds.

EQO 6. Health

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

50% (4) of the indicators could not be assessed as there is no data. These concerns mostly the state of the health facilities and health personnel in the Erongo Region, as well as the incidence rate of diseases attributed to uranium mining in the public. The other 50 % of the indicators are MET, there was no road accident attributed to uranium mining and the cumulative dose and the public doses where all below the legal limits. Two cases of dermatitis where recorded in 2012. Nonetheless they are not directly attributed to uranium mining.

Although it seems that the performance of the health indicators has declined from 100% MET in the SEMP Report of 2011, but this is not the case. The 2011 health indicators assessment concentrated merely on the direct employees of the uranium industry. However, the desired outcome for the health sector was supposed to be assessed on a region that has cumulative impacts as a result of the uranium industry. It must be noted that the health benefits in associated industries are not necessarily as good as the ones for direct mine employees.

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 the Uranium Rush; and to identify ways of avoiding conflicts between the tourism industry and prospecting/mining, so that both industries can coexist in the Central Namib.**
- **The Uranium Rush 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.**

In the previous report (GSN, 2012), three (just over a third) of the indicators were NOT MET, while three were MET, one was EXCEEDED and two IN PROGRESS. Since then the situation has improved somewhat, with none NOT MET, six being MET and only one IN PROGRESS. One indicator remained EXCEEDED, but one more had to be rated as No data because of a poor response by tour operators to a questionnaire distributed by NERMU.

The slow development of the National Policy on Prospecting and Mining in Protected Areas (NPPMPA), one of the important tools for managing impacts to specifically scenic and attractive areas, by the Ministry of Environment and Tourism has been a source for concern, because without this guidance it remains difficult to manage the different land uses inside the protected areas. Lack of such policy causes uncertainty and no doubt also decreases the attractiveness of the central Namib for tourism investors. This has been alleviated somewhat by recent progress in the finalisation of this policy, albeit outside the reporting period.

Part of the improvement in this EQO is due to changes in the formulation of the indicators. However, although four of the indicators have been redefined, the status of only one has been affected by the wording itself. Indicator 7.1.1.2 is now MET (changed from NOT MET) because the requirement of a specialist report has been removed from the indicator. However, the change reflects what can be expected on the ground (public access is never assessed in a specialist study by itself) and now represents a fairer assessment of environmental performance. Another important change between the two periods is that the previous report contained a large number of EIAs in its database that were assessed; in the current reporting period only three EIAs were assessed, vastly increasing the chances of better performance.

The results of the tourism survey were both disappointing (because of the low sample size of tour operators that could be reached in the time available) and very interesting. Although the questionnaire was significantly revised from the previous study, the key question (for both tourism operators and tourists) remained essentially the same and led to broadly comparable results, suggesting that the mining activities are not yet affecting key aspects of the attractiveness of the region, at least from the perspective of the tourists. A larger sample size for tourists this time allowed a more critical analysis of the key question, showing that Namibian-based tourists experience the central Namib similarly to the full sample of tourists, but tend to be slightly less satisfied than those of the full sample. This is exactly the kind of trend and differences in trends that will become both important and interesting after more surveys.

Regardless of the changes in formulation of indicators and the numbers of studies assessed, we believe that these results are an accurate reflection of performance by the mining industry (and associated stakeholders) in controlling and mitigating their impacts on tourism. Overall, the performance in this EQO appears to be acceptable, although the critical policy initiatives reflected in Indicator 7.2.1.1 require urgent attention.

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 the Uranium Rush. 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.

EQO 8 gained two indicators, bringing the total to 20. Three of the indicators relate to policy environment, with a key one here – the issue of red, yellow and green flag areas – still being IN PROGRESS. Although disappointing, this is not surprising because it requires a number of other components to be in place (e.g. the NPPMPA, which is still being finalised) and regulatory initiatives at national level. It is unlikely that this will be rated as MET soon, but because the far-reaching nature of this aspect, it is very important that all stakeholders maintain momentum in the development of all aspects of this initiative.

Overall, the indicators related to the efficiency of the EA process (8.1.1.4 – 7) are showing positive results, probably reflecting the effective implementation of the Environmental Management Act of 2007 and its Regulations. An important indicator that was NOT MET is the issue of sharing of infrastructure corridors. This is disappointing, but it probably reflects the fact that this is a cross-cutting, regional-scale impact, and is thus difficult for the current EA process to assimilate. In addition, mining companies experience difficulty in making decisions that will have negative financial implications and no real regulatory guidance. It is unlikely that this will change significantly in the future. The need to stick to existing infrastructure corridors is evident from many perspectives and doing this will have many positive outcomes, but it clearly requires stronger commitment by the industry and stronger regulation by the government.

There is ample opportunity for improvement in the extent to which the industry supports conservation initiatives and overall aims for a no net loss of biodiversity, but overall it appears that their commitment to the management processes related to conservation (and in general their commitment to conservation of biodiversity as a principle) is good in spite of a general lack of policy guidance. Seven of the indicators relate to the industry's management response to potential impacts – how they mitigate and monitor their impacts. Only one of these indicators was MET, while most

remain IN PROGRESS and one was NOT MET. The latter relates to how the MET perceives the commitment and actions of mining companies in managing their impacts on the national protected areas. The same issue is however viewed differently by the mining companies, suggesting that there is a communication gap that needs to be filled. It is therefore suggested that a forum should be established to facilitate better communication between the mining industry and MET (Parks).

Finally, MET needs to be better resourced, because it appears to be struggling to maintain vigilance and law enforcement, and thus both to understand the extent of impacts better, and to control them better. The reasons for this are many, but an important aspect seems to be a lack of adequate human resources, in which regard it is becoming critical to move forward on the issue of Honorary Wardens. The MET also recognizes that better communication with the industry will relieve a lot of pressure on them, and (better directed) support from the industry for specific developments could have a major positive impact.

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.

Indicator 9.1.1.2 had no data and its status could therefore not be determined. It was stated by MoE that there are no statistics that supported the indicator, as there was no way of correctly calculating it, and the result would therefore be non-representative of the real situation. It is therefore recommended that the indicator should be excluded or amended for future SEMP reports. In case of an amendment it is proposed that the indicator should measure the number of students who are able to obtain the minimum of 25 points in 5 subjects, which is the UNAM minimum entry requirement. These statistics can then be used to assess the number of grade 12 learners that can qualify for tertiary education in Namibia.

EQO 10. Governance

Aims of this EQO: Institutions that are responsible for managing the Uranium Rush 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.

73% of the indicators are MET while 27% are still IN PROGRESS. Most of the indicators in this EQO are MET, the indicators that are still IN PROGRESS are mostly related to the red and yellow flag areas that are not all yet legally approved and the honorary conservators who are not yet appointed. The governance EQO has a significant improved performance compared to 2011.

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 palaeontological heritage resources.

- **Survey, assessment and mitigation will result in significant advances in knowledge of archaeological and palaeontological heritage resources, so that their conservation status is improved and their use in research, education and tourism is placed on a secure and sustainable footing.**

The uranium mines and exploration companies in the central Namib remain truly compatible with the concept of sustainability; no irresponsible conduct has been witnessed during the 2012 period. The archaeological model for the region remains outstanding.

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.

All uranium mining companies have approved closure plans which include their cost estimates and financial sureties, resulting in 75% of the indicators being MET. Although there is a regulatory closure framework, it is still being updated so that it will properly regulate the mining industry. The indicator is hence rated as IN PROGRESS (25% of the indicators). The overall performance for this EQO is the same as for 2011.

CONCLUSIONS

This publication marks the second time an annual report for the Strategic Environmental Management Plan (SEMP) is presented. Once again, the SEMP report has provided clear indications of which indicators are MET, NOT MET, or even EXCEEDED, and those IN PROGRESS. As recommended during the establishment of the SEMP, the assessment results and recommendations from the 2012 Strategic Environmental Management Plan annual report will hopefully be used to guide mining, related industrial developments, and the government, so that the natural, social, economic and physical environments of the central Namib are never compromised.

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Appendix 1: Tourism Survey

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APPENDIX 1 TO SEMP REPORT FOR 2012: TOURISM SURVEY	
RESULTS AREA	Monitoring of indicators related to EQO 7 and EQO 8
Project	**SEMP 2012: Perceptions of tourists and tourism operators on developments associated with uranium mining and exploration**
Research Permit no.	NA
Duration of project	1 July 2013 to 31 March 2014
Date of report	3 March 2014
Principal Investigator/s	Dr Theo Wassenaar
Collaborator/s	Assistance by Sugnet Smith, Angi Storbeck, Thorsten Machauer
Financial support	Gobabeb (NERMU)
Logistical support	Gobabeb (NERMU)
Degree purposes	NA

Introduction

Guidance on how sustainability principles can be mainstreamed throughout the life cycle of mining activities and projects is provided through the Uranium SEA's Strategic Environmental Management Plan (SEMP). The SEMP is an over-arching framework and roadmap for addressing the cumulative impacts of a suite of existing and potential developments.

NERMU at Gobabeb has been identified as the responsible agency in the monitoring of a number of indicators falling into three of the Environmental Quality Objectives (EQOs) (Wassenaar 2011). One of these is EQO 7: Effect on Tourism.

This is the second report by NERMU on the SEMP tourism theme and gives an overview of a survey of the tourists and tourism operators based at the coast regarding their perceptions of the activities and developments around uranium mining and exploration. The surveys were specifically designed to answer indicators 7.2.1.1 and 7.2.1.2, and provide some context for the interpretation of the results. Copies of both questionnaires (one for the tourists themselves and one for the operators) are available as Appendices to the main SEMP Report.

Background and objectives

Two of the desired outcomes of EQO7 are:

1. That the natural beauty of the desert and its sense of place are not compromised unduly by the Uranium Rush; and to identify ways of avoiding conflicts between the tourism industry and prospecting/mining, so that both industries can coexist in the central Namib.
2. The Uranium Rush 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. Tourists' expectations are 'met or exceeded' more than 80% of the time in terms of their visual experience in the central Namib.

The targets set to meet these aims are (1) that Uranium Rush does not result in a net loss of publicly accessible areas, and (2) that the direct and indirect visual scarring from the Uranium Rush is avoided or kept within acceptable limits (SEMP). The first target is gauged through studying EIAs of projects already under way or being undertaken now. The second target, in particular, is a critical aspect for the tourism industry and is the one that is being monitored through polling tourists and tour operators respectively to gauge their experiences and perceived value of tourism products.

The SEMP is not a once-off effort; monitoring will carry on for a number of years. The first report (NERMU 2012) was implemented as a pilot survey and as such targeted a very small number of respondents (20 tourists and 12 operators). The pilot allowed us to introduce the long-term objectives to particularly the tourism operators but also to streamline the questionnaire and methods. The current report is therefore essentially laying the foundation for future monitoring, although a number of provisos need to be evaluated together with the results reported here.

The current report is a summary of:

1. The answers of tourism operators to a question posed to assess 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'
2. The answers of tourism operators to a number of ancillary questions designed to provide context for their answer to 1;
3. The answers of tourists to a question posed to assess 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'';
4. The answers of tourists to a number of ancillary questions designed to provide context for their answer to 3

Methods

Refining the questionnaire: The original questionnaire was based on a draft questionnaire developed by a student from the University of Freiburg. Mary Seely (Gobabeb/DRFN), Mary Hikumuah (MME/GSN), Mark Gardiner and Michelle Pfaffenthaler (FFI) provided inputs into the pilot questionnaire and Theo Wassenaar and Steph Fennessy subsequently refined it. The main changes between the pilot and the final versions were a drastic reduction in the number of ancillary questions and a reduction in the number of choices in some of the multiple choice questions (see Appendix 2 to the main SEMP Report for copies of both questionnaires). The final tourist questionnaire consisted of 30 (down from 91) questions in six main topics, and the final operators questionnaire of 23 questions (down from 50) in four main topics. Questions were two-way (yes/no), scaled (1-5; low-high) and open-ended where the respondent could reflect his/her own thoughts. Open-ended questions were

kept to the minimum however, as structured questions were deemed more objective, thus more suited for monitoring purposes.

A great deal of effort was put into defining contextual questions. These are the questions that establish the background of the respondent. We deemed this to be necessary because the answers to the question of whether their expectations were being MET or EXCEEDED can be influenced by numerous variables such as their country of origin, their previous experience of the Namib and of mining. This ancillary information permits a more intelligent analysis.

Distribution of questionnaires: The questionnaire was printed and copies distributed to tour operators in Swakopmund between October and December 2013, with a few more done in January and February 2014. Although the main objective was to engage the tour operators to distribute questionnaires to their clients, in practice one of us (Sugnet Smit), with permission from the operators, approached tourists as they completed their tours. Tour operators on a list provided by the Coastal Tourism Association of Namibia were approached directly by us with a request to participate both by allowing us to ask their guests to complete a questionnaire, and by doing so themselves. Some tourists were also approached at the Namib I information centre.

Analysis of results: In total 55 questionnaires were answered by tourists, but only five were completed by operators themselves. Although the target number of respondents was 100 tourists and 40 operators, this proved to be beyond our available resources to obtain. The data were entered into the computer and qualitatively analysed. The raw data and analysis are available upon request. In the current report we only summarise some of the variables and discuss their relative implications. It was again not possible to analyse and interpret the results within their appropriate context; that will require a much larger number of responses.

Results

TOURISTS

Questionnaire response rates

All of the 55 tourist questionnaires were completed (100 %).

Respondent profiles

All respondents were in Swakopmund when the survey was conducted. The greatest proportion (49 %) of respondents were resident in Namibia, 31% in Germany, 5% in South Africa and the rest (all < 4%) from a number of European countries and Australia (Figure 1). Of the foreign respondents, 42 % (n=12) have visited Namibia before. The age of respondents ranged from 22 to 78 years with a mean of 41 years. Except for a wider spread of ages, the respondent profile is very similar to the previous study, but the countries of present residence differed markedly, with Namibians dominant this time (Figure 1; NERMU 2012).

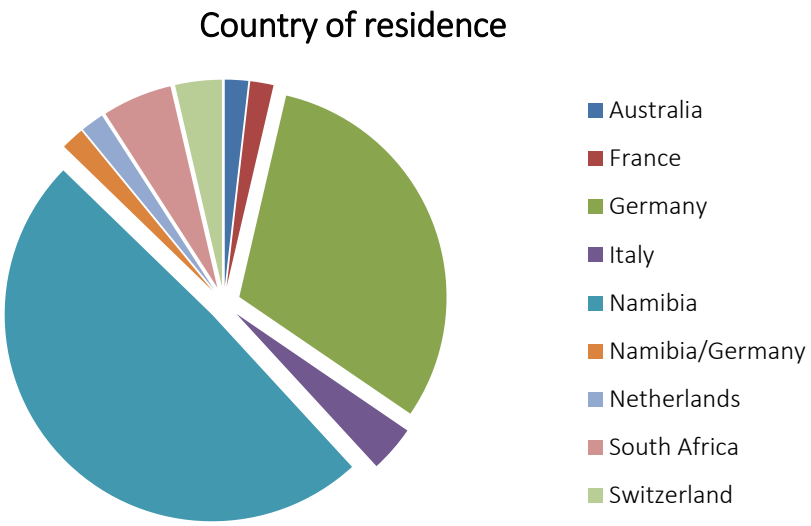

Figure 1. The composition of respondents in terms of the country of residence.

Different from the previous study, female respondents comprised the largest proportion at 58%. As before, the majority (64 %) of respondents received education at a tertiary level, with most of the rest (35%) educated to secondary school level and 1% with a Technical Diploma.

Of the foreign visitors, about 42% have visited Namibia before, of which about 55% have been to the central Namib before. Thirty six percent of the respondents spent between 10 and 20 days on their Namibian tour and 32% between 20 and 30 days, with a median of 10.5 days across all of those who answered the question. Only nine of the foreign visitors indicated their previous visits, and of those, for just over a third each this was their first (38%) or third (38%) trip.

Of the Namibian residents, most (37%) visit the central Namib three times per year, 33% come only once, 16% more than three times and 11% come twice. For most of the Namibian respondents (54%) the current trip was their first and only so far, with 8% having been here once before and 4% twice before. Nineteen percent of those answering this question have been here every year since 2000.

Interests and quality of experience of tourists with regard to the Central Namib

Judging on the percentage of respondents giving "Nature" the highest score, most tourists came to the Namib to experience the natural environment (a fairly broad category that probably includes biodiversity and scenic values) (Table 2). Perhaps more importantly, none of the respondents scored this aspect in the two lowest categories. "Adventure tourism" and "Culture" both received a median score of 4, but a larger percentage of respondents scored these aspects as being of low interest (Table 2). Although the category "Other" also received a large number of high scores, only 14 respondents scored this (Table 2).

Table 2: Responses of tourists asked to estimate their interest in different aspects of the Central Namib on a 5 point scale (1=lowest, 5=highest). Values are the percentage of the number of respondents that scored a particular aspect. Note that many respondents left open a few questions on each questionnaire – hence the total across all scores do not necessarily reflect the total received.

Topic	Percentage of scores in category					Median	Number of scores given
	Lowest 1	2	3	4	Highest 5		
Nature	0	0	11	18	71	5	55

Adventure tourism	8	9	26	36	26	4	53
Culture	6	17	22	30	26	4	54
Other	0	7	21	21	50	4.5	14

The scoring categories for the question about whether expectations of their experience were MET or NOT MET (the key one for answering Indicator 7.2.1.2 in the SEMP) have changed from the previous study, making a direct comparison difficult. However, the scenic qualities of the central Namib still mostly MET or EXCEEDED the expectations of the respondents, with all but four of them giving no scores below 3 and providing a median score of 4.5 (Table 3). The category "Nature" (which here was probably understood similarly to "fauna and flora") also MET or EXCEEDED their expectations, with all but two respondents giving no scores below 3 and with an overall median score of 4.5 (Table 3). At a median score of 4.2 and with only two scores below 3, "Sense of place" still mostly MET or EXCEEDED the expectations of tourists, but "Adventure tourism" and "Culture" fared worse with median scores of only 3.9 and 3.4 and a larger percentage of low scores (Table 3). In general, the Namibian residents' experiences matched those of the whole sample, but Namibians tended to score their experiences slightly lower in all categories (Table 3).

Table 3: Responses of all (Namibian and foreign) respondents, with Namibian residents' answers in brackets when asked to estimate the extent to which their expectations of the central Namib experience were MET or NOT MET on a 5 point scale (1=did not meet expectations, 5=exceeded expectations). The highest percentage in each category is underlined. Note that many respondents left open a few questions on each questionnaire – hence the total across all scores do not necessarily reflect the total received.

Topic	Percentage of scores in category					Median	Number of scores given
	Did not meet 1	2	3	4	Exceeded 5		
Scenic quality	0 (0)	4 (8)	9 (19)	20 (15)	67 (58)	4.5	54 (26)
Sense of place	0	2 (4)	24 (30)	25 (22)	49 (44)	4.2	51 (27)
Nature	0	2 (4)	15 (30)	16 (22)	67 (44)	4.5	55 (27)
Adventure tourism	0	10 (11)	27 (30)	29 (15)	35 (44)	3.9	52 (27)
Culture	4 (8)	17 (32)	29 (44)	33 (12)	17 (4)	3.4	48 (25)
Other	0	0	45 (80)	0	55 (20)	4.1	11 (5)

Only 24% of respondents reported experiencing problems in accessing all the attractions they planned/wanted to visit, but only 12 provided reasons for this. Of these only two (both Namibian residents) blamed the restricted access on mining. When asked whether they encountered any developments that increased the attractiveness of the region, only 35% answered yes, with reasons ranging from better roads or infrastructure development to, inexplicably, "biodiversity". In contrast, when asked whether they encountered developments that decreased the attractiveness of the region, only 45% answered yes, with the reasons overwhelmingly (13 of 24 reasons given) related to mining. Of these, only two were foreign-based tourists and 11 where Namibian based. A range of positive changes between their previous and current visits were identified, with most being related to infrastructure or the development of a desalination plant. Negative changes were again overwhelmingly given as mining-related.

Tourist perceptions and experience of mining

Eighty seven percent of respondents were aware that uranium mining was occurring, and most of these (73%) were aware of this even before they arrived. Although 47% supported Namibia's drive to establish a uranium mining industry, a surprisingly large percentage (22%) was against it, and 27% were uncertain (4% considered this question not applicable). Thirty four percent said that their tour operator did not inform them of the extent and impacts of mining, 30% said they did and the rest did not consider the question applicable. The largest number of respondents (41%) thought that the overall impacts of mining will be negative (only 21% said it will be positive and the rest did not know), with most of these identifying the loss of scenic landscapes and pollution of groundwater as the culprits (24% each), followed by loss of ecological integrity (20%) and air pollution (13%). Social problems and loss of sense of place were not considered important. About a third of the respondents have actually visited a mine before. Only 3 respondents thought that mining was an activity that should be allowed in a national park, while 15 thought that agriculture would be acceptable, 41 thought that tourism was an acceptable land use and none considered any other industries to be acceptable.

OPERATORS

Questionnaire response rates

Due to time limits and constraints on human resources, only five respondents were polled. Because of the small sample size, the answers that they provide cannot be seen as representative of the tourism industry as a whole, but we provide a summary here below.

Respondent profiles

Three of the respondents were based in Swakopmund, one in Walvis Bay and one in Henties Bay. Most take out day visitors or do bus tours, two provide accommodation and two provide food. Other activities listed were bicycle tours, Topnaar cultural tours, quad bikes and "information centre". Three have been operators for more than ten years, one between five and ten years, and one between one and five years. Only two answered the question of whether the central Namib was their core area of operations, and both said yes. Only three answered the question about the size of their visitor groups, with two saying these were more than ten and one hosting between one and five visitors. Three of four answering said that their businesses have increased over the last five years, and one said it had decreased.

Assessment of the central Namib as a viable base for the tourism business

Only three rated the different attractions for the extent to which they form part of their packages. The outcomes of this question are provided in Table 4. Some of the answers that stand out are 1) the Welwitschia Plains are not highly rated as a destination, but the Swakop and/or Khan Rivers, the coastline, Spitzkoppe and the Moon Landscape are.

Table 4: Responses of three (of five polled) tour operators to the request to rate the extent to which different attractions form part of their tour packages on a 5 point scale (1=not used at all, 5=highly significant component, always go there).

Topic	Respondent ratings					Median
	respondent 1	respondent 2	respondent 3	respondent 4	respondent 5	
Swakop and/or Khan River(s)	-	3	5	5	-	5

Topic	Respondent ratings					Median
	respondent 1	respondent 2	respondent 3	respondent 4	respondent 5	
The giant Welwitschia	-	5	3	4	-	4
The Welwitschia flats	-	3	3	2	-	3
The coastline	-	5	4	5	-	5
Coastal dunes	-	4	3	5	-	4
Spitzkoppe	-	5	2	5	-	5
The moon landscape	-	5	3	5	-	5
Other	-	Bird Paradise, Goanikontes	-	-	-	-

Only three respondents answered the question of whether they enjoyed free access to the attractions, and all three said yes. Two (of three answering) said they have not encountered developments increasing the attractiveness of the region, but one (of two answering) said he/she encountered developments that decreased the visual attractiveness of the region (it was ascribed to off-road tracks made by tourists).

Operator perceptions and experience of mining

None (of three answering) took their guests to the Uranium Institute and three (of four answering) take their guests to the Namib i. None (of four answering) includes uranium mines as part of their tour package, but one plans to do this in the future and two (of three answering) do discuss uranium mining with their guests. Three (of three answering) support Namibia's drive to establish a uranium mining industry.

Final comments (by three respondents) include a concern about radiation, a lack of permission to access mining areas, and an unequivocal statement that "Unless there is a major disaster there is really no issue we have with the mining industry".

Conclusions, challenges and future directives

TOURISTS

In terms of the statistical validity of the results, the current study, with 55 respondents, is a huge improvement on the previous one. In spite of the fact that we did not apply any more sophisticated statistics than tallying responses and evaluating percentages of classes, it is clearly better to have as large a sample size as possible. Interestingly however, in spite of a fundamentally different respondent profile with the majority this time being Namibian-based, the general patterns remained fairly similar to the previous study. As before, most tourists come to the central Namib for its natural properties, but the pattern of answers is perhaps most important in terms of the response to the key question about the quality of their tourism experience. Similar to the previous study, tourists' expectations were overwhelmingly MET or EXCEEDED, tellingly so in those categories that relate to the scenic value of the place ("scenic quality", "sense of place" and "nature"). Whether the metric as it is used here is sensitive enough to pick up changes over time remains to be seen but from the similarity to the previous study it does appear to be fairly robust.

Interestingly, although their current experiences are still overwhelmingly positive (and a surprisingly large proportion were aware of the uranium mining even before they arrived), more than 40% thought that the overall impact of mines will be negative, and about a quarter of them expect this to be due to a loss of scenic quality. This may point to a simple fact of human nature – we always expect

the worst, even if current conditions point to the opposite – but it may also be that the current developments are not yet visible enough to have an effect. This particular aspect should be followed closely in the future.

The value of the descriptor and context questions can be seen in the slight dichotomy of answers when the Namibian-resident tourists' answers are analysed separately: they consistently viewed their experience in a slightly more negative way and were more inclined to point to the mines as the reason for a decrease in the attractiveness of the region. This dichotomy was to be expected – foreign tourists have not experienced the same amount of change that the locals have, and change is generally viewed as negative – but it does point to a potentially important aspect of the image of uranium mining in Namibia in the minds of an important audience.

Based on this result, there should be more pressure on the industry to improve their dialogue with Namibian-based tourists (often lumped into the general category of "the public", but probably significantly different from the general public in most respects) and to be more transparent and pro-active in their dealings with them. An important statistic in this regard: about a third of the tourists said that their hosts (i.e. the operators) had not informed them about the extent and impacts of mining. Although the mining industry has clearly done quite a lot to involve operators, this result means that more should be done, not simply to swing the perception of the tourists, but to ensure that they are provided with a balanced perspective.

OPERATORS

Because of the very low sample size (only five operators were interviewed and almost none of the questions were answered by all of them), we do not want to draw any conclusions regarding patterns in the results.

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Appendix 2: Questionnaires

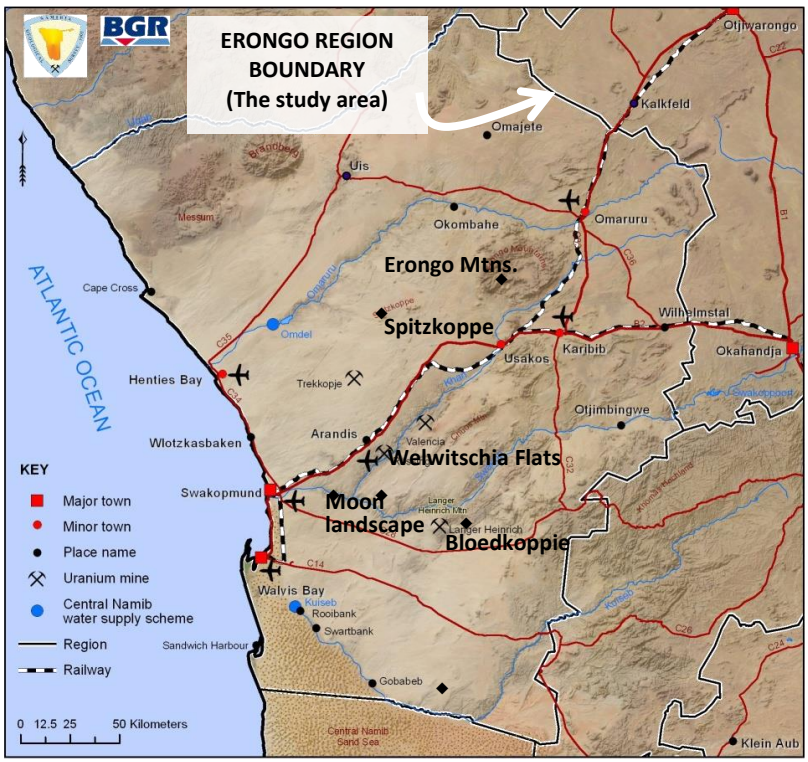
Ministry of Mines and Energy

STRATEGIC ENVIRONMENTAL MANAGEMENT PLAN FOR THE CENTRAL NAMIB URANIUM PROVINCE

Mining for various minerals has been ongoing in the central Namib since 1901, and the first uranium mine was commissioned in 1976. The relatively low intensity of mining and exploration changed recently when a predicted world-wide scarcity in nuclear fuels resulted in a sudden scramble for uranium exploration licences and unprecedented growth in the uranium mining industry. Over the last half decade or so, one uranium mine has been commissioned (bringing the current total to two), one more is in an advanced stage of construction and at least one more has recently received environmental clearance, and will likely begin construction by 2013.

This "mining rush" is of course a vital part of Namibia's economic growth prospects, but could also potentially result in harm to the central Namib's environment. The Ministry of Mines and Energy commissioned a Strategic Environmental Assessment (SEA) to ensure that the utilisation of our mineral resources is not accompanied by environmental degradation. The SEA's primary tool to implement the principles of sustainable utilisation is the Strategic Environmental Management Plan (the SEMP), in which 12 so-called "Environmental Quality Objectives" (EQOs) were defined. Each EQO deals with a different theme, e.g. air, water, infrastructure, biodiversity and tourism. Within each theme a number of desired outcomes, specific environmental management targets and indicators for monitoring were identified.

This questionnaire is related to the monitoring of mining impacts on tourism (EQO 7), which is a crucially important aspect because a large part of the economy in the central Namib has always depended on tourists visiting the area for its various attractions. These qualities could easily be lost without careful management. It is thus crucial that we understand and monitor how the developments around uranium mining affect the scenic values, the quality of the tourist experience, the perception of biodiversity integrity and the size and health of the tourism industry. The questions you will be answering in this questionnaire will help us to gauge the size of the impacts and to monitor it over time. The questions were designed to capture anonymous information about the respondent (yourself), and to then assess your perceptions and experiences as a specific type of tour operator. Finally, we would like to get your opinion on how to improve things.



both ourselves and future generations! Find out more about the SEA and the SEMP, and become informed about the Namib environment, by visiting www.uraniumsemp-namibia.org, the Uranium Institute or *Namib i* in Swakopmund.

<u>This is the way that the indicators that we are monitoring are defined in the SEMP:</u>

STRATEGIC ENVIRONMENTAL MANAGEMENT PLAN FOR THE CENTRAL NAMIB URANIUM PROVINCE
Environmental Quality Objective 7: Effect on Tourism
Aims of this EQO:

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

Desired outcome 2: *The Uranium Rush does not significantly reduce the visual attractiveness of the Central Namib.*
Target: *Direct and indirect visual scarring from the Uranium Rush is avoided or kept within acceptable limits.*
Indicator[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.*

Gobabeb Research and Training Centre: Namib Ecological Restoration and Monitoring Unit
Geological Survey of Namibia
Bundesanstalt für Geowissenschaften und Rohstoffe (BGR) (Federal Institute for Geosciences and Natural Resources)

[1] *Indicator 1 relates to the impact on tourists' perceptions*

TOUR OPERATORS QUESTIONNAIRE 2012-2013

Although we may be contacting you personally, the information you will be asked to provide will be entered anonymously. All such information will be treated as confidential and will not be provided to third parties. Kindly complete the questionnaire below. If a specific question is not applicable, please tick the "na" box.

Where are you based?		Date:	

1. <u>About the type, size and locality of your business</u>. This will help us to put your answers in the proper context.							
1.1 Select the type/s of tourism service that best describes your business:							
Guiding day visitors	Bus tours	Guided safaris	Adventure	Accommodation	Food	na	
Other (list):							

1.2 For how long have you been operating as a tourism service provider?	<1yr	1-5yr	5-10yrs	>10yrs
1.3 Is the central Namib the core area of your operation?	YES		NO	
1.4 What is the typical number of guests that you host per day or per activity?	1	1-5	5-10	>10
1.5 Over the <u>previous</u> five years has the size of your business …	Increased	Decreased	Remained stable	na
1.6 Do you predict that the size of your business over the <u>next</u> five years will …	Increase	Decrease	Remain stable	na
1.7 Why is that?				na

2. <u>Your assessment of the central Namib as a viable base for your business in the past and future:</u> This will help us to gauge and then monitor the impacts of mining on the tourism sector in the central Namib.													
2.1 Rate the extent to which the following attractions form a part of the tour packages that you offer (1=not used at all, 5=highly significant component, always go there)													
Swakop and/or Khan River(s)	1	2	3	4	5	na	Spitzkoppe	1	2	3	4	5	na
The giant Welwitschia	1	2	3	4	5	na	The moon landscape	1	2	3	4	5	na
The coastline	1	2	3	4	5	na	The Welwitschia flats	1	2	3	4	5	na
Coastal dunes	1	2	3	4	5	na		1	2	3	4	5	na
Other (list):								1	2	3	4	5	na

2.2 Are you enjoying free access to all these attractions?	YES	NO	
2.3 If no, why are/were they off-limits?			na
2.4 Have you encountered any developments that <u>increased</u> the visual attractiveness of the region?	YES	NO	
2.5 If yes, which ones?			na
2.6 Have you encountered any developments that <u>decreased</u> the visual attractiveness of the region?	YES	NO	
2.7 If yes, which ones?			na
2.8 Which changes (if any) in the central Namib are positive?			na
2.9 Which changes (if any) in the central Namib are negative?			na

3.	**<u>Your thoughts on and experiences of mining</u>: Here we want to find out what your position is on mining, and what your knowledge and experience of mining is. This will help us to gauge and then monitor the impacts of mining on the tourism sector.**				
3.1	Do you take your guests to the Uranium Institute?	YES	NO	MAYBE	na
3.2	Do you take your guests to the Namib ***i*** information centre?	YES	NO	MAYBE	na
3.3	Do you currently use any uranium mines as part of a tour package?	YES	NO	MAYBE	na
3.4	Do you talk to your guests about uranium mining in Namibia?	YES	NO	MAYBE	na
3.5	Do you foresee that uranium mines will be a part of a tour package that you offer in the future?	YES	NO	MAYBE	na
3.6	Knowing that Namibia is a developing country, do you support its drive to establish a uranium mining industry?	YES	NO	MAYBE	na

4.	**<u>Some final thoughts</u>:**
Do you have any general comments regarding your experience in the Namib as a tourism operator, especially with reference to the mining industry and your perceptions of it?	
Are you interested in receiving information about uranium mining, biodiversity protection, and environmental management in the Namib? If yes, kindly provide your e-mail address[2]:	

THANK YOU!

The SEMP team thanks you for your participation in this study, and for your contribution in ensuring that the Namib's resources are utilised in an environmentally responsible manner! Remember to regularly visit the Uranium Institute in Swakopmund for updates on the uranium mining industry in the central Namib and how its environmental impacts are being managed.

Please contact Theo Wassenaar (theo.wassenaar@gobabeb.org) for more information.

[2] *By providing your address, you agree to receive regular updates from us. All contact information will be used solely for sending newsletters and/or updates on the SEMP. E-mail addresses are considered confidential and will not be shared with third parties.*

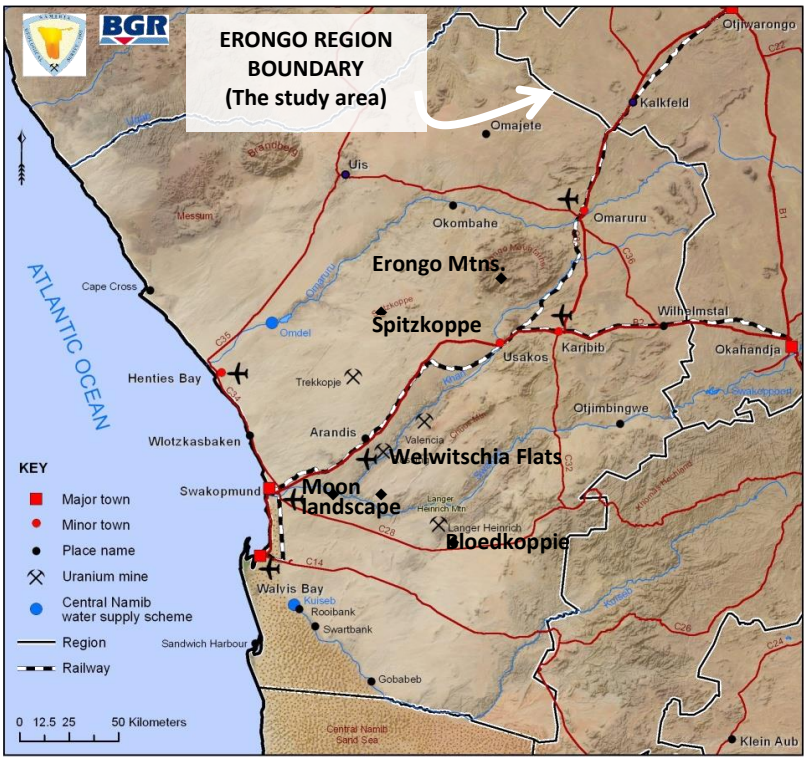
Ministry of Mines and Energy

STRATEGIC ENVIRONMENTAL MANAGEMENT PLAN FOR THE CENTRAL NAMIB URANIUM PROVINCE

Mining for various minerals has been ongoing in the central Namib (Figure 1) since 1901, and the first uranium mine was commissioned in 1976. The relatively low intensity of mining and exploration changed recently when a predicted world-wide scarcity in nuclear fuels resulted in a sudden scramble for uranium exploration licences and unprecedented growth in the uranium mining industry. Over the last half decade or so, one uranium mine has been commissioned (bringing the current total to two), one more is in an advanced stage of construction and at least one more has recently received environmental clearance, and will likely begin construction by 2013.

This "mining rush" is of course a vital part of Namibia's economic growth prospects, but could also potentially result in harm to the central Namib's environment. The Ministry of Mines and Energy commissioned a Strategic Environmental Assessment (SEA) to ensure that the utilisation of our mineral resources is not accompanied by environmental degradation. The SEA's primary tool to implement the principles of sustainable utilisation is the Strategic Environmental Management Plan (the SEMP), in which 12 so-called "Environmental Quality Objectives" (EQOs) were defined. Each EQO deals with a different theme, e.g. air, water, infrastructure, biodiversity and tourism. Within each theme a number of desired outcomes, specific environmental management targets and indicators for monitoring were identified.

This questionnaire is related to the monitoring of mining impacts on tourism (EQO 7), which is a crucially important aspect because a large part of the economy in the central Namib has always depended on tourists visiting the area for its various attractions. These qualities could easily be lost without careful management. It is thus crucial that we understand and monitor how the developments around uranium mining affect the scenic values, the quality of the tourist experience, the perception of biodiversity integrity and the size and health of the tourism industry. The questions you will be answering in this questionnaire will help us to gauge the size of the impacts and to monitor it over time. The questions were designed to capture anonymous information about the respondent (yourself), and to then assess your perceptions and experiences as a specific type of tourist. Finally, we would like to get your opinion on how to improve things.



We thank you for your participation in this and for your help in ensuring a sustainable utilisation of the Namib's natural resources, to the benefit of both ourselves and future generations! Find out more about the SEA and the SEMP, and become informed about the Namib environment, by visiting www.uraniumsemp-namibia.org, the Uranium Institute or *Namib i* in Swakopmund.

This is the way that the indicators that we are monitoring are defined in the SEMP:

STRATEGIC ENVIRONMENTAL MANAGEMENT PLAN FOR THE CENTRAL NAMIB URANIUM PROVINCE
Environmental Quality Objective 7: Effect on Tourism
Aims of this EQO:

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

Desired outcome 2[3]: *The Uranium Rush does not significantly reduce the visual attractiveness of the Central Namib.*
Target: *Direct and indirect visual scarring from the Uranium Rush is avoided or kept within acceptable limits.*
Indicator: *Tourists' expectations are 'met or exceeded' more than 80% of the time in terms of their visual experience in the central Namib.*

[3] *Desired outcome 1 relates to the impact on tour operators*

TOURISM QUESTIONNAIRE 2012-2013

Kindly complete the questionnaire below. If a specific question is not applicable, please tick the "na" box.

Where are you right now?		Date:	

1. <u>Some anonymous information about yourself</u>: Here we want to find out where you come from and what your interests are.						
1.1	Country of origin:			SEX:	MALE	FEMALE
1.2	Country of residence:			Year of birth:		
1.3	Highest educational level:	Primary school	High school	Tertiary (e.g. University)	Other:	na

2. <u>FOREIGN VISITORS: Your past tourism experience</u>: Here we want to find out about your past tourism experience in Namibia. This will help us to put your answers in the proper context.														
2.1	Have you visited Namibia before?									YES			NO	
2.2	Have you visited the central Namib before?									YES			NO	
2.3	If you answered YES, please mark the years of your previous visits below:													
<1990	<2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
2.4	How many days have you spent in Namibia so far during your current visit?													

3. <u>NAMIBIAN RESIDENTS: Your past tourism experience</u>: Here we want to find out about your past tourism experience in Namibia and elsewhere. This will help us to put your answers in the proper context														
3.1	How often per year do you visit the <u>central Namib</u> as a tourist on average?							0	<1	1	2	3	>3	na
3.2	When have you previously visited the central Namiba? Please mark they years of your previous visit/s below:													
<1990	<2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013

4. <u>Your current experience in the central Namib</u>: Here we want to find out about your current trip. This will help us to gauge and then monitor the impacts of mining on tourism.														
This section should be completed by all respondents, including <u>both</u> Namibian residents and foreign visitors														
4.1	Are you conducting your current trip as part of an organised tour?									YES			NO	na
4.2	How interested are you in the following aspects of the Namib (1=not interested at all, 5=very interested)													
	Nature	1	2	3	4	5	na		Adventure Tourism	1	2	3	4	5	na
	Culture	1	2	3	4	5	na	Other:		1	2	3	4	5	na
4.3	Please rate the extent the following aspects of the central Namib met your expectations (1=did not meet expectations at all, 5=far exceeded my expectations)													
	Scenic quality	1	2	3	4	5	na		Sense of place	1	2	3	4	5	na
	Nature	1	2	3	4	5	na		Adventure	1	2	3	4	5	na
	Culture	1	2	3	4	5	na		Other	1	2	3	4	5	na
4.4	Did you have access to all attractions that you had planned to visit?												YES		NO

4.5	If not, why are/were they off-limits?		na
4.6	Have you encountered any developments that <u>increased</u> the visual attractiveness of the region?	YES	NO
4.7	If yes, which ones?		na
4.8	Have you encountered any developments that <u>decreased</u> the visual attractiveness of the region?	YES	NO
4.9	If yes, which ones?		na
4.10	Since your last visit, which changes in the central Namib are positive?		na
4.11	Since your last visit, which changes in the central Namib are negative?		na

5. <u>Your thoughts on and experiences of mining</u>: Here we want to find out what your position is on mining, and what your knowledge and experience of mining is. This will help us to gauge and then monitor the impacts of mining on the tourist's experience.

5.1	Are you aware that there is uranium mining in Namibia?	YES	NO	5.2 Did you become aware	before arrival	after arrival
5.3	Knowing that Namibia is a developing country, do you support its drive to establish a uranium mining industry?	YES	NO	MAYBE	na	
5.4	Did your tour operator inform you about the extent and potential impacts of uranium mining?	YES	NO		na	
5.5	Do you think the overall environmental impacts of uranium mining will be …	NEGATIVE	POSITIVE	DON'T KNOW		

5.6 If you answered NEGATIVE, select what you think might be the most important potential impact:

Loss of ecological integrity and biodiversity	Loss of sense of place	Loss of attractive scenic landscapes ("visual scarring")	Pollution of groundwater	Air pollution (dust and radon[4])	Social problems	na

5.7	Have you visited any mines in the central Namib?	YES	NO
5.8	Do you think the overall environmental impacts of uranium mining will be …	NEGATIVE	POSITIVE	DON'T KNOW

5.9 Should any of the following activities be allowed in a national protected area, e.g. a National Park?

Agriculture	Mining	Tourism	Other Industries

[4] *Radon is one of the decay products of uranium. It is a gas and is present everywhere, but its concentration could potentially be increased where uranium minerals are mined.*

6. Some final thoughts:	
Do you have any general comments regarding your experience in the Namib as a tourist, especially with reference to the mining industry and your perceptions of it?	
	na
Are you interested in receiving information about uranium mining, biodiversity protection, and environmental management in the Namib? If yes, kindly provide your e-mail address[5]:	
	na

THANK YOU!
The SEMP team thanks you for your participation in this study, and for your contribution in ensuring that the Namib's resources are utilised in an environmentally responsible manner! Feel free to ask us at NERMU for more information, or to visit the Uranium Institute in Swakopmund. You can also visit www.uraniumsemp-namibia.org, www.gobabeb.org or www.namibiauraniuminstitute.com for updates on the uranium mining industry in the central Namib and how its environmental impacts are managed. Please contact Theo Wassenaar (theo.wassenaar@gobabeb.org) for more information.

[5] *By providing your address, you agree to receive regular updates from us. All contact information will be used solely for sending newsletters and/or updates on the SEMP. E-mail addresses are considered confidential and will not be shared with third parties.*

Appendix 3: Wetlands, vegetation and water levels report by mines

Company	Information on wetlands, vegetation and water levels
AREVA Resources Namibia	Trekkopje mine has only local, saline groundwater occurrences and there are no downstream users. There are no major aquifers that support wetlands, riparian vegetation or phreatophytes (deep-rooted plants dependent on water from the saturated zone of groundwater). The water levels of the production boreholes used for dust suppression were lowered by pumping in 2009 and 2010, but recovered when abstraction was suspended in 2011 and 2012.
Bannerman Resources	Bannerman Resources does not draw any water the Swakop River or surrounds. Fresh water for its exploration activities is obtained from the Namwater pipeline to Rössing via Goanikontes.
Langer Heinrich Mine	An extensive groundwater monitoring programme (water levels and quality) is implemented for the Gawib River and Swakop rivers. An Annual Groundwater Monitoring Report is submitted to the Ministry of Agriculture, Water and Forestry.
Reptile	Monitoring certain water boreholes in the Tumas drainage system; considering the use of saline groundwater available on site during operational phase.
Rio Tinto Rössing	Rössing abstracts saline groundwater from the Khan River, in line with an abstraction permit of MAWF which is valid until 2014. In 2012, an average of 797 m^3/day was abstracted against an internal target of 600 m^3/day, and a DWAF permitted abstraction of 2383 m^3/day. Vegetation and water levels in the Khan are measured as part of internal water quality and vegetation monitoring programmes, as well as permit requirements. The vegetation survey carried out in the Khan River in March and September 2012 showed that most of the trees at the monitored transects were in a satisfactory condition except for Transects 3, 6 and KEM 16 away from the mine which are in poor condition. This confirms a long-observed trend related to the generally low recharge received from runoff in this part of the river. The water quality in the Khan River shows no trend or significant change and remains within the range of natural variation. Monitoring and sampling of boreholes are continuing.
Swakop Uranium	Permits in place to abstract from on-site boreholes for diamond drilling activities and for dust suppression on some EPL roads and early construction activities. Groundwater levels monitored regularly on site and in the Swakop and Khan Rivers. The permit to abstract water from the Swakop River has not been used
Valencia	No impact on aquifers was identified in the EIA. No groundwater extraction from the Khan River is taking place. Water to supply the camp is extracted from a borehole on the farm Valencia from a depth of 90 metres. The quantities are minimal and there is no impact on the vegetation. The water quality is extremely poor and a reverse osmosis plant is used on site to make it potable.

Appendix 4: Swakop and Kuiseb Riparian Forest Monitoring Programme (SwaKuRiFoMo)

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PRIVATE AND CONFIDENTIAL

PROGRESS REPORT

RESULTS AREA 1: Monitoring of indicators related to EQO 7 and EQO 8

PROGRAMME	Swakop and Kuiseb Riparian Forest Monitoring Programme (SwaKuRiFoMo)
PROJECT	NERMU 2012-12.1: Baseline for the development of riparian vegetation monitoring programme For the Strategic Environmental Management Plan for the Uranium Rush
Research Permit no.	N/A
Aims	1. To do a baseline study of the ecological integrity of riparian vegetation in ephemeral rivers of the uranium province; 2. To use the baseline to identify and quantify indicators of change in the ecological integrity of riparian vegetation, potentially as a result of over abstraction; and 3. To define a long-term cost-effective monitoring programme.
Duration of project	March 2013 to 2014
Date of report	22 October 2013
Principal Investigator/s	Theo Wassenaar, Titus Shuuya
Collaborator/s	Field assistance by Banele Mngaza and SDP 2012/13
Financial support	BGR through NERMU
Logistical support	Gobabeb (NERMU)
Degree purposes	NA

Baseline for the Development of a Central Namib River Vegetation Monitoring Programme for the SEMP

by Theo Wassenaar[1] and Titus Shuuya[1]

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Introduction

Background

The western ephemeral Swakop and Kuiseb Rivers contain dense forests of large trees, including *Faidherbia albida, Combretum imberbe, Colophospermum mopane, Acacia erioloba, Tamarix usneoides,* and *Euclea pseudebenus (*Jacobson et al. 1995). These rivers and their vegetation communities have been described as "linear oases" (Kok & Nel 1996) because they form resources that are critical to the survival of at least part of the central Namib ungulate population. Similarly, these river systems provide food and water for human and animal survival (Huntley, 1985; Jacobson et al., 1995).

The central Namib is also home to the "Uranium Province", a geographically distinct area that contains a number of areas with uranium mineralisation. A dramatic increase in uranium prices in 2007 lead to a rush for exploration licences and a subsequent Strategic Environmental Assessment (SEA) study of the most likely cumulative impacts should a number of mines be developed simultaneously (SAIEA 2010). The SEA identified water as a key driver and a critical resource, and defined a number of mechanisms through which this resource could potentially be impacted as a result of mining (SAIEA 2010). Because of the ephemeral rivers' central role in maintaining biodiversity in this hyper-arid areas, the potential effects of water abstraction on riparian ecosystems was considered to be an important one that should be studied and monitored. For this reason, At least three indicators in the Strategic Environmental Management Plan for the Uranium Province (the SEMP), falling under Environmental Quality Objectives (EQO) 4 and 8, ask whether there is a monitoring programme in place to detect changes in riverine ecosystems that could be ascribed to abstraction of water by mines (GSN 2013).

The Omaruru, Swakop and Kuiseb riparian systems, including their main tributaries such as the Khan River, are characterised by extremely dynamic ecosystems due to fluctuations in climatic, geomorphological, hydrological and ecological processes (Huntley, 1985). It is especially trends in the volume, rate and directions of water flows that have major consequences for riparian ecosystem dynamics (Huntley, 1985). The continuity of water flow, both above and below ground, is essential for maintaining the perennial vegetation (a critical resource for life on the plains) while the larger river flows recharge aquifers (SAIEA 2010). Jacobson et al. (1995) found that riparian forests of the western catchments are well adapted to the natural variability in flow regimes, however if long periods of little or no flow occur, the water table will drop and older trees may die. Furthermore, episodic massive floods have the longest-lasting impacts on the structure of riparian forests. Flood intervals longer than the normal life-expectancy of riparian forest can result in the demise of whole forest reaches, creating new channels within the floodplain (Jacobson et al., 1995).

Human-induced changes to the hydrology of the systems might therefore influence ecological processes, and these can occur either through interference with natural flooding regimes or abnormal lowering of the water table through over-abstraction. In the context of mining, especially the effects of over-abstraction are important to understand. Ultimately, direct and indirect impacts on water flow will manifest itself in the health of riparian ecosystems, making it important to monitor indicators that reflect their ecological integrity.

Although the riparian ecosystem comprises much more than just vegetation, the vegetation component is arguably the basis upon which the rest of this ecosystem rests (Jacobson et al. 1995). Riparian vegetation monitoring can provide evidence of effective management practices (Herrick et al., 2005) and can place apparent impacts into the right context of dynamic natural change, especially in terms of cumulative impacts (Gitzen, Millspaugh, Cooper, & Licht, 2012).

Here we report on progress in the development of a monitoring programme, called the Swakop-Kuiseb Riparian Forest Monitoring Programme (**SwaKuRiFoMo**). This Programme, being developed by Gobabeb and partners in response to a need expressed in the Strategic Environmental Management Plan for the Uranium Province, includes both large ephemeral river systems and their main tributaries like the Khan River. We focused on these rivers because the Khan and Swakop Rivers are both potentially affected by cumulative impacts from mining, while the Kuiseb is a relatively pristine river system that can be used as a limited reference or benchmark. At this stage, for purely logistical reasons, SwaKuRiFoMo does not include the Omaruru River, but it is hoped that it may be included in the future.

Purpose of study

1. To do a baseline study of the ecological integrity of riparian vegetation in ephemeral rivers of the uranium province;
2. To use the baseline to identify and quantify indicators of change in the ecological integrity of riparian vegetation, potentially as a result of over abstraction; and
3. To define a long-term cost-effective monitoring programme.

Key questions

Specifically, the following key questions were investigated:

1. What is the physiological and visual health status of riparian vegetation?
2. What are the species composition plus distribution of riparian vegetation?
3. What are the impacts of groundwater abstraction on the riparian vegetation?

Progress

A core principle followed by Gobabeb in all its activities is the close integration of capacity building and training with research projects. With this in mind, we aligned the objectives of the 2012-2013 Summer Development Programme (SDP) at Gobabeb with the need to develop a monitoring programme answering indicators in EQO 4 and EQO 8 of the SEMP. The SDP is a six-week course, under supervision of Dr Mary Seely of Gobabeb, that takes in between 10 and 14 postgraduate students over the summer holidays and directs them to investigate a focused environmental problem. In this case their brief was to determine patterns of mortality in ana trees (*Faidherbia albida*) and camel thorn (*Acacia erioloba*) along the Swakop and Kuiseb rivers, with the Swakop being the "impacted" river and the Kuiseb the relatively unaffected control. They additionally had to survey stakeholders and users of the rivers' resources to canvas their opinions on the environmental state of both systems. Their reports are currently being written up, but we used their experimental designs (that we also provided input into) and their data as our first pilot study.

The pilot study thus took about six weeks to complete and produced about a 1000 records of the distribution, occurrence, frequency and morphological vitality of both species in both rivers. The design and preliminary results are summarized below. In addition to the SDP work, we also sent two technicians to the field for three weeks to measure physiological and morphological variables as indicators of plant health, specifically as these relate to the plants' distances from abstraction and monitoring boreholes. At the same time we measured morphological health variables along longitudinal and transverse transects (similar to the SDP design) in the Khan River, a major tributary of the Swakop. This additional fieldwork, completed during March-April of 2013, produced a further ~450 records of all the physiological and morphological variables previously measured. In total we

drove over 200km of longitudinal transects and completed 20 sets of transverse transects, as well as measured tree health around ten boreholes.

Since that time, a staff member of Gobabeb spent about two months cleaning and quality checking the data, and doing the initial analysis. We also developed the theoretical underpinnings of the programme and defined a broad framework for the development of the monitoring programme. In addition, we started compiling the spatial database and preparing the spatial data for analysis, and identified gaps. Below we report on our development of these aspects, and present some of the preliminary findings.

Theory

Indicators of health

Although seasonal or longer fluctuations in its physiological state may occur, a plant in a normal state of health[6] is able to maintain turgor, grow and reproduce (Hopkins & Hüner 2009). Stressors such as disease, heat and, most pertinently for this study, water shortage, will result in fewer resources being mobilised for reproduction and growth in favour of survival (Lichtenthaler 1996). When conditions are highly stressful, parts of the plant may die off and if the stressor exists for long enough, the whole plant may eventually die. In addition, plants in a stressed state may be more susceptible to parasites, indirectly exacerbating a decline in physiological health.

To understand the impacts of water shortage on the riparian ecosystem, it is necessary to measure a range of variables that reflect the health of both individual plants and populations. In Figures 2-4 we depict the theoretical effects of a stressor such as water shortage on both the individual and population level. The health status variables that are implied or referred to in these conceptual models are:

1. Photosynthesis efficiency,
2. Reproduction rate (seeding, flowering and phenology),
3. Mortality of plant parts,
4. Presence of parasites,
5. Mortality of whole plants,
6. Mortality of groups of plants, and
7. Population size.

Although all the above variables will respond to stress at some level, not all will manifest over a short period. For instance, depending on the stress level, it will probably take a few years before population size is affected. Even measures such as various reproduction variables, which more closely reflect health status, may be very subtle over a shorter period (REFXX) and will only become apparent at a population level. On the other hand, photosynthesis is particularly sensitive to water stress (Hopkins & Hüner 2009), making photosynthetic efficiency the ideal indicator of plant health on the individual plant level and potentially also on the population level. Overall it is however necessary to integrate all the variables for a more comprehensive understanding, at least at this baseline stage.

[6] We use the term “health” throughout as meaning the opposite of “stress”. In other words, a plant that is stressed is not healthy. Similarly, a measure of health is the inverse of a measure of stress.

Physiological and physical mechanisms of expected impacts

In the case of the riparian ecosystems, the basic premise of the mechanisms behind an "impact" (or several impacts) on the riparian ecosystem is **interference with water supply**. Theoretically this could be either positive or negative, but for all intents and purposes we are here concerned only with negative impacts, meaning that the water available to an individual plant is decreased below the level that is normally available to it. The alluvial aquifers of both the Khan and Swakop Rivers are not homogenous, but are separated into sections called compartments created by outcropping bedrock or narrowing of the river gorge (SAIEA 2010; **Figure**A). Aquifers are thus essentially open containers with inputs only from episodic floods (and minimally from very rare local rain events) and outflows through decanting (at least until the water table has dropped below the rim of the constriction) and evapotranspiration.

In normal conditions (no abstraction of water), losses through decanting and evapotranspiration could result in lowering of the water table below the level of root growth. It is possible that some plants will adapt through increased root growth, with the rate of growth limited principally by the rate of carbon assimilation and available energy, both of which are compromised during water stress (Hopkins & Hüner 2009, Ackerly & Stuart 2009). The critical level of the water table – the level beyond which a plant cannot efficiently take up water anymore – is likely to be dependent on the species. In this regard, species such as *Acacia erioloba* are known to reach great depths (56m or more), but others such as *Faidherbia albida* may not (Schachtschneider 2010). In addition to rooting depths, the large tree species of the ephemeral rivers differ in many structural and physiological ways in terms of their adaptations to drought (Schachstchneider 2010), leading to a range of possible physiological responses to water stress.

An abnormal decrease in available water is expected to occur as a result of abstraction of groundwater out of a so-called "compartment" in either river by users, principally mining companies, but also in places by farmers. In response to the recommendations made by the SEA (SAIEA 2010), only one mine (Langer Heinrich Mine) is using a limited amount of water from the Langer Heinrich Compartment of the Swakop River, and Husab Mine will require more water from the Husabberg Compartment for construction. Although the volumes used by these two users are less than the modelled sustainable yield for both compartments, localised or general impacts on the riparian ecosystem could still occur due to the physical properties of the aquifers.

Apart from the basic effect of a decrease in volume of available water, interference with water supply could manifest itself on two further axes, namely space and time. For instance, abstraction from a point source like a borehole could result in a draw-down cone and a consequent gradient of water availability away from the hole – a distinct spatial pattern. Similarly, the temporal variability in water availability could increase through variation in the rate of water abstraction related to demand, resulting in increased fluctuations in stress levels.

We therefore assume that as long as abstraction does not exceed the maximum sustainable yield, plants should have enough available moisture and maintain a normal, healthy physiological state independent of their distance from a production borehole (relationship x in **Figure**B). At the population level this will result in a stable stress state structure with most plants in a healthy reproductive state as in **Figure** -1. Excessive abstraction close to or just above sustainable yield could have a local effect with plants closer to the point of production experiencing more frequent and longer periods in a stressed state, but plants further away not being affected – we term this the draw-down effect (relationship y in **Figure**B). In this case, the population stress state structure would be somewhere between the two extremes depicted in **Figure** . Finally, when all plants are experiencing stress independent of their distance to a production borehole, we expect relationship z in **Figure**B, and a population stress state structure like in **Figure** -2. If this is the result of excessive abstraction, it could be that plants in other compartments are not similarly affected, but there is no reason not to expect a different result – overall this would be very difficult to prove conclusively.

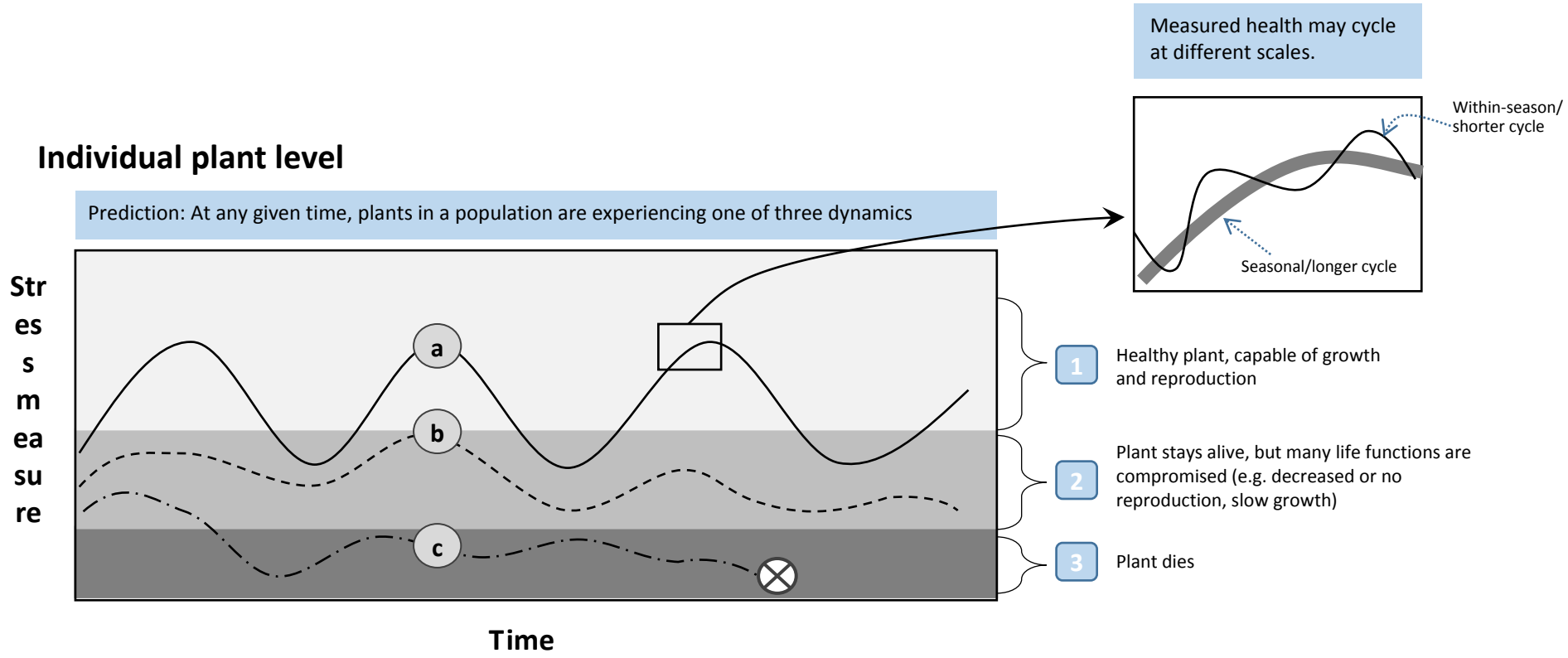


Figure 1. A diagram showing the conceptual changes in stress level over time for individual plants in a population growing in a desert. The critical presumed stressor here is water, or more broadly defined plant-available moisture. Moisture supply will vary over time at different temporal scales, leading to fluctuations in a theoretical measure of stress (e.g. photosynthetic efficiency). For plants growing in the alluvium of an ephemeral river experiencing regular flooding, these fluctuations are likely to be dampened to varying degrees, and closely dependent on the rate of re-charge through flooding. The model predicts that a population will comprise plants that occur in one of three (or possibly more) stress categories (labeled 1, 2 and 3 here) ranging from healthy and reproductive (a, stress state 1), through alive, non-reproductive (b, stress state 2) to dying or dead (c, stress state 3). Plant (a) is experiencing transient stress and is able to adapt or repair any damage. Plant (b) is experiencing chronic, low-level stress, preventing adaptation or repair of damage. Plant (c) is experiencing a chronic, high-level stress (such as a prolonged drought), which will lead to death.

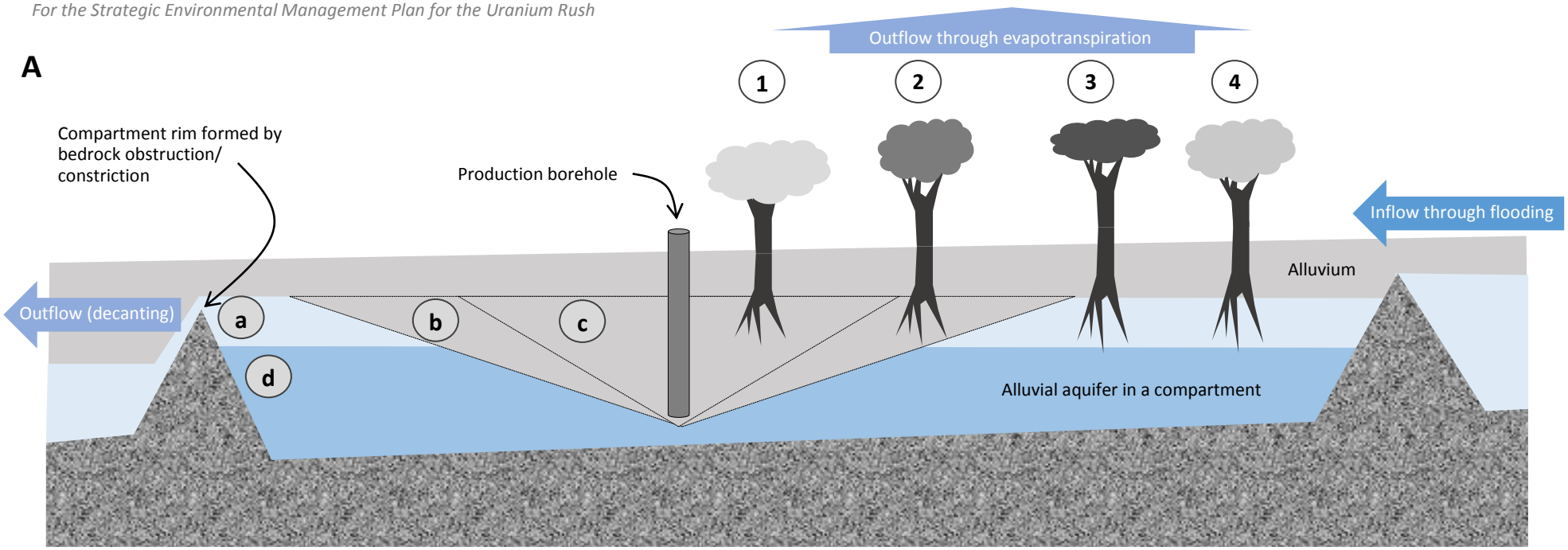


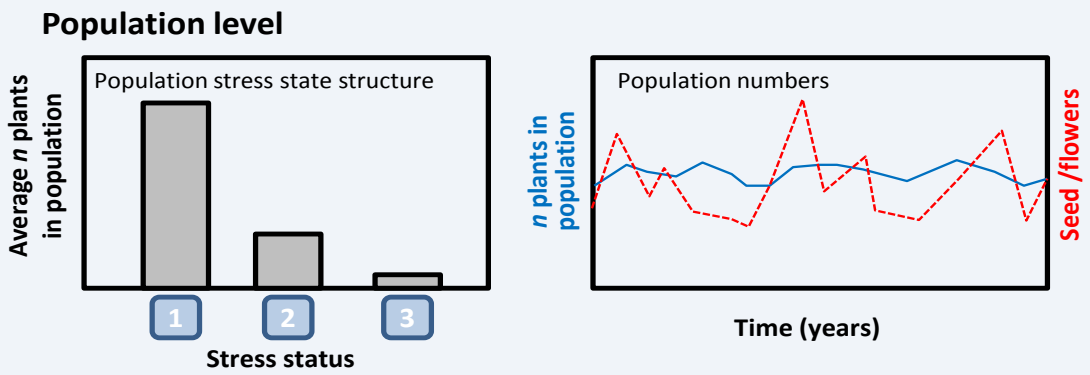
Figure 2. (A) A diagram of the basic premise behind the expected impacts of the abstraction of water from an alluvial aquifer, here shown in longitudinal section). The four plants depicted above grow at increasing distances from the production borehole with their roots in the groundwater (level (a)). We expect the continuous pumping of water to result in a draw-down cone of different dimensions and duration depending on the level of production (b and c). This could result in water stress (manifested in decreased photosynthetic efficiency) in plants closer to the borehole. If abstraction continues long enough before new inflows through flooding, the water table itself may drop lower than the roots of the majority of plants (d). This may however also occur naturally through evapotranspiration that exceeds inflows.

(B) The relationship between health status and distance from borehole could theoretically take three forms:

(x) low stress state, no change over distance, slope zero (abstraction is less than sustainable yield, draw-down cones small or very short);

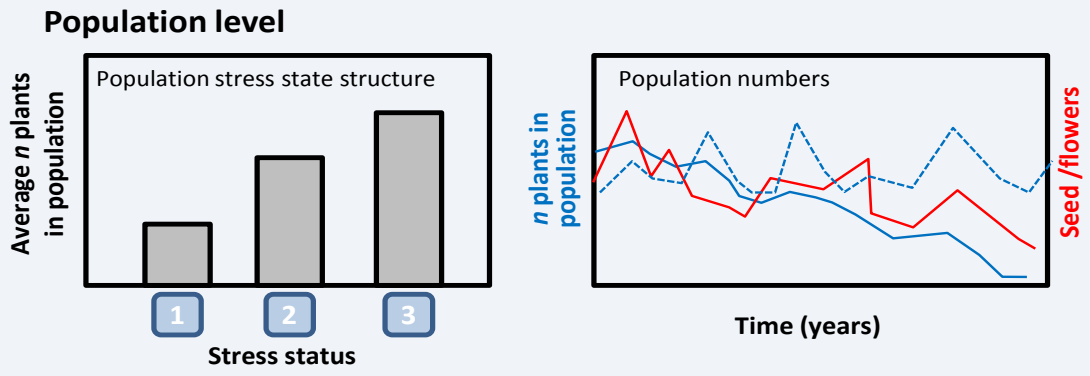
(y) plants near borehole more stressed (abstraction close to or more than sustainable yield,

1. No abnormal stressors (healthy population)



Predictions
1. Relatively stable population stress state structure
2. Population numbers (integrated over space and time) remain stable
3. Highly variable reproduction rate (many years with low, some with high), but integrated values remain stable
4. Temporal pattern is function of rainfall or floods
5. Spatial pattern is function of long-term distribution of groundwater
6. Long-term and large space averages remain fairly stable

2. With abnormal stressors (unhealthy population)



Predictions
1. Population stress state structure slowly inverts
2. Decline in population numbers
3. Highly variable reproduction rate (increasing years with low reproduction rates))

Figure 3. With reference to the stress states defined in Figure: Without abnormal stressors, we expect most plants to be in level 1 (although these plants may experience transient periods of stress, they are generally healthy and reproductive), with only a relatively small percentage in a slow walk to death (stress state 3). With an abnormal stressor present, this distribution will change, with fewer plants in stress state 1 and more in stress state 3. Changes in population sizes are less easy to predict from this model, but generally we expect populations without abnormal stressors to have stable population sizes and reproductive rates (although the latter may fluctuate with environmental conditions) over long periods. Population sizes and reproductive rates in species experiencing abnormal stressors may decline over time (long-lived K-selected species) or fluctuate wildly (r-selected species). For such r-selected species the population stress state structure may also fluctuate as new individuals are added to the populations when stress levels decrease at times.

Flooding

The previous section considered the main mechanism of impact to be increased outflows, caused either by natural factors (evapotranspiration and decanting), or excessive abstraction. There is however another important aspect that has to be considered, namely decreases in inflows. In this regard it is relevant to note that the Swakop River is unique in this study in that it is dammed in two upstream locations: Swakoppoort and Okahandja (Von Bach Dam) (SAIEA 2010). Studies have shown that the total groundwater recharge to the Swakop alluvial aquifer has dropped by 32% as a result of these dams (Marx 2009, BIWAC 2010). The Kuiseb River is also dammed at Friedenau, but this relatively small dam is located close to the edge of its catchment, and hence probably plays only a minor role in the hydrology of the lower reaches.

The ultimate effect of the reduced inflow on the riparian ecosystems has not been studied before. However, with fewer re-charge events, it is possible that evapotranspiration alone could result in water tables dropping to the point that many individual trees will experience chronic water stress for longer periods than previously. Even relatively low levels of water abstraction could therefore result in mortalities.

Study Area

The study area encompassed the lower reaches of the Kuiseb and Swakop Rivers within the Namib-Naukluft Park and the Dorob National Park. In the Swakop River the study site extended from the gravel road crossing the river to the Welwitschia Flats 72 km up river to the eastern park boundary and included the Khan River. In the Kuiseb River the study site extended from within the Kuiseb Delta area 68 km up river to the Gobabeb Weir downstream to Rooibank.

The rationale behind the selected study area is to investigate and monitor vegetation around areas where water abstraction might be significant. In this regard it is relevant that the Kuiseb River is relatively under-utilised (water abstraction occurs only in the lower reaches and it is not dammed), water levels in the Khan River tend to be more sensitive to abstraction than in the Swakop River, and the Swakop River's inflows are reduced by two dams in the upper reaches (SAIEA 2010).

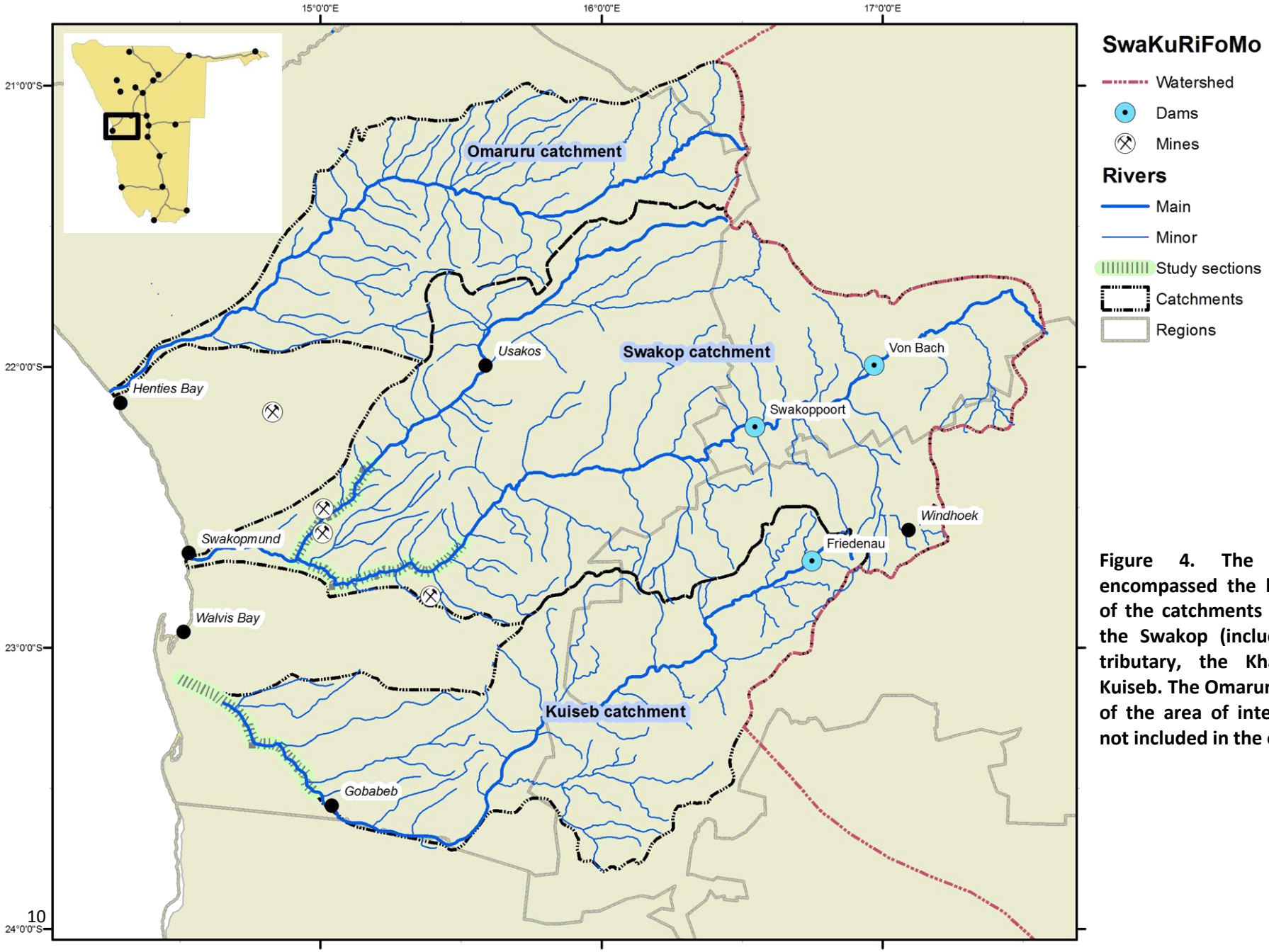


Figure 4. The study area encompassed the lower reaches of the catchments of two rivers: the Swakop (including its large tributary, the Khan) and the Kuiseb. The Omaruru River is part of the area of interest, but was not included in the current study.

Methods

Fieldwork was conducted in the Swakop, Kuiseb and Khan Rivers from December 2012 to April 2013. A variety of methodologies were used to establish the species composition, distribution and health status of woody vegetation in the lower Swakop and Kuiseb Rivers. Particular attention was paid to the areas that are associated with water abstraction: the Langer Heinrich compartment of the Swakop River, the Rössing compartment of the Khan River and the Swartbank compartment of the Kuiseb River where NamWater is abstracting water for Walvis Bay. These compartments are demarcated within the main rivers by bed-rock highs which prevent continuous underground water movement through the alluvium (SAIEA 2010).

Survey design

Principles of design

A systematic sampling design was used to collect samples with an initial random start (Gitzen et al., 2012). Three basic surveys of spatial vegetation vitality were made: 1) clusters of three transverse transects at regular intervals, 2) longitudinal "drive" transects along the length of the focal sections of each river, and 3) concentric bore-hole centred surveys. The first of these surveys – the transverse transects – were conducted to understand the health status of woody plants relative to their position in the river, as well as to obtain a representative sample for a description of the frequency distribution of health variables in the population. The second – the longitudinal transects – were done to understand the spatial pattern of tree condition along the length of the river and the final survey was done to determine whether there is a relationship between distance to borehole and health status. In the latter case, we measured plants at both production (treatment) and monitoring (control) boreholes.

The focal species were *Faidherbia albida* (ana tree) and *Acacia erioloba* (camel thorn), because these are the most prominent components of the riparian ecosystems and especially ana trees are perceived to be sensitive to changes in the water levels. Variables measured were:

1. Longitudinal transects: live, standing dead and the presence of parasites.
2. Transverse transects: canopy cover, density, diameter at breast height (DBH), height, visual and physiological vitality.
3. Borehole concentric transects: canopy cover, diameter at breast height (DBH), height, visual and physiological vitality.

Longitudinal ("drive") transects

To establish the spatial vegetation distribution of main woody vegetation species found in the Swakop, Khan and Kuiseb Rivers within the Namib-Naukluft Park, drive transects of vegetation were carried out. Drive transects consisted of a vehicle driving down the centre of the river course with three observers counting live trees, standing dead trees, prostrate dead trees, and trees with parasites. Prostrate dead individuals of *A. erioloba* and *F. albida* were considered those trees which had not been moved from the place where they had fallen in the water course. Tree counts were segregated to track the number of trees on the South floodplain, North floodplain and within the main water course separately.

Counts were tallied over 200 m intervals. *Acacia erioloba* and *Faidherbia albida* were counted individually while the presence of *Euclea pseudebenus*, *Salvadora persica*, *Tamarix usneoides* and *Prosopis* sp. were noted as present or absent in each 200 m interval. Non-woody vegetation such as *Cupressaceae* family present in each interval was recorded as well. Occurrence of *Tapinanthus* sp., an aerial parasite, was noted on trees other than Acacia or Faidherbia in each 200 m interval also.

Transverse transects

A random initial starting point was selected, thereafter three line transects were used to effectively asses the riparian vegetation across the width of the riparian zone (Theron, van Rooyen, van Rooyen, & Jankowitz, 1985). Transects were installed perpendicular to the channel width at an interval of one kilometre. The preceding tri-transects were established at five kilometres interval.

Vegetation structure was measured in terms of canopy distribution, density, diameter at breast height (DBH), height and composition (Theron et al., 1985). Vegetation vitality was examined by the percentage of dead material (canopy dieback) in the crown of each woody plant as well as standing and lying dead materials. Pods, leaves and flowers vitality was assessed as well. In order to have a reflection of the potential regeneration of vegetation communities, the presence and absence of seedlings was recorded (Theron et al., 1985).

A Handy PEA (Plant Efficiency Analyser, Hansatech instrument, Norfolk, UK) was used to measure chlorophyll *a* fluorescence. Five healthy leaf samples were collected on the southern aspect of each sampled tree. Samples were kept in the brown paper bags and measured at night to ensure maximum dark adaptation, using a pulse of saturating light at an intensity of 3000 µmol $m^{-2}s^{-1}$, with a wavelength of 650 nm for between 0.01 and 1000 ms. The same procedure was used also to measure chlorophyll fluorescence at concentric transects at both production and monitoring boreholes.

Borehole concentric transects

To establish the relationship between tree vitality and the draw-down cone, vegetation structure and physiological and gross vitality indicators of woody vegetation were measured in all directions around production ("treatment") and monitoring ("control") boreholes. Variables were canopy distribution, diameter at breast height (DBH), tree height and chlorophyll fluorescence. We stopped after about 300m or when there was no further vegetation.

Numerical analyses

A Handy PEA was used to average the samples from each focal tree, thereafter the Biolyzer software was used to load the full fluorescence transients and to calculate the O-J-I-P parameters from variable fluorescence. The vitality parameters were plotted on a linear regression model against the distance from borehole to investigate the relationship of tree vitality to the abstraction cone and the slopes of the relationships were tested for significant difference from zero and from each other.

Mapping and spatial analysis

ArcGIS 10 was used for all mapping and spatial analyses. A module in ArcGIS (Cluster Analysis) was used to detect clusters of mortality along the length of the rivers, based on the longitudinal transect data.

Results

Transverse transects

Vegetation structure and distribution

Analysis in progress, here we report only on basic summary results.

Table 1. Number of individuals assessed and average characteristics of A. erioloba and F. albida in the Langer Heinrich compartment of the Swakop River and the Gobabeb Weir and Swartbank compartments of the Kuiseb River.

SWAKOP RIVER	Number of Trees	Average Height	Average Canopy Area	Average Trunk Number	Average of Total Percent Live Canopy	Average Stem Diameter	Average Leaf Vitality	Average Flower Vitality	Average Pod Vitality	Proportion of Trees Parasite Infested
A. erioloba	43	5.22	99.76	2.21	65.58	0.39	2.76	0.38	1.51	0.09
F. albida	46	6.68	182.41	1.64	63.14	0.72	3.10	0.17	2.31	0.23
KUISEB RIVER										
A. erioloba										
Gobabeb Weir	100	3.83	101.27	3.35	73.49	0.26	3.41	0.25	1.41	0.02
Swartbank	83	3.57	115.65	3.26	69.14	0.29	3.20	1.11	1.70	0.00
A. erioloba Total	**183**	**3.71**	**107.83**	**3.31**	**71.52**	**0.27**	**3.32**	**0.64**	**1.54**	**0.01**
F. albida										
Gobabeb Weir	62	6.82	307.48	2.08	80.69	0.66	3.39	0.54	1.79	0.00
Swartbank	19	5.87	308.33	1.16	85.95	0.88	3.42	0.53	3.13	0.00
F. albida Total	**81**	**6.59**	**307.69**	**1.86**	**81.93**	**0.71**	**3.40**	**0.54**	**2.10**	**0.00**

Table 2. Regression output assessing relationship between height, canopy area, or DBH on percentage live canopy.

	KUISEB RIVER						SWAKOP RIVER					
	A. erioloba			F. albida			A. erioloba			F. albida		
	Height	*Canopy Area*	*DBH*	*Height*	*Canopy Area*	*DBH*	*Height*	*Canopy Area*	*DBH*	*Height*	*Canopy Area*	*DBH*
Obervations	183	182	179	79	78	79	38	36	37	42	41	39
R Square	0.0105	0.0173	0.0073	0.0010	0.0002	0.0005	0.0065	0.0498	0.0086	0.0011	0.1068	0.0185
Intercept Coefficient	79.2837	75.5889	74.1573	83.4690	81.6619	81.1769	70.5515	79.1639	60.8653	62.4384	53.5866	55.7137
X Variable Coefficient	-2.0942	-0.0392	-11.3912	-0.2957	-0.0008	0.9420	-0.9898	-0.1031	16.9124	0.3191	0.0686	11.0224
Significance	0.1675	0.0765	0.2565	0.7865	0.9030	0.8421	0.6296	0.1908	0.5852	0.8359	0.0370	0.4097

Physiological vitality

Analysis in progress.

Visual vitality

Analysis in progress.

Longitudinal transects

Preliminary results show that there is a strong and definite difference between the Kuiseb and the Swakop rivers in terms of the relative number of dead and alive *F. albida* individuals, with the Swakop especially containing larger numbers of dead F. albida. *Acacia erioloba* on the other hand seems to be less affected than *F. albida*, in both rivers (Figure , Figure). Overall the number of trees increase with distance from the coast, possibly because there is more moisture available since these areas experience more regular flooding. The largest proportion and highest numbers of dead *F. albida* trees were found in the Langer Heinrich compartment of the Swakop River (Figure).

Spatial patterns

In terms of spatial patterns, we spent most effort in finding a set of techniques to depict the longitudinal distribution of health parameters. For instance, we digitised all the rivers and developed a procedure to divide the study sections into roughly 200m-long sections, each containing at least one survey point. An example of what such a sectioned river looks like is provided in Figure . These

sections will now be used to establish the relationship of river area/width to health parameters, and also, using techniques in ArcGIS to depict gradients of health.

Figure 5. A part of the Khan River sectioned into roughly 200m-long sections, each containing a survey point at which a number of variables were measured. These survey points were used to detect longitudinal spatial patterns in numbers and densities of dead trees. The total length of the Khan River that has been sectioned in this way is 55km.

Population-level vitality patterns

Analysis in progress.

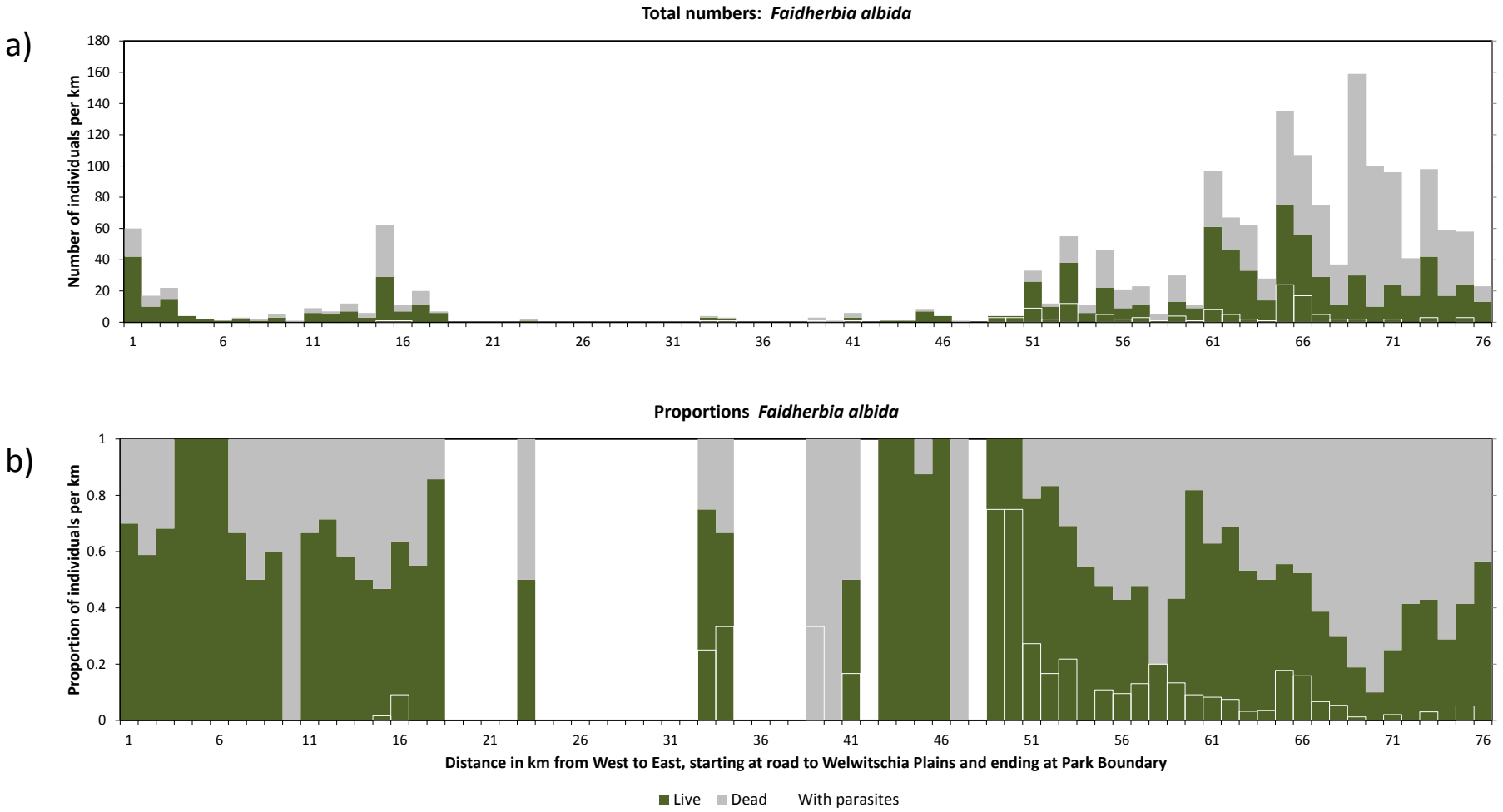


Figure 6. The numbers of dead and alive *F. albida* trees in the Swakop River (a), and the proportion of dead and alive trees (b). The numbers (in a) and proportion (in b) trees that supported parasites (in this case *Tapinanthus* sp.) is shown as white outlined bars.

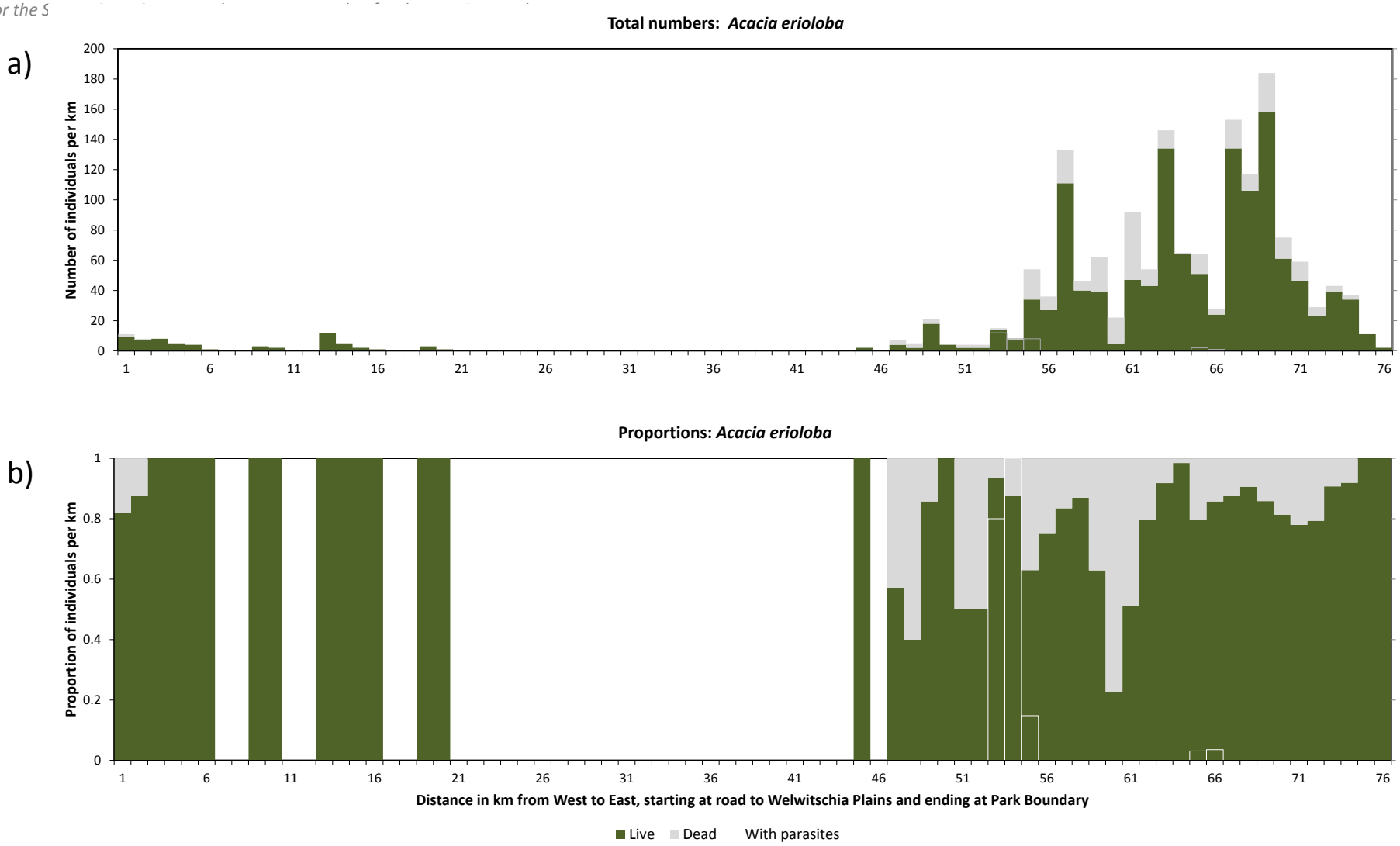


Figure 7. The numbers of dead and alive *A. erioloba* trees in the Swakop River (a), and the proportion of dead and alive trees (b). The numbers (in a) and proportion (in b) trees that supported parasites (in this case *Tapinanthus* sp.) is shown as white outlined bars.

Borehole concentric transects

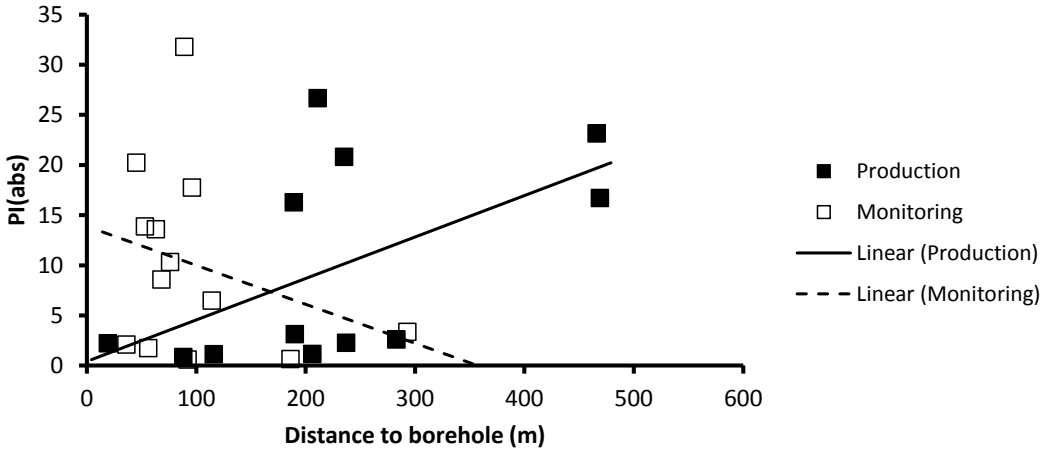
Physiological vitality

1. Relationship between distance to borehole and PI(abs) for *Faidherbia albida*

The trees closer to the production borehole are less healthy than those further away, and for the monitoring boreholes this is the other way around. The slope is not significantly different from zero for either relationship (Ordinary Least Squares Linear Regression: $F_{1,10} = 4.35$, $P = 0.06$; $F_{1,11} = 1.04$, $P = 0.33$ respectively). Visual inspection of the graph suggests that the pattern for the production boreholes may be real, while that for the monitoring boreholes is unduly influenced by one very low value far away from the hole. If health is measured as Pi(total) – another indicator of health calculated from the data collected using a photosynthesis analyser – the relationship for the production borehole is in fact significant ($F_{1,10} = 6.24$, $P = 0.03$), but not that for the monitoring borehole ($F_{1,11} = 1.47$, $P = 0.25$).

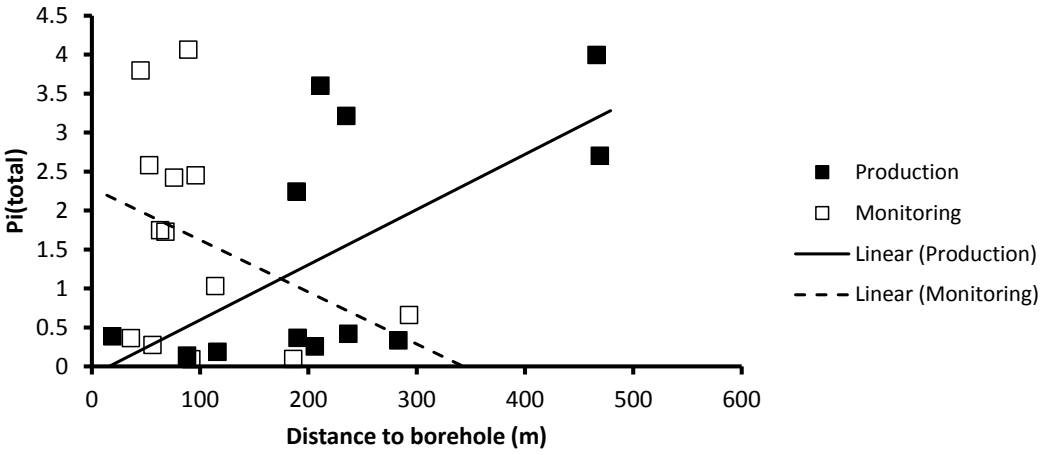
a)

Relationship of health of *Faidherbia albida* (PI(abs)) to distance from borehole



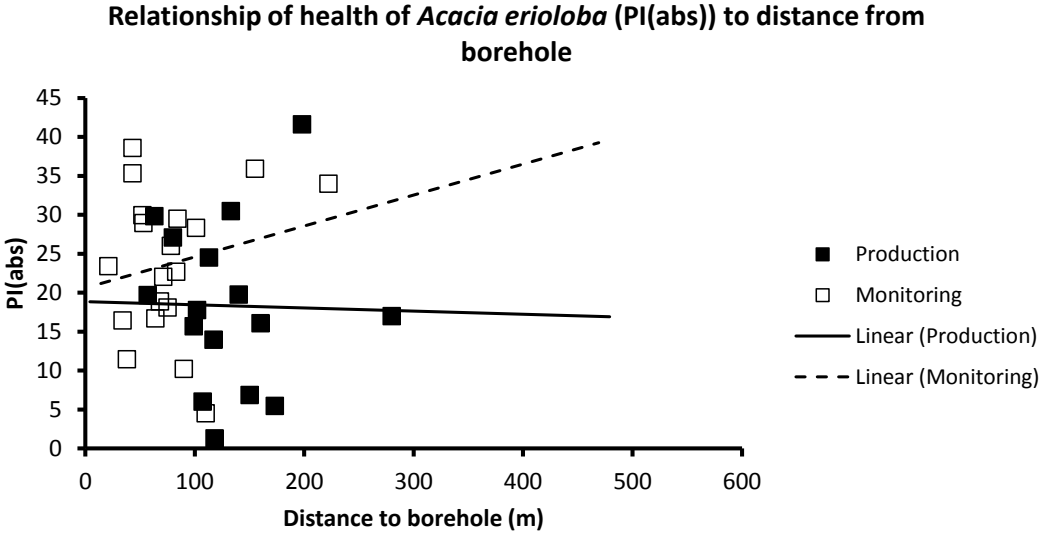
b)

Relationship of health of *Faidherbia albida* (Pi(total)) to distance from borehole



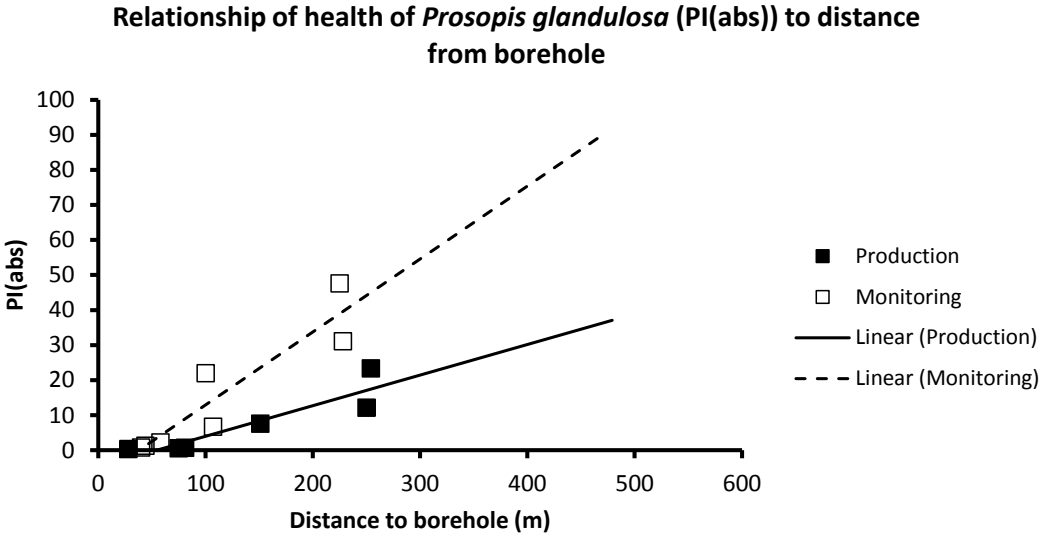
2. Relationship between distance to borehole and PI(abs) for *Acacia erioloba*

The health status of individual Acacia erioloba trees around production boreholes does not seem to increase with distance from borehole, but there is a slight trend for those around monitoring boreholes to be healthier further away from the borehole. Neither slope was significantly different from zero (OLSR, Production: $F_{1,14} = 0.006$, P = 0.9; Monitoring: $F_{1,17} = 0.69$, P = 0.42)



3. Relationship between distance to borehole and PI(abs) for *Prosopis glandulosa*

The trend in the case of Prosopis glandulosa was for trees to be healthier away from both monitoring and production boreholes. Both slopes were significantly different from zero (OLSR, Production: $F_{1,4} = 19.24$, P = 0.01; Monitoring: $F_{1,5} = 29.12$, P = 0.003). However, in both cases the number of data points was low.



Visual vitality

Analysis in progress

Discussion

Our preliminary results show the existence of interesting spatial patterns of health and mortality in especially *Faidherbia albida*. The Swakop River seems to have most of the dead trees, and abstraction from boreholes in the Khan River appear to be affecting the health of trees closer to the hole. These preliminary patterns seem to support the casual observations that pumping is causing mortality in *F. albida*, but we do not yet have enough data to draw confident conclusions. Ultimately the question can only be answered by comparing changes over time in different rivers while taking account of other important drivers (such as flooding). The measurement of changes of over time is indeed the subject of a monitoring programme that has to be developed on the basis of the current baseline study.

Our initial attempts at measuring plant health relative to boreholes produced tantalisingly interesting patterns, but too few data to draw confident conclusions. We intend filling in this data gap by extending the measurements to as many of the monitoring and production boreholes as we can access in both rivers (including the Khan).

Acknowledgements

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