Ministry of Mines and Energy

Annual Report
Strategic Environmental Management Plan (SEMP) for the Central Namib Uranium Province
2013

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Prepared by

Geological Survey of Namibia

Project Management:	Ministry of Mines and Energy, Geological Survey of Namibia, Division of Engineering and Environmental Geology
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Compiled by:	Rosina Leonard (GSN), Israel Hasheela (GSN), Michelle Hijamutiti (GSN), Norwell Mwananawa (GSN), Selma Penna Utonih Jr (GSN), Hiskia Mbura (NERMU), Gobabeb Namib Ecological Restoration and Monitoring Unit, Theo Wassenaar (NERMU), Gobabeb Namib Ecological Restoration and Monitoring Unit
Contributions from:	Namibian Uranium Association
Final editing:	Gabi Schneider, Rosina Leonard and Selma Penna Utonih Jr

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Additional Information and queries to:

SEMP-GSN

Dr. Gabi Schneider
Chairperson
Geological Survey of Namibia
Ministry of Mines and Energy
Private Bag 13297
Windhoek
Namibia
Tel: 061-2848242
gschneider@mme.gov.na

Ms. Rosina Leonard
Coordinator
Geological Survey of Namibia
Ministry of Mines and Energy
Private Bag 13297
Windhoek
Namibia
Tel: 061-2848157
rleonard@mme.gov.na

SEMP-NERMU

Mr. Hiskia Mbura
Namib Ecological Restoration and Monitoring Unit
(NERMU)
Gobabeb Research and Training Centre
PO Box 953
Walvis Bay
Namibia
Tel1: +264-61-230752
Tel2: +264-64-694199

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

EXECUTIVE SUMMARY

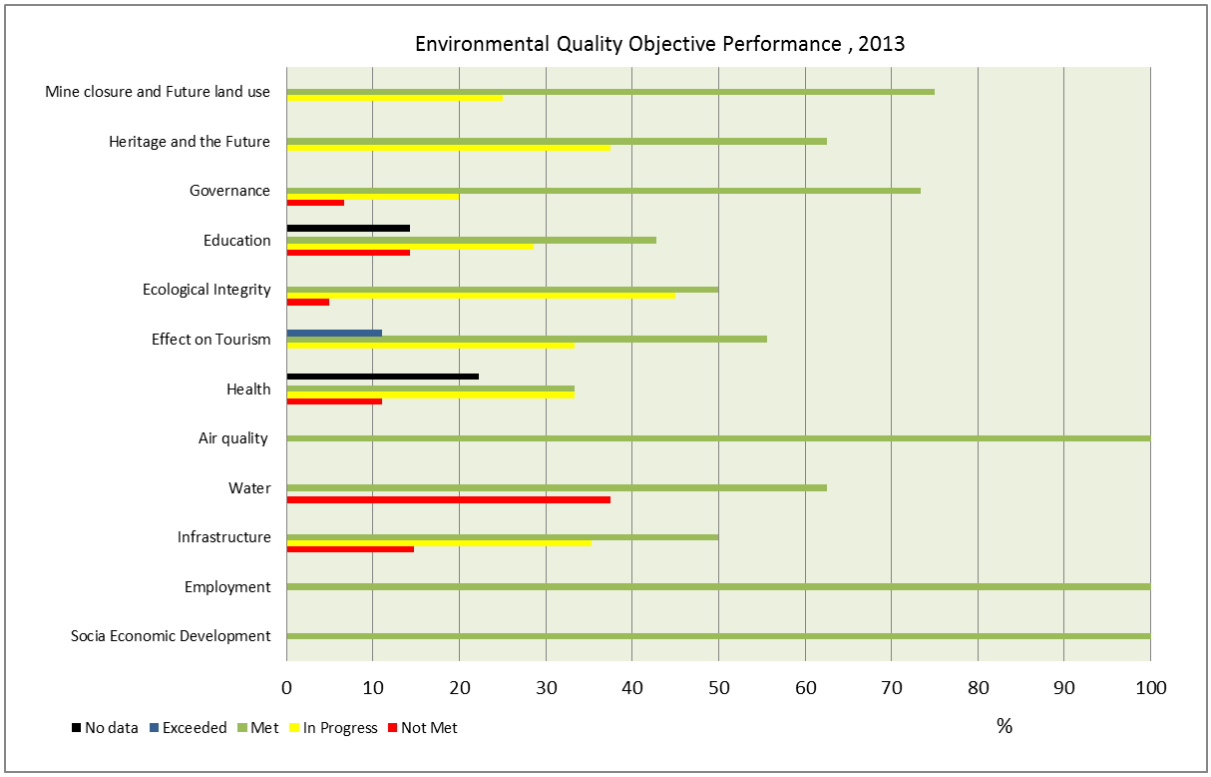
As a result of the Strategic Environment and Socio-Economic Assessment of the Uranium industry "rush" in 2009, the Strategic Environmental Management Plan (SEMP) was developed. The world-wide first Strategic Environmental Assessment (SEA) for the uranium province was an initiative that provided vision and generated a culture of collaboration within the uranium mining industry, government, and the public. The SEMP is a public-private collaborative initiative housed within the Geological Survey of Namibia, Ministry of Mines and Energy and it is supported by the Namib Ecological Restoration and Monitoring Unit (NERMU) at the Gobabeb Research and Training Centre. SEMP is an over-arching framework and roadmap addressing the cumulative impacts of existing and potential developments, within which individual projects have to be planned and implemented; measured around twelve Environmental Quality Objectives (EQOs) and the extent to which uranium mining is impacting the central Namib. Each EQO articulates a specific goal, provides a context, sets standards and elaborates on a number of key indicators that are monitored.

The uranium industry fell in Scenario 1 in 2013 with Rio Tinto's Rössing Uranium and Paladin's Langer Heinrich the only producing uranium mines. Although the upcoming Husab Mine has commerce with development, the uranium market in 2013 was unfavourable, with a spot price of US$35/lb. Consequently most uranium exploration projects could not progress into their next phases. Rössing Mine announced both cost reductions and a retrenchment of 257 employees. Additional retrenchment and other cost cutting initiatives where taken in most uranium mining and exploration companies.

The 2013 SEMP operational table consisted of 122 indicators, 45 targets and 37 desired outcomes, a slight reduction of the 125 indicators, 46 targets and 38 desired outcomes in 2012; as some indicators are either combined or reformulated into newer indicators or indicators are discontinued as they do not serve the desired outcome of the SEMP. Also, the Air Quality and Radiation (EQO 5) was changed to Air Quality, as the radiation part will be well represented under the Health EQO6.

The performance of 2013 indicator is much better than the previous assessed years (2011 and 2012. 57 percent of the indicators are MET, with the 100% a performance by the Socio-Economic development (EQO1), Employment (EQO2) and Air Quality (EQO6). These are followed by EQO12 Mine Closure and Future Land use, Heritage and the Future (EQO11), Effect on Tourism (EQO7) and Governance (EQO10); although these also carry indicators that are IN PROGRESS. Like in 2012, 30% of the overall indicators are rated IN PROGRESS. Ten percent of the indicators are NOT MET. A larger percentage of the NOT MET indicators are from the Water EQO4, Infrastructure (EQO3), Education (EQO9) and Health (EQO6). As experience in the previous year, the water data from DWAF is never made available to the SEMP. Correspondingly, to the absence of auditors, water and air monitoring at waste disposal site, the ongoing tracks traffic still on the B2 road and the absence of cargo container data from Namport from the infrastructure EQO; add to the 10 % of indicator that are NOT MET. Three of the indicators could not be measured as there are no data to assess them currently or the indicator(s) requires rephrasing for practicality.

Currently in it 3rd assessment period, the SEMP's major achievements to date includes the establishment of a long-term monitoring and decision-making tool through which potential impacts are avoided and/or remedial measures are developed to mitigate unavoidable impacts; and the commitment of key government institutions, the uranium industry, NGOs and the public who have undertaken certain actions towards the desired future state of the SEMP.



ACKNOWLEDGEMENTS

The SEMP management would like to thank all those who have been involved directly and indirectly since its initiation. The biggest gratitude goes to the committed Stakeholder steering Committee Members that continue leading the activities of the SEMP and ensuring its continual existence. The uranium industry through the NUA has been instrumental and at the forefront when submitting data to the SEMP Office. We would also like to thank the Namibian Uranium Association and Bannerman Resource Namibia for hosting the SEMP Steering Committee meetings, thank you for your hospitality. Our greatest appreciation and thanks go to all the authors from the GSN-SEMP office, NERMU, Sandra Müller of Areva for gathering all the uranium companies' data, all ministerial offices, tour operators and other individuals who contributed to the compilation of this report.

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ABBREVIATIONS

CTAN	Coastal Tourism Association of Namibia
DWAF	Department of Water Agriculture and Forestry
ECB	Electricity Control Board
ECC	Environmental Clearance Certificate
EIA	Environmental Impact Assessment
EMP	Environmental Management Plan
EQO	Environmental Quality Objective
GSN	Geological Survey of Namibia
HAN	Hospitality Association of Namibia
HWI	Hazardous Water Inspector
IAEA	International Atomic Energy Agency
MAWF	Ministry of Agriculture, Water & Forestry
MET	Ministry of Environment & Tourism
MME	Ministry of Mines & Energy
MoE	Ministry of Education
MoF	Ministry of Finance
MoHSS	Ministry of Health & Social Services
MoWT	Ministry of Works and Transport
NACOMA	Namibian Coastal Conservation and Management Project
NERMU	Namibia Ecological Restoration and Monitoring Unit
NHC	National Heritage Council
NIMT	Namibian Institute of Mining and Technology
NMCF	Namibian Mine Closure Framework
NRPA	National Radiation Protection Authority
NSA	Namibian Statistic Agency
NTB	Namibia Tourism Board
NUA	Namibian Uranium Association
PM10	Particulate Matter <10 µm
RA	Roads Authority
RMP	Radiation Management Plan
SANS	South African National Standards
SEMP	Strategic Environmental Management Plan
TSF	Tailings Storage Facility
UI	Uranium Institute
UNAM	University of Namibia
VTC	Vocational Training Center
WB	Walvis Bay
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

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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 generated a culture of collaboration within the uranium mining industry, government, and the public. As a result of the SEA, the Strategic Environmental Management Plan (SEMP) was developed. The SEMP, a public-private collaborative initiative, is housed within the Geological Survey of Namibia, Ministry of Mines and Energy and it is supported by the Namib Ecological Restoration and Monitoring Unit (NERMU) at the Gobabeb Research and Training Centre. SEMP is an over-arching framework and roadmap for addressing the cumulative impacts of existing and potential developments, within which individual projects have to be planned and implemented. It has a collective of twelve Environmental Quality Objectives (EQOs), measuring the extent which uranium mining is impacting the Erongo Region (Figure 1). Each EQO articulates a specific goal, provides a context, sets standards and elaborates on a number of key indicators that need to be monitored. The desired outcome is that development and utilization of Namibia´s uranium resources significantly contribute to the goal of sustainable development for the Erongo Region and Namibia as a whole.

The SEMP Office and NERMU collect data on indicators of environmental performance and publish an annual report. This is in a form of an annual audit report consisting of a set of matrices, in which 125 indicators, 46 targets and 38 desired outcomes spread across 12 'environmental quality objectives' (EQOs) are assessed. Each indicator is assessed in terms of whether it is "Not Met", "In progress", "Met", or "Exceeded", using a four tiered color coding system.

In its 3rd assessment period, the SEMP's major achievements to date are the establishment of a long-term monitoring and decision-making tool through which potential impacts are avoided and/or remedial measures are developed to mitigate unavoidable impacts; and the commitment of key government institutions, the uranium industry, NGOs and the public who have undertaken certain actions towards the desired future state of the SEMP (Figure 2, Figure 3 and Figure 4).

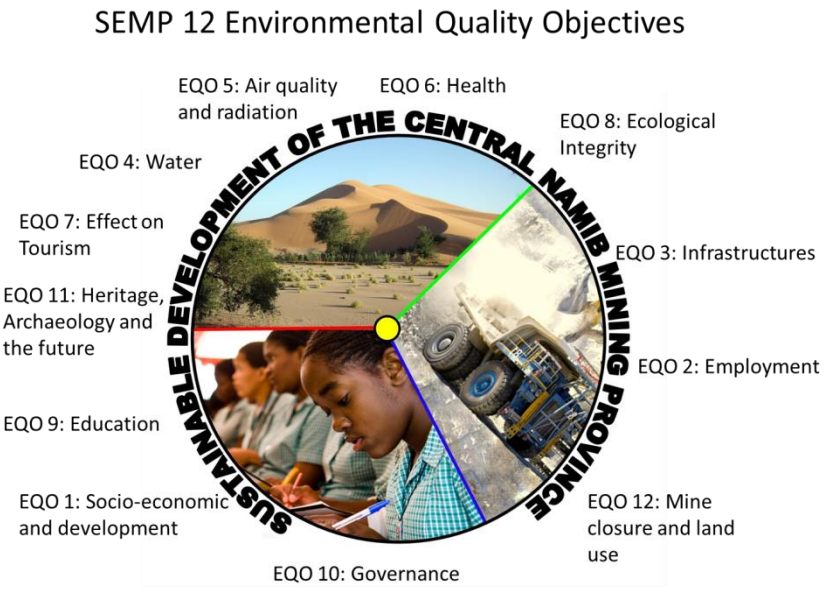

Figure 1: The Environmental Quality Objectives (EQO) of the SEMP Operational Plan

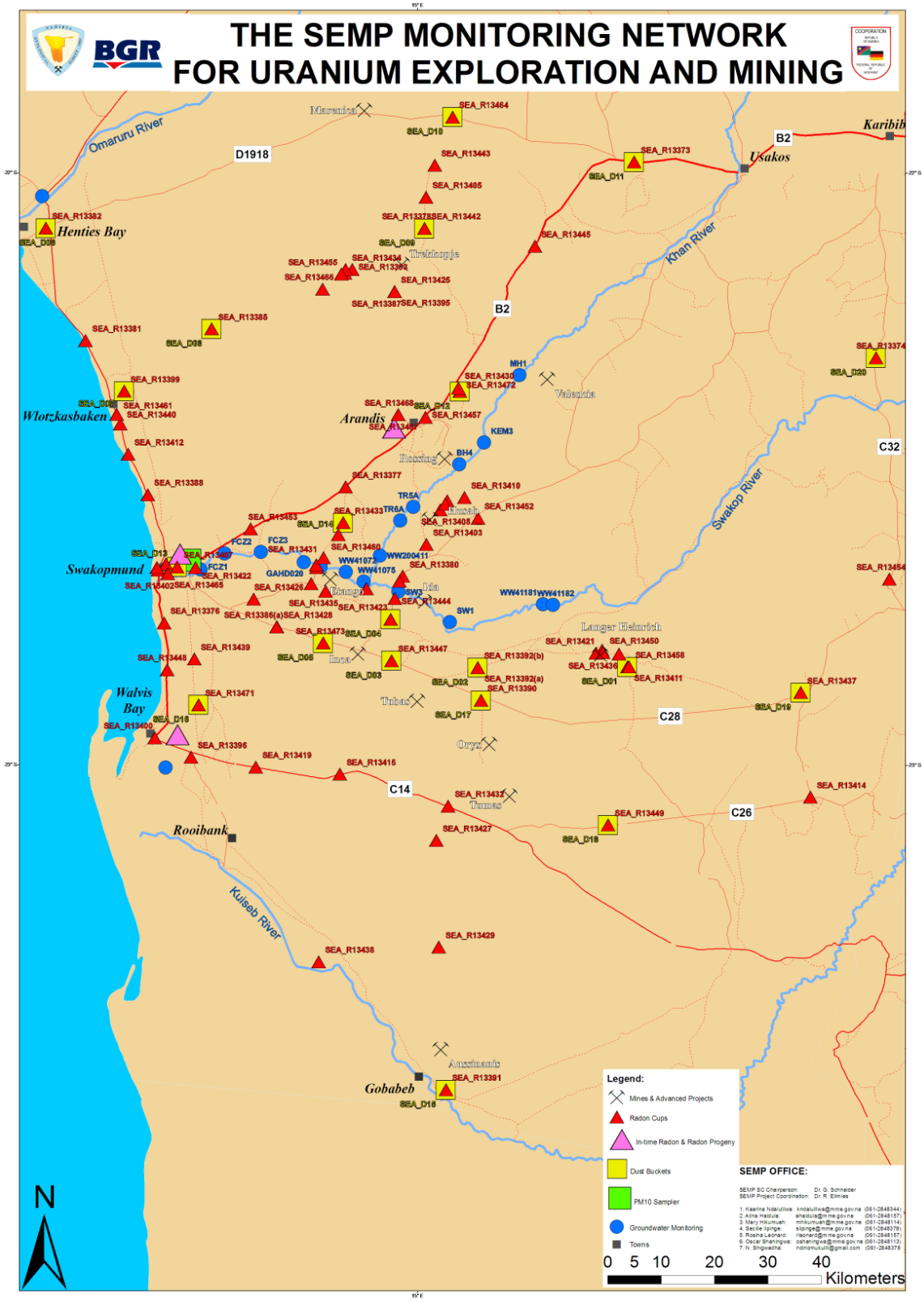

Figure 2: SEMP motoring network, including baseline monitoring stations and the ongoing monitoring stations

Figure 3: Monitoring activities[1] for the Strategic Environmental Management Plan (SEMP)

[1] The SEMP Projects have baseline data on Radon cups, Dust buckets and Ground water in the Swakop and Khan River. Ongoing radon monitoring is measured by the 3 Radon and Radon Progeny stations at Walvis Bay, Swakopmund and Arandis. The PM10 in Swakopmund monitors the particulate matters in the air. Annual water sampling and biodiversity studies are also conducted.

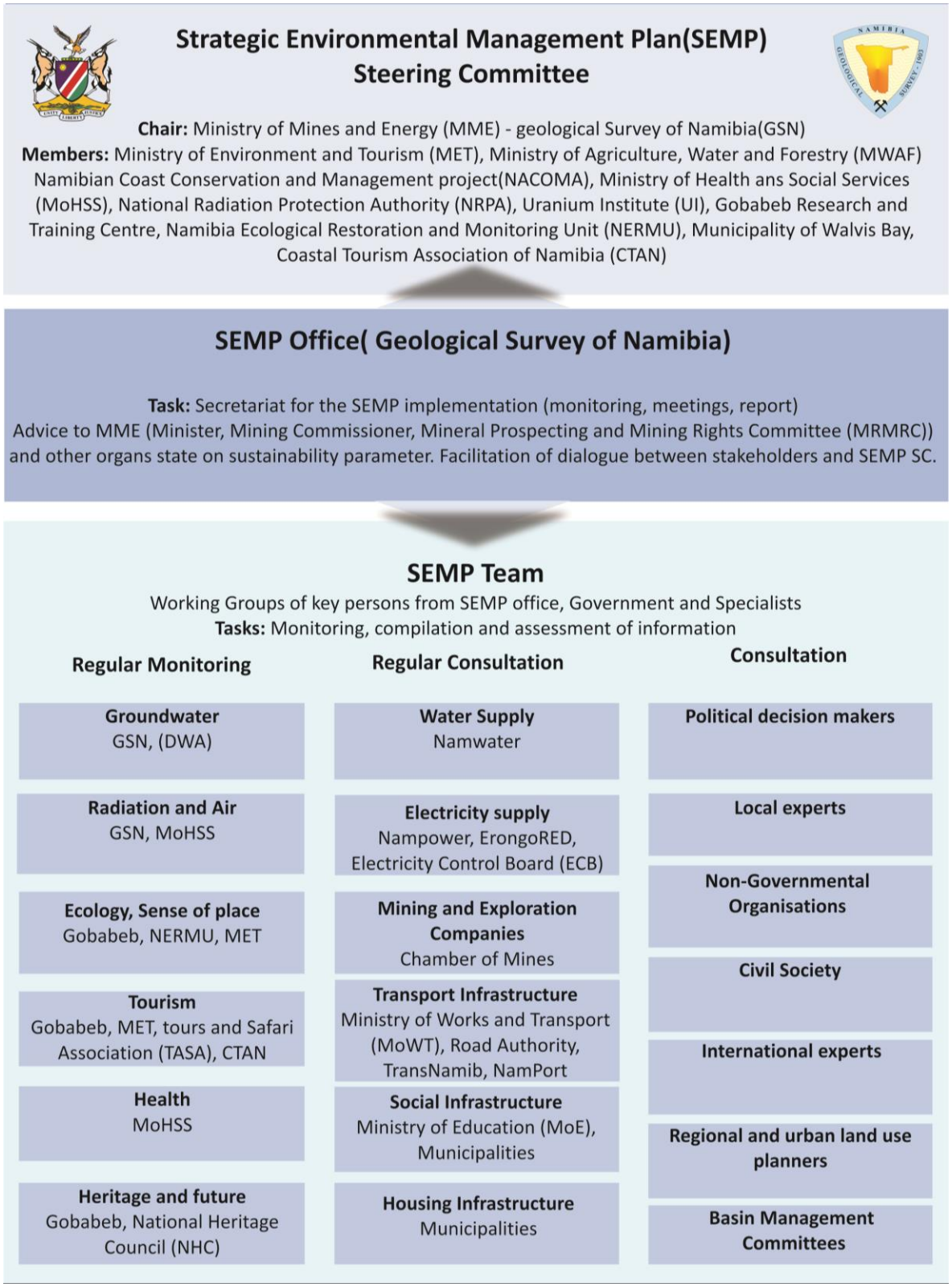

Figure 4: SEMP Governance structure

Uranium Mining Scenario in 2013

Mining and exploration companies operating in the central Namib

Namibia has two significant uranium mines capable of providing 10% of worlds mining output. The first Namibian commercial uranium mine, the Rössing Uranium Mine, began operating in 1976. Since then, uranium exploration to further define potential reserves and resources for economic development has been at the forefront of government**.** Rio Tinto's Rössing Uranium and Paladin's Langer Heinrich are currently Namibia's only two producing uranium mines, with production targets of up to 12 million pounds per annum (Table 1 and Table 2). A summary of measured and inferred uranium resources in Namibia is given in Table 1.

Table 1: Uranium resources of mines and exploration projects in Namibia (WNA Market Report, 2015)

	Deposit type	Known resources	
		Measured & indicated	Inferred
Rössing SJ	hard rock	25,866 tU in 0.02% ore**	2035 tU in 0.017% ore
Rössing Z20	hard rock	20,656 tU in 0.024% ore	25,354 tU in 0.022% ore
Langer Heinrich	palaeochannel	57,500 tU in 0.055% ore	9,200 tU in 0.06% ore
Trekkopje	palaeochannel	26,000 tU in <0.011% ore	3,000 tU in 0.01% ore
Husab (Rössing S)	hard rock	137,700 tU in 0.039% ore	50,000 tU in 0.029% ore
Norasa	hard rock	39,700 tU in 0.0167% ore	8,500 tU in 0.014% ore
Etango *	hard rock	57,330 tU in 0.019% ore	24,630 tU in 0.016% ore
Marenica	palaeochannel & hard rock	2500 tU in 0.010% ore	19,600 tU in 0.008% ore
Omahola	hard rock	10,400 tU in 0.036% ore	6950 tU in 0.036% ore
Tubas-TRS	aeolian	0	10,900 tU in 0.0125% ore

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

Table 2: Namibia Uranium Production - tonnes U ((WNA Market Report, 2015)

		2008	2009	2010	2011	2012	2013
Rössing	Rio Tinto	3449	3519	3083	2641	2289	2043
Langer Heinrich	Paladin	919	1108	1419	1437	1960	2098
Trekkopje	AREVA	0	0	0	0	251	186
Total					4078	4500	4327

The reserves of the Rössing uranium mine at the end of 2013 were 4,884 t U proven, and 35,275 t U probable, at 0.027% U in ore (calculated without allowing for 85% mill recovery). In 2013, resources for the Z20 orebody, south of the main pit, were quoted, with 46,274 t U at higher grades than the main orebody.

Paladin's Langer Heinrich is situated 50 km south-southeast of Rössing, in the Namib-Naukluft Park, and 80 km from the coast. It was bought by Paladin Resources Ltd (now Paladin Energy) in 2002. The open pit mine commenced operation late in 2006 with 1000 t U/year capacity. The ore occurs over 15 km in a palaeochannel system, some 50 m deep. The main ore mineral is carnotite. The plant comprises of a conventional hard rock mill with an alkaline leaching circuit.

The Husab ore body is situated about 5 km south of the Rössing mine. The Husab Uranium Mine, operated by Swakop Uranium, was acquired from the Australian-listed company Extract Resources at a cost of 19 billion Namibian dollars (US$ 2.1 billion) by the Chinese state-owned company Guangdong Nuclear Power Company (CGNPC) Uranium Resources Co. Ltd. with Epangelo Mining, the Namibian government-owned mining company as a strategic partner. Construction of the mine started at the end of 2012, first production is targeted for late 2015. The mine construction created 6,000 temporary jobs, and there will be 2,000 permanent jobs when the mine goes into full production. The mine, which is said to hold about 280 million tonnes of uranium ore and has a life of about 20 years, is expected to contribute to Namibia's gross domestic product by 5%. Husab will produce 15 million pounds (6,800 tonnes) uranium oxide per annum, more than twice the total current uranium production of Namibia.

AREVA Resources Namibia's Trekkopje mine, approximately 65 km north-east of Swakopmund, is another uranium project under development. AREVA plans to mine very low grade (0.012-0.015%) uranium resources, comprising of two adjacent palaeo-channel deposits (Klein Trekkopje being the main one) over an area about 16 km by 1 to 3 km. Due to the current low uranium price, the mine is at present under "Care and Maintenance" since October 2012. The Trekkopje mine nevertheless is a strategic asset for AREVA and the group will reassess the economic situation on a regular basis. AREVA's Erongo desalination plant is in operation and produces water for local industries and the supply of Swakopmund.

The Valencia Uranium Mine (now known as Norasa) is another uranium project which was granted a mining licence in 2008. The uraniferous alaskite deposit is found along strike from Rössing and 25 km northeast of Rössing Mine. Like the Trekkopje Mine, Norasa is expected to continue with additional exploration. Consolidated measured and indicated resource figures (October 2013, NI 43-101 compliant) are 39,700 t U at 0.0167% U with a 100 ppm cut-off at Valencia and 160 ppm at Namibplaas. This includes reserves of 35,000 t U at 0.017% U. Inferred resources are 8,500 tU at the same grade (WNA, 2015). The projected Valencia open pit will be 1,600 x 1,000 m and 450 m deep, with a small satellite pit adjacent to it.

Zhonghe Resources (Namibia) Development (PTY) LTD received a mining license in 2012. The main shareholders and investors are China Uranium Corporation Limited (CUC) (58%), a wholly owned subsidiary of China National Nuclear Corporation (CNNC), and a private enterprise, Namibia China Mineral Resources Investment and Development (PTY) LTD (Nam China) (42%). The Zhonghe licensing area is located in the Namib Desert, near the Rössing Uranium Mine and the Husab Project. The Zhonghe Project is expected to be an open pit mine, with the total project investment estimated at between US$ 600 million (N$ 5,4 billion) and US$ 700 million (N$ 6,3 billion). The company hopes to achieve a mine lifespan of around 10 to 15 years, at a production capacity of 700 to 1,000 tonnes of uranium per year.

A number of exploration companies, notably Bannerman Resources and Reptile Uranium, are still awaiting governmental approval to proceed with mining. Bannerman Resources applied for a mining license for its Etango Project with an estimated US$ 870 million capital cost for a mine and heap leach concentrate plant. Marenica Energy continued with its intensive metallurgical test work programme and made significant progress in the development of its proprietary.

The emerging projects offer the prospect of significant investment, direct and indirect job creation, infrastructure development and a contribution to the creation of wealth in Namibia. These new projects put Namibia in a position to become the second largest producer of uranium in the world.

Uranium market in 2013

All mineral commodity markets tend to be cyclical, and prices rise and fall substantially over the years. The reasons for fluctuation in mineral prices relate to demand and perceptions of scarcity. The price cannot indefinitely stay below the cost of production (

Figure 6), nor will it remain at very high levels for longer than it takes for new producers to enter the market and anxiety about supply to subside. Soft uranium prices (US$35/lb) have put a dent in the uranium market in 2013 (
Figure 7). Nevertheless, world production at 70,015 t U_3O_8 increased compared to the 68,864 t U_3O_8 produced in 2012; and Namibia's production was increased from 4,000 t to 4,323 t (WNA, 2015). Overall, the uranium industry performed below expectations (Scenario 1 as classified by the SEA). Under Scenario 1 (which only considers the existing mines plus the two under construction), Rössing and Langer Heinrich where the only operating mines. With continuous low uranium prices in 2013, Rössing/Rio Tinto announced both staff and cost reductions. Areva retrench 98 workers, additional retrenchment and other cost cutting initiatives where taken in most mining and exploration companies. On the positive side, the Husab mine, which contains the highest grades in Namibia, was officially opened in April 2013.

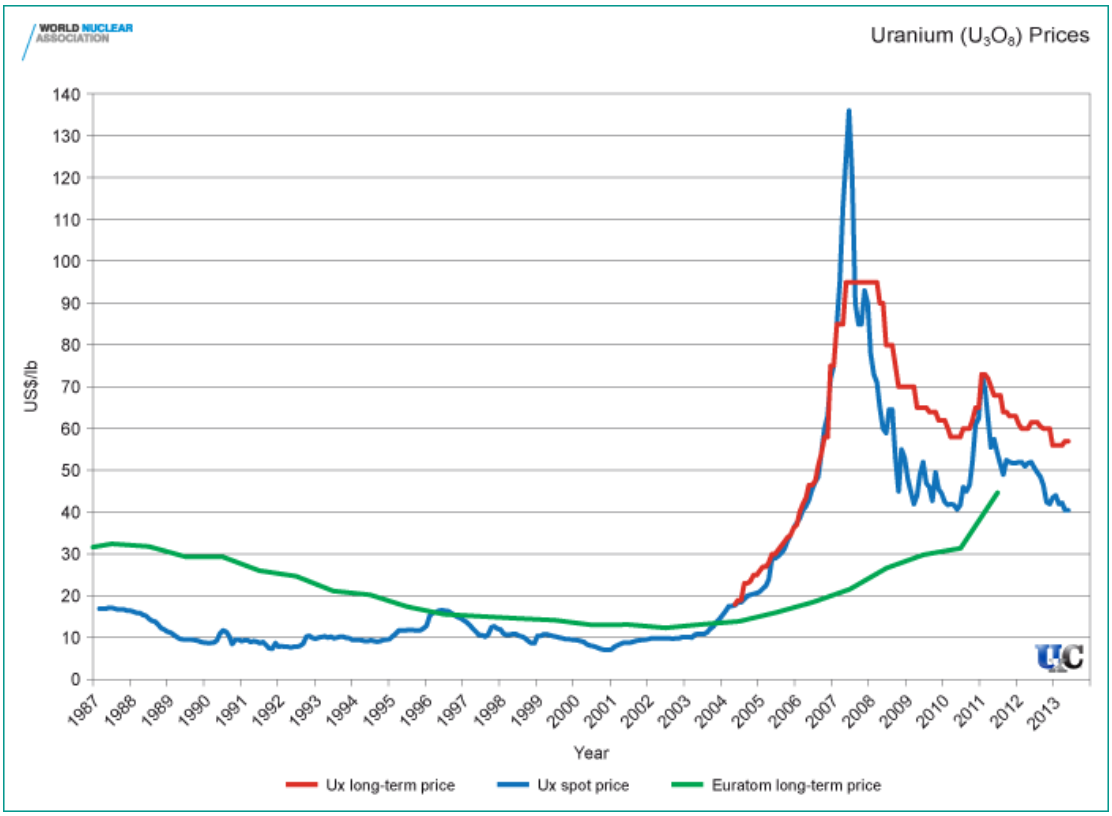

Figure 6: Uranium price trend (Source: WNA Market Report, 2015)

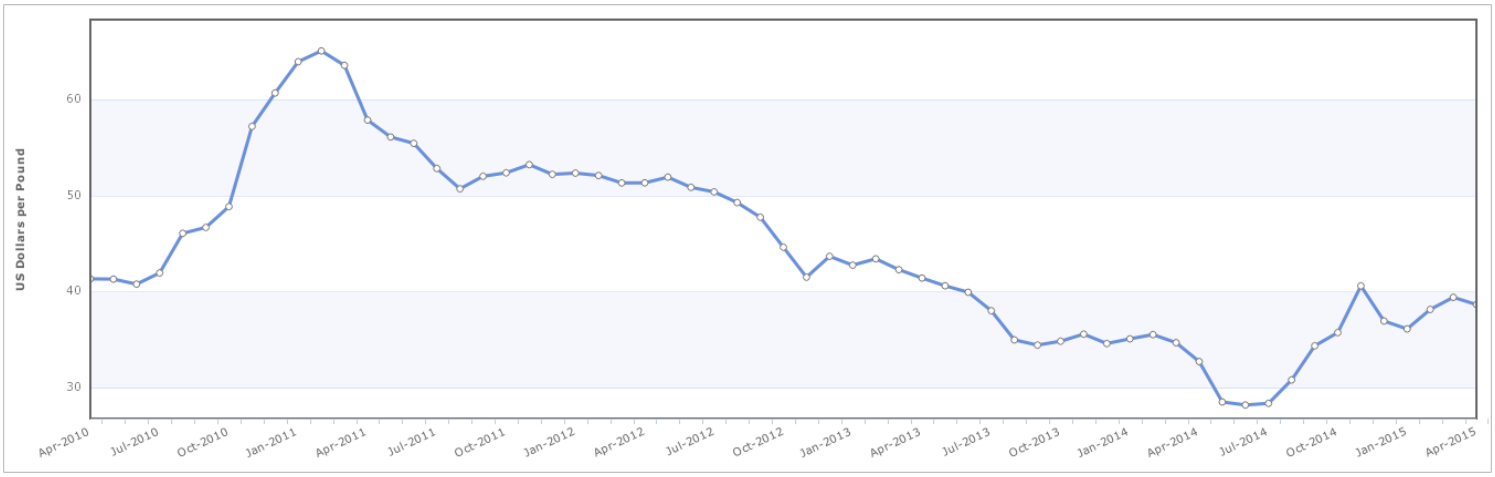

Figure 7: Uranium Monthly Price - US Dollars per Pound (Source http://www.indexmundi.com/commodities/?commodity=uranium&months=60)

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.

Preliminary statistics produced by the Namibia Statistics Agency (NSA) show that the mining sector performed moderately well in 2013 and contributed 9.3 percent to the country's Gross Domestic Product (GDP) in 2013, down from 10.8 percent in 2012 (http://www.chamberofmines.org.na/). The decline in contribution to GDP was largely a result of escalating input costs, depressed commodity prices and declining ore grades. Despite the decline in overall contribution by mining in 2013, significant investments were made, particularly in the development of three new mines in Namibia. In the Erongo Region it was the Husab Uranium mine. Chamber statistics show that Namibia's mining industry generated revenue of N$ 20.93 billion in 2013, a 13 % increase from 2012 which totalled N$ 18.51 billion. In 2012/13 (the latest year for which actual revenue as opposed to budget estimates are available), the Ministry of Finance (MoF) estimated that tax revenue from profits taxes on the mining industry amounted to approximately N$ 1 billion from diamond mining and N$ 16.8 million from other mining.

The Socio-Economic Development EQO measures the uranium industry's contribution to society in the Erongo Region and Namibia as a whole. The Socio-economic development in this case is measured with indicators such as royalties paid by the mines, corporate taxes paid in full, if inputs that can be sourced locally are not imported, and processing companies connected to uranium mines are not granted EPZ status. Several uranium projects have been delayed because of the depressed uranium market, which is a result of low global demand after the Fukushima incident, as stated in the Chamber of Mines of Namibia 2013 annual review. Nevertheless, Langer Heinrich reported record production during the year; they successfully achieved their stage 3 expansion nameplate production in 2013. After three years of operating loss, Rössing returned to profitability due to a wide ranging cost reduction exercise. Rössing produced a total of 2,409 t of uranium oxide, a 10.7% decrease from the production recorded in 2012. Areva continued its care and maintenance programme and will commence with operations at Trekkopje mine once market conditions improve. Swakop Uranium has announced that it is on schedule with the construction of the Husab mine. Once this mine is commissioned, Namibia will become the World's second largest uranium producer. Overall the Namibian mining sector generated N$ 11.3 billion of value added towards the country's GDP. Diamond mining delivering N$ 8.23 billion of the value added, while other mining and quarrying contributed N$ 3.07 billion to GDP.

Mining companies further support the local economy by acquisition of goods, services or works they procure from local sources. Avera Resources Namibia spent N$ 1,189 million on local goods and services in 2013. Goods and services worth N$ 613.5 million were purchased from Namibian businesses and companies by Langer Heinrich, of which N$ 26.7 million were purchased from previously disadvantaged Namibians. In 2013, Rössing Uranium spent N$ 2.2 billion on goods and services, of which N$ 1.4 billion were procured from Namibian registered suppliers. On 18 April 2013, Swakop Uranium announced its decision to forge ahead with the construction of the mine at an investment of N$ 20 billion, despite adverse conditions in the uranium market. The value of goods purchased from Namibian registered companies amounted to approximately N$ 3.5billion, about 45 % of the procurement value.

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**
Target 1.1.2.	**Royalties are paid in full by mining companies**
Data Source	**SEMP Office/MoF/NUA**
Status:	**MET**

In 2013, the two mines that are in operation paid the royalties presented below (Table 3). Mining royalties generally comprise of a percentage of the export value of the uranium. Royalties are only levied on the products sold. In a case where the mining company is not making taxable profits but exports large quantities of product, revenue is still generated through royalties.

Table 3: Royalties paid by the uranium mining companies in 2013

Company	Royalties paid in 2013 (N$)
AREVA Resources Namibia	0*
Langer Heinrich Mine	56 277 197
Rio Tinto Rössing	85 240 000

*AREVA Resources Namibia paid royalties in 2012 for the entire uranium production from the pilot testing phase. This included royalties on the batch of product that was exported in mid-2013.

Motivation of status: The producing uranium mines have paid their royalties hence this indicator is considered to be MET.

Indicator 1.1.2.1.	**Corporate taxes are paid in full by mines**
Data Source	**SEMP Office/MoF/NUA**
Status:	**MET**

This indicator is not applicable to exploration companies or (usually) mines under construction, although Swakop Uranium paid N$ 40.6 million corporate tax in 2013 (Table 4). Rössing Mine made a loss in 2013 and therefore is not required to pay company tax in such a situation (Table 4). The same applies to Langer Heinrich Mine (Table 4).

Table 4: Corporate taxes paid by the uranium mining companies and exploration in 2013

Company	Corporate taxes paid in 2013 (N$)
Langer Heinrich Mine	0
Rio Tinto Rössing	0
Swakop Uranium	40 629 582

Motivation of status: Although none of the operating mines paid corporate taxes, this indicator is regarded as MET because the operating mines made a loss in 2013, and were therefore not required to pay tax.

Indicator 1.1.2.2.	Increasingly, inputs that can be sourced locally are not imported.			
Data Source	NUA			
Status:			MET	

The indicator measured local procurement within Namibia as a percentage of a company's total procurement. The table below highlights the percentage of goods procured locally by mines and exploration companies in 2013 (Table 5).

Table 5: Percentages of local procurement of goods and services by the uranium mining industry

Company	Local procurement of goods and services (as % of total procurement)		
	2013	2012	2011
Rio Tinto Rössing	**64%**	**63%**	**63%**
Langer Heinrich Mine	**78.1%**	**85.6%**	**56.5%**
Valencia Uranium mine	74.2%	89.1%	93.7%
Swakop Uranium	45%	0	0
Bannerman Resources Namibia	99%	100%	28%
AREVA Resources Namibia	65.8%	52.7%	43.8%
Reptile Uranium Namibia	88.7%	97.0%	97.0%
Marenica	N/A	N/A	N/A

Rössing has spent significant amounts on local procurement, ranging from N$ 1.7 billion in 2011 to N$ 1.5 billion in 2012 and N$ 1.2 billion in 2013. The share of local purchasing increased slightly from 63% to 64% in 2013.The figures for AREVA have been rising because they include payments related to the desalination plant. Bannerman reported that the 1% of costs for international procurement in 2013 related to training and bursary costs incurred. The high percentage for Langer Heinrich in 2012 was due to the phase 3 extension project. Marenica is still in the exploration phase and not required to provide figures. The philosophy of the company is to source goods and services locally and only specialist goods and services not available locally will be obtained from foreign sources. Swakop Uranium's remark for 2011 and 2012 was: No expenditure under Operations in 2011 and 2012. The figures for Valencia Uranium Uranium exclude salaries, bursaries and social/community programs. A high percentage of Valencia's expenditures for 2011 and 2012 were drilling contracts to Namibian-registered companies, while the majority of non-Namibian expenditure in 2013 was for technical consultants.

Motivation of status: Only operational mines are required to comply with this indicator, namely Langer Heinrich mine and Rössing mine. Although there was a 1% increase in the Rössing Mine procurement, Langer Heinrich Mine procurement has decreased. This this indicator is nevertheless MET.

Indicator 1.1.2.3.	Processing companies connected to uranium mines are not granted EPZ status.			
Data Source	SEMP Office			
Status:			MET	

There was no EPZ status awarded to a uranium mine

Motivation of status: This is indicator is MET as there was no uranium mines granted an EPZ status.

************************** * * * * * * * * * * * **************************

Summary of performance: EQO 1

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

Overall performance: For the past reporting years, the Socio-Economic EQO's performance is exceptional (100%).

EQO 2. Employment

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

In 2013, mining and exploration companies collectively employed 7,582 people in permanent positions. The total direct employment including temporary employees and full time contractors was 16,709; which is 1,571 more jobs than in 2012. Although mining is not the largest employer, this is a very significant contribution given Namibia's small population and its high level of unemployment, which has recently increased by 2.2% to 29.6% in 2013 (NSA, 2014 and CoM, 2014). In 2013, the uranium industry has experienced challenging times, mainly because of global influences. The uranium industry has provided about 1,940 permanent jobs, which is a decrease compared to 2012. The uranium price continued to decline globally, putting substantial pressure on mining and exploration. Consequently, severe cost-cutting initiatives including retrenchment where executed to ensure continuous operations.

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

All operational mines reported that they complied with the Employment Equity (Affirmative Action) Act and received a certificate for 2013. Exploration companies also reported that they were in possession of certificates, except for Reptile Uranium. Reptile ceased to be a relevant employer in September 2013 following collective retrenchment. The Employment Equity Commissioner was notified on 10 September 2013. The remaining employee numbers at the end of 2013 are shown in brackets in the table below. Bannerman Resources is not a relevant employer any longer but has decided to continue submitting an affirmative action plan and has received a certificate. The table shows the number of persons employed by the Namibian Uranium Association (NUA) member companies (Table 6).

Table 6: Uranium mines and Exploration Company's permanent workforce for 2013

Company	Employment statistics 2013						
	Total men	Total women	Non-Namibian men	Non-Namibian women	Previously disadvantaged men	Previously disadvantaged women	Disabled persons
AREVA	35	11	1	1	28	6	0
Bannerman	4	2	0	0	2	2	0
Langer Heinrich	317	85	6	1	273	77	0
Marenica	5	1	1	0	3	1	0
Reptile	25 (14)	7 (7)	0 (0)	1 (1)	21 (11)	3 (3)	3
Rössing	1141	168	18	0	904	156	1
Swakop Uranium	89	18	41	5	44	9	0
Valencia Uranium	26	4	2	0	22	4	0

Previous SEMP reports did not state whether the mines' contractors complied with this target as well. This question was included in the survey for the first time and in response, AREVA and Rössing reported that their contractors had AA certificates for 2013, while Langer Heinrich and Swakop Uranium did not have the information available. Table 7 below shows how many contractors were employed at various mines in 2013. Bannerman, Marenica and Valencia Uranium did not employ any contractors. Figures from January to April 2013 for Swakop Uranium where not recorded.

Table 7: Uranium mines and Exploration Company's contractor workforce for 2013

Month	**Number of contractor employees**				
	AREVA	**LHM**	**RUL**	**Reptile**	**Swakop U**
Jan	795	700	605	40	Not recorded
Feb	783	697	626	38	Not recorded
Mar	447	730	584	40	Not recorded
Apr	326	747	565	46	Not recorded
May	152	764	543	48	706
Jun	147	767	558	46	923
Jul	115	779	566	16	1125
Aug	121	759	618	16	1377
Sep	93	770	631	16	1790
Oct	93	762	671	16	1875
Nov	93	747	600	16	2174
Dec	93	746	587	11	2255

Due to the poor performance of the uranium market companies were forced to retrench a significant number of employees in 2013. The graph below shows the statistics (Figure 8).

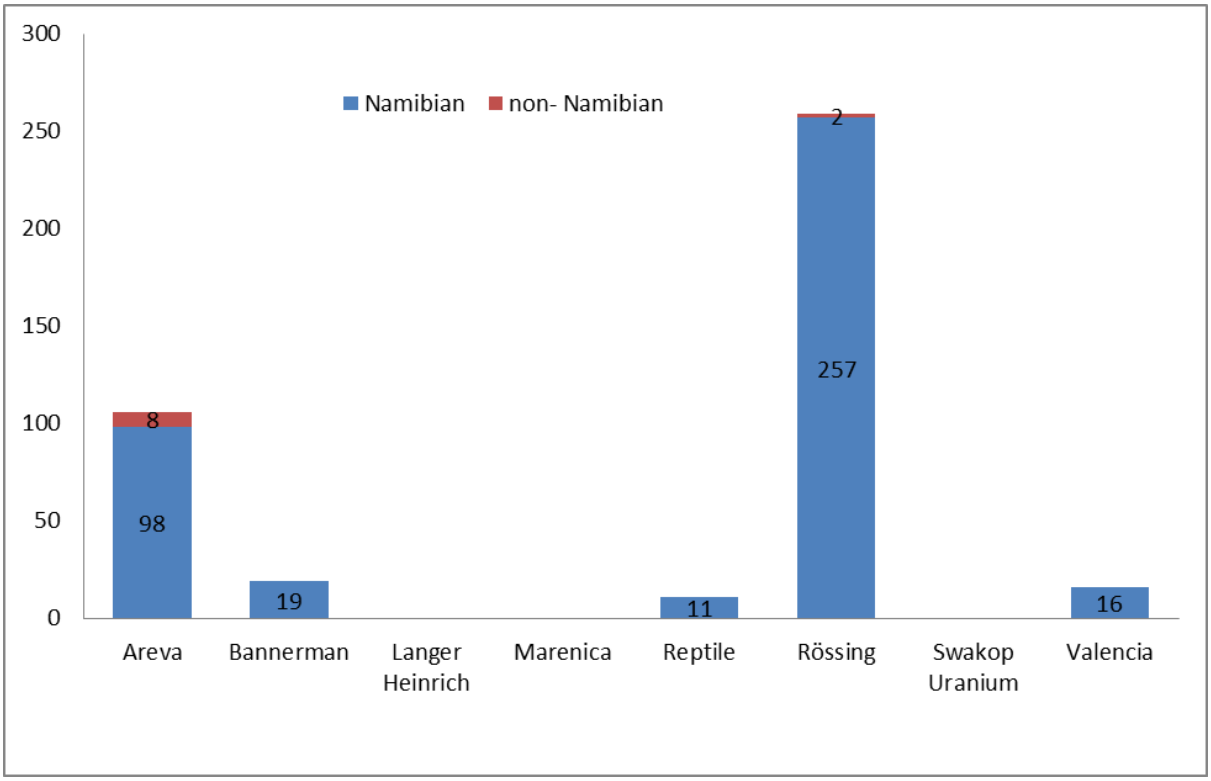

Figure 8: Uranium Mines and Exploration retrenchment statistics for 2013

The majority of the retrenched workers were Namibian citizens because most companies employ over 90% locals (Figure 8). AREVA had a minor percentage of expatriates who were all retrenched when Trekkopje Mine was placed under care and maintenance. Rössing retrenched 259 employees in 2013 and a similar number in 2012. In both cases the retrenchment process was agreed with the Mineworkers Union of Namibia (MUN) and followed the provisions of the 2007 Labour Act.

Motivation of status: All mines and exploration companies have received their AA certificates and therefore this indicator is MET.

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Summary of performance: EQO 2				
Total no. indicators assessed				
	NOT MET	**IN PROGRESS**	**MET**	**EXCEEDED**
Number of indicators in class	0	0	1	0
Percentage of indicators in class	0%	0%	100%	0%
Overall performance: For past reporting years, this EQO remain to be fully MET				

EQO 3. Infrastructure

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

Infrastructure development is a vital component in encouraging a country's economic growth. Developing infrastructure enhances a country's productivity, transportation and communication. It is therefore in the best interest of Namibia to provide an enabling infrastructure environment for the Uranium and associated industries. Amongst these infrastructure developments we count good social services and amenities, water and electricity supply and a safe transportation system. The aim of this 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 environmental impacts.

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

Indicators 3.1.1.1 and 3.1.1.2 are closely related and therefore assessed together. Besides the temporary construction village at the Husab Mine, none of the mines have or plan to have mine only townships. All employees of the uranium mines live in proclaimed towns mainly in Swakopmund, Walvis Bay and Arandis. Additionally, exploration companies reported that their employees will live in existing towns and no company housing developments are planned. Valencia Uranium Mine however plans to provide operational staff with accommodation near site while they are on-shift only and will assist with transport to and from their homes during their off periods.

Motivation of status: Indicators 3.1.1.1 and 3.1.1.1.2 are MET because there are no mine only townships created.

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

The Roads Authority has reported that the main utilised gravel roads M36 (C14), M52 (C28), and M44 (C34), are graded timeously to avoid deterioration (Mr. Michael Greeff, as per comm).

Motivation of status: There is no report of road deterioration of the gravel roads used. This indicator is MET.

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

The Roads Authority (RA) office has reported that there are plans to tar the gravel road MR 36 (C14) hopefully in 2017. However, data on traffic volumes was not available for full assessment.

Motivation of status: There are future plans to upgrade MR36 (C14) but the implementation has not commenced. This indicator is therefore IN PROGRESS

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

The Roads Authority (RA) has reported that the B2 tar road is free of pot-holes and crumbling verges (Roads Authority, as per com).

Motivation of status: This indicator is assessed as MET.

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

At this stage RA is busy replacing all the road signs at the coast. All the tarred roads are scheduled to be repainted before the end of 2015. In general, road marking and signage in the central Namib are in place and in good condition.

Motivation of status: Road signage and marking are in place and in good condition, this indicator is therefore MET.

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

The MR44 is not tarred although plans have been made to get it tarred (Michael Greef,RA, pers. comm.). The previous SEMP reports stated that a feasibility study to upgrade the Walvis Bay – Swakopmund road to Bitumen Standard was completed and the preliminary design of the road was finalised during April and May 2013. The Roads Authority has also approved a dual carriage way to be constructed along the MR44, plans are far advanced and the road is expected to be constructed in the next five years (Andre Brummer, Walvis Bay Municiplaity, per comm).

Motivation of status: Since the project to upgrade the road in question is in progress, 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**
Data Source	**SEMP Office/RA**
Status:	**NOT MET**

RA stated that the traffic on the B2 coastal road comprises 70% light vehicles, and that the heavy vehicles B2 road utilisation increases yearly.

Motivation of status: The utilisation of the coastal B2 road by light vehicle is less than 90%, this indicator is NOT MET.

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

The uranium companies have reported that they keep their vehicles in roadworthy condition and that they are regularly serviced to prevent accidents and breakdowns. Additionally, companies give induction on site traffic rules to their employees and contractors to ensure compliance with speed limits and prohibition of off-road driving. The observance of speed limits is also monitored by means of satellite tracking devices installed in company vehicles. The SEMP Steering Committee recommended in 2013 that permanent contractors who drive on tourist roads and in the national park should also have these devices installed. Feedback on this topic will be collected in the 2014 SEMP report.

Bannerman Resources Namibia 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. Valencia Uranium does not use any Roads Authority gravel roads, but has constructed a private gravel road (28 km) from the B2 to site. Part of the road is available to tourists into the Khan River valley at their own risk. Valencia Uranium maintains the road through regular grading and repairs following heavy rainstorms (if required).

Motivation of status: 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 therefore MET.

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

Rössing and Langer Heinrich mines receive their bulk reagents transported by rail and by road as shown in (Table 8) below. Since there is no rail connection to Langer Heinrich Mine, only Rössing Mine is considered. The overall share of rail transport was 86.4% and the target of 80% was thus exceeded.

Table 8: Weight of goods transported by rail and roads

Company	Tonnes by		Remarks on use of rail transport
	Rail	Road	
Langer Heinrich	0	108,579	No existing railway nearby and new construction found to be prohibitively expensive
Rio Tinto Rössing	230,763	36,204	Uses rail for all bulk reagents and diesel

Furthermore, the Husab Mine has carried out an engineering study for a new railway line from Walvis Bay across the Swakop River for the transportation of bulk materials such as diesel and reagents to the mine. Since the cost estimate for this route was N$ 1.2 billion, the company looked for a more economical solution that could combine the road and rail across the Khan River, consequently resulting in an ideal infrastructure corridor. The study showed that, while it would be feasible to construct a new railway line, it would not be economical because of the steep gradients leading to the Khan River. It was thus decided to abandon the railway option and only provide for a proper tar road to connect Husab Mine with the national road network (Chamber of Mines Newsletter August 2014, pg. 10).

Motivation of status: Rössing is the only mine that is connected to the rail system. The overall share of rail transport was 86.4%. This indicator is 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**			
	NOT MET			
Indicator 3.4.1.3.	**No oil/chemicals/contaminants/sewerage spills enter the Ramsar site**			
Data Source	**Namport**			
Status:			**MET**	

The Cargo Container NAMPORT Office did not give information on indicators 3.4.1.1.1 and 3.4.1.3.

There were no oil, chemicals, contaminant and sewerage spills that entered the Ramsar site (Tim Eimann, Namport, pers. comm). Namport abide to best practice when dealing with potential sewerage spill or seepage sources. They constantly survey and monitor contaminants, oil and chemicals to ensure that the mentioned harmful substances are prevented from entering the Ramsar site. In the odd event that it does happen, it is appropriately dealt with according Namport's contingency plans in an ecologically friendly manner (Tim Eimann, Namport, pers. comm).

Motivation of status: Indicators 3.4.1.1 and 3.4.1.2 are NOT MET because NAMPORT did not give data for the indicators. Active measures are taken to ensure that no oil, chemicals, contaminants and sewerage spills enter the Ramsar site, therefore indicator 3.4.1.2 is 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:			**MET**	
Indicator 3.5.1.5.	**Electricity provision does not compromise human health**			
Data Source	**SEMP Office/Nampower/NUA**			
Status:			**MET**	

The following indicators 3.5.1.1, 3.5.1.2, 3.5.1.3, 3.5.1.4, 3.5.1.5, are discussed and assessed together.

NamPower has reported that high standards of technical excellence continued to be achieved through innovation, customer focus and proactivity. No total system blackouts were experienced during the period under review in Erongo Region. Although the electricity supply industry in Namibia continues to operate under difficult conditions, Nampower did not report disruptions in electricity supply as a result of the uranium rush.

Erongo RED in particular is challenged by supplying and distributing electricity at a reasonable rate while the cost of bringing this service is always increasing. The backlog is on the aging infrastructure that needs maintenance and refurbishment and keeping up with the demand for electricity and security of supply. The Erongo Red Annual Report 2012/2013 states Walvis Bay and Swakopmund load demand to have greatly increased due to industrial and residential activities. As a result, Erongo RED and NamPower have embarked on a joint project to increase the Existing Firm Capacity of 30 MVA (N-1) to 80 MVA (N-1) in Walvis Bay. This upgrade is scheduled to be partially completed by the 4th Quarter of 2015. In Swakopmund, Erongo RED has also appointed a local contractor for the construction of a new Intake Sub Station building to the tune of N$ 4.6 million. Additionally, Erongo RED is in the process of appointing an electrical contractor for the completion of the substation equipment that is expected to be completed during June 2015. This project will strengthen the supply to the town of Swakopmund. Following successful negotiations with the Erongo regional electricity distributor on an increased supply capacity to Walvis Bay, an investment decision was taken to upgrade the main Kuiseb GIS substation from 66 to 132 kV, construct two 132 kV lines from Kuiseb to Walvis Bay, and build a new 132/11 kV GIS substation at Walvis Bay. In addition to the scheduled upgrade, Erongo RED also recently completed the installation of street lights along the Swakopmund/ Henties Bay road to the value of N$ 883,705. Under the Electrification Project, Erongo RED has completed the electrification of 20 houses in the Omdel Residential Area of Henties Bay to the value of N$ 294,000. Similar projects are planned to be undertaken in Uis, Omaruru, Usakos and Karibib in the 2013-2014 Financial Year. Usakos Project – Erongo RED installed two high mast lights in the Hakhaseb Township in order to provide lighting for the community and to make it safer for residents. Land Development Fund – Erongo RED partnered with the Swakopmund and Henties Bay Municipalities to jointly provide services to Extension 10 Phase 2 and Omdel Extension 3

respectively. Based on this it is evident that the public does not suffer disruptions in electricity supply as a result of the Uranium Rush.

The negotiations between the new Husab Mine and NamPower as stated in the 2013 Nampower annual report concluded to supply Husab with a 50MW, proofing that no investment decision are being deferred because of electricity unavailability. This necessitates the construction of a new 220 kV line from Khan to Lithops, a new 220/132 kV substation near Husab, a 220 kV line from Walmund to Kuiseb and two 132 kV lines from Lithops to Husab. A temporary 132 kV supply will already be provided in 2013, whereas the main supply will only be made available in 2014.

The Electricity Control Board (ECB) embarked on a consultative process in 2004 for determining appropriate standards governing the quality of electricity supply and quality of service (QOSS) provided by licensed electricity undertakings in Namibia. The key objective of the process was to involve all relevant stakeholders to the maximum possible extent and to come up with standards that are applicable to and can be implemented in Namibia. The ECB Annual Report for 2013 states that zero load shedding experienced in the Namibia ESI to date and that the Namibia electricity sector has done exceptionally well in comparison with other players in the SADC region and beyond. Additionally, Nampower won an ESI Award for the best power quality management system and ERONGO RED won an ESI Award for the least number of customer complaints (ECB, pers. comm.). This further proves that ECB is well aware and provides for the uranium industry's power needs. Even though the electricity industry performed well, the power supply situation is currently critical and is expected to remain as such until the Kudu Gas Power Plant comes on stream in 2018. The country's current maximum (peak) demand is estimated at about 534 MW and grows by 4% annually.

The last indicator in this section analyses the electricity provision and its effects on human health. The 2012 SEMP report focused on the impacts on human health assessed in EIAs. In the absence of an impact assessment for Van Eck it is was not possible to draw conclusions on this indicator for the year 2012. The SEMP Steering Committee was advised to discuss if and how this indicator can be measured in the future. Assessment for this indicator focuses on the impact of electricity production on the environment and the safety aspects.

The safety of the company's employees, contractors and visitors remains a top priority at NamPower. During the year under review, no fatalities, and only 14 lost-time injuries were recorded as compared to 11 lost-time injuries in the previous financial year ending June 2012. Over 80 internal safety audits and inspections were conducted, with no major safety non-conformances recorded. There were no work site shutdowns. Numerous in-house safety training courses were presented. The NamPower 2013 annual report states that its environmental section carried out 54 internal inspections and audits over the past year at various work areas. Though some minor non-conformances were identified, no major issues were identified. The section also developed several new policies and procedures, including the sensitive area of herbicide application. The section also actively participated in the National Biodiversity Working Group, the National Climate Change Committee, and the Southern Africa Power Pool Environmental Sub-Committee.

NamPower's mandate as expressed in the licenses it holds under the Electricity Act of 2007 is to generate, transmit, supply and trade electricity, while also exporting, importing and to a limited extent distributing it. In order to fulfil its mandate and to meet the anticipated increase in electricity demand, NamPower has embarked on the development of the 800 MW Kudu gas-to-power station near Oranjemund and on upgrading transmission lines across the country. Although Nampower is performing well in supplying power to the nation; Namibia's electricity supply-demand balance will remain tight over the next few years.

Motivation of status: NamPower reported no disruptions in electricity supply as a result of the uranium mining. There was no evidence that industrial development was delayed by electricity

shortage or that investment decisions were deferred because of electricity unavailability. Based on the praises from ECB it is clear that the electricity quality of supply meets ECB standards. The above indicators are MET.

Indicator 3.5.1.6.	**Mines pursue renewable power supply options as far as possible.**			
Data Source	**NUA/Nampower**			
Status:		**IN PROGRESS**		

NamPower recognizes the importance of sustainable operations to society. The company is guided by international and national objectives such as Vision 2030 and their mission statement to facilitate the energy needs of Namibia without compromising future generations (NamPower, 2013). NamPower has created a Renewable Energy section and launched the Renewable Energy Policy aimed at sourcing at least 10% of the energy mix from renewables other than hydro. A number of consequent projects are in various stages of development, covering wind, biomass and solar resources. Early examples include the Tsumkwe Photovoltaics (PV)/Diesel Hybrid (200 kW of PV) plant and the Net Metering (64 kW) PV system at NamPower's head office in Windhoek. NamPower seeks to investigate the building of a hybridized power plant combining biomass with solar to increase output and improve plant performance. Cooperative work has also yielded benefits with 26 kW tracking Concentrated Photovoltaics (CPV) installed by Soitec at Usib (Rehoboth). These projects utilise the latest technology to provide NamPower with data and operational experience of a "hands on" nature (NamPower, 2013).

Some of the uranium companies are investigating or have implemented renewable power supply options, but mostly on a small scale. At Trekkopje Mine, a project to investigate the feasibility of a large photovoltaic power station has started in 2013. Langer Heinrich Mine had high-level discussions with various parties and has installed solar panels at the remote access control gate, mine-site turnstiles, and the lights at the entrance. Additionally, energy-saving lights were installed in the plant and further renewable energy opportunities are investigated on an ongoing basis. Studies on alternative power supply options at Rössing Mine concluded that solar power generation was technically feasible but prohibitively expensive. However, solar power supply has been implemented at some production boreholes and environmental monitoring stations.

Motivation of status: Because of efforts by the mining companies to pursue renewable power supply, this indicator is IN PROGESS.

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**			
Data Source	**Municipality of WB and Swakop**			
Status:			**MET**	

The Walvis Bay (WB) landfill site has and will have adequate capacity for the next 35 years. The existing Sewage Treatment Plant in WB is running near its capacity of 8000 m^3/day. They have already appointed consultants to advise them on the increase in capacity of the current works, and have started with the design of the new works, which are envisaged to be up and running by 2018. The Swakopmund landfill site only handles general waste but not hazardous waste. All hazardous

waste is being transported to the Walvis Bay landfill which has the capacity to handle hazardous waste from Swakopmund, Arandis and Henties Bay. The Swakopmund landfill site has a capacity of ± 35 years more to come. The construction of a material recovery facility at the landfill in order to reduce the impact of waste entering the landfill in the future is in the pipeline.

Motivation of status: The indicator is assessed as MET because Walvis Bay has adequate capacity for waste disposal sites and new works are expected to be completed in 2018. The Swakopmund landfill site has a life capacity of ± 35 years more to come.

Indicator 3.6.1.2.	**Independent audits are undertaken for waste sites**			
Data Source	**Municipality of WB and Swakop**			
Status:	**NOT MET**			

Generally, there are no audits being undertaken for waste sites. For the reporting there were no independent audits done for the Walvis Bay (WB) site. Auditing was conducted at the Swakopmund site but only on solid waste.

Motivation of status: Auditing was conducted at the Swakopmund site but only on solid waste and none was done for Walvis Bay. The 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**			
Data Source	**Municipality of WB and Swakop**			
Status:		**IN PROGRESS**		

Walvis Bay has applied for an operating license from the Ministry of Environment and Tourism. At the time the Swakopmund landfill site was constructed, the regulation was not yet in place, as it only came into force in February 2012. However, the landfill has a licence (pers. comm. Swakopmund Municipality).

Motivation of status: The regulation to obtain a licence before waste site construction and operation has only been enacted in February 2012; therefore the Walvis Bay and Swakopmund Municipality did not require a licence. The Swakopmund landfill has a licence and Walvis Bay Municipality has applied. This indicator is therefore IN PROGRESS.

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

The Walvis Bay Municipality has a Hazardous Waste Inspector who is in charge of the Walvis Bay site. He has undergone extensive training in landfill and hazardous waste operations. The landfill of Swakopmund is being managed by Enviro-Fill on behalf of the Swakopmund Town Council. The company has an operational manager responsible for the entire management of the site and oversights staff training. Overall, the landfill is properly managed.

Motivation of status: This indicator is MET as the manager for the Walvis Bay and Swakopmund Municipalities are adequately trained.

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

All waste is weighed at the weighbridge and records are kept of all waste entering the Walvis Bay landfill site on a daily basis.

Motivation of status: The Walvis Bay Municipality has records of all waste entering its landfill sites daily but Swakop does not have. The indicator is therefore IN PROGRESS.

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

No hazardous waste is dumped at the Walvis Bay hazardous waste site unless pre-approved by the Hazardous Water Inspector (HWI). Certificates are issued to clients on request. Only hazardous waste acceptable for the Walvis Bay site is allowed. No hazardous wastes are disposed of at the Swakopmund site.

Motivation of status: No hazardous waste is dumped at the WB hazardous waste site unless pre-approved by the HWI, the indicator is therefore MET.

Indicator 3.7.1.4.	**Water and air quality monitoring data at waste disposal sites show no non-compliance readings**			
Data Source	**Municipality of Walvis Bay and Swakop**			
Status:	**NOT MET**			

No specific monitoring is done on water and air quality at the Walvis Bay waste disposal site. Generally mmunicipalities do not monitor water and air quality at waste disposal sites, because there is no legal requirement to do so and no standards set and it is therefore impossible to identify non-compliance.

Motivation of status: Indicator is NOT MET because no water and air quality monitoring is being done at the Walvis Bay waste disposal sites.

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

Sufficient budget is available and the Walvis Bay solid waste section operates on a break-even budget. Swakopmund reported that their yearly budget is always sufficient for their waste management programs.

Motivation of status: The indicator is MET for the Walvis Bay and the Swakopmund Municipalities.

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:		**IN PROGRESS**		
Indicator 3.7.2.3.	**Complies with approved EMP**			
Status:		**IN PROGRESS**		
Indicator 3.7.2.4.	**Complies with approved closure plan**			
Data Source	**Municipality of Walvis Bay and Swakop/DWAF/NRPA/MET**			
Status:		**IN PROGRESS**		

The indicators under target 3.7.2 have replaced the old indicator 3.7.1.6 "Tailings management in compliance with permit conditions". The current indicators apply to operating mines or mines under development where mineral waste has been produced. Excluded are exploration companies where the only mineral waste produced consists of drill cuttings. The assessments of these indicators are as follows.

Assessment for **indicator 3.7.2.1**:

AREVA reported that the DWAF permit for the pilot testing phase did not prescribe any conditions related to mineral waste management. However, DWAF corrected that such provisions would be included in the permit for the AREVA's operational phase. Langer Heinrich Mine and Rössing Mine where both in compliance with the waste water and effluent discharge exemption permit conditions granted by DWAF. Their operation captures and returns tailings seepage into the processing plant where it is recycled (for LHM) and at Rössing, reused in the processing plant to prevent contamination of the Khan River.

Assessment for **indicator 3.7.2.2**:

The National Radiation Protection Authority (NRPA) requires all companies that deal with radioactive materials as per a Radiation Management Plan (RMP). Compliance with NRPA regulations can therefore be measured in terms of implementation of the approved RMP and feedback from NRPA inspections. AREVA Resources Namibia carried out waste rock and tailings management as described in the RMP. The NRPA inspected Trekkopje Mine in August 2013 and did not record any non-conformances. There were no inspections conducted at Langer Heinrich Mine, but LHM operated their waste rock and tailings as per operational management plan. Rössing Mine reports annually on mineral waste management to the NRPA and there was no non-conformance reported in 2013.

Assessment for **indicator 3.7.2.3**:

The NUA confirmed that relevant companies had updated their EMPs in 2012 and obtained new environmental clearances as required by the Environmental Management Act from the Ministry of Environment and Tourism. Though the Ministry of Environment and Tourism did not inspect the mines in 2013 to check for compliance with their EMP, the companies employed consultants to carry out third-party audits and reported their results to the ministry.

Table 9 below provides information on the most significant environmental effects of mineral waste disposal at uranium mines that have been identified in EIAs and are addressed in EMPs. Mining companies apply the mitigation hierarchy in managing environmental impacts, which aims to

- avoid impacts;
- reduce / minimize impacts that cannot be avoided;
- rehabilitate (if possible) the impacts; and
- offset residual impacts (i.e. impacts that could not be rehabilitated).
-

Table 9 also includes a summary of remedial measures that can be taken to mitigate impacts, though the options implemented by each company depend on the site-specific risk assessment. Rössing Mine has provided the following main mitigation actions as an example:

- Seepage from the tailings facility is managed by means of avoidance: no discharge and possible contamination of the Khan River is allowed (e.g. impoundment, cut-off trenches, abstraction and dewatering and monitoring).
- Mitigation measures are in place to suppress dust from vehicular movements (e.g. spray of brackish water), to reduce dust erosion of the tailings facility (e.g. wind rows), and to minimize dust from the crushers (e.g. dust extractors). To avoid dust dispersal furthermore, blasting and crushing are prevented during windy conditions.
- For the prevention of adverse impacts on biodiversity, land clearance and disturbance is minimized, and access onto land is restricted to prevent illegal activities (e.g. poaching, plant collection, vandalism, and unauthorized entry into the Namib Naukluft Park).
- For the prevention of soil and groundwater contamination, waste is separated at source. Hazardous waste is contained and disposed in approved facilities while domestic waste is disposed at a landfill on site. Contractors remove recyclable waste (scrap metal, plastic, wood, paper, conveyor belting and used oil) from the site.
- Management of radiation safety at Rössing is carried out according to the Radiation Management Plan, which has been approved by the NRPA.

Table 9: Environmental Impacts caused by local mines in Erongo and associated mitigation measures taken.

Impact	Mitigation
Seepage from spent leach heaps	Double liner on pads and storm water/seepage collection system
Radionuclide contamination of surface water	Diversion of water courses around mineral waste facilities
Radionuclide contamination of groundwater	Capping of tailings to prevent rainwater infiltration
Dust-borne radionuclides	Capping of tailings to prevent wind erosion
Radon emanation	Capping of tailings to reduce radon emanation, modelling of public health risk to design cover and confirm its effectiveness

Indicator 3.7.2.4: In the absence of national mine closure legislation, mining companies prepare their closure plans based on the Chamber of Mines Namibian Mine Closure Framework (refer to EQO 12). Current practice dictates that initial closure plans are included in the EMP and are thus approved by MET/DEA when an environmental clearance is granted. More detailed plans are prepared in consultation with stakeholders and updated during mine operation. At this stage, it is not possible to say if the industry fully complies with this indicator because no mine has closed. Langer Heinrich Mine is however doing progressive rehabilitation; the rehabilitation on Tailing Storage Facility TSF #2 has commenced in October 2013. All companies have been asked whether

mineral waste management was included in the closure plan and whether the envisaged measures had been approved by government agencies.

AREVA reported for Trekkopje Mine that mineral waste management after mine closure was described in the approved EMP (2012) and the closure plan, which had not yet been presented to government. Waste rock and tailings will be backfilled into the open pit and the tailings will be capped with overburden to reduce radon exhalation and infiltration of rain water.

Langer Heinrich's mineral waste management is described in the approved EMP that was submitted to government in 2012. In this EMP commitments have been made for the different phases (construction, operational and closure) of the life-of-mine. As far as possible, waste rock and tailings material will be backfilled into mined-out pits. Permanent above-ground waste facilities and stockpiles will be rehabilitated in a manner that they present landforms that have similar safety attributes to the natural landforms in the area. In this regard, structures will be stable, protected from flood damage, and steep slopes will be contoured where possible. Tailings seepage will continue to be controlled by the pumping system.

According to the approved Rössing Mine closure plan, mineral waste of the tailings storage facility will be entirely covered with waste rock to prevent wind and water erosion and reduce direct radiation and radon emissions. Tailings seepage will continue to be controlled by the existing pumping systems. Waste rock piles will be shaped to prevent rainwater infiltration and sloped towards the open pit.

Motivation of status: Although mining is in compliance with tailings management conditions, no data was available from DWAF and NRPA to fully assess the indicator. All the indicators are therefore IN PROGRESS.

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

Recycling is done at the Walvis Bay site by five different operators and the Swakopmund Municipality reports that the recycling system is in place but not yet fully implemented.

Motivation of status: There is some recycling done at Walvis Bay and Swakopmund, but there is no established recycling system servicing the uranium industry and the public. This indicator is therefore 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**			
Data Source	**Municipality of Walvis Bay and Swakop**			
Status:		**IN PROGRESS**		

The Walvis Bay Municipality reported that recycling is done by local individuals for income. The problem these individuals are experiencing is the fact that the markets for waste are far, therefore making transportation expensive. Thus only limited recycling is done in Walvis Bay. Rent-A Drum recycles for the Swakopmund Municipality.

Motivation of status: Recycling is conducted in Swakopmund but difficulties are experienced in Walvis Bay. This indicator is therefore IN PROGRESS

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

Walvis Bay Municipality recorded a slight reduction in the volume of waste removed or disposed of over the past 2 years as shown in Figure 9 below. The volume is also much less than 12 years ago. Uranium mining companies contribute to the reduction of volumes of waste by separating waste and recycle items such as office paper, cardboard, printer cartridges, electronic waste, scrap metal, wood, plastics and containers.

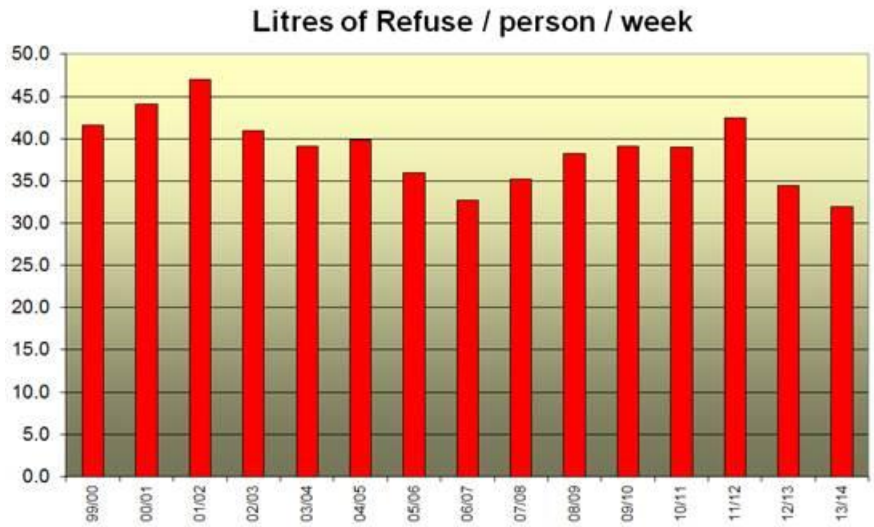

Figure 9: Walvis Bay records a slight reduction in the volume of waste removed / disposed of, per capita

The Swakopmund Municipality reported no current decrease in the volume of waste disposed at their landfill. There is however an upcoming recovery facility and it is anticipated that it will result in the reduction of waste entering the landfill.

Motivation of status: The Swakopmund Municipality is planning on building a recovery facility that will ultimately reduce the amount of waste entering the site. At the Walvis Bay site, waste volumes have shown a slight reduction and mining companies contributed by doing recycling; this indicator is therefore rated as IN PROGRESS.

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Summary of performance: EQO 3

Total no. indicators assessed	**34**			
	NOT MET	**IN PROGRESS**	**MET**	**EXCEEDED**
Number of indicators in class	5	12	17	0
Percentage of indicators in class	15 %	35%	50%	0%

Overall performance: The Infrastructure EQO is made of 8 desired outcomes and 8 targets measured by 34 indicators. The 2013 EQO performance has slightly increased compared to 2012. There were five indicators that didn’t have data in 2012. In the 2013 assessment, 50% of these indicators are MET, 35% are IN PROGRESS 15% are NOT MET. The NOT MET indicators are related to the absence of Auditors, water and air monitoring at waste disposal site; the ongoing tracks traffic still on the B2 road and the absence of cargo container data from Namport

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.

This EQO is assessed by 8 Indicators with a focus on ensuring the quality and quantity of water supplied to the public, as well as maintenance of the integrity of aquifers in the Erongo Region (Uranium Province). Key stakeholders in this EQO are the Department of Water Affairs (DWA) under the Ministry of Agriculture Water and Forestry (MAWF) as the regulator, NamWater, the distributor and the uranium mining industry as a major consumer.

Monitoring of groundwater in the uranium province is undertaken in 18 boreholes (recommended by SEA) along the Swakop and Khan Rivers. In addition to these, potable water at the coastal towns is also sampled to assess the quality against recommended Namibian DWA guidelines for drinking water. The water quality and quantity assessments are undertaken annually by DWA as the custodian of water resources in Namibia.

Water quality monitoring involves analysis of anions, cations, trace elements and radionuclides (depending on expertise and finances available in the monitoring institution), which are measured against the Namibian Guideline Values for drinking water. 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 indicator was modified to include drinking/potable water.

In the year under review, contributions to the water EQO were mainly made by NUA, with DWAF's contributions were very limited and in most cases not indicator specific. This has once again hindered the process of assessing the water EQO given since the DWAF is the regulator for the water resources in the country.

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 DWACC** • **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**
Data Source	**DWAF**
	NOT MET

Motivation of status: No data was provided by DWAF, and hence the indicator was 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**
Data Source	**DWAF**
Status:	**NOT MET**

Motivation of status: No data was provided by DWAF, and hence the indicator is NOT MET.

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

NamWater has an abstraction permit of 4.6 Mm^3/annum for OMDEL, translating to380,000 m^3/month. Their abstraction has not exceeded this figure (DWAF)

Motivation of status: Information provided by DWAF indicates that abstraction from NamWater's Central Namib water scheme did not exceed the aquifers' sustainable yield in the year under review. The indicator is therefore MET.

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

Bannerman, and the Langer Heinrich, Rössing and Husab mines monitor water levels in the Khan and Swakop rivers. Water data such as those for Rössing Mine are advanced (since 1970s) and therefore add much volume to the 2 year old data that the SEMP project has collected from the 18 recommended boreholes. The SEMP water monitoring sites aim to better define the concept of fluctuation "within existing norms". Generally, water levels in the boreholes rise when the aquifers are recharged during floods and fall as a result of evapotranspiration and drawdown due to pumping. It is important to note that water levels always decrease except during and just after runoff. The "natural" decline results in a gently sloping line, while a steeper drop may indicate that abstraction exceed the sustainable yield of the aquifer (see graphs under each mine). Since the water table can be situated at various depths, it is not possible to set absolute limits for "existing norms", e.g. not deeper than 15 m below surface. The rate of water level decline could be used, e.g. not more than 0.1 m per month or 1.2 m per year.

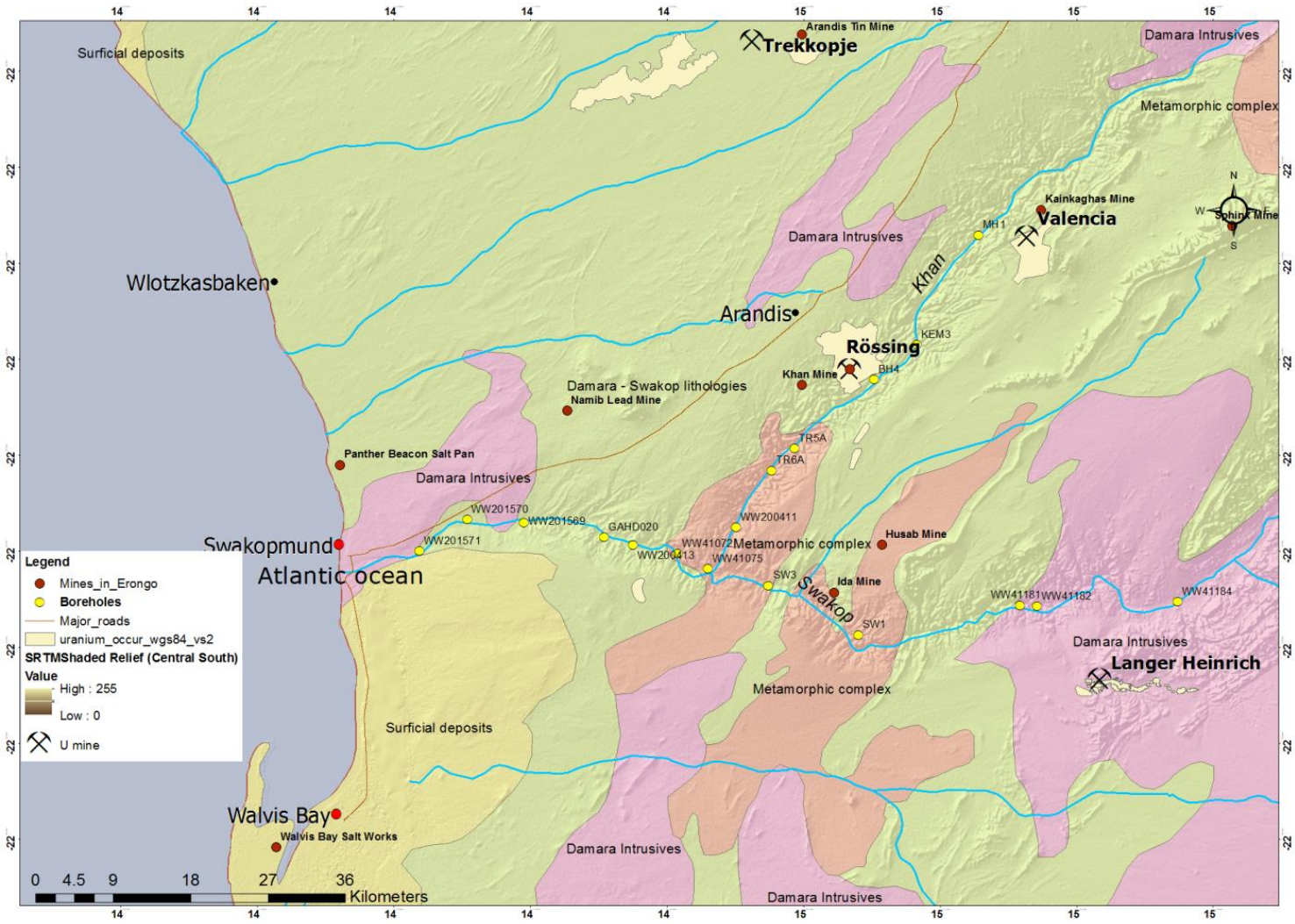

Figure 10: SEMP groundwater monitoring boreholes in the Swakop and Khan River

Figure 11 below shows water levels for Bannerman Resources Namibia. For the purpose of this indicator, only four boreholes in the Swakop River are of interest. Bannerman's boreholes show the same water level trend at the two upstream sites, WW41072 and WW 41075, as in the downstream boreholes GAHD0020 and GAHD0021 **(**Figure 11). The water table was around 6-7 metres below surface before the 2011 flood, which resulted in a rise to 1-3 metres below surface. The levels declined slowly during 2012 and 2013 until some runoff in December caused another small rise. Based on long-term experience in water level monitoring it can be concluded that the fluctuation was in line with the normal trend due to water consumption by the vegetation (evapotranspiration), except for sites WW200414 and WW41072 that showed the effects of water abstraction in the Goanikontes area.

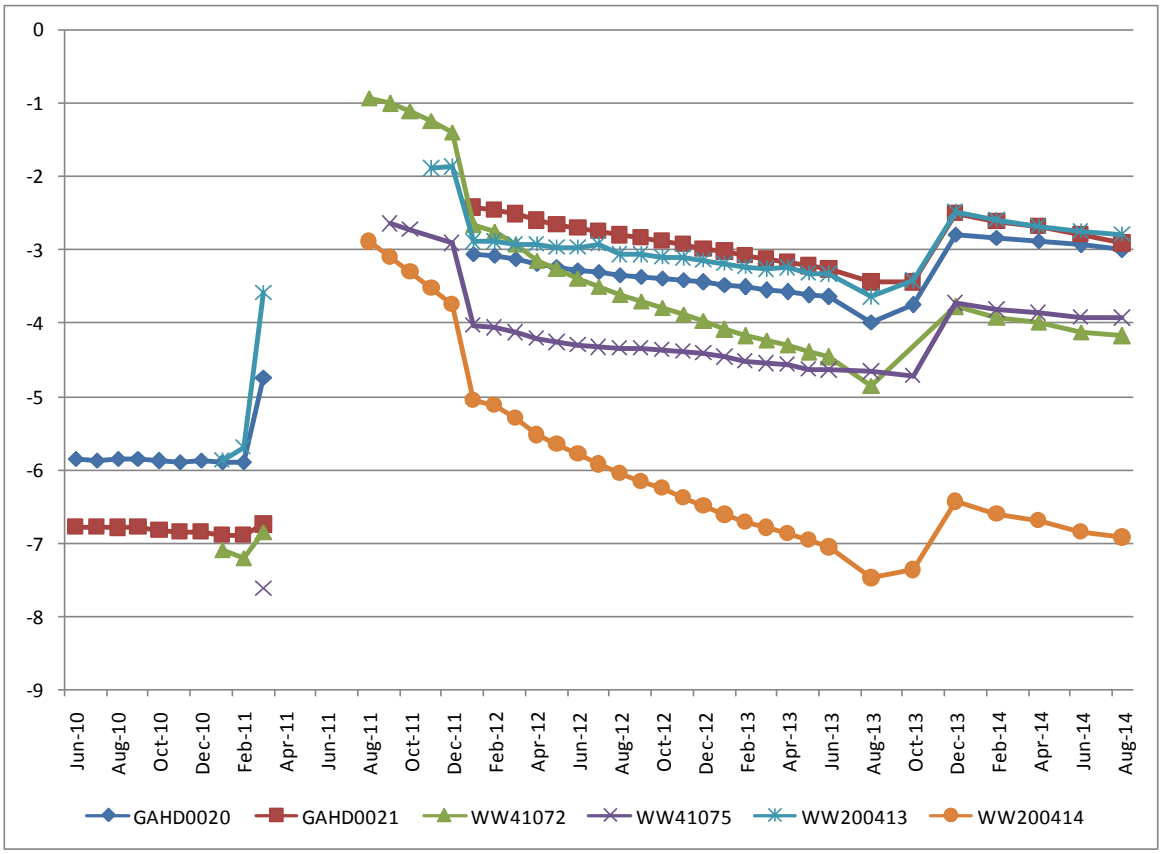

Figure 11: Water level trends for the Bannerman boreholes from year 2010 to 2014

Langer Heinrich mine operates a well field in the Swakop River to abstract saline groundwater for industrial purposes. The company has recently installed a small desalination plant to treat Swakop water and replace some of its freshwater input. The water levels of 15 boreholes are measured monthly to monitor the effect of abstraction on the aquifer. Figure 12 below shows the water level trends at four representative sites. The water table was situated around 3-5 metres below surface in 2009 and 2010. The short dips in the graph could indicate that the pumps were running at the time of measurement. A flood in January 2011 raised the levels by up to 2 metres and further flooding prevented access to the river until August 2011. The water level then dropped to its usual 3-5 metres until the next floods in early 2012 caused a further rise to 2-3 metres. The gradual decline during 2013 is a natural response to evapotranspiration, which would also happen in the absence of abstraction.

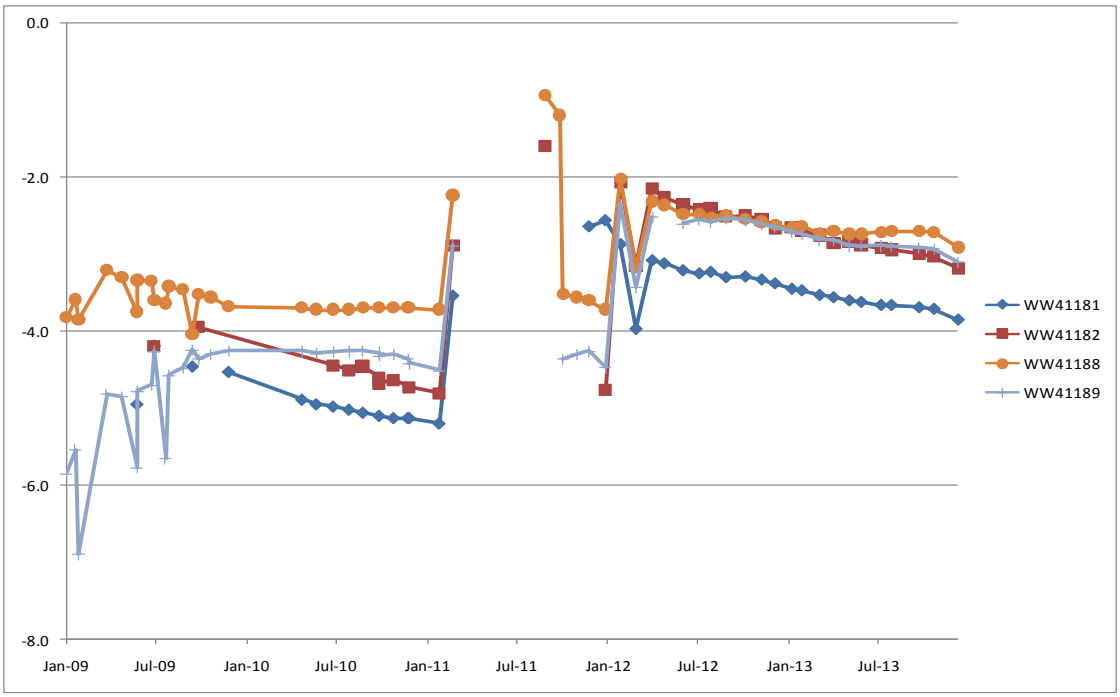

Figure 12: Water level trends for Langer Heinrich boreholes from year 2009 to 2013

Rössing Mine abstracts saline groundwater from the Khan River, in line with an abstraction permit issued by MAWF. In 2013, the daily average groundwater abstraction was 865 m^3 against an internal target of 800 m^3/day and a DWA permitted abstraction of 2,383 m^3/day. As part of an internal water quality and vegetation monitoring programme, as well as permit requirements, water levels in the Khan River are measured and the vegetation is also monitored continuously. The vegetation surveys carried out from March and September 2013 showed that most of the trees at the monitored transects were in a good to satisfactory condition, except for Transects 6 and KEM 16 far upstream and downstream of the mine which are in poor condition. This confirmed a long observed trend related to the generally low recharge from runoff received in this part of the river. The water quality in the Khan River showed no trend or significant change and remained within the range of natural variation.

Rössing has a long time series of water level measurements in the Khan River that can be used to assess the range of variation. Figure 13 below shows the response to the major runoff event in 2000. Before the flood, the water table was at 6-14 metres below surface, depending on the position of the site in relation to compartment boundaries. The flood volume diminishes from upstream to downstream as water infiltrates into the aquifer, but the response to recharge also depends on the depth of the water table. Boreholes with shallow water levels receive more recharge than those where the water table is deep. For instance, the water level at borehole UK4B on the compartment boundary upstream of the mine rose by 5 m after the 2000 flood, while the increase at boreholes 1.10 and 1.11 downstream of the mine was only around 2 m. The general trend between 2000 and 2009 was a gentle decline of the water table, interrupted by small recharge events in 2005 and 2006. Borehole KEM3 upstream of the mine gives a good indication of the natural trend. Steeper drops such as BH1.4, BH7 and BH1.6 in 2001 and 2002 can be attributed to high groundwater abstraction. The pumping rate was reduced in 2003. Water levels in the central part of the Rössing compartment remained between 6 and 10 m below surface in 2004 to 2013, indicating a well-managed water resource.

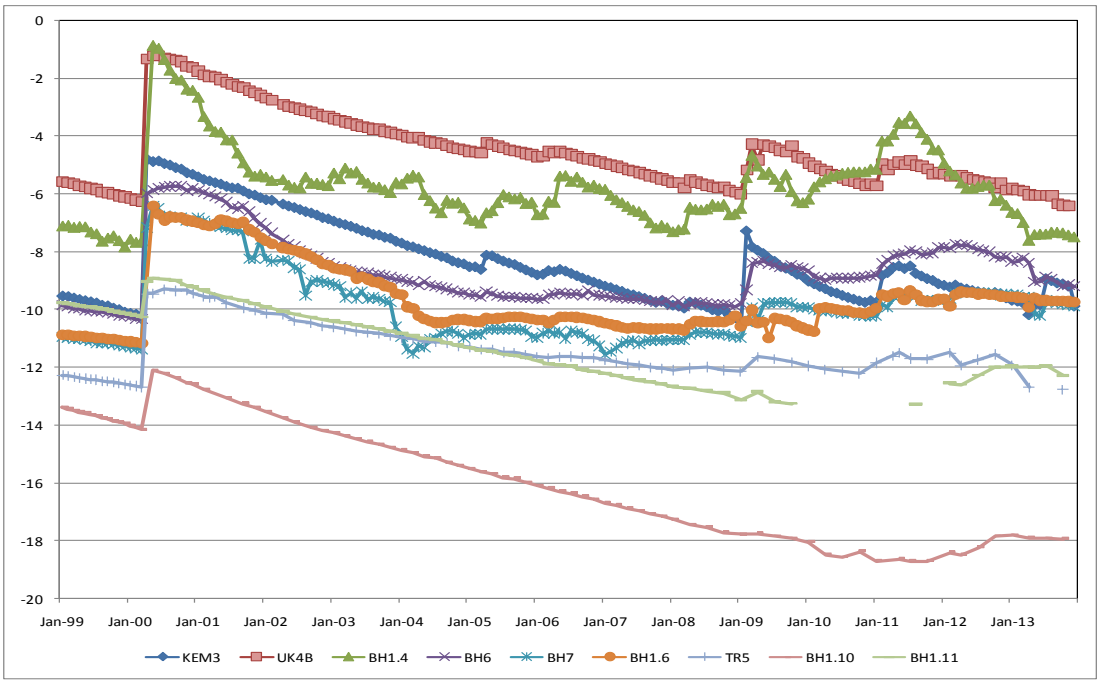

Figure 13: Water level trends for Rössing boreholes from year 1999 to 2013

The declining water level trend at BH1.10 is abnormal compared to the other sites (Figure 13). This borehole is in the lowest compartment close to the Khan-Swakop confluence and a possible explanation of the long-term decline is that the Swakop was "draining" the Khan. Since the Swakop River was recharged in 2011 there was a modest recovery of the water table at boreholes 1.10 and 1.11, though there was some direct recharge in the Khan as well. The water levels declined slowly in 2012 and 2013. There is little vegetation in this area and thus less water consumption by evapotranspiration compared to the compartments closer to Rössing Mine.

The Husab Mine has been monitoring two boreholes in the Swakop River since 2010 (SW1 and SW2), and three in the Khan River since 2011 (WW202081-83). The data gap in 2011 was due to inaccessibility of the river (Figure 14). There was less fluctuation at Swakop Uranium's sites in the Swakop River than at Langer Heinrich's boreholes, except for some readings in June 2013. Swakop Uranium's Khan River boreholes WW202081-83 are in the same compartment as Rössing's BH1.10 and 1.11 with similar water levels in the range of 12-17 m below surface. It is interesting to note that the water table in the Swakop was much higher than in the Khan since the 2011 floods. This confirms that the lower reaches of the Khan River received very little recharge.

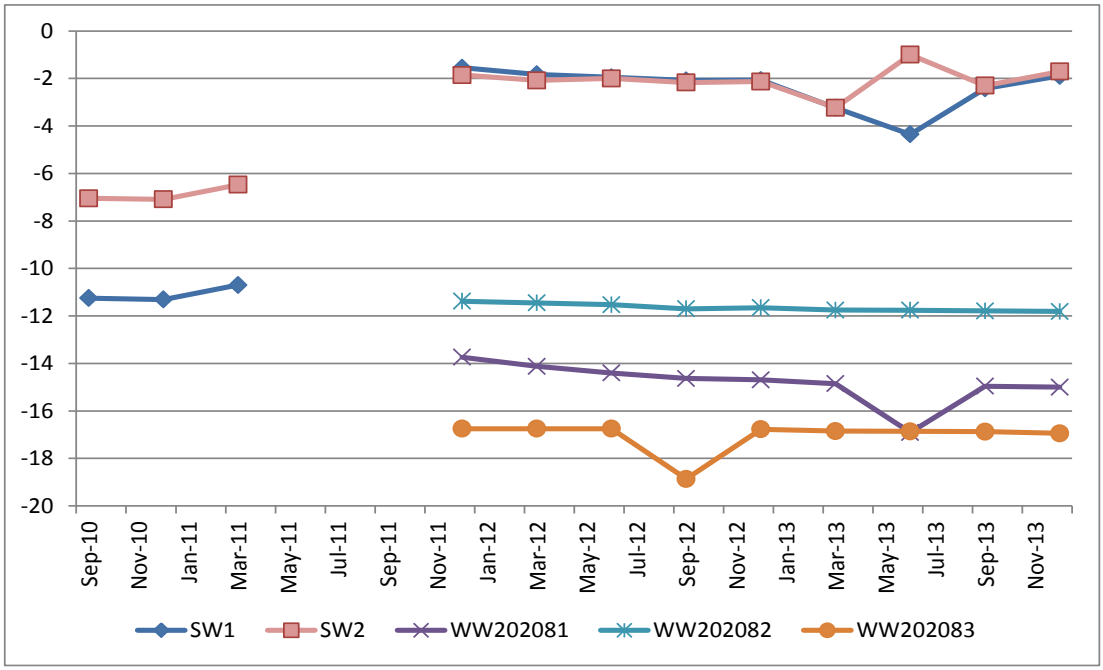

Figure 14: Water level trends for Husab Mine boreholes from year 2010 to 2013

Motivation of status: Fluctuations of most boreholes (16 out of 18 Boreholes) are within existing norms (in this case, the rate of water level decline) except for boreholes WW200414 and WW41072 that showed the effects of water abstraction in the Goanikontes area. The indicator is MET.

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

According to the information provided by NUA, residents of the coastal towns still pay the aquifer water tariff, even though they have been receiving a mix of groundwater and desalinated seawater since August 2013. However, the supply agreement with NamWater states that participating mines are paying the higher tariff for 100% desalinated water for the same mix.

Motivation of status: Coastal town residents still pay approved aquifer water rates; there were no increment to the water rates even after adding desalinated water to the potable water supply. This 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**
Data Source	**DWA**
Status:	**NOT MET**

Motivation of status: No data was provided by DWAF and Namwater, and hence the indicator is NOT MET.

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

The Areva desalination plant was built to supply potable water to the Trekkopje mine. However, the drop in uranium demand as well as correspondingly lower prices after the Fukushima accident caused a slowdown in the development of the Trekkopje project. The company has now signed a contract with NamWater providing for the distribution to the Rössing, Langer Heinrich and Husab mines, hence curbing water constraints in the Erongo region. There was no report on any investors lost due to water unavailability.

Motivation of status: Although DWA did not supply data for this indicator; there was no known report of any investors lost due to water unavailability. The indicator is therefore MET.

Indicator 4.3.1.2.	**Desalinated water meets mine demand**
Data Source	**DWA**
Status:	**MET**

At full capacity AREVA Desalination Plant can produce 20 million cubic metres of potable water per annum, which is more than enough to meet the current demand of the mines. An interim off-take agreement between AREVA and NamWater was signed in August 2013 and since then the desalination plant has been feeding into the Omdel pipeline to help meet the water demand of the coastal region. At first, NamWater supplied desalinated water to Swakop Uranium as per agreement. As of November 2013, the Langer Heinrich and Rössing mines have also been receiving a mix of desalinated water, Omdel and Kuiseb water. Rössing reported that although the full desalinated tariff was paid for the mix, the proportion of desalinated water to Omdel groundwater was one to one.

The Langer Heinrich Mine used freshwater from the NamWater system (Omdel and Kuiseb aquifers) for most of the year 2013. The company is also permitted to abstract groundwater from the Swakop River not exceeding 500,000 m^3 per annum. During the reporting period (Jan-Dec 2013) Langer Heinrich abstracted 321,142 m^3 from the Swakop River (36% less than permitted quota). The desalination plant provided water from November 2013 and will be the main freshwater source going forward. AREVA's Trekkopje Mine consumed very little water for care and maintenance and the water demand was met fully by desalinated water.

Motivation of status: Desalinated water and fresh water from Namwater system are mixed to meet mine and coastal town water demand. This indicator is MET.

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Summary of performance: EQO 4				
Total no. indicators assessed	**8**			
	NOT MET	**IN PROGRESS**	**MET**	**EXCEEDED**
Number of indicators in class	3	0	5	0
Percentage of indicators in class	38%	0%	62%	0%
Overall performance: 63% (5) of the indicators are MET, while 38% (3) were NOT MET due to data not provided by DWAF. A lack of commitment by DWAF in terms of compilation of the Water EQO and collecting relevant data from other stakeholders (i.e NAMWATER) continues to hamper the assessment of this EQO.				

EQO 5. Air quality

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

EQO 5 has been changed from "Air Quality and Radiation" to "Air quality" only and radiation has been included in EQO 6 Health. This is mainly because the impact of radiation on the public and workers was also included in Desired Outcome 6.1. The most important public radiation protection measure is stated in Target 6.1.1: *"Cumulative radiation dose to members of the public is reasonably minimized and does not exceed 1 mSv per annum above background."* Taking radiation out of EQO 5 will remove the duplication and place radiation impacts where they belong – under "Health".

The Air Quality Objective (EQO 5) involves assuring the quality and quantity of the air from mines and settlements in the Erongo region to acceptable international standards. Dust emissions may occur during each stage of the mine cycle, in particular during Exploration, development, construction and operational activities. The principal source includes dust from blasting, exposed surfaces such as tailings, stockpiles, waste dumps and haul roads and to a lesser extent gases from combustion of fuels from equipment.

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 has a PM10 E-Sampler at Swakopmund and three real time radon/radon progeny monitors at Arandis, Swakopmund and Walvis Bay. The data collected includes PM10 concentrations, ambient temperature (AT), barometric pressure (Pa), wind speed (WS), relative humidity (RH), and wind direction (WD). The 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 uranium industry in Erongo supports the SEMP office by monitoring of PM10 at Arandis (AREVA and Rössing) as well as management of the Radon equipment (Bannerman Resources and UI).

The mining and exploration companies' reports on the air quality in their mining areas and operations are covered through the UI SEMP compliance report. 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).

Desired Outcome 5.1.	**Annual human exposures to particulate concentrations are acceptable (IFC Standard).**			
Target 5.1.1.	**Ambient PM_{10} concentrations at public locations and mines should not exceed the required target/limit to be set for the Erongo Region for both annual and 24-hour averages. The target/limit should be based on international guidelines but should consider local environmental, social and economic conditions.**			
Indicator 5.1.1.1.	**Ambient PM_{10} monitoring ($\mu g/m^3$) at Swakopmund**			
Data Source	**SEMP Office/NUA**			
Status:			**MET**	

Mines are monitoring PM10 dust concentrations on site and at receptor locations; the SEMP project also has an independent PM10 monitoring station in Swakopmund (Figure 15). The mines' information has been provided to enable comparison of the dust levels at mines and receptor

locations and to inform the public. Table 10 below summarises the PM10 dust concentration results from Trekkopjie, Langer Heinrich, Husab and the SEMP Office (Swakopmund). None of the inhalable dust concentration averages (mean) exceeded the WHO Limit of 0.075 mg/m^3 during 2013, they were all far below the limit with the highest at 0.04 mg/m^3 at Langer Heinrich. However a maximum dust concentration higher than the 0.075 ug/m^3 was recorded at each of the stations except the Swakopmund station, where it was 0.044 mg/m^3. The highest maximum value of 0.17 mg/m^3 occurred at Swakop uranium's Husab mine.

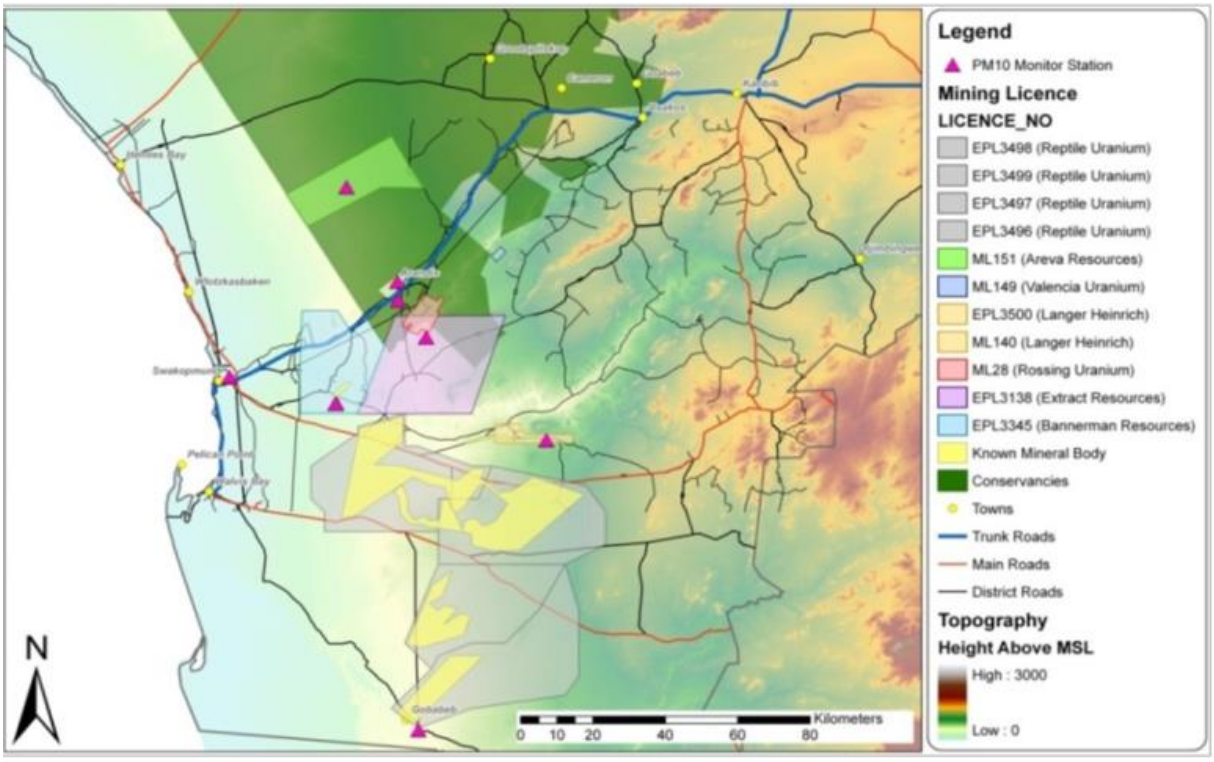

Figure 15: Location of PM10 monitoring stations in the Erongo Region. The station at Gobabeb ceased to operate in 2011

Table 10: PM10 dust concentration results at mine sites and receptor locations

Location	No. of samples	PM10 dust concentration in mg/m^3		
		Maximum	Mean	St. dev.
AREVA, Trekkopje Mine	continuous	0.08	0.02	0.02
AREVA, Arandis(Town)	continuous	0.15	0.01	0.01
Langer Heinrich Mine	46	0.11	0.04	0.02
Swakop U, Husab Mine	39	0.17	0.03	0.04
Swakopmund (Town)	continuous	0.044	0.011	0.002

AREVA's graphs (Figure 16 and Figure 17) compare the PM10 concentrations at Trekkopje Mine and Arandis to the World Health Organisation (WHO) interim target (IT-3) of 75 µg/m^3. Inhalable dust levels of 0.02 mg/m^3 (20 µg/m^3) on the mine were twice as high as those measured at Arandis (10 µg/m^3), though both were well below the WHO IT-3 limit. Rössing also operates a monitoring station at Arandis and has measured similar PM10 concentrations as shown in figure 5 below.

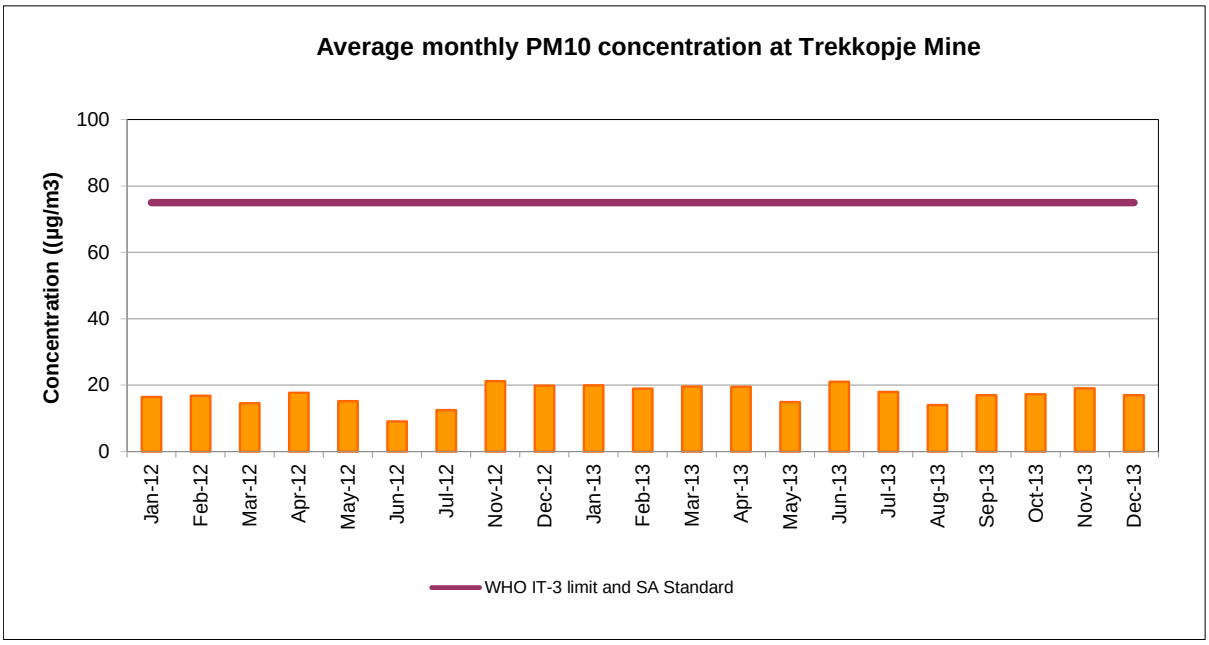

Figure 16: Monthly PM10 concentration at Trekkopje Mine (Areva) from Jan 2012 to Dec 2013

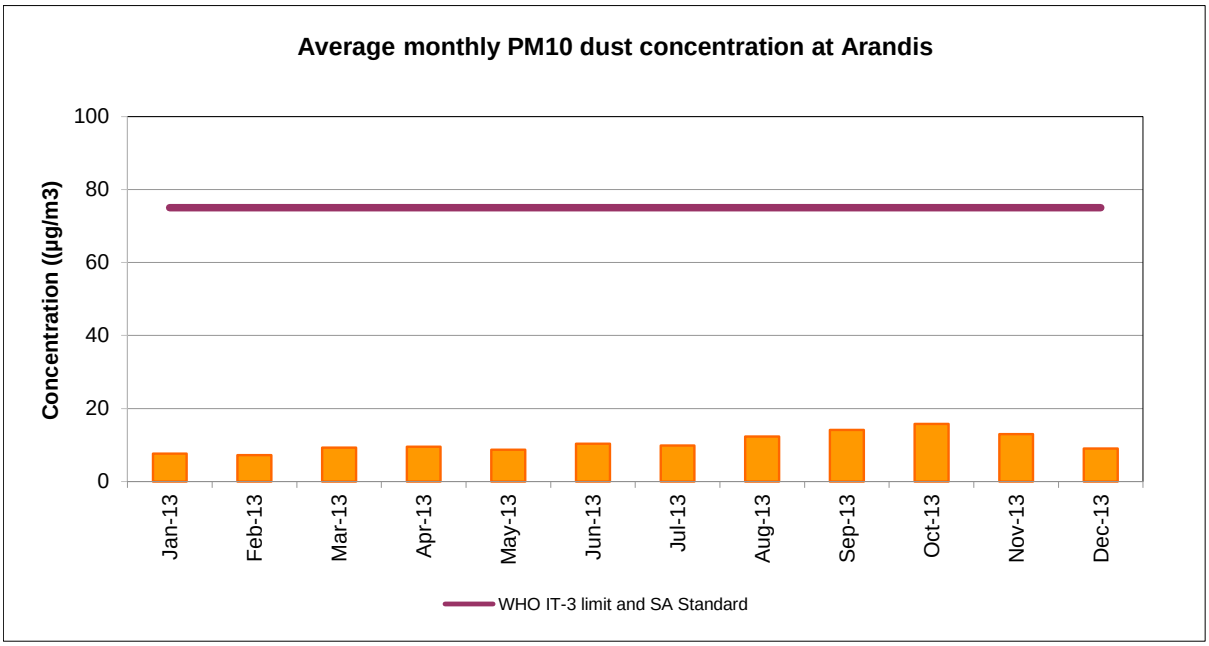

Figure 17: Monthly PM10 dust concentration at Arandis Town, monitored by Areva

In 2013 Rössing had two PM10 monitoring stations in place to measure ambient PM10 concentrations (

Figure **18** and Figure 19). The background reading for PM10 was determined at 13 µg/m^3 in 2009. Rössing is using an internal standard of 0.12 mg/m^3 based on Schedule 2 of the South African National Environmental Management Act: Air Quality Act No.39 of 2004. A PM10 monitoring point at the southwest mine boundary was established in February 2012 and was functional until the end of September 2013, after which components of the station were stolen. Despite several east wind events, dust concentrations recorded at this station only twice exceeded 0.02 mg per m^3 throughout the period January to September 2013 (

Figure **18**). The very low readings (average 0.012 mg/m^3) indicate that PM10 dust dispersal from potential sources in the operational areas is limited in distance and does not cross the boundary to the southwest of the mining licence area.

PM10 dust levels are continuously monitored at Arandis. Although the monitoring station was malfunctioning during the winter months and readings were incorrect, readings for all the other months were lower than 0.04 mg/m^3 as can be seen in Figure 19.

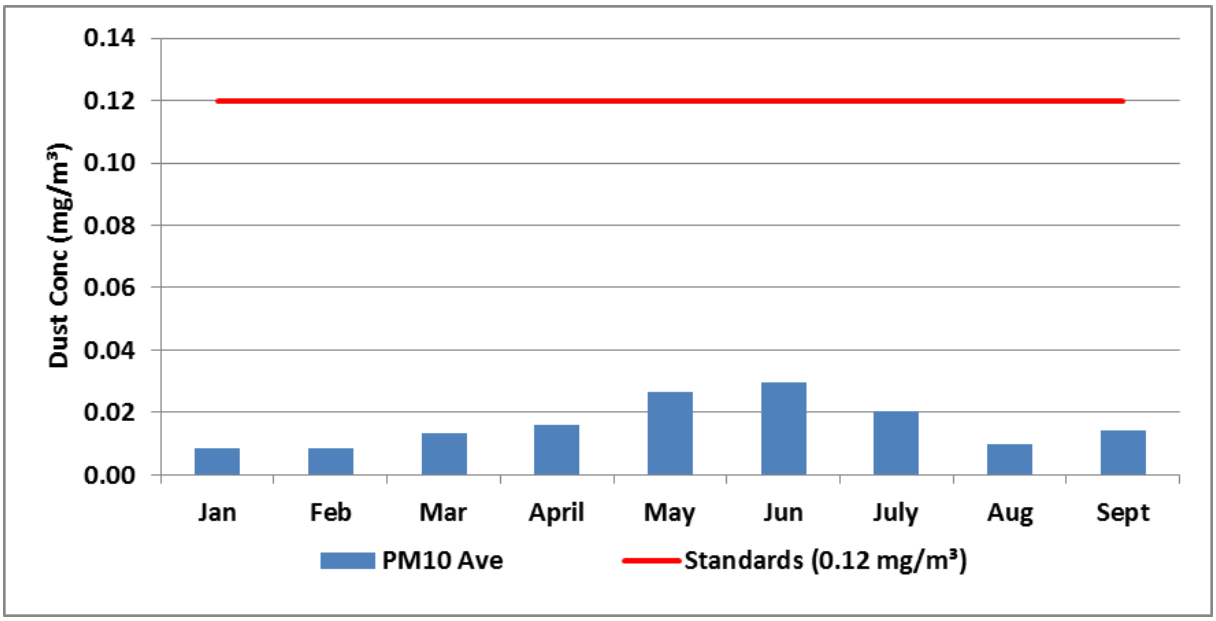

Figure 18: Monthly PM10 concentration measured at Rössing Mine in 2013

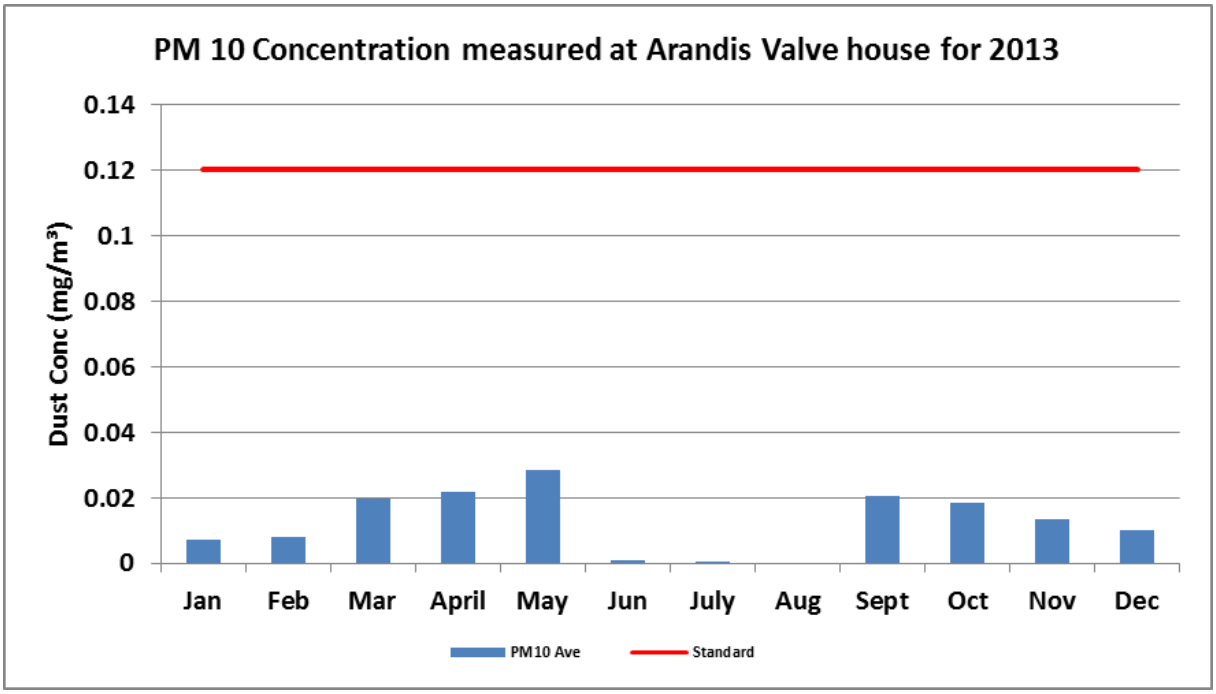

Figure 19: Monthly PM10 concentrations measured in Arandis Town (Valve House) by Rössing Mine 2013

Swakop Uranium monitored PM10 dust at one location at the Husab mine site and provided a set of weekly sampling data for 2013, with a gap in June to August when the monitor was out of order (Figure **20**). The inhalable dust concentration varied from 0-167 µg/m^3 with a mean of 34 µg/m^3. PM10 dust concentration exceeded the WHO IT limit of 75 µg/m^3 on few occasions in the fourth quarter of 2013. The exceedances relate to the peak of mine construction stated in May/ June 2013.

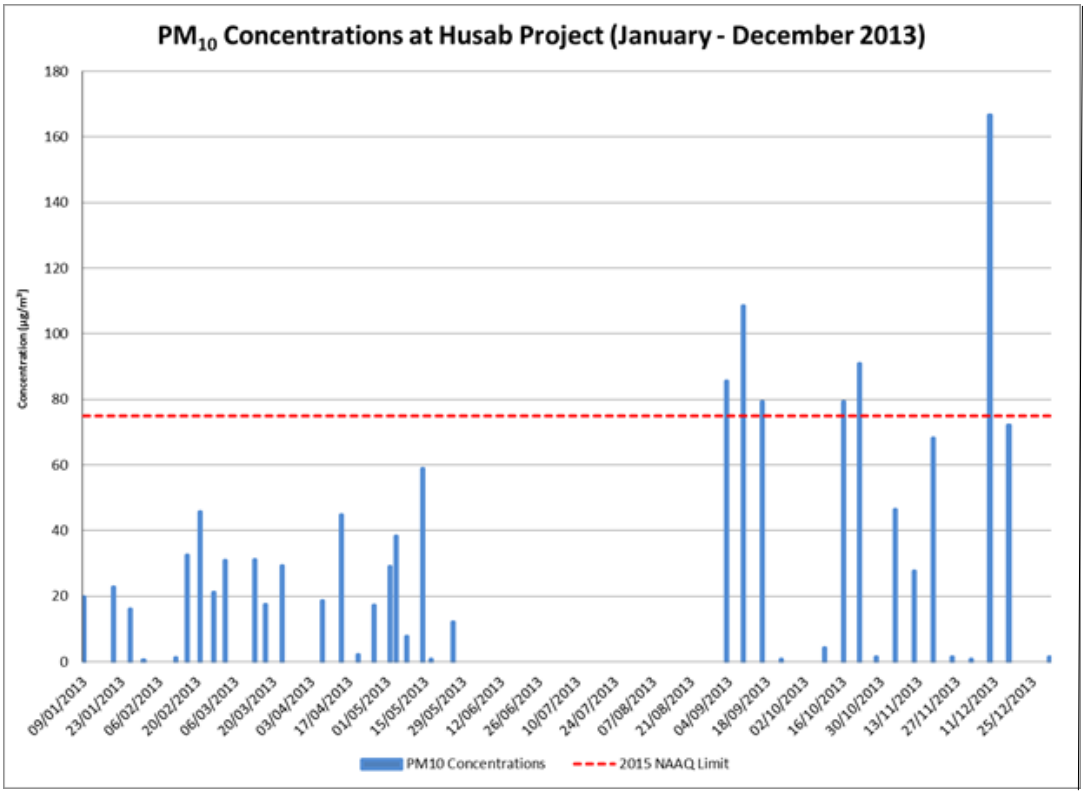

Figure 20: Weekly PM10 concentrations at the Husab Mine for 2013

The SEMP office monitors the PM10 dust concentration at Swakopmund town. Data is available for the months of April to September and was not downloaded for other periods. However, the dust concentration recorded is well below the WHO-IT 3 and South African standards of 75ug/m3. The highest quantity recorded is 44µg/m^3/day on the 3rd of May, whereas the rest of the data is below 40µg/m3/day as shown in figure 7. The monthly averages are below 10µg/m3/day for April to June and slightly above 10µg/m3 for July to September (figure 8). Therefore the average concentration is far below the limit to be of any concern to the public in Swakopmund.

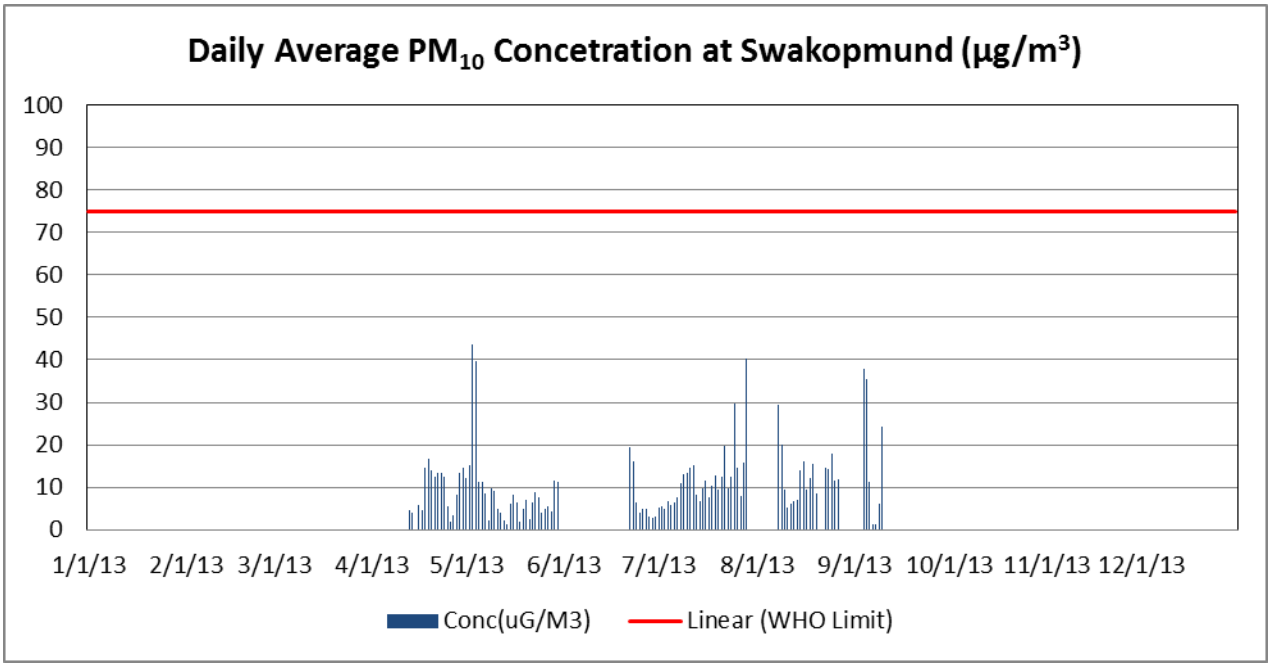

Figure 21: Daily PM10 concentration for Swakopmund Town (SEMP PM10 station)

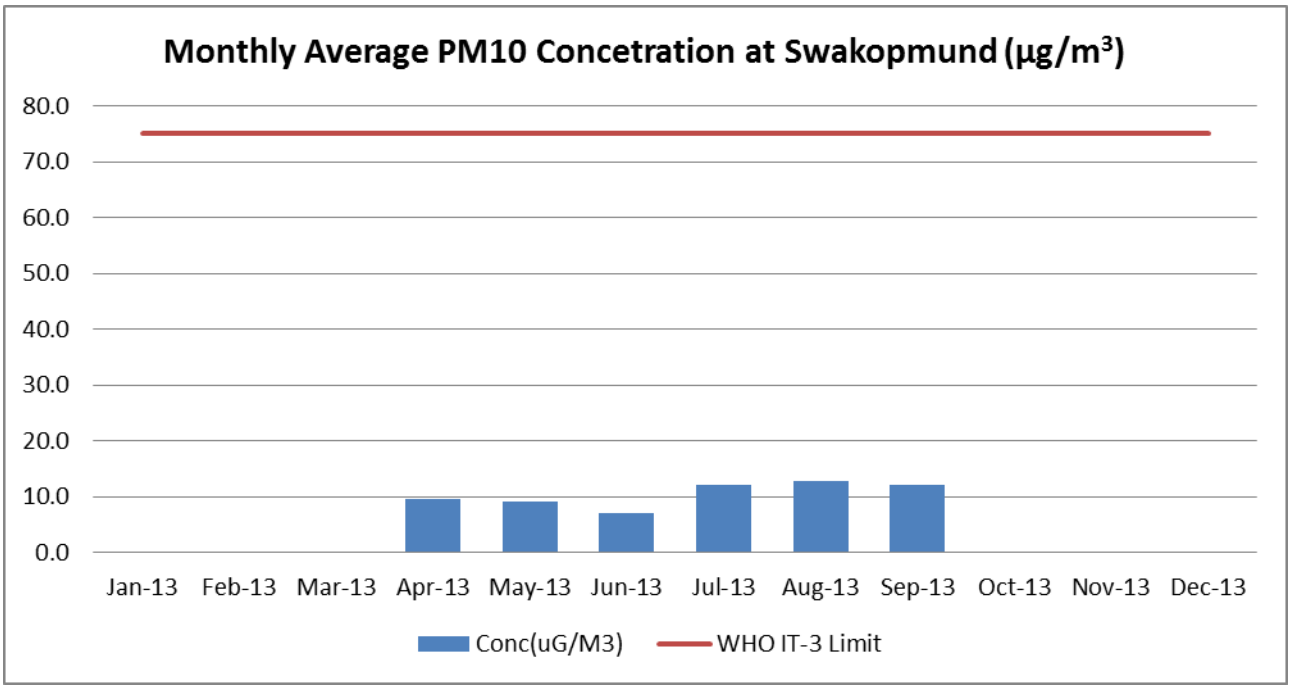

Figure 22: Monthly average PM10 concentration at Swakopmund, 2013

Motivation of status:

With the exception of the PM10 at Swakop uranium's Husab mine, all the other monitoring stations recorded dust concentrations of acceptable standards. Considering that the Husab mine is under construction and exceeded standard values on only a few occasions based on weekly data, with the annual PM10 average is well below the WHO-IT limit, the indicator is therefore rated as a MET.

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

Monitoring of the SEA dust fallout network ended in 2012 after an adequate baseline of regional dust fallout levels had been established. The baseline data survey ascertains that the highest dust concentrations outside of mining areas occurred in the vicinity of gravel roads. None of the towns in the region were affected by dust fallout exceeding the recommended limit of 600 mg/m^2/day. This indicator has therefore become obsolete and could be omitted from the next report.

In the meantime some information is available to assess whether any towns in the region were affected by dust fallout exceeding the recommended limit. Fallout dust were measured at Arandis, where AREVA's sites DM33 and DM34 on the outskirts of the town recorded average dust concentrations of 21 and 36 mg/m^2/day respectively (Figure 23).

Motivation of status:

Seeing that Arandis is the town closest to an operating mine and has a dust fallout lower than the recommended limit of 600mg/m^2/day, it may be safe to conclude that other towns are unlikely to have received more dust fallout than Arandis in 2013. Therefore the indicator is rated as MET.

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

There were no dust-generating activities at Areva's Trekkopje Mine, because they were no exploration/ mining activities in 2013 except for vehicle traffic, hence dust fallout was very low (chamber of Mines of Namibia, 2013). Figure 23 below shows the average dust fallout concentration at 30 sites on the mine, at Arandis and at the desalination plant. The average concentration was 21 mg/m^2/day with a standard deviation of 10 mg/m^2/day. Values around 10-20 mg/m^2/day can be regarded as natural background, while slightly higher levels were measured close to gravel roads. Sites DM33 and DM 34 on the outskirts of Arandis recorded 21 mg/m^2/day and 36 mg/m^2/day.

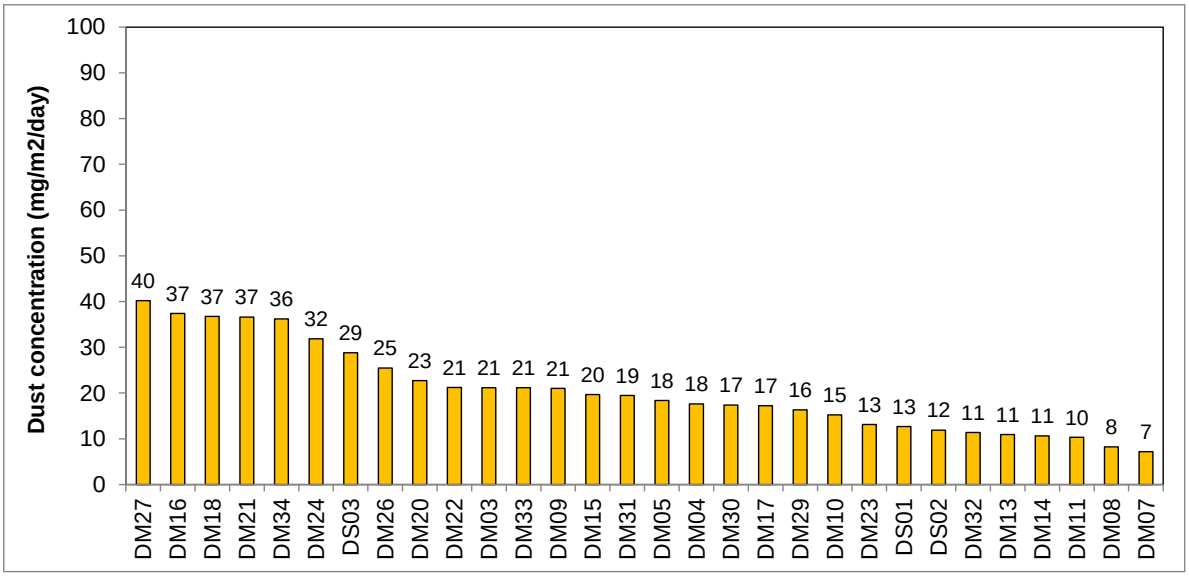

Figure 23: Areva fallout dust concentration

Langer Heinrich's single-bucket dust fallout monitoring network consists of 11 sample points which are all located very close to the dust generation sources, whilst the multi-directional dust fallout buckets are located on the outskirts of the mining areas (Figure 24). The fallout from background dust is not subtracted. The single dust bucket monitors are deployed following the American Society for Testing and Materials standard method for collection and analysis of dust fall (ASTM D1739-98).

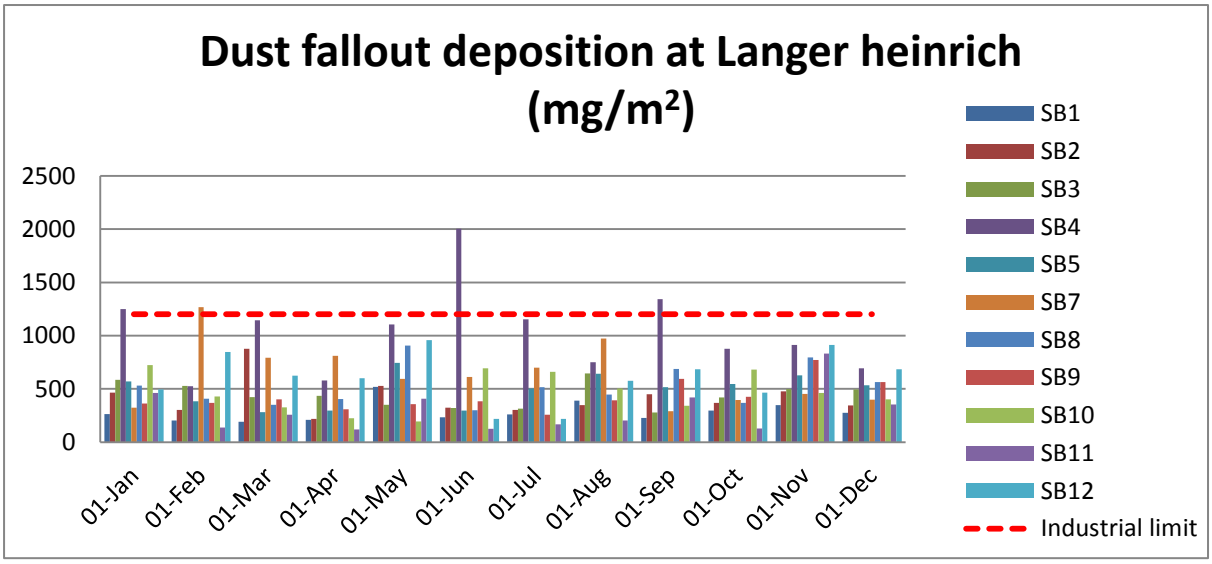

Figure 24: Langer Heinrich dust fallout concentration

Figure 24 above reflects the average daily dust fallout rates for the months January to December 2013. The dust fallout rates collected at sample point SB4 exceeded SANS industrial action level of 1,200 mg/m^2/day on three occasions; however the exceedances were not consecutive, nor were they more than three times per year. The single bucket dust fallout rates collected at sample point SB7 exceeded the SANS industrial action level of 1,200 mg/m^2/day on one occasion.

At Rössing Mine, the dust deposition buckets were erected to the northeast and southwest - according to the prevalent wind directions - of the operational areas to collect particulates of a size above 5 µm. The international standard "ASTM 1982 Standard Method for Collection and Analysis

for Dust Fall" is used. The samples are collected monthly and the dust deposition rates are expressed in units of mg/m²/day. In keeping abreast with current best practice, Rössing is using the ambient air quality standards based on Schedule 2 of the South African National Environmental Management Act: Air Quality Act No. 39 of 2004, as a reference to set criteria. Accordingly, the fallout dust depositions at Rössing were interpreted against a four-band scale, which stipulates averaged values over 30 days as follows:

- Band 1: <600 mg/m²/day (permissible for residential and light commercial areas)
- Band 2: 600-1,200 mg/m²/day (permissible for heavy commercial and light industrial areas)
- Band 3: 1,200-2,400 mg/m²/day (requires investigation and remediation if two sequential months lie in this band)
- Band 4: >2,400 mg/m²/day (immediate action and remediation on the first exceedance is required, and an incident report is necessary)

The results of 2013 in Figure 25 averaged between 22.8 mg/m²/day and 37.5 mg/m²/day, against the background values which averaged 13.7 mg/m²/day. The highest average values were recorded in March (94 mg/m²/day). No value higher than 100 mg/m²/day was recorded.

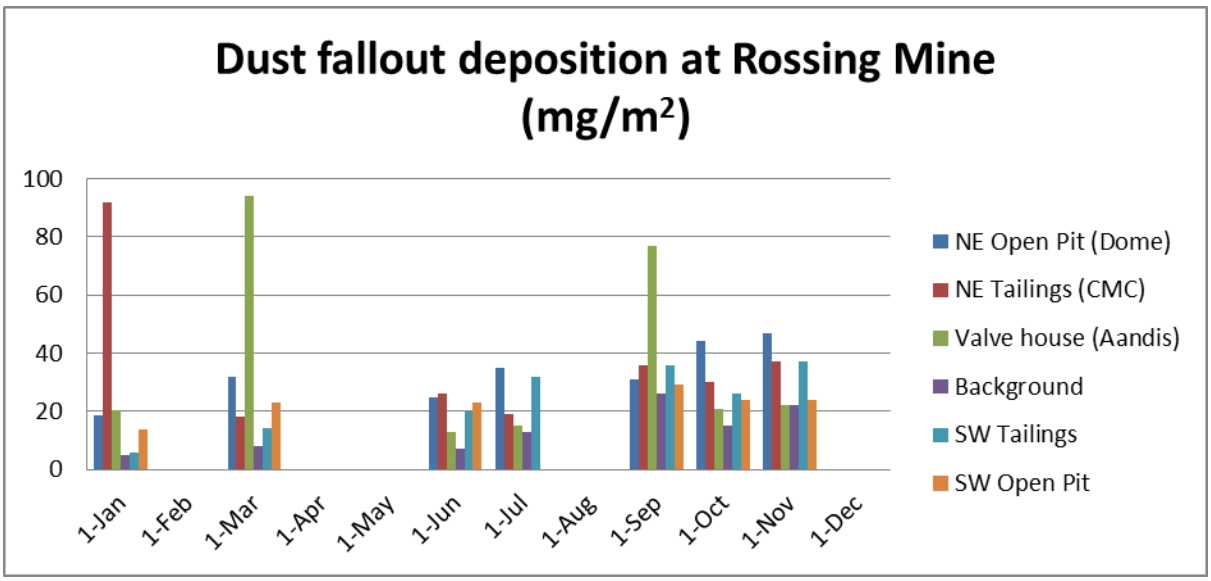

Figure 25: Dust fallout at Rössing Mine, 2013

Dust levels at Swakop Uranium were low at background locations and higher on the mine site, especially close to construction activities. Most readings were below the SANS industrial limit (Figure 26). Values exceeding the limit were related to specific dust-generating events, e.g. earthworks and traffic and earthworks at the tailings storage facility (EXT 04) that started in May/June 2013 and continued into 2014; or the peak of earthworks for haul roads A and B construction at EXT 27 in August/September 2013. Peaks at EXT 13 were due to the bridge construction in the Khan River.

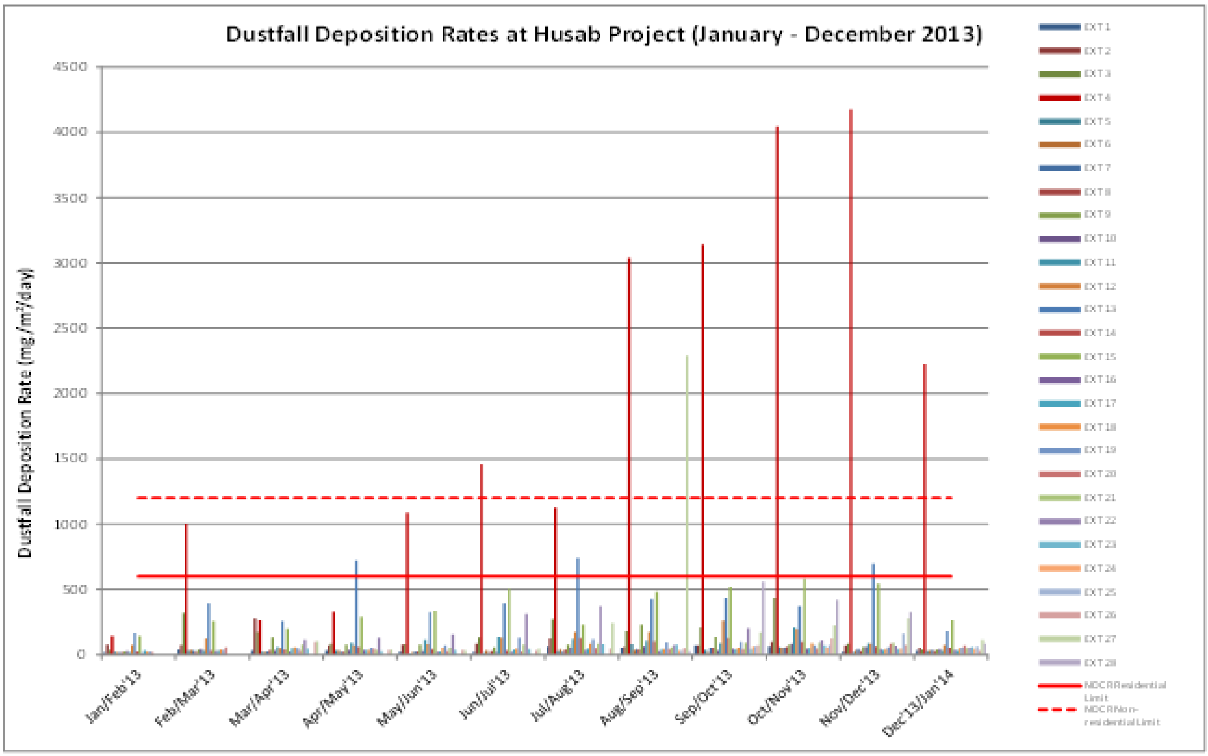

Figure 26: Dust fallout at Husab Project, 2013

Motivation of status: All mines have dust fallout monitoring network at dust generating sources and all fall below SANs industrial limit of 1,200 mg/m^2/day except for two monitoring points at Husab Mine. Considering that Husab Mine is under construction and only two of their 28 monitoring stations exceeded standard values on a few occasions only, this indicator is rated as a MET.

*************************** * * * * * * * * * * * ***************************

Summary of performance: EQO 5				
Total no. indicators assessed	**3**			
	NOT MET	**IN PROGRESS**	**MET**	**EXCEEDED**
Number of indicators in class	0	0	3	0
Percentage of indicators in class	0%	0%	100%	0%

Overall performance: EQO 5 has been changed from "Air quality and radiation" to "Air quality" only and radiation has been included to EQO 6 Health, The numbers of indicators have reduced from seven to three. The indicators performed well during 2013 and received a 100% MET status compared to 2012 when one of the indicators was NOT MET.

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 Namibian Uranium Institute-NUI). The NUI 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 NUI-www.namibianuranium.org.

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

The primary purpose of the NUI training programme is to promote learning and to build capacity in specialized skills in the fields of health, environmental management and radiation safety. The NUI has entered into partnerships with various private service providers to develop a suite of training courses to cater for the needs of the uranium industry in Namibia. The NUI 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. Furthermore, the Director of the UI acts as the joint Health Advisor for the NUI’s member companies providing advice, clinical support and coordinates the development of medical facilities. First-aid stations are established at all mines with attached contracted ambulance services. As the uranium industry grows, occupational medical facilities were created at Arandis, Walvis Bay and Swakopmund.

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. Another worrying aspect is the lack of an independent Health Impact assessment epidemiological study.

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 new mine project include the cumulative impact of other operating mines.**
Data Source	**NUA/NRPA**
Status:	

Due to the move of the radiation-related Desired Outcome from EQO 5 to EQO 6 there was a need to redefine the indicators for Target 6.1.1 to make sure that the desired outcome is achieved. It is not enough that each mine produces a public dose assessment. Indicator 6.1.1.1 was changed as shown above and a new Indicator 6.1.1.2 was added to determine what the actual outcome is: *"Modelled cumulative radiation dose to critical groups of the public does not exceed 1 mSv/a above background."*

There have been no new public dose assessments since the indicator has been changed. Assessments carried out previously did not include the cumulative impact of other operating mines, except for the air quality and radiation study carried out as part of the SEA. The indicator can only be evaluated against new assessments from 2014 onwards.

Motivation of status: To make sure that Desired Outcome 6.1 is achieved, indicator 6.1.1.1 was changed to "Public dose assessments produced by each new mine project include the cumulative impact of other operating mines. But, there have been no new public dose assessments since the indicator has been changed; that include the cumulative impact of other operating mines. The indicator can only be evaluated against new assessments from 2014 onwards.

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

Public dose assessments are only required for mines in operation or under construction. AREVA, Bannerman, Langer Heinrich, Rössing, Swakop Uranium have completed public dose assessments and provided a short summary of the outcome as shown in the Table 11 below. The results for Swakop Uranium were included in the 2012 SEMP report and given as "not available" this time. The additional dose at the mine boundary is only important if the critical group, that is the main receptors of the dose, are so far from the mine that the additional dose is zero (Table 11). This is the case for AREVA, Bannerman and Langer Heinrich. A good example is the latest Rössing assessment where modelling showed an additional dose to the residents of Arandis of 0.02 mSv/a originating from the mine (Table 11). This is only a small fraction of the permissible limit of 1 mSv /a above background. Marenica, Reptile, Valencia Uranium and Zhonghe were not required to carry out dose assessments.

Table 11: Public dose assessment results from uranium mines and exploration companies

Company	Public dose assessment results (mSv/a)			
	Assessment done	Additional dose at mine boundary	Dose to critical group (CG)	Critical group location
AREVA	Yes	0.04-0.4 mSv/a	0 mSv/a	Arandis
Bannerman	Yes	0 mSv/a	0 mSv/a	Goanikontes
Langer Heinrich	Yes	2.1 mSv/a	not applicable	no CG nearby
Rössing	Yes	0.04-0.05 mSv/a	0.02 mSv/a	Arandis
Swakop Uranium	Yes	not available	not available	not available

As stated in the SEA report, the average population-weighted public dose from radon progeny in the Erongo Region is 0.5 mSv/a. To determine the actual public dose and validate the mines' modelled results the SEMP Office operates radon monitoring stations at Arandis, Swakopmund and Walvis Bay as shown in the map below (Figure 27).

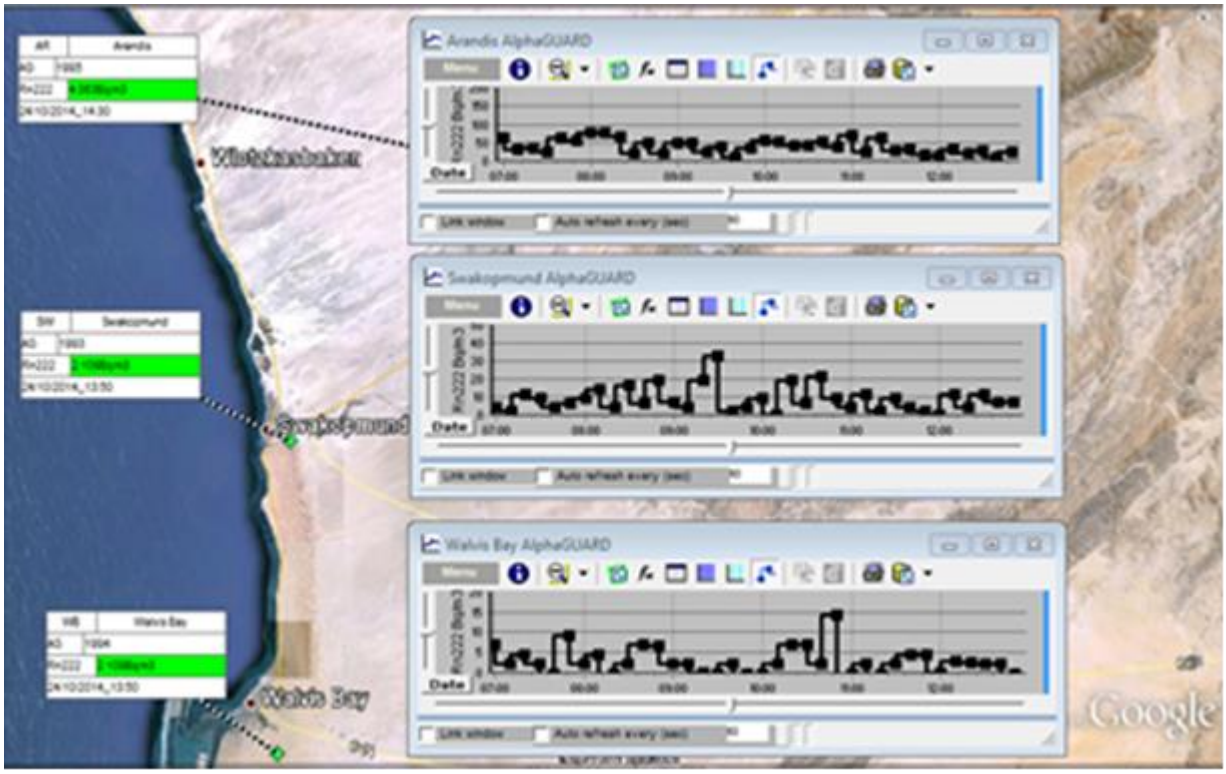

Figure 27: Interfaces of the SEMP radon monitoring station in Walvis Bay, Swakopmund and Arandis

Ambient radon concentrations measured in 2013 varied from 7.1 to 22.2 Bq/m^3, with the highest values recorded at Arandis and the lowest at Walvis Bay (Table 12). Since radon is emitted from any type of soil but not from ocean water, one would expect higher values away from the coast. Public doses[2] calculated from the measured data are 0.5 mSv/a at Arandis, 0.3 mSv/a at Swakopmund and

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

0.2 mSv/a at Walvis Bay (Table 12). These are natural background doses, except for a small contribution from Rössing at Arandis (0.02 mSv/a according to the dose assessment).

Table 12: Average Radon concentration measured at Walvos Bay, Swakopmund and Arandis SEMP stations

	Average Radon Concentration (Bq/m^3)			Radon Dose (mSv/a)	
	2011	**2012 (2 mths)**	**2013**	**2011**	**2013**
Arandis	21.3	15.7	22.2	0.3	0.5
Swakopmund	11.0	9.3	11.9	0.2	0.3
Walvis Bay	8.8	3.9	7.1	0.2	0.2

Table 12 shows similar average radon concentrations in 2011 and 2013 at all three sites. The 2012 data were only recorded in November and December and are not representative (see 2012 SEMP report). Many factors can affect the radon activities, most of them climate-related (wind speed and direction, soil moisture, etc.). The land/sea effect is very clear in the graphs for Swakopmund and Walvis Bay where the prevailing wind pattern causes the highest readings in winter (Figure 28 and Figure 29). In summer, south-westerly winds blowing in from the sea have very low radon concentrations, while the easterly winds predominating in winter carry radon from inland to the coast. Arandis, which is situated 60 km from the coast, does not show this effect (Figure 30).

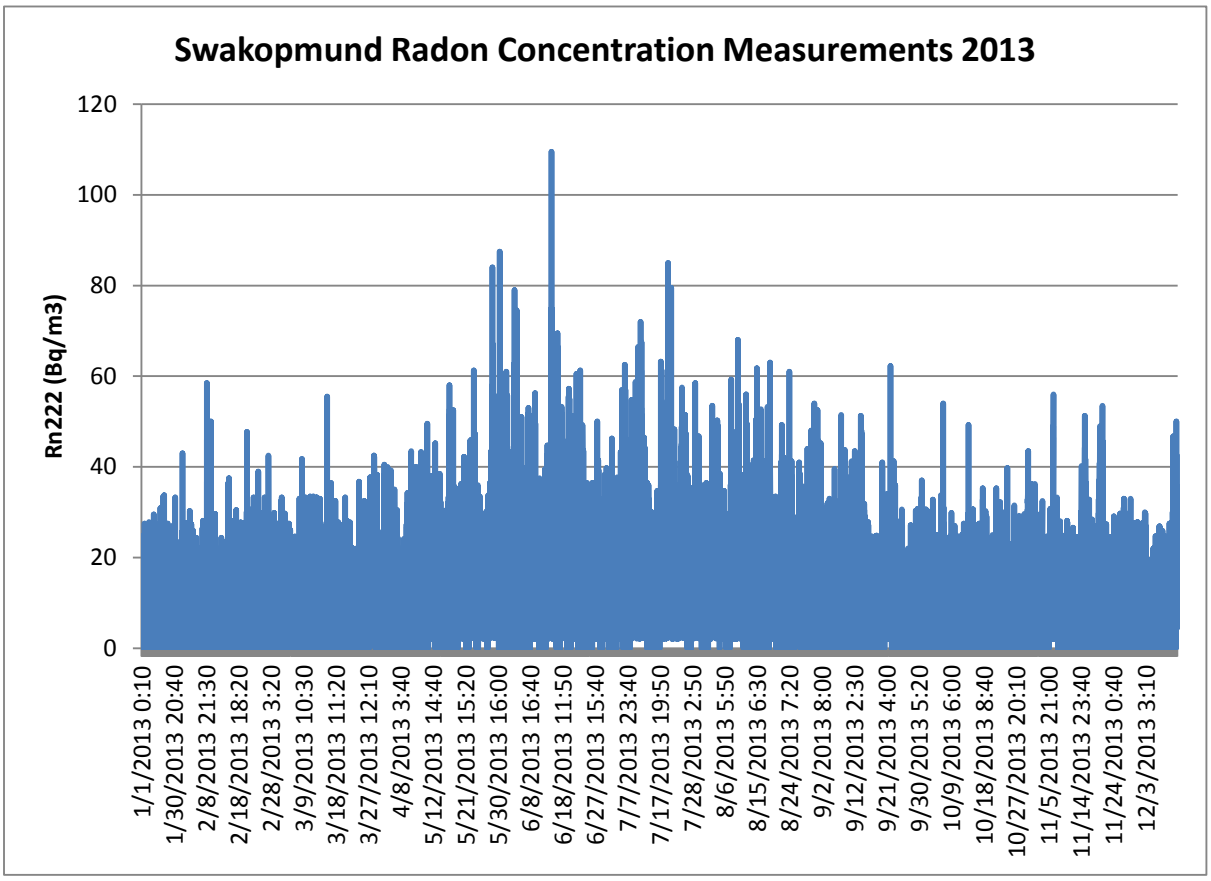

Figure 28: Radon concentration measured at the SEMP station in Swakopmund for 2013

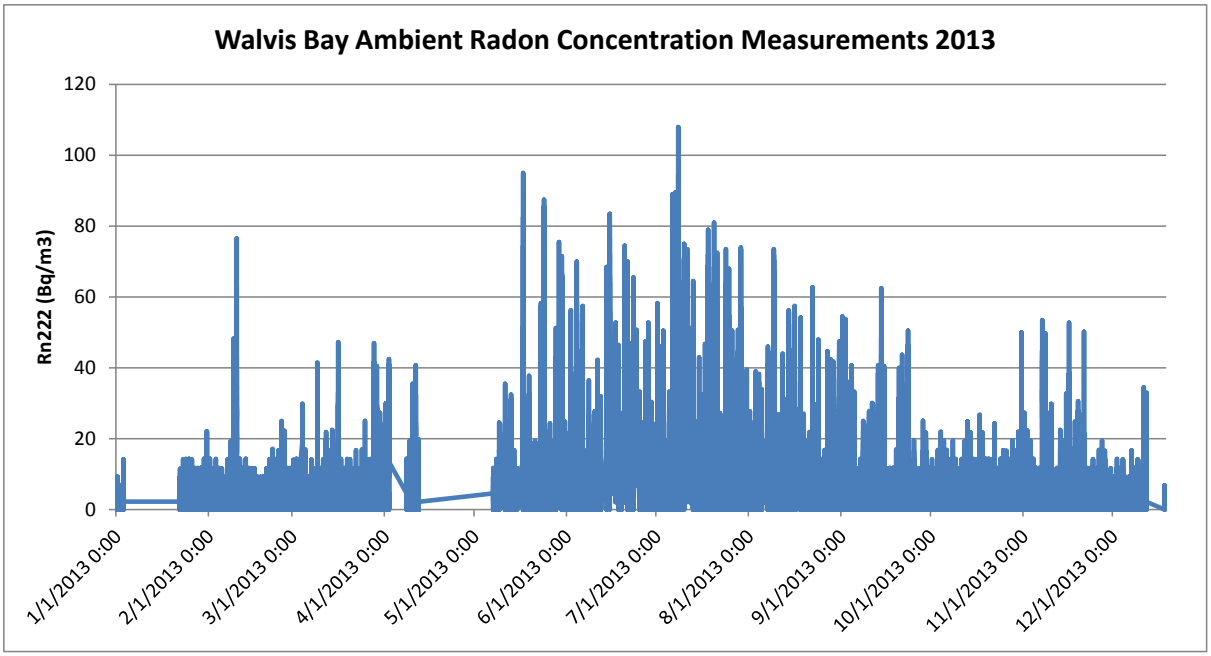

Figure 29: Radon concentration measured at the SEMP station in Walvis Bay for 2013

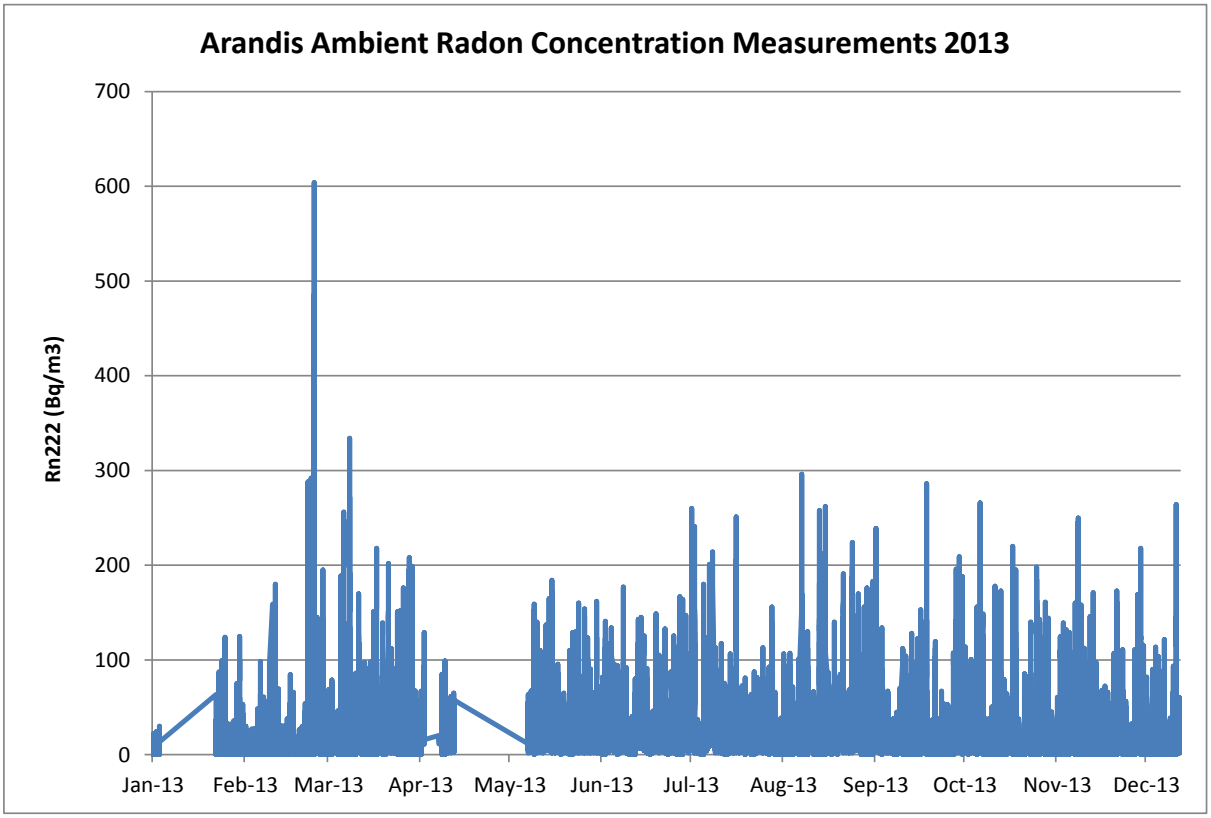

Figure 30: Radon concentration measured at the SEMP station in Arandis for 2013

Motivation of status: The cumulative radiation dose to critical groups of the public did not exceed 1 mSv/a above background. 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)**
Data Source	**NUA**
Status:	**MET**

The NUA encountered some problems with this indicator. Firstly, "absorbed radiation dose" is not correct in the context of worker doses and should be replaced with "radiation dose". Secondly, Namibian legislation only refers to "occupational exposure" and does not define "designated radiation workers". Operational mines usually classify all employees working on site as "occupationally exposed persons" (OEP), while designated radiation workers are only those that are at risk of being exposed to higher radiation doses, e.g. 5 mSv/a or more at Rössing. In the context of this indicator it would be better to replace "designated radiation workers" with "occupationally exposed persons".

Companies are still waiting for guidance from the NRPA whether or not to include background radiation in the reported doses to radiation workers. In the meantime, each company is using its own system and definitions as follows:

- The average exposure for all workers at AREVA's Trekkopje Mine in 2013 was 0.55 mSv/a including background radiation.
- Bannerman reported an average dose of 0.07 mSv/a above the natural background for all site personnel.
- The dose determined at Langer Heinrich of 3.7 mSv/a above the natural background applies to designated radiation workers only.
- At Marenica the average dose for workers whose job station was on site and who worked for the full year was 1.3 mSv/a including background radiation.
- Reptile's figure of 0.21 mSv/a above the natural background radiation is for all employees.
- Rössing defines radiation workers as only those that are considered to be at risk of an annual dose of 5 mSv or more. The average dose for radiation workers was 2.0 mSv/a, while the weighted mine-wide average dose was 1 mSv/a in 2013. This refers to the time spent at work (2,000 hours per annum) and includes background radiation.

Motivation of status: Although Swakop Uranium and Zhonghe did not provide data, none of the workers at AREVA Resources Namibia, Bannerman Mining Resources, Langer Heinrich Mine, Marenica, Reptile Uranium Namibia, Rio Tinto Rössing and Valencia Uranium was exposed to more than 20 mSv in 2013. This indicator is therefore considered as 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.**
Data Source	**NUA**
Status:	**MET**

From 2009 the injury statistics are worked out on 1,000,000 man hours as per the CoM definitions. In 2013, an increase in the Disabling Frequency Rate (DFR) was noted. This could be due to the massive increase in construction activities at the new Husab mine.

There has been no measurable increase of industrial disease attributable to the uranium industry thus far (Table 13). To unravel causal links, an independent epidemiological study is needed. This is not available and is considered to be overdue. Statistics on HIV remain confidential. HIV is treated like other chronic diseases such as diabetes and hypertension. HIV infected patients are not barred from employment but provided with antiretroviral medication and afforded free medical care. The prevalence rate amongst the mine employees is significantly lower than among the general population.

Table 13: Summary of industrial diseases for radiation workers at mines

Key Performance Indicators	2007	2008	2009	2010	2011	2012	2013
Employees							
Number of Medical Examinations	1175	1307	1415	7523	10251	9920	9852
Production							
Tonnes of Uranium oxide produced	3046	4108	4150	3628	2137		
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	1	0
New cases of Dermatitis	0	0	0	1	1	4	5
New cases of Noise Induced Hearing Loss	4	0	0	1	0	1	2
New Cases of Lung Cancer	1	1		1	1	1	1
New cases of Occupational Chronic Bronchitis						0	0
Disabling injury frequency rate (DIFR)	0.71	0.91	1.33	1.81	1.22	1.53	4.33
Number of Lost Time Injuries (LDI)	9	8	10	19	14	13	26

Motivation of status: Although the mines stated objective is "Zero harm" the statistics still compare favourably with available international figures. This indicator is MET.

Indicator 6.1.3.2.	**Measured change in the incidence rate of diseases scientifically attributed to radiation amongst members of the public, uranium mine workers and medical personnel**			
Data Source	**NUA**			
Status:	**NOT MET**			

The health statistics provided by the MoHSS do not indicate a measured increase in disease attributable to radiation, but there is also no verifiable data from an independent epidemiological study.

Motivation of status: The lack of data from an independent epidemiological study makes it impossible to draw accurate conclusions on the health impact and this indicator therefore remains 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**			
Data Source	**NUA**			
Status:				

A definite increase of traffic was noticed but this is due to increased industrial activities in the Erongo region. It is impossible to unravel the individual root causes. A regional task team was appointed to address the issue.

Motivation of status: Serious attention should be given to re-address the value of this indicator. Indicator 6.1.4.1 will be reviewed in the next reporting year.

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**			
Data Source	**SEMP Office/MoHSS**			
Status:		**IN PROGRESS**		

Target 6.2.2.	**An increase in registered healthcare facilities in Erongo, available to all, reaching 2.5 acute care beds per 1000 population and 0.5 chronic care beds per 1000 population by 2020**
Indicator 6.2.2.1.	**Number of available registered healthcare facilities: 1 per 1000**
Data Source	**SEMP Office/MoHSS**
Status:	**IN PROGRESS**

Target 6.2.3.	**An increase in ambulances in Erongo, reaching 1 per 20,000 by 2020.**
Indicator 6.2.3.1.	**Number of available ambulances: 1 per 20,000.**
Data Source	**SEMP Office/MoHSS**
Status:	**IN PROGRESS**

As stated in the employment EQO, the unemployment rate for 2013 was 29.6%. Namibia is classified as an upper middle-income country, but a large proportion of the Namibian population is particularly vulnerable to unfavourable developments in the global economy. According the 2012/2013 annual report for MoHSS, Namibia's average spending on the health sector is above that of sub-Saharan Africa and that of the upper-middle income countries. More than 6% of GDP is spend on health. However, in comparison with other countries, Namibia's health expenditure has remained static. Quality health is important for people to live a productive life.

Despite a relatively high rate of spending on health, Namibia is struggling to meet its health-related goals. The health sector is faced with an acute shortage of medical doctors and specialists, registered nurses, and other allied health professionals (MoHSS, 2014). The new UNAM School of Medicine is yet to produce the required medical doctors and pharmacists. Even at the current pace of intake, there will still be significant shortages (MoHSS, 2014). The Ministry of Health and Social Services is working to ensure that health service provision in the country conforms to national laws, standards and prescribed international standards.

The health care sector therefore remains inadequate in the Erongo region and Namibia as a whole. However, the required number of medical staff and hospital facilities has been reached for the private sector. This is not the case in the public sector.

Motivation of status: Although the required medical staffs and health facilities are adequate for the private sector/uranium mining personnel, it remains inadequate for the public. These indicators are therefore IN PROGRESS

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Summary of performance: EQO 6				
Total no. indicators assessed	**9**			
	NOT MET	**IN PROGRESS**	**MET**	**EXCEEDED**
Number of indicators in class	1	3	3	0
Percentage of indicators in class	14%	43%	43%	0%

Overall performance: The Health EQO previously had 8 indicators, due to the move of the radiation-related Desired Outcome from EQO 5 to EQO 6, this EQO now has 9 indicators. Overall, the 2013 performance has improved in comparison to that of 2012, as the NOT MET indicators have decreased from 4 to 1. However, the MET indicators have also decreased by one, and there are more IN PROGRESS. This is partially due to lack of an independent epidemiological study that can assess if there are diseases scientifically attributed to radiation; the absence of road accident data attributed to uranium mining and the public dose assessments indicator that is not measurable in this year's review.

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.**

The tourism sector in Namibia remains of considerable importance to the national economy, contributing between 14.8% and 15.7% to GDP in terms of direct and indirect impacts in 2013 (NTB 2013, WTTC 2014). While an increase of 9% in overall tourist arrivals to Namibia (Figure 31) and a 1% increase in national "Bed Occupancy" were recorded in 2013 (Figure 31), the coastal region experienced a drop in number of tourists i.e. bed occupancy dropped from 47.1% in 2012 to 38.70% during the current review (HAN 2013).

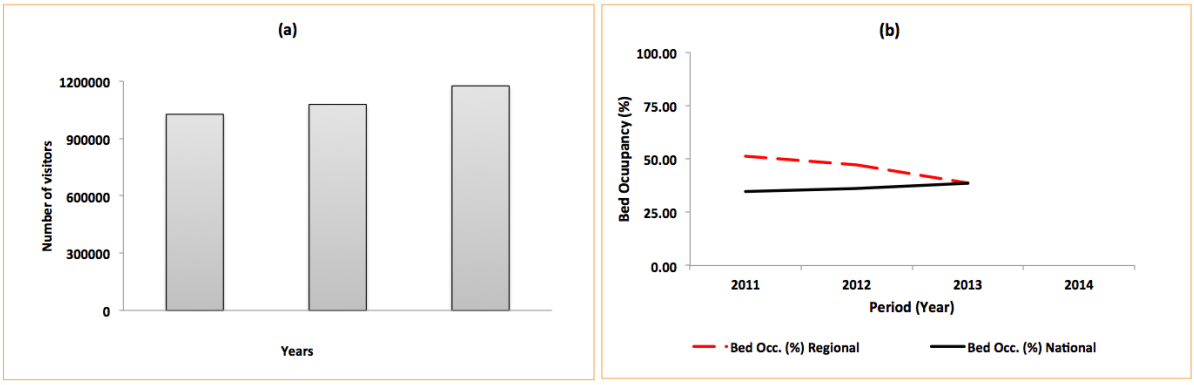

Figure 31: (a) Overall number of tourist arrivals to Namibia, and (b) the proportion of Bed occupancy within the "Uranium Province" Erongo Region between 2011 – 2013 SEMP monitoring periods (data source: MET 2013)

Apart from being of tourism importance, the coastal region is home to a resident human population whose quality of life is defined as being enhanced by opportunities to access parts of the region's area for sport, leisure or adventure activities (MET 2012, MME 2010). 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).

However, the Uranium development in the region raised 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 (SEA 2010). The SEMP therefore strives to monitor the effects of impacts on inter alia the four key concerns expressed above.

In the previous report (GSN 2012), indicators in this EQO suggested that the visual attractiveness of the Central Namib has not yet been reduced to the point that it affected tourists' perceptions or (most likely) visitor numbers. In 2012, tourist expectations regarding their visual experience in the Central Namib were 'met or exceeded', suggesting that the central Namib remained a satisfying tourism destination. To monitor and compare changes and trends in tourist satisfaction from the previous years to the current reporting period, the tourism survey was conducted again. Some of

these results of the survey have been used to assess the status of indicators in this EQO section (the complete results of the survey are provided in Appendix 1).

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, KNUAseb 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.**
Data Source	**NERMU/NUA**
Status:	**IN PROGRESS**

Monitoring of net loss in public accessible areas will be regulated through the "red" and "yellow" flagged area principles proposed in the SEA.

Motivation of status: This indicator is limited by the lack of a legislative tool to enforce compliance with the Red/Yellow flags, though in principle these areas were declared and the mining companies are voluntarily complying. The indicator is therefore rated IN PROGRESS.

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

With the 2007 national moratorium in effect, there were no new EPLs issued or new prospecting projects implemented during the reporting period. However, several existing prospecting projects (with licenses issued prior to the moratorium) have advanced into potential mining projects with applications launched through the Ministry of Mines and Energy and these include:

- **EPLs at end of 2012**, Langer Heinrich Uranium EPL 3500 (Mining licence applied for to cover EPL 3500)
- **ECC** Husab EIA amended August 2013; finer grind for stand-alone tailings storage and an increase in pit sizes.
- Bannerman Renewal of **EPL 3345 licence 2013**, however 50 % of the area was relinquished after seven years of exploration work.

Other developments, for which various Environmental Clearance Certificates were awarded by the MET, include the Valencia Village, Husab Valley road and Bannerman Resources (Table 14).

Table 14: List of Environmental Clearance Certificates issued by the Ministry of Environment and Tourism in 2013 for uranium mining and related projects

Permits or Licences issued for mining and related activities in 2013		
Permit name	**Issued By**	**Date Received**
ECC** – BMR, Pilot Plant on EPL 3345 and 3346	MET*	11 Feb 2013
ECC – BMR, Etango Linear Infrastructure, renewed	MET	11 Feb 2013
ECC – BMR, Amendment to ECC for EPL 3345	MET	18 Mar 2013
ECC – Valencia Village	MET	11 Apr 2013
ECC – Valencia Mining	MET	11 Apr 2013
ECC – EPL 3439 situated in the NNP	MET	30 Jan 2013
ECC – EPL 3138 situated in the NNP	MET	30 Jan 2013
ECC – EIA for Temporary Truck Staging Area	MET	03 July 2013
ECC – Husab Mine, Khan Valley Road	MET	29 Apr 2013
ECC – Husab Mine EIA Amendment (TSF***)	MET	28 Aug 2013
ECC – Husab Mine Linear Infrastructure, Renewed	MET	20 Sept 2013
ECC – Rössing Z20 Infrastructure Corridor	MET	XX Jul 2013

*MET= Ministry of Environment and Tourism, **ECC = Environmental Clearance Certificate,

***TSF = Tailings Storage Facility (source: CoM 2013, MET 2013)

Motivation of status: With the moratorium in effect, no new exploration and mining license were granted during the current review period. However, as evidence of compliance to this indicator, all clearance certificates were issued on the grounds of EIAs that all addressed public access. The indicator is therefore MET.

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

This indicator only applies to mines or projects that are situated in areas that the public usually wants to access; this currently excludes AREVA, Marenica and Valencia Uranium. The closure plan or environmental contracts of other operating companies address public access for personal recreation as follows.

Since the Etango open pit will not be backfilled it will permanently close off part of the 'Welwitschia Drive' and Bannerman Resources will provide an 'alternative Welwitschia Drive' for tourists to access the Moon landscape and Welwitschia plain (BMR 2009). As far as Bannerman's exploration activities are concerned, access has not been prevented to any recreational areas in the Central Namib (NUA 2014 and BMR 2013). Langer Heinrich addressed the topic related to public access throughout the different phases of the mine cycle – construction, operation, rehabilitation and closure (LHU 2009 and LHU 2011). Reptile's Scoping report has identified the historic Van Stryk mining pits as the only

tourist attraction area within its exploration areas (RUN 2013). Reptile's exploration activities do not prevent access to any usually accessible recreational areas. Full public access to safe areas of the Rössing mine site will be provided once mining and processing has been completed (RUL 2005 and RUL 2011). There will be free access through the Khan River as conditions for access to Swakop Uranium's Husab Mine have been included in the Environmental Pro forma Contract (NUA 2014).

Motivation of status: All mining companies have considered and made provision for addressing public access upon decommissioning; this indicator is 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.**			
Data Source	**CTAN, NERMU, NUA, Ministry Environment and Tourism,**			
Status:			**MET**	

With an improvement in sample size, the 2013 survey results present a slightly different tour operators view on the extent to which different attractions in the Namib Desert forms part of their tour package. About 20 tour operators were polled for the survey with only 12 who actually returned their survey responses, representing a 75% increase in sample size from the 2012 study. The median scores dropped by one or two levels down the scale for four of the attraction sites (Walvis-Swakop Dunes, Coastline, the Giant Welwitschia and Welwitschia Flats), increased by 1 level up the scale for the Swakop-Khan River and remained unchanged for Spitzkoppe (Table 15). When tour operators responses are clustered into three significant classes i.e. not significant, significant and highly significant, more than 70% of the respondents indicated that all attraction sites are still a significant or highly significant part of their tour packages (Figure 32).

Table 15: Median score of tour operator's response to the request to rate the extent to which different attractions forms part of their tour packages on a 5 point scale (1=not used at all, 5=highly significant component).

Tourism site	Baseline: pre-2011*	2011	2012	2013
Walvis-Swakop Dunes	5	-	5	3
Coastline	5	-	4	3
Moon Landscape	5	-	3	4
Spitzkoppe	5	-	5	5
Swakop-Khan Rivers	5	-	4	5
The Giant Welwitschia	5	-	5	4
Welwitschia Flats	5	-	5	3

*Baseline assumes that prior to the SEMP, all tour operators would rate all sites as 5 as having a significant potential to be included in their tour packages.

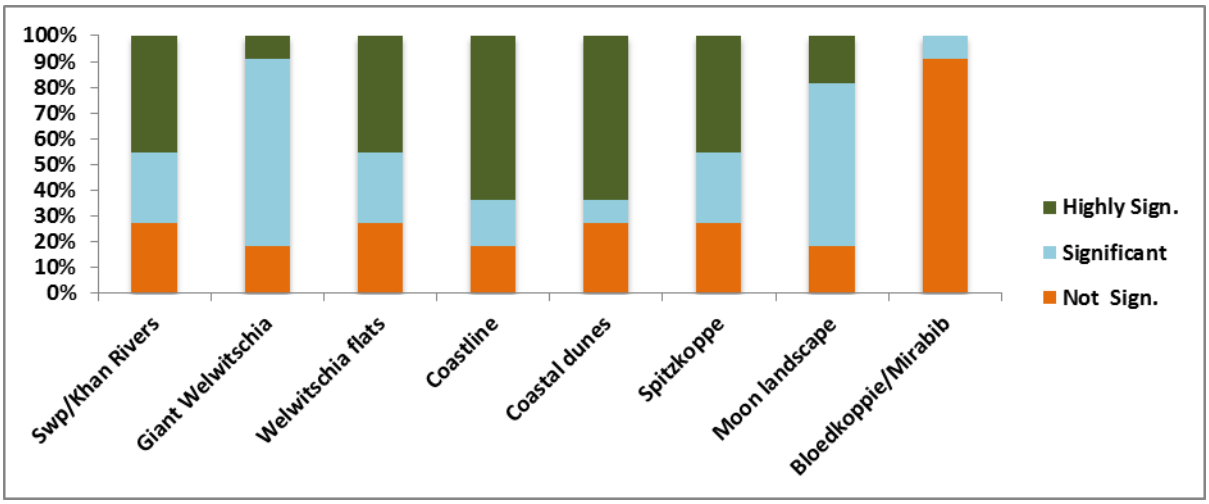

Figure 32: Shows the significance of the particular attraction sites as important component of the Central Namib's tour packages in percentage proportion. The site with least significance (Bloedkoppe/Mirabib) in this graph is not part of the initial SEMP listed Y

Motivation of status: Because the majority of tour operators still consider the particular attractions as significant or a highly significant component of their tour packages, the indicator is rated MET.

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

The tourist's interests and quality of experience in the Central Namib remains stable. The majority percentage of the survey respondents scored a 3 or greater (Table 16). Comparing scoring categories for the question on whether expectations of tourists experience were MET or NOT MET, a slight negative or positive change from the previous (2012) study is evident. There was a drop between two and eight percent in expectations for "scenic quality" (4%), sense of place (5%), "nature" (4%) and "adventure tourism" (8%). While the expectation for the category "culture" experience was NOT MET in the previous study, a majority (90%) of the respondents in 2013 scored it a MET or EXCEEDED. Nonetheless, 83% and more of the respondents scored the overall expectation across all categories as MET or EXCEEDED.

Table 16: Responses of all respondents, 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).

Topic	**Percentage of scores in category**									
Score*	**Lowest**								**Highest**	
	1		**2**		**3**		**4**		**5**	
Reporting Period	**2012**	**2013**	**2012**	**2013**	**2012**	**2013**	**2012**	**2013**	**2012**	**2013**
Scenic quality	0	6	4	0	9	3	20	23	**67**	**68**
Sense of place	0	7	2	0	24	7	25	**54**	**49**	32
Nature	0	6	2	0	15	6	16	22	**67**	**66**
Adventure tourism	0	7	10	11	27	29	29	**29**	**35**	25
Culture	4	3	17	7	29	31	**33**	**31**	17	28

* The number of scores given is 55 in 2012 and 32 in 2013.

Motivation of status: The expectations of 83% (while the target was 80%) and more of the survey were MET and EXCCEDED across most of the experience categories, this indicator's overall score therefore remains EXCEEDED.

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

The applications for projects for which new environmental clearance certificates (Table 17) or renewal EPLs (Table 17) were granted, were based on already existing EIA/EMPs reports as activities were restricted within the same previous license areas.

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, except for Marenica which did not yet do an EIA, but a prospecting environmental assessment (PEA). A review of the mining company's EIA's, EMP's and or PEAs also confirms that both the issue of visual impact and sense of place are addressed (Table 17).

Table 17: Review of mining company's EIAs and EMPs reports for visual impacts and sense of place, the tick (✔) are those that addressed visual impact and sense of place, and (✗) those that did not.

Company	Visual Impacts Addressed	Sense of Place Addressed	PEA, EIA/EMP Year
Rössing Uranium	✔	✔	1991, 2008 & 2011
Langer Heinrich	✔	✔	2009 & 2011
AREVA – Trekkopje	✔	✔	2007
Swakop Uranium	✔	✔	2010, 2011 & 2013
Valencia – Norasa	✔	✔	2008
Bannerman Resources Namibia	✔	✔	2009, 2011 & 2013
Marenica Energy	✗	✗	-
Reptile Uranium	✔	✔	2006, 2007 & 2011

Motivation of status: No EIAs/EMPs were published for new projects in 2013, the only two EIA amendments (SU – Proposed changes to Husab Mine and BMR – Proposed Pilot Plant) reviewed address both the "Visual Impacts" and "Sense of Place". Thus this indicator is 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**

While the intent and drive to include tourism and biodiversity values as key factors for consideration in the decision-making process is evident, the legislative tool to enforce compliance is still a constraint. However, together with MET, MME has finalized the Policy on Mining and Exploration in protected areas, and it will soon be submitted to Cabinet. This policy document includes zonation for all the National Parks, and these will be honoured by MME when allocating licenses (G Schneider, MME, pers. comm., 2013).

Motivation of status: Policies to enforce compliance with the yellow flag principle are still pending, the indicator remains 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.**
Data Source	**NERMU/MME**
Status:	**IN PROGRESS**

Similar to indicator 7.3.1.1, no change has occurred to this indicator since the previous report.

Motivation of status: Policies to enforce compliance with the yellow flag principle are still pending, the indicator remains 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**
Data Source	**NERMU/NUA**
Status:	**MET**

The uranium moratorium prohibits the issuing of new prospecting licenses in the area of relevance to the SEMP, therefore prospecting and mining developments only occur in areas where EPLs/MLs already exist (granted prior the moratorium). With the moratorium still in effect, the MME can only grant new mining licenses for existing or renewal EPLs and those granted during the current reporting are listed in Table 18. These are acknowledged to fall within some of the identified

"yellow/red flagged areas but pending a legislative tool to enforce the implementation of "yellow/red" flags principle as a criteria for granting or denying EPL/MLs application. But because the moratorium is still in place, no new licenses will be awarded in any area.

Table 18: List of Exclusive Prospecting License renewals granted by the Ministry of Mines and Energy in 2013

Exploration License Renewals Granted in 2013 (MME)			
Holder	**Type**	**Status**	**Date Granted**
Swakop Uranium	EPL 3138 – B&R* Metals and Nuclear Fuels	Granted	20 Apr 2013
Bannerman Resources	EPL 3345 – Nuclear Fuels	Granted	27 Apr 2013
Yellow Dune Uranium Namibia	EPL 3498 – B&R Metals and Nuclear Fuels	Granted	08 May 2013
Yellow Dune Uranium Namibia	EPL 3499 – B&R Metals and Nuclear Fuels	Granted	06 Jun 2013
Reptile Uranium Namibia	EPL 3496 – B&R Metals and Nuclear Fuels	Granted	06 Jun 2013
Reptile Uranium Namibia	EPL 3497 – B&R Metals and Nuclear Fuels	Granted	06 Jun 2013
Nova Energy Namibia	EPL 3668 – B&R Metals and Nuclear Fuels	Granted	21 Nov 2013
Nova Energy Namibia	EPL 3669 – B&R Metals and Nuclear Fuels	Granted	21 Nov 2013
Nova Energy Namibia	EPL 3670 – B&R Metals and Nuclear Fuels	Granted	21 Nov 2013

* B&R = Base and Rare (source: MME, 2014a)

Motivation of status: With the moratorium still in effect, new prospecting licenses are not awarded and thus the indicator is regarded as MET.

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	Summary of performance: EQO 7			
Total no. indicators assessed:	**9**			
	NOT MET	**IN PROGRESS**	**MET**	**EXCEEDED**
Number of indicators in class	0	3	5	1
Percentage of indicators in class	0	33%	56%	11%

Overall performance: All the indicators under this review were either MET or IN PROGRESS. Fifty six percent of indicators in EQO 7 were met, representing an 11% improvement from the previous year. Due to the improvement in the sample size for the tour operator's survey, there was no indicator without data. However, 33 % of the indicators particularly those relating to the policy environment on Red and Yellow flagged areas remained IN PROGRESS due to the pending policy. As before, the tourist expectation indicator is once again exceeded.

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.

During the previous reporting period, EQO 8 gained two indicators bringing the total to 20. The mix of these indicators relate to policy environment, efficiency of the EIA process, and supports for conservation initiatives by the mines. The policy environment indicators revolved mainly around the issue of red, yellow and green flag areas. This still remains an issue, because it requires a number of other components such as the Policy on Prospecting and Mining in Protected Areas and regulatory initiatives at national level to be in place.

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

Currently or prior to the 2007 moratorium, prospecting or mining applications are not by regulation expected to comply with “Red/Yellow” flags principle.

Motivation of status: Policies to enforce compliance with the red and yellow flag principle are still pending, the indicator remains **IN PROGRESS**.

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

Although there were no new projects commissioned in 2013, all projects conducted in the reporting period have EIAs that follow the mitigation hierarchy. The current assessment considered whether the "offset concept" features in these reports or not. None of the EIAs reviewed include the concept of Offsets (Table 19), though in principle most of the mining companies are willing to incorporate it, provided that it becomes a legislative/compliance requirement. However, the EIAs do follow and incorporate the first three components of the hierarchy, i.e. avoidance, minimization or mitigation and rehabilitation or restoration.

Table 19: Application of the mitigation hierarchy by the exploration and mining company's EIAs and EMPs reports, the tick (✔) applicable level of the hierarchy, and (✗) not incorporated.

Application of mitigation hierarchy considered in EIA/EMPs				
	Avoidance	Minimization / Mitigation	Rehabilitation / Restoration	Off-set
Rössing Uranium	✗	✔	✔	✗
Langer Heinrich	✔	✔	✔	✗
AREVA – Trekkopje	✔	✔	✔	✗
Swakop Uranium	✔	✔	✔	✗
Valencia – Norasa	✔	✔	✔	✗
Bannerman Resources Namibia	✔	✔	✔	✗
Marenica Energy*	✗	✗	✗	✗
Reptile Uranium	✔	✔	✔	✗
Zhonghe Resources	✔	✗	✔	✗

*Marenica Energy has not conducted an EIA yet, Source: EIA Reports – available by request

Motivation of status: Although the avoidance, mitigation and restoration components of the mitigation hierarchy are greatly applied by the mining industry, the indicator requires that the Offset component also be applied. The legislative tool that enforces application of the offset principle and the incorporation thereof in the industry's environmental management systems is still pending, the indicator therefore remains 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.
Data Source	NERMU/NUA/MET
Status:	MET

The minutes of meetings and decisions taken on recommendations pertaining to approval and renewal of exploration or mining licenses are kept by the Ministry of Mines and Energy while the Ministry of Environment and Tourist's Directorate of Environmental Affairs keeps record on the granted Environmental Clearance Certificates.

Motivation of status: Because both, the Ministry of Environmental and Tourism, and the Ministry of Mines and Energy keep records of meetings where decisions are taken, the indicator is 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.**
Data Source	**NERMU/NUA**
Status:	**MET**

Operational mines indicated that they have specific programmes and projects to actively avoid, mitigate, restore or offset their impacts. These programmes are documented in the form of government-approved environmental management plans and company-internal policies, strategies and procedures, e.g. environmental codes of practice (NUA 2013). Most companies stated that avoidance was the predominant approach. However, there is currently no evidence or means to explicitly verify that avoidance pre-dominate the mitigation measures proposed in some projects. Sometimes avoidance is not possible because the activity that causes an impact has to be carried out to enable mining to proceed. In these cases minimisation and mitigation are the only options, followed by restoration of the disturbed surfaces.

Motivation of status: Because the EIAs of most of the mining companies comply with the mitigation hierarchy as stipulated in the SEA and EIA review/assessment process, the indicator is MET.

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

All mines identified biologically sensitive areas (NUA 2014); active mines explicitly attempted to minimize the size of their footprint on sensitive biodiversity. Companies have introduced a system of ground disturbance permits that are issued prior to the start of construction to reduce the extent and severity of disturbance. These enable environmental staff to inspect the areas and demarcate plants and other species that may not be removed or arrange for the rescue and relocation of endemic species (Table 21). Other companies have mapped out sensitive areas during the planning and design stage and they continuously try to minimize their footprint or rehabilitate the disturbed areas (Table 20). Nonetheless, the assessment of actual indications for biodiversity properties recovery is still not well accounted for.

Table 20: Proportion of disturbed and rehabilitated area compared to mining companies areas that fall within the national protected area.

Company	Disturbed area (ha)	Rehabilitated area 2013 (ha)	Rehabilitated area 2012 (ha)	Protected area (ha)
AREVA - Trekkopje	1891	174	26	4941
Bannerman	233	207	176	No data
Langer Heinrich	724	0	0	0.82
Marenica Energy	No data	No data	No data	No data
Reptile Uranium	15900	2100	2100	No data
Rössing Uranium	2541	93	93	No data
Swakop Uranium	992	108	No data	No data
Valencia - Norasa	130	40	40	0
Zhonghe Resources	1500	1500	1100	No data

Source: NUA 2014, CoM Annual Review 2013

In addition to its own disturbed areas, Bannerman Resources has rehabilitated land that was disturbed by the public (off-road driving) and past exploration activities in the 1970s (NUA 2013). They have also put up signs to discourage this type of behaviour. Reptile is not shown in the graph because they gave the size of disturbed areas in line kilometres of tracks. Twenty line km remained disturbed in 2013, while 148 km have been rehabilitated. This includes rehabilitated tracks from the previous year. Swakop Uranium's figures are estimates for the mine site and access road. The area around Valencia Uranium mine has been disturbed by exploration activities only. Most of the area was explored in the 1970s and never rehabilitated by the former mineral rights holders. Valencia is planning an extremely confined footprint due to surface rights limitations and topography. Rehabilitated areas consist mainly of the borrow pits opened up for road construction and service roads used during construction.

Table 21: List of plant species relocated and transplanted in 2013

	Swakop Uranium	**Rössing**
Species Name	*Welwitschia mirabilis*	*Adennia pechuelii*
Number of Individuals	5	7
New Location (s)	3 SU*, 2 NBG*	5 RU*, 2 NBG
Survived	3	-

*SU = Swakop Uranium, RU = Rössing Uranium and NBG = Namib Botanical Gardens.

Motivation of status: The mining industry continued with their rehabilitation efforts, two of which successfully relocated and replanted several endangered plant species in an attempt to avoid disturbance. All mines mapped out sensitive areas within their MLs for which they continuously monitor impacts and mitigate accordingly, hence the indicator remains 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'**
Data Source	**NERMU/NUA**
Status:	**IN PROGRESS**

Assessment of this indicator is limited to recent developments, i.e. linear infrastructure designed since the previous report. During the current reporting period, there were no new EIA's published. The previous assessment therefore remains relevant, citing that the most recent linear infrastructure developments (AREVA's Trekkopje and LHM) were carefully planned, while the Husab Mine could not avoid crossing sensitive areas by force of location (MME 2014).

Motivation of status: Because there were no new EIAs or Linear Infrastructures commissioned during the current reporting period, the indicator remains IN PROGRESS.

Indicator 8.1.1.7.	Mines share infrastructure as much as possible, thus minimizing infrastructure proliferation.
Data Source	NERMU/NUA
Status:	NOT MET

In 2011, NamWater planned to upgrade its water supply capacity to the existing and potential uranium mines located in the Central Namib south of the Swakop River and carried out an EIA (Enviro Dynamics 2011a). A second water supply pipeline was to be built along the same route as the existing one along the C28 main road. NamWater planned the new Swakop South pipeline as a shared structure with off-takes to Etango (Bannerman), Langer Heinrich, Swakop Uranium and Reptile's Tubas project (
Figure 33).

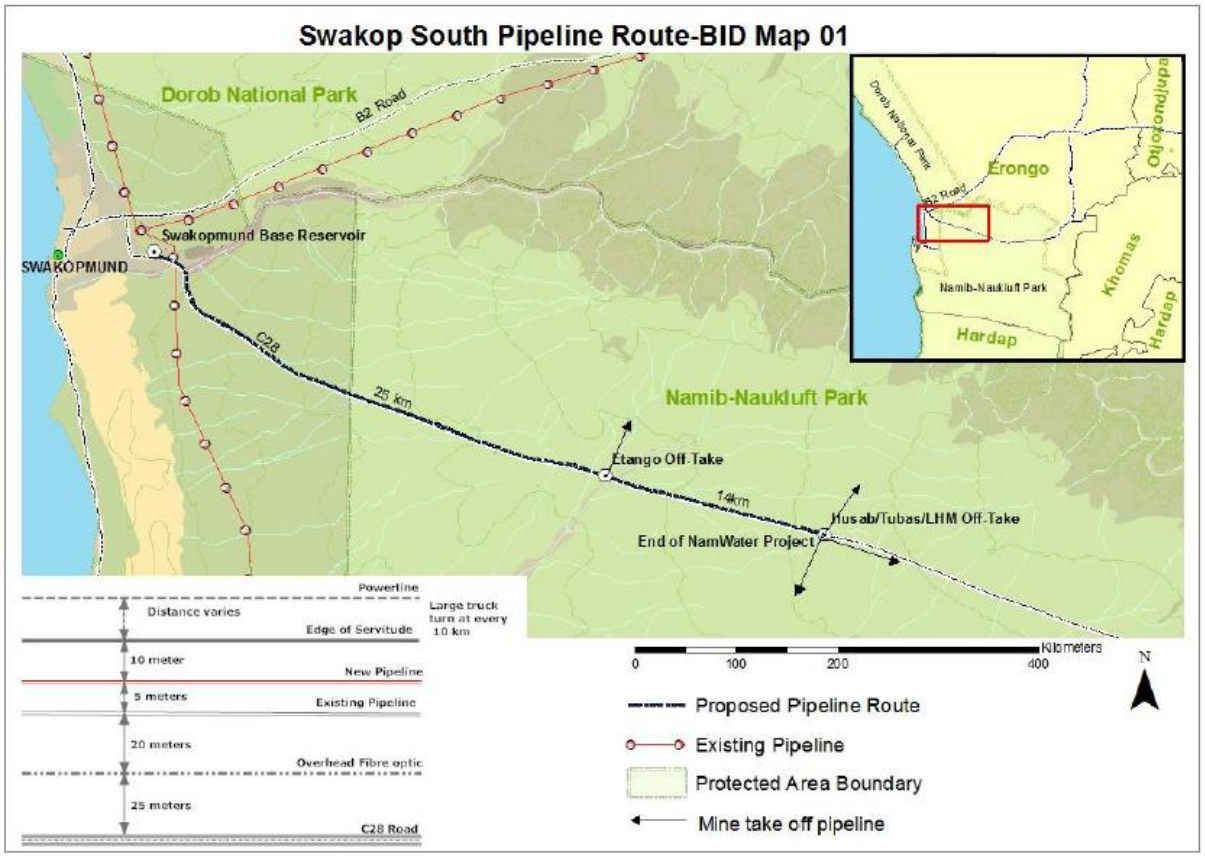

Figure 33: Map indicating the different off-takes of the proposed shared NamWater Swakop South pipeline development of 2011 which was discontinued due to a lack of capital investment (Enviro Dynamics 2011a).

This plan was eventually cancelled and Swakop Uranium is currently building its own pipeline. NamWater expected the mining companies to pay for the pipeline, but Reptile and Bannerman could not commit funds to the project because there is uncertainty when exactly the mines would be developed. It would have been unrealistic to expect Swakop Uranium to install a larger pipeline for possible use by other separate entities. To achieve the desired outcome Government would have to finance such large infrastructure for future development of other mines so that the companies could later refund their share of the costs to the state.

Motivation of status: With the cancellation of the NamWater Swakop South pipeline, the mining companies with plans to upgrade their water supply resorted to doing so independently and

therefore not sharing their infrastructures. Because mines are not sharing infrastructure, the indicator is rated 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).**			
Data Source	**NERMU/NUA**			
Status:			**MET**	

The infrastructure development initiatives that made planning provisions to accommodate future water and/or power demands were those spearheaded by NamWater and NamPower. These were to be co-financed by the uranium mining industry but due to unfavourable uranium market conditions at the time of planning, the initiatives could not be continued. However, NamPower did consider future expansion at the Rössing to Walmund power line. At least one circuit will be installed with the possibility of adding another circuit when needed (Enviro Dynamics 2011b). As is evident, the intent exists from the stakeholder to drive infrastructure investment towards reducing ecological impacts through planning that takes into account future demands. As previously reported in the 2012 SEMP report), AREVA and Langer Heinrich Mine reported that their power lines and pipelines were planned to allow for additional users, while Swakop Uranium preferred to construct their linear infrastructure across the Khan River from the north rather than through the Namib Naukluft National Park.

Motivation of status: The existing mines infrastructure took into account future demands and therefore the indicator is 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).**			
Data Source	**NERMU/NUA/MET**			
Status:			**MET**	

The two currently operating mines (Rössing Uranium and Lange Heinrich Uranium) continued their partnership with conservation organisations and providing mainly funding for research into biodiversity issues relating to uranium mining in the Central Namib. Mine specific partnership and type of commitment and or support provided is presented in

Table 22 below. Though operations have not commenced at Bannerman Resources, they interact with the Ministry of Environment and Tourism and rehabilitated sites within their EPL area that were disturbed prior to their operations e.g. the old 1970 exploration camp. Marenica, Zhonghe Resources and Reptile Uranium indicated that they did not have any partnership and thus do not currently support any conservation projects.

Table 22: Types of partnerships between the mine and conservation organizations including the types of biodiversity impacts management commitments implemented in 2013.

	Commitment	Partner (s)	Status/Progress
Rössing Uranium	Development of Biodiversity Action Plan	Birdlife Int., Fauna & Flora International (FFI)	Completed
Langer Heinrich	Gobabeb Training and Research Internship Programme	Gobabeb Research and Training Centre - NERMU	Funding agreement ended in 2012. Renewal negotiations on-going.
AREVA - Trekkopje	Coastal biodiversity conservation	Namibian Coastal Conservation and Management project (NACOMA)	Annual contributions to biodiversity weeks and clean-ups since 2010
Swakop Uranium-Husab	Rehabilitation options, Husab Sand lizard & Welwitschia research	Gobabeb Research and Training Centre - NERMU, NedBank Go Green Fund	3 Studies completed, reports published, monitoring is ongoing.
Valencia-Norasa *	No data	No data	No data
Bannerman Resources	Rehabilitation of 1970's Exploration Camp and Signage upgrades at Moon Landscape	MET	Completed and sites handed back to MET during the reporting period (2013).

* Efforts to obtain these information form Valencia Norasa Namibia were futile

Motivation of status: A fraction of the mining companies (particularly those operating within the Namib-Naukluft Park) have partnerships with conservation organisations, while others are only committed to rehabilitation projects carried out internally or outsourced to environmental management consulting firms (not necessarily conservation organisations). Because the indicator's emphasis is on the Namib-Naukluft Park, the indicator is 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).**
Data Source	**NERMU/NUA/MET**
Status:	**IN PROGRESS**

Mining companies are in principle committed to a 'no net loss' policy and sustainable offset initiatives. Langer Heinrich will investigate a biodiversity offset if irreplaceable biodiversity will be permanently lost and restoration is not possible, while Rössing is following the stated biodiversity strategy of all Rio Tinto operations. The mines will establish partnerships with conservation partners once the offset opportunities have been defined in consultation with government and stakeholders.

Motivation of status: There is still no practical commitment by the mining industry towards implementing 'no net loss' initiatives and identification of partnerships rather than acknowledgement and theoretic engagement with the principles of no net loss. The indicator therefore remains 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.**
Data Source	**NERMU/NUA/MET**
Status:	**MET**

The intent and emphasis of this assessment is to look at projects mining companies have undertaken above and beyond their impact management. Again, several projects and events of varying magnitudes were supported including research enquiries, public awareness and environmental waste management initiatives. However, as in the previous indicator (8.2.1.2) it was mainly operational mining companies within the Namib-Naukluft Park that were supporting these projects (see detailed information in

Table 23).

Table 23: List of additional conservation projects carried out with support from or through collaboration between conservation institutions and the uranium mining industry.

2013:	Conservation partner	Type of Support	Progress/Status
Rössing Uranium	NACOMA	Donation of science laboratory equipment to participating schools and awareness event.	Supported the hosting of the 13th Birdwatch, at the Walvis Bays Lagoon
Langer Heinrich	- National Uranium Association - MET	- Environmental Health and Radiation issues - Ulatbank Renovations	Continued funding for Working Groups.
Swakop Uranium	- MET	- Waste Management within the Namib Naukluft National Park, close to Husab Mine Operations.	21 old waste drums at the Swakop River campsite, the Big Welwitschia and Welwitschia Flats were replaced with new ones.
Bannerman Resources	- George Mukoya,	- Sponsored attendance	- Successfully

	Uibasen & Okangundumba Conservancies - Employee initiative - MET	of members at the AWS* - Dune 7 clean-up - Moon landscape rehabilitation and signage	completed. - Continuous. - Completed and handed back to MET

* AWS = Adventure World Summit

Motivation of status: There is support from the uranium mining industry to the conservation projects. This indicator is therefore MET**.**

Indicator 8.2.1.4.	**Protection and management of key biodiversity offset areas is supported (e.g. NW Kunene, Messum, Spitzkoppe, Brandberg and other special areas in Namibia).**
Data Source	**NERMU/NUA/MET**
Status:	**IN PROGRESS**

There is a general consensus within the mining industry that the matter of biodiversity offset areas should be discussed and agreed upon with government before mining companies can commit to supporting such offsets (NUA 2013). There is therefore little to no effort towards achieving this indicator without it being incorporated into national legislative regulatory requirements. So far, only three (Table 24) of the mines have started the first steps of developing internal biodiversity management strategies and or policies.

Table 24: Biodiversity protection and management programs developed and implemented by the mines in compliance with the SEMP, with Rössing Uranium and Langer Heinrich mines currently taking the lead.

	Commitment	Off-set initiative	Progress/Status
AREVA Trekkopje	No Net Loss	Protection of lichen fields	Implemented, to be formalised
Rössing Uranium	Rio Tinto policy	Biodiversity strategy	Implemented
Langer Heinrich U	Biodiversity management plan	Where relevant (where restoration is not an option), investigate offsets relating to the residual impacts arising from the disturbance.	Progress on program implementation to be reviewed during 2015

Motivation of status: The adoption of the Biodiversity Offset principle or regulation is hampered by a lack of policy emphasising it as a compliance requirement, and thus the indicator remains IN PROGRESS as only two mines have adopted a Biodiversity management strategy so far.

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.**
Data Source	**NERMU/NUA/MET**
Status:	**MET**

To achieve this outcome, consideration of species extinction during environmental impact assessments and management plan development processes is key, thus a mining license application

may be denied should an EIA and or EMP report identify species extinction as likely. EIA's and EMPs assessed for projects being implemented and or operating during the current reporting period presented no risk of species extinction. The mitigation hierarchy (avoid, minimize, rehabilitate, offset) is applied in the assessment of impacts at all operating mines.

While the emphasis of this indicator is on species extinction, several endangered species not yet at the risk of extinction were identified in EIAs of operational mines and mitigation measures were identified (Table 25). These include a new *Pachydactylus* gecko species, with existing knowledge suggesting that about 10% of its habitat would be affected by the Etango mine. Two high priority lizard species, two bird species and two mammals of a threatened status were recorded at Rössing Uranium, and so was a potential impact on *Welwitschia* and the Husab Sand Lizard at Swakop Uranium (GSN 2012). Rössing and Valencia were both concerned about their possible impact on the endemic species *Lithops ruschiorum* and *Adenia pechuelli* (GSN 2012).

Table 25: Strategies employed by mining and exploration companies to assess risks and avoid species extinction Source: Uranium Institute 2013.

Company	Species extinction			
	Progress 2013	Measures taken in 2012	Was considered in EIA (year)	Endangered species identified
Bannerman Mining Resources	No action	Research	Yes, 2012	Yes
Rössing Uranium*	No action	Mapping	Yes, 2010 and 2012	Yes
Swakop Uranium	On-going	Research	Yes, 2010, '11, '13	Yes

*The Zhonghe EIA, contrary to their own assessment does not provide evidence of assessing extinction risk, apart from providing lists of species of different conservation concern.

Motivation of status: The mitigation hierarchy (avoidance, minimization, rehabilitation, offset) is applied in the assessment of impacts at all operating mines; this is evident in all EIA reports reviewed. The indicator is therefor MET.

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

Overall, there were no species at the risk of extinction identified with the current prospecting and operating mining projects. There was therefore no need to allocate resources for the management of species at risk of extinction but rather for enhancing knowledge to managing overall biodiversity impacts. In particular, Swakop Uranium for instance continued to allocate funds towards research and worked with NERMU at the Gobabeb Research and Training Centre (Table 26). These studies were on the recovery of hypolithic cyanobacteria in rehabilitated, non-rehabilitated and undisturbed sites, baseline values for the monitoring of the effects of mining-generated dust and water flow interference, and baseline for monitoring potential impacts of construction and mining activities.

Table 26: Types of resources allocated towards the management of endangered species identified within mining license areas in 2012.

Company	Species extinction		
	Type of Resources made available 2013	Was considered in EIA (year)	Endangered species identified

Bannerman Mining Resources	No Resources made available	Yes, 2012	Yes
Rössing Uranium	No Resources made available	Yes, 2010 and 2012	Yes
Swakop Uranium	Budgetary Provision, Funding.	Yes, 2010, '11, '13	Yes

Motivation of status: Although there are currently no direct risks of extinction to species within the operating exploration and mining projects areas, certain companies are taking proactive measures to manage potential impact on endangered species. This indirectly contributes to positive measures of making sure these species are not pushed towards the level of near extinction. The indicator is thus MET.

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

All companies take similar measures to minimise secondary impacts. The most important approach is to create awareness by informing all employees, contractors and visitors that off-road driving, poaching, illegal camping and littering is prohibited. This is done in the form of an environmental site induction, usually as part of a short HSE induction for visitors and a more detailed site induction for new employees and contractors. Mines within the NNP distribute the park rules to all employees, contractors and visitors during environmental inductions. Additional measures taken to reduce transgressions by mines employees or service providers include:

- Security checkpoints are in place to control access and no person can enter the mine site without a valid permit and those issued limit visitors to the mining site only.
- Use of access roads required for mining-related activities is regulated through EIA recommendations and signs, barricades and fences are erected to reduce off-road driving in the Namib-Naukluft Park.
- Inspections to identify transgressions are carried out and corrective action taken at all exploration sites by Environmental Control Officers (ECOs) supported by mine staff and contractors.
- Strict waste management practices are applied, litter is picked up
- Incident investigation, reporting with mitigation measures, and reporting of incidents to MET after internal investigation (in the Namib-Naukluft Park) is taking place.

Despite the rigid measures (listed above) applied by the mining industry to reduce secondary impacts, there is still evidence of occurrence, although though these are not pointing to mining as the main cause (R Solomon, MET, pers. comm., 2015). The Ministry of Environment and Tourism confirmed to NERMU that illegal incidences such as poaching, off-road driving and littering within the Park were still evident (Table 27) and that their distinct impression is that these incidents have increased since the start of mining. NERMU has in the meantime attempted to meet with MET to push forward a mining-conservation forum; MET has indicated their willingness to participate. This initiative is being followed up.

Table 27: Indications of transgressions record by Ministry of Environment and Tourism during the current reporting period (2013) and their respective remedial measures taken

Type of Incident	✔/✗	Location (ML Area e.g. RUL)	Remedial action taken
Off-road driving	✔	NNP	Fines were issued to trespassers
Poaching	✔	NNP	Fines were issued to trespassers
Illegal Camping	✔	NNP	Fines were issued to trespassers
Littering by Mining personnel	✗	-	-
Others: _____	✗	-	-

Motivation of status: There are measures and efforts from both the mining industry and Ministry of Environment and Tourism; however incidents of secondary impacts are still evident. The indicator is therefore IN PROGRESS.

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

Mines will welcome improved vigilance and visibility of law enforcement personnel and Honorary Wardens and hope that MET will come up with a workable solution for the latter (NUA 2013). MET reported that there has been improved vigilance and visibility of law enforcement with support of the Ministry of Fisheries and Marine Resources, and the Namibian Police (Table 28). The Ministry of Environment and Tourism also makes reference to Control/Check-points and reports from the mines and the public, particularly from tour operators as key measures in reducing conservation transgressions (Table 28). However, the MET could not provide statistical data or information for assessment on the extent to which vigilance and visibility of law enforcement has improvement.

Table 28: Efforts by the uranium industry that contributed to a reduction in transgressions recorded by MET in 2013

Measure applied to reduce transgression	✔/✗	Any comments
Deployment of More MET Staff	✔	Support by MET personnel from other stations
Appointment of Honorary Wardens	✗	Not applicable, law does not make provision for this
Reports of incident by the public	✔	Mostly tour guides who report illegal activities
Reports of incidents by Mining	✔	Environmental Officers briefs MET
More Control/Check Points	✔	Increased joint patrols with Fisheries and NamPol

Motivation of status: There is confirmation of measures being taken to improve vigilance and visibility of law enforcement, therefore the indicator is MET.

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

There are still no formal initiatives by MET or other regulatory bodies to monitor the health of riverine ecosystems or of any other biodiversity components relative to potential impacts by mines. NERMU's mandate includes the monitoring of impacts on biodiversity by mining, and progress has been made in developing a monitoring programme to detect impacts on riverine ecosystems, on *Welwitschia mirabilis*, and on other endemic plant species. For riverine ecosystem health, an ecological baseline study was completed (see Appendix 2), which highlighted the level of natural variability across seasons, but left some questions about the relative impact of water abstraction. This baseline study encompassed the Swakop River, including its tributary, the Khan River, and the Kuiseb as an unaffected control for comparison. For practical purposes, this study focused on the Ana tree as a typical component of riverine vegetation, and the Camelthorn, as the most important phreatophytes.

Motivation of status: 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 still 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.**
Data Source	**NERMU/NUA/MET**
Status:	**IN PROGRESS**

This indicator depends on the development of an established monitoring programme (which is in progress; see Indicator 8.5.1.1) and follow-up monitoring surveys. It is therefore not yet possible to meet the intention of the indicator in this regard.

Some progress has however been made in trying to resolve the issue raised in the previous report about who should be responsible for maintaining such a monitoring programme on a long-term basis when preliminary discussions were held with the Directorate of Scientific Services at the Ministry of Environment and Tourism. These discussions will be taken further in the next year

Motivation of status: The process to develop a regular monitoring programme is still in development, the indicator is 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**			
Data Source	**NERMU/NUA/MET**			
Status:		**IN PROGRESS**		

Mines that abstract water from the rivers do so within the given permits (Langer Heinrich, Rössing, Husab), 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. A preliminary survey by NERMU in the previous reporting year showed higher mortality of Ana trees in the Langer Heinrich compartment of the Swakop River than in any other compartments or rivers investigated. A follow-up survey, conducted in three rivers and including an analysis of tree health relative to the location of boreholes, showed that the Langer Heinrich compartment still showed relatively high mortalities. However, it appears that all trees measured, regardless of their position in the river, were stressed (Appendix 2). Since there was no difference between plants close to a production borehole and a borehole that is only being monitored, the most likely explanation is a lowering water table as a result of evapotranspiration or simple evaporation. Unfortunately this is contrary to the results of the preliminary survey, where there were some indications that trees closer to boreholes were more stressed.

It therefore becomes important to maintain data collection in two seasons of each year in order to detect whether trees closer to boreholes remain more water-stressed or not. Such a finding will provide reasonable evidence whether or not trees could be dying as a result of water abstraction, even if this abstraction is within the abstraction quota for each mine. NERMU is currently busy collecting more data and doing further analyses to improve understanding of how water levels are related to plant stress.

Motivation of status: Because progress has been made in developing a baseline for a longer-term monitoring programme which will be the only way to detect unusual loss of vegetation, this indicator is still 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)**			
Data Source	**NERMU/NUA/MET**			
Status:			**MET**	

The Camelthorn (*Acacia erioloba*) is the most important phreatophyte in the ephemeral rivers and is, as such, a good indicator of whether deep-rooted plants are affected. In the baseline study conducted by NERMU, the Swakop River showed the highest levels of mortalities of this species, compared to the Kuiseb and Khan Rivers, suggesting that deep groundwater levels have been affected in the past, if not currently. However, it is important to show whether there is a link between active extraction and plant stress level – this will provide evidence of a mechanism tying plant health (and therefore chances of dying) to abstraction, and will also improve understanding of whether spatial patterns of losses of camel thorns are unusual or not.

In this regard, the NERMU study showed that the Camelthorn is behaving much as expected: the preliminary study (reported on in the 2012 SEMP Report) suggested that it is unaffected by active pumping of groundwater, while there was some evidence that the shallow-rooted Ana tree was affected. It therefore appeared that water was not being abstracted to the level that the The much

more comprehensive follow-up study however showed that Camelthorn was as stressed as the Ana tree, but this was across the board (i.e., not necessarily associated with abstraction of water from specific boreholes). This suggests that both species experience periods of water stress, and that the effects of pumping may only be picked up over a number of years of measurement. The water table did appear to have remained well above (Figure 11, Figure 12 Figure 13 and Figure 14 in EQO 4) the documented rooting depths (Schachtschneider, 2010) of the Camelthorn.

Motivation of status: Because groundwater levels are still well within the reach (also as assessed in indicator 4.2.1.2) 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**
Number of indicators in class	1	9	10	0
Percentage of indicators in class	5%	45%	50%	0%
Overall performance: A majority (50%) of the indicators reviewed during the period were “MET” and 45% were “IN PROGRESS”. Only one (5%) indicator was rated as “Not MET”, this is an improvement compared to three Not MET in the previous year. Overall, substantial efforts by stakeholders to ensure that all indicators in this EQO are “MET” were made, however challenges such as lack of ample resources, policy or regulation limitations continues to hinder performance.				

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 Uranium SEA projected the expansion of uranium mining in the Erongo Region to be accompanied by a high public expectation such as skills development. With hopes of finding job opportunities, migration into the region which places considerable pressure on schools and the education authorities are some of the cumulative impacts to be expected. There is already a consistent growth in education demand in the Erongo region that has resulted in an increase in the number of schools, a 1.3% average annual growth rate is experience, but from 2011 to 2012 a 4.8% increase was encountered (Figure 34).

Tertiary education plays a big role in contributing to the skills demand in the mining industry. The Chamber of Mines reported that its members spent some N$ 58.5 million on skills development and awarded a total of 67 new bursaries in 2013 for tertiary education at institutions in Namibia and South Africa, as well as vocational training at the Namibian Institute of Mining and Technology (NIMT). Despite some of the economic challenges faced by Namibia’s mining sector during 2013, mining companies continued to invest heavily in people.

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.

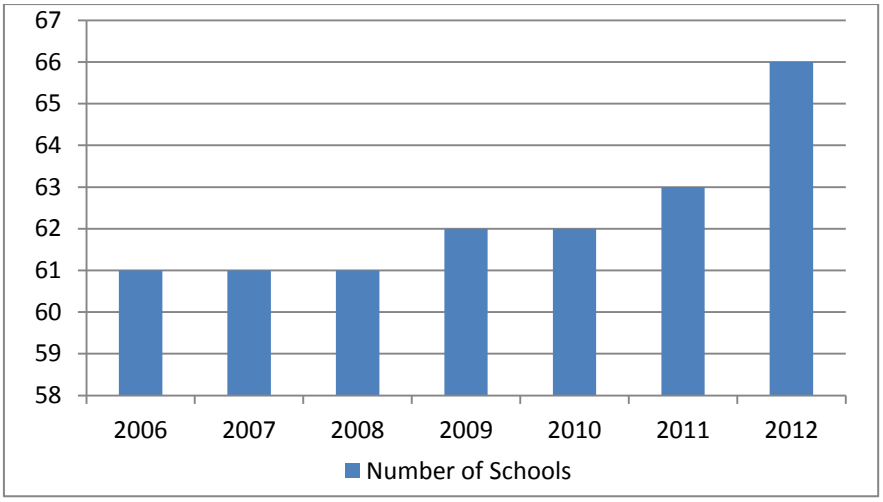

Figure 34: Numbers of Schools in the Erongo Region from year 2006-2012 (EMIS - 2012)

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

According to the Education Management Information System (EMIS) Report of the Ministry of Education (MoE), the survival rate to a specific grade indicates the percentage of learners expected to stay in school until they reached at least that particular grade. The indicator is based on the promotion, repetition and school-leaving rates between two consecutive years only. The EMIS Report states that the survival rates should be interpreted as 'if the flow rates remained constant for all grades, then the said percentage of learners would stay in school until they reached at least the set Grade'. The EMIS report of 2010 used in this assessment is the latest.

Flow rates do change annually, and the survival rate should, thus, be interpreted as an indicator applying to the transition of learners between two consecutive years. Flow rates are not projections of the percentage of new enrolments that will actually reach a certain grade. Interpreted correctly, the survival rate is a sensitive indicator showing the theoretical cumulative effect of the flow rates between several grades. Its sensitivity causes the indicator to vary rapidly for higher grades.

This indicator is measuring the survival rate to grade 10. The two graphs below are showing the survival rates to grade 10 for the years from 1996 to 2002 and from 2005 to 2011 (Figure 34 and Figure 36). This indicator was assessed using the latest statistics for the year 2011. The rest of the data is presented for background information. The National survival rate to grade 10 in 2011 was recorded to be 65.9% which is 9.1% less than the targeted 75% (EMIS.2012).

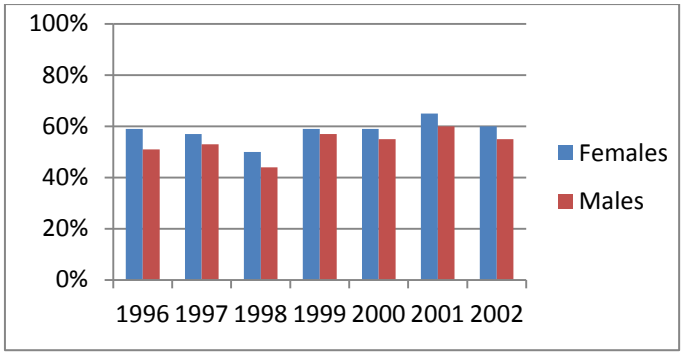

Figure 35: Survival Rate to Grade 10 for Erongo Region (1996-2002) (EMIS - 2003)

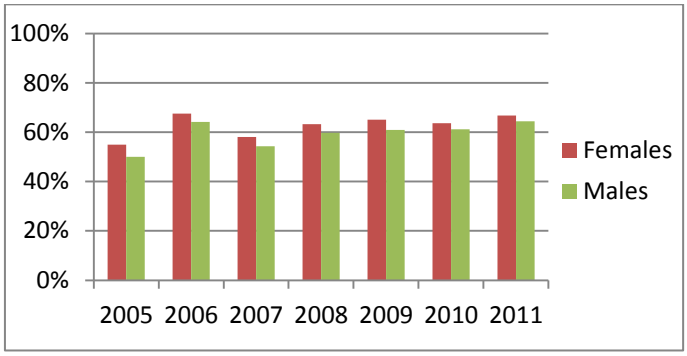

Figure 36: Survival Rate to Grade 10 for Erongo Region (2005-2011) (EMIS - 2012)

The Survival rates are calculated using an artificial cohort method and applying the slow rates of promotion, reception and school leaving rates from 2005 to 2011 to an imaginary cohort of 1000 learners who entered Grade 1. Returners were calculated as repeaters.

Motivation of status: The National survival rate to grade 10 in 2011 was 65.9% and a representative from MoE indicated that the Erongo region is always placed amongst the top three. However, in view of the above average national survival rate the status of the indicator is considered to be IN PROGRESS.

Indicator 9.1.1.2.	**75% of grade 12 graduates obtain 25 points in six subjects with a D in English**
Data Source	**MoE**
Status:	

The Ministry of Education does not have records of the data needed to assess this indicator.

Motivation of status: MoE does not have data to measure this indicator. This indicator is current not measurable

Indicator 9.1.1.3.	National examination results in Grade 10 and 12 in maths, English and science are a D or better for more than 50% of learners from public (GRN) schools.
Data Source	MoE
Status:	NOT MET

The national performance of grade 12's and 10's for the year of 2013 is summarized below.

The performance of the 2013 candidates was similar to that of the 2012 candidates. The general performance of learners in 2013 was better at grades D, E and F for Grade 12. The performance in grades B and G did not however change and the performance for grades A* and C went down by 0.1 % and for grade A by 0.2 %. The percentage increase for grade D was 0.6 %, while for grade F it was 0.3% and for grade E 0.2%.

During the year reviewed, 34,054 Full-time Grade 10 candidates registered for the national examinations. Since 2000, MoE has kept the minimum points at 23 and F grade as a minimum symbol in English for admission to Grade 11. Of the 34,054 candidates who registered for the Grade 10 examinations this year, 54.7% compared to 52.1% in 2012 have qualified for admission to Grade 11 in 2014. On average, since 1993 the percentage of learners qualifying for admission has increased steadily from 37.2% to 54.7%. Table 29 below shows the national and Erongo regional results. This indicator only measures the National examination results for Grade 10 and 12 in Maths, English and Science. The symbols required are a D or better for more than 50% of learners from public (GRN) schools. The grade symbol defined as D or better applies to grade 10 (Junior Secondary Certificate) and grade 12 ordinary level examination results, and it 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 this indicator are expressed as the total number of students who sat for the specific exam.

Table 29: National Results for Science, Mathematics, and English for Grade 10 and 12 in 2013 (Grades from A - G). Source: MoE (2013)

National Results for Science, Mathematics and English Subjects	*% of learners who obtained a D or better*		Status
	Erongo Results	***National Results***	*For National Results*
Grade 10			
Mathematics	39.1	45.5	NOT MET
Physical Science	36.0	52.7	MET
Life Science	35.1	49.1	NOT MET
English as a Second Language	66.9	41.4	NOT MET
Grade 12			

NSSC Ordinary Level of 2013 (Grade from A* - G)			
English as a Second Language:	73.48	31.18	NOT MET
Biology	27.89	30.74	NOT MET
Physical Science	41.37	44.60	NOT MET
Mathematics	41.30	40.19	NOT MET
NSSC Higher Level of 2013 (Grades from 1 - 4)			
English as a Second Language:	89.19	82.26	MET
Biology	84.21	78.26	MET
Physical Science	67.02	76.33	MET
Mathematics	74.68	79.41	MET

Motivation of status: Only 5 out of a total of 12 subjects (41.7%) met the indicated requirement and 7 out of 12 subjects (58.3%) did NOT MEET the requirement. Additionally, there was no improvement from the 2012 performance. This indicator is NOT MET.

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

This indicator was assessed using the Namibian National Standardized Achievement Tests (SATs). The last 2012 SAQMEC III (Southern and Eastern African Consortium for Monitoring Educational Quality) report of September 2007 is not updated regularly; therefore its data could not be used. The SATs are assessments that provide diagnostic information regarding learners' achievement of key learning competencies in the curriculum at Grades 5 and 7. The SATs further help to keep track of school growth. The outcome of the SATs included reports on achievement at national, regional and school level to assist teachers to diagnose problems learners experienced mastering key skills and competencies specified in the approved national syllabuses. The baseline for Grades 5 and 7 were implemented alternately in 2009 in English Second Language and Mathematics and in 2010 in English Second Language, Mathematics and Natural Science, respectively. Two follow up tests at Grade 5 and one at Grade 7 were administered over the past three years, 2011, 2012 and 2013.

Table 30 shows that Namibia made substantial improvements in Grade 7 mathematics in 2012 as compared to 2010 with 3%. No change was observed in the test results for Grade 7 English subject. Table 31 shows the Grade 5 percentage of learners that have made minimal improvement in Mathematics as compared to English as a Second Language. In a nutshell, the majority of the Grade 5 learners within the regions continue to be classified into the lower categories in English and Mathematics; which indicates that learners demonstrate insufficient knowledge and skills to sufficient knowledge and limited skills across all themes in English and Mathematics syllabuses. MoE stated that the SAT results are worrisome and efforts from all stakeholders in order to reduce the large number of learners who continue to be classified in below and basic performance level categories is necessary.

Table 30: Average National Percentage Scores for Grade 7 in 2010 and 2012

Subject	2010 (Baseline)	2012	Change
English (2nd Language)	45%	45%	0%
Mathematics	42%	45%	3% ↑

Table 31: Average National Percentage Scores for Grade 5 in 2009, 2011 and 2013

Subject	2009 (Baseline)	2011	2013
English (2nd Language	42%	46%	44%
Mathematics	43%	43%	44%

The regions with different demographic and socio-economic indicators performed differently in the SATs. In the Grade 7 SATs, all regions performed very similar and had scores ranging between 37% and 62%. The Erongo Region obtained the second highest average percentage score in 2010 and 2012 (Figure 37 and Figure 38).

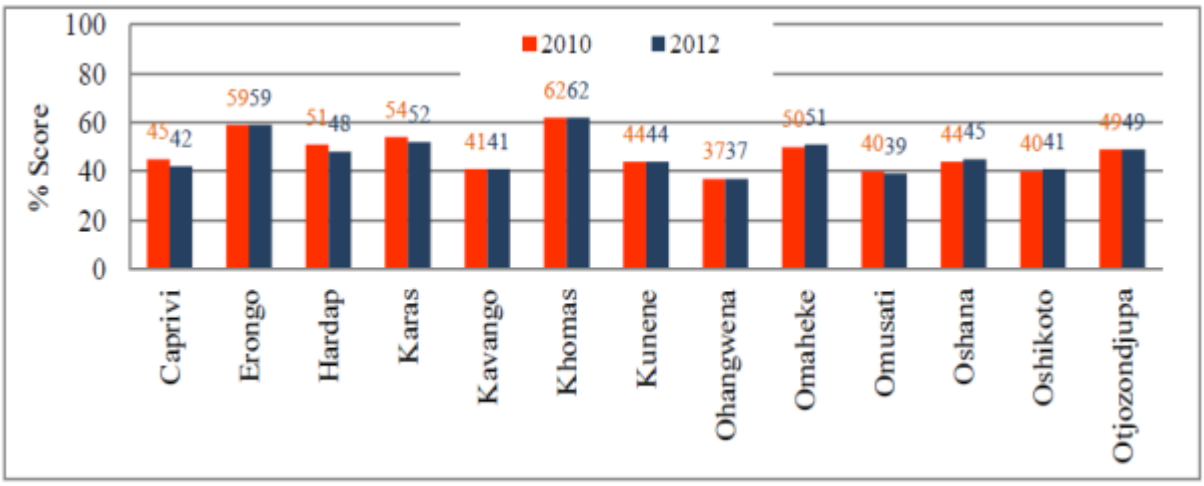

Figure 37: Percentage of Scores by Region for English- Grade 7

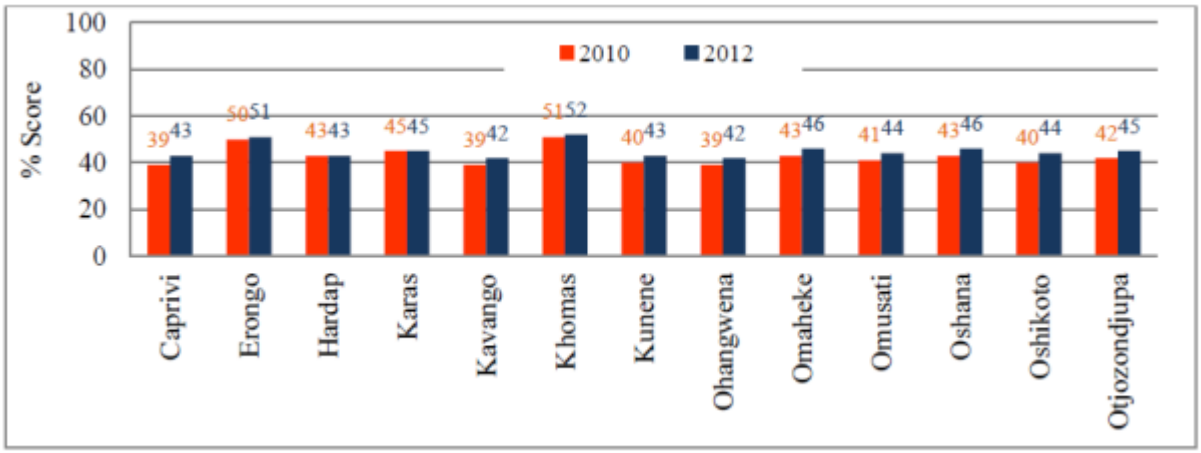

Figure 38: Percentage Scores by Region for Mathematics

Since the national performance had declined from 46% in 2011 to 44% in 2013 in English Second Language, a slight difference was anticipated in the regional performances. The regional performance declined in the range of 1% to 6%. All regions had average scores that ranged between between 39% and 54% for Mathematics. The highest and lowest percentage scores came out of Khomas, Erongo and Kavango (Figure 39 and Figure 40). The general performance trend over the period 2009 to 2013 in Grade 5 Mathematics is somewhat satisfactory because the majority of the regions continue to perform above 50%.

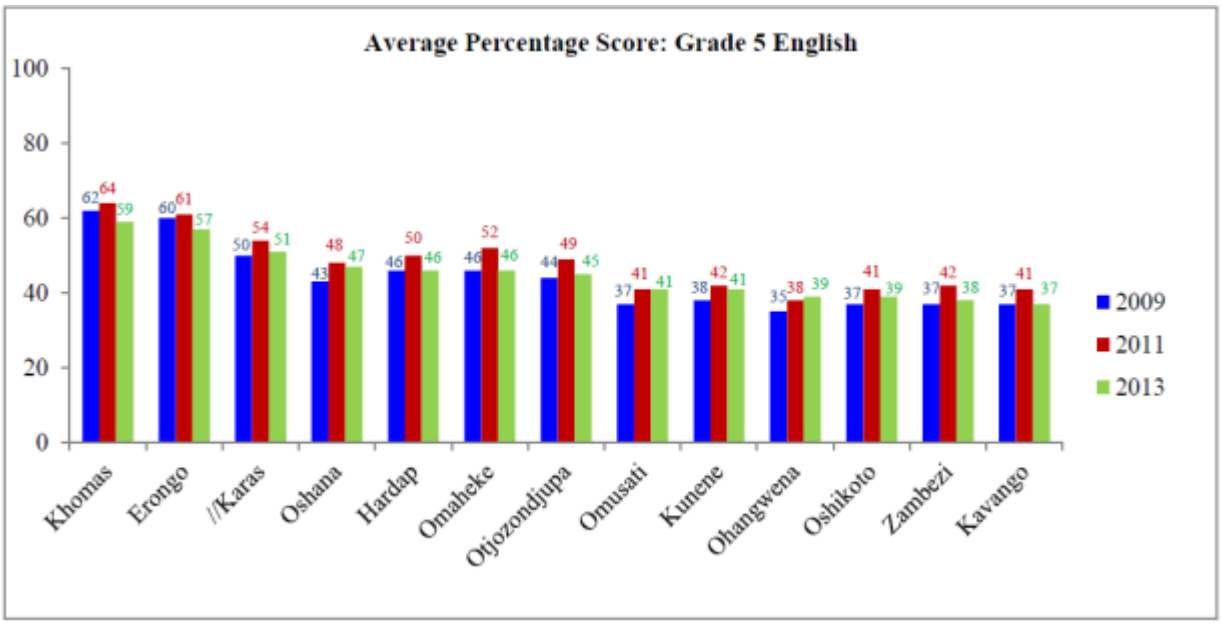

Figure 39: Percentage scores by Region – English Grade 5

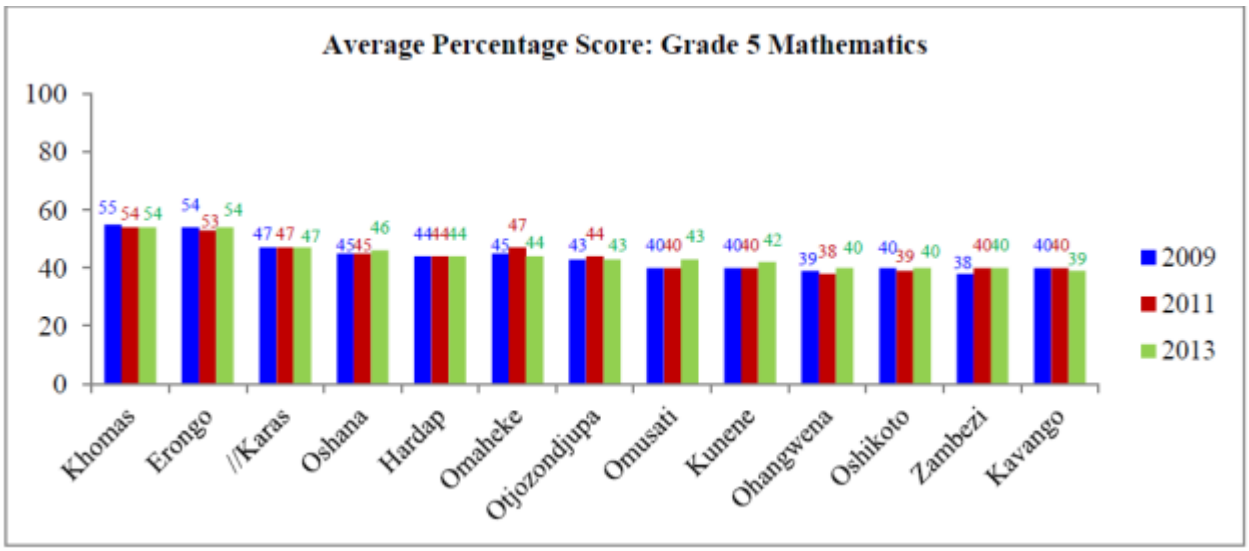

Figure 40: Percentage scores by Region – Mathematics Grade 5

Motivation of status: The Erongo Region did not improve its performance in the SATs (English and Mathematics). This Indicator is therefore rated as IN PROGESS.

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.**			
Data Source	**SEMP Office/ Unam/Poly/VTC/ NIMT**			
Status:			**MET**	

Despite depressed commodity prices for uranium, the development of new uranium mines continued throughout 2013. In the Erongo Region the construction a new mine, Husab Mine, remains on track and is scheduled to commence production in early 2016 with ramp up to full production in 2017. The Husab Mine is set to become the world's second largest producer of uranium oxide. The mining industry provides Namibians with job opportunities. More qualified artisans, technicians, geologists, accountants and engineers are needed to supplement the demand for skilled workers in the mining industry. An increasing number of graduates from NIMT, the Polytechnic of Namibia, the proposed VTC facility in Walvis Bay, and UNAM are therefore needed.

Data provided by tertiary institutions indicate a growth in the number of graduates each year. For instance, graduates from NIMT increased from 406 in 2012 to 429 in 2013 (Figure 41).

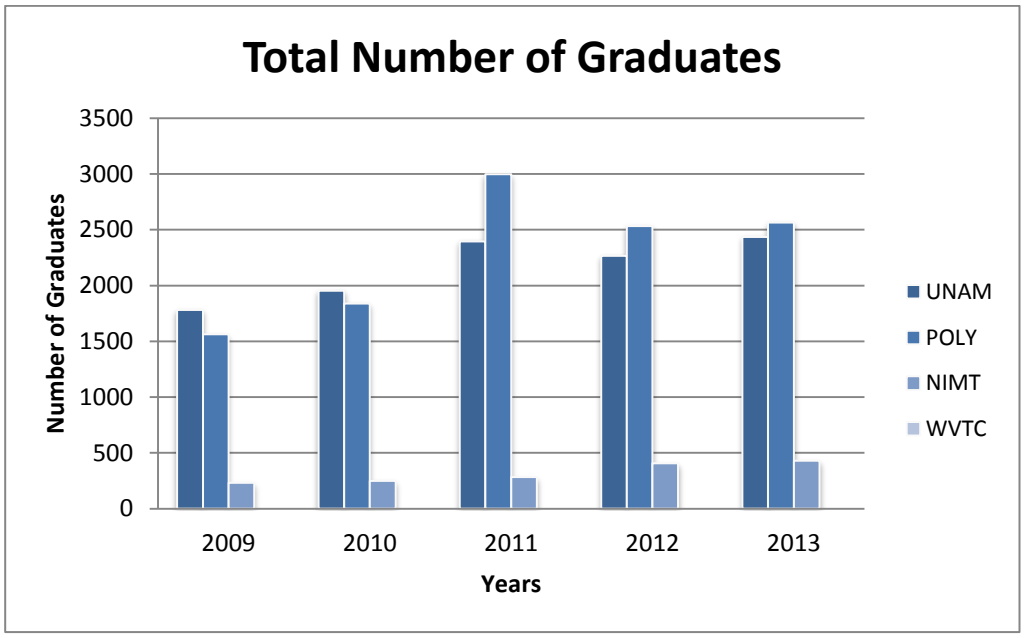

Figure 41: Total number of graduates from NIMT, VTC (no data), UNAM and the Polytechnic of Namibia.

Motivation of status: 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.

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

Indicator 9.2.1.3.	Each mine has 10% more bursary holders than work-permit holders.
Data Source	NUA
Status:	MET

Mining companies' feedback regarding indicators 9.2.1.1, 9.2.1.2 and 9.2.1.3 is shown in Table 32 below. Compliance with these indicators is compulsory for operating mines (Rössing and LHM); the exploration companies have added their data for complete picture.

Table 32: Skills development in 2013 (internal and external) by the mines in Erongo

Company	Skills development in 2013 (internal and external)			
Number of:	NIMT apprentices	Work permits	Bursary holders	% of wage cost
AREVA Namibia	3	1	6	3.3%
Bannerman	7	0	2	2.0%
Langer Heinrich	**59**	**7**	**10**	**5.0%**
Marenica	0		11	0.0%
Reptile Uranium	0	1	1	0.8%
Rio Tinto Rössing	**54**	**10**	**23**	**2.0%**
Swakop Uranium	7	46	12	<1.0%
Valencia Uranium	0	1	3	2.0%

Rössing and Langer Heinrich, the only two operating mines in 2013, are supporting 113 NIMT students to increase technical skills in the Erongo Region. The average percentage of wage cost spent on training at the two mines is 3.5%, which exceeds the target of 3%. The total number of work permits is 17, while bursary holders are 33. This means that almost double the number of bursary holders exists compared to the work permit holders. The target of 10% is by far exceeded in 2013.

The uranium industry has also provided additional support to education, training and skills development that is not captured under the formal indicators. AREVA Namibia has supported the following education initiatives in the Erongo region:

- A new classroom at Kolin Foundation Secondary School in Arandis was sponsored via the Erongo Development Foundation and handed over in October 2013.
- At Mondesa Youth Opportunities, an after-school learning centre in Swakopmund, AREVA Namibia extended and furnished the library to meet a growing need for educational resources.
- AREVA and the Erongo Regional Director of the Ministry of Education partnered to establish a new bursary scheme to assist promising students from the #Gaingu conservancy area. The scheme started in 2013 and the first three bursaries were allocated for the year 2014.

Bannerman Resources Namibia implemented a Learner Assistance Scheme in 2011, whereby school clothes are donated to needy learners in the Erongo Region, the company also contributes to the schools' development fund. To date, 1,160 less privileged learners have been assisted across the Erongo region in this way. Bannerman also continues to assist 7 less privileged students in the Erongo region to obtain their trade diplomas at NIMT through funding towards the Erongo Development Foundation. Langer Heinrich Mine supports Mondesa Youth Opportunities, an after-school learning centre in Swakopmund and awarded bursaries to Namibian students to further their tertiary education. Furthermore, LHM sponsored the mathematics teachers' initiative, school books, a career day and teacher awards for excellence. The Educational Assistance scheme at Rio Tinto Rössing Mine sponsored 35 employee dependants at tertiary level during 2013.

Motivation of status: The average percentage of wage cost spent on training at the two mines exceeds the target of 3% for Indicator 9.2.1.2. All operating mines had more than 10 % bursary holders than work-permit holders, for Indicator 9.2.1.3. Both indicators are MET

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Summary of performance: EQO 9				
Total no. indicators assessed	**7**			
	NOT MET	**IN PROGRESS**	**MET**	**EXCEEDED**
Number of indicators in class	1	2	3	0
Percentage of indicators in class	14%	29%	43%	0%

Overall performance: Overall performance: In comparison to 2012, the overall performance for EQO 9 has declined. Indicator 9.1.1.2 assessing if 75% of grade 12 graduates obtain 25 points in six subjects with a D in English could not be measured. Currently, MoE does not keep track of these records. The way forward for this indicator (14%) will be discussed in the next report. 43% of indicators, 29% are IN PROGRESS and 14% are NOT MET.

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 SEA states that political will, technical capacity, enabling policies and laws, and mutually-beneficial partnerships are needed to ensure that adequate capacity exists. In combination with strong leadership, transparency and consistency in decision-making will ensure that the Uranium Rush is a blessing and not a curse, and companies subscribe to good governance. Governance can be used in several contexts such as corporate governance, international governance, national governance and local governance- all of which are important in the context of the Uranium rush.

This EQO keeps track of institutions that are responsible for managing the Uranium rush and looks at whether these institutions provide effective governance through strong leadership, oversight and facilitation, transparency and consistency so that all legal requirements are met by all parties involved, either directly or indirectly, in the prospecting for and mining of uranium.

Desired Outcome 10.1.	**Prospecting and mining avoids environmentally high value, sensitive areas.**			
Target 10.1.1.	**Sensitive areas in need of protection are not generally available for prospecting or mining.**			
Indicator 10.1.1.1.	**Declared 'red flag' areas undergo the required high level of scrutiny before mineral licenses are considered**			
Data Source	**SEMP Office/MME/MET**			
Status:		**IN PROGRESS**		

Through the Strengthening the Protected Areas Network (SPAN) programme, the Ministry of Environment and Tourism commissioned Fauna and Flora International (FFI), in collaboration with international and local specialists, to undertake a Landscape Level Assessment 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 successful 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 robust methodology which will support decision-makers evaluating the cumulative impacts of mining and land-uses on biodiversity and ecosystem services.

The LLA produced a series of map and data sets that helped in better understanding 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 (Ministry of Environment and Tourism, 2012).

The current red and yellow flag areas identified in the SEA study are being refined, while this is taking place, the Ministry of Environment and Tourism has acknowledged their existence and together with MME and other stakeholders a steering committee on "Mining in Protected Areas" facilitates dialogue between the various stakeholders.

The Namibian constitution mandates government to put legislation in place to maintain and protect the environment which is in turn beneficial to the citizens of Namibia. Namibia has developed sound legislation and policies in this regard including the Environmental Management Act, the Minerals Act, the National Heritage Act, the Tourism Policy, as well as Marine Resources Act and various other related acts.

The Ministries of Environment and Tourism and Mines and Energy are also drafting a policy aligned to the Environment Management Act which is the Exploration and Mining in Protected Areas policy which is already in an advanced stage. The policy together with the results of the LLA will ensure that prospecting and mining avoids environmentally high value and sensitive areas.

The policy makes provision for excluding mining from biodiversity hotspots, archaeological and paleontological sites and highly sensitive and fragile areas. Associated rehabilitation and restoration guidelines for disturbed areas will be developed (Mulonga, 2013).

The designated red and yellow flag areas will have to be redefined now that the study of Fauna and Flora International is completed.

Motivation of status: The policy for exploration and mining in protected areas is still being drafted however it is in its advanced stages. The status of this indicator 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.**			
Data Source	**SEMP Office/MME/MET**			
Status:		**IN PROGRESS**		

Indicators 10.1.1.2 and 10.1.1.3 are related and are therefore assessed here. The Ministry of Environment and Tourism and MME are in the advanced stages of drafting a Policy for Exploration and Mining in Protected Areas. However, Husab mine located near the town of Swakopmund was awarded a mining license in a protected area, nonetheless there are environmental conditions attached to their EIA.

Motivation of status: Since the Policy for Exploration and Mining in Protected Areas is still being drafted and MET's current Environmental Management Act does not fully cater to the protection of yellow and red flagged areas, these indicators are 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)**			
Data Source	**SEMP Office/MET/NUA**			
Status:			**MET**	

No new power lines, pipelines or roads linked to uranium mining were constructed in 2013.

Motivation of status: There was no new construction in 2013 therefore this indicator is 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).**
Data Source	**SEMP Office/MME/MET**
Status:	**MET**

Husab Uranium Mine has been granted a mining license in 2013. Their operation falls within a high biodiversity and tourism area; however, their application was only awarded after full consultation of, and consensus with, the Mineral Rights Committee.

Motivation of status: The required decision making process has been followed in awarding the Husab Mine with a mining license and with the relevant conditions. This indicator is therefore MET.

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

Detecting whether any corruption has occurred during the allocation of mining exploration licenses is quite challenging but during the year of 2013 there were no such reports. (E. Shivolo, H. Itamba, MME, pers. comm.2014).

Motivation of status: Since there have been no reports of corruption in 2013, 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**
Data Source	**SEMP Office/MME/MET**
Status:	**MET**

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

During the reporting year of 2013, Swakop Uranium's Husab Mine has been granted a mining license. Full EIA's for the Husab Mine as well as for associated linear infrastructure have been submitted to the Ministry of Environment and Tourism and Environmental Clearance Certificates have been awarded for both.

Motivation of status: Since full EIA's have been submitted to MET and Environmental Clearance Certificates have been awarded for prospecting, mining and infrastructure projects, the status of this indicator can 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.**			
Data Source	**SEMP Office/MME**			
Status:			**MET**	

The division of Engineering and Environmental Geology in the Geological Survey of Namibia and the Mines Inspectorate in the Directorate of Mines, both of which are under the Ministry of Mines and Energy are mandated to monitor current and abandoned mine sites.

DWA'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. The Ministry of Environment and Tourism requires regular reports on the status of the environment and does spot checks. The MoHSS inspects and licenses 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 33 shows the inspection conducted at mines and exploration sites by government institutions in 2013.

Table 33: Summary of Government inspections of mines in 2013

Company	**Government inspections in 2013 (which ministries, date/month, any measurements done or samples taken?)**
AREVA Namibia	NRPA in Aug 13 (radiation readings taken), Min Health inspected First Aid station in Jul-13, Min Labour inspections several times
Bannerman	None, mine not yet active
Langer Heinrich	MAWF - Department of Water Affairs (9 Oct 2013, water sampling at 3 Swakop river boreholes)
Marenica	None
Reptile Uranium	All EPLs in current and good standing with relevant authorities. All statutory reports completed and submitted as prescribed. Inspection of MET staff to drill site, regular interaction with NNP park wardens. As a result of significant decrease in field activities during 2013, no sign-off by MET personnel during 2013, however MET sign-off took place in April 2014. Radiation Management Plan approved by NRPA and quarterly reporting since November 2012.
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	Mining Commissioner, Inspector of Mines, Department Parks and Wildlife, MET, MAWF - DWAF, Ministry of Education, Office of the Prime Minister, Office of the President, Erongo Governors, Erongo Municipalities, Ministry of Trade and Industry, MoHSS, MME, NIMT, Chamber of Mines
Valencia Uranium	None

Motivation of status: Since 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.**			
Data Source	**SEMP Office/MME/MET**			
Status:	**NOT MET**			

NACOMA had received 9 applications for honorary conservators and these had been submitted to the Ministry of Environment and Tourism. However, the Ministry informed that there is currently no legislative provision for the appointment of honorary conservators.

Motivation of status: Since there is currently no legislative provision allowing for the appointment of honorary conservators this indicator is considered to be NOT MET.

Indicator 10.3.1.3.	**International agencies regularly inspect mines and provide independent opinion on their performance**			
Data Source	**SEMP Office/MME**			
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: The IAEA carries out regular inspections at 4 year intervals; this indicator is considered to be MET.

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

The Annual SEMP Report covers all the various monitoring aspects of mines. The report is freely available to the public through the SEMP office, NERMU and the NUA. Moreover, the SEMP assessment findings are also presented to stakeholders through Roadshows.

Motivation of status: Annual SEMP Reports are freely available to the public, the indicator is MET.

Desired Outcome 10.4.	**Non-compliance is rectified.**			
Target 10.4.1.	**Transgressions are noted and acted upon timeously.**			
Indicator 10.4.1.1.	**The activities of proponents / developers / service providers, who have caused unauthorised negative impacts, are suspended, and they are forced to remedy impacts.**			
Status:			**MET**	
Indicator 10.4.1.2.	**If impacts are not remedied, the operation is closed and the project authorisation is cancelled.**			
Status:			**MET**	
Indicator 10.4.1.3.	**Fines are issued for non-compliance.**			
Data Source	**SEMP Office/MME/MET**			
Status:			**MET**	

The indicators 10.4.1.1, 10.4.1.2 and 10.4.1.3 are related and are therefore assessed together. No unauthorized negative impacts occurred during the reporting period of 2013. (E. Shivolo, H. Itamba, MME, pers. comm.2015).

Motivation of status: Because there were no unauthorized negative impacts during the reporting period, the indicators are 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.**			
Data Source	**SEMP Office**			
Status:			**MET**	

Issues of non-compliance if it does occur are dealt with in the Mining Commissioner's office within the Ministry of Mines and Energy.

- 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 0.75% 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. For the reporting period of 2013 there were no issues with regards to non-compliance reported to the Mining Commissioner's office. (E. Shivolo, H. Itamba, MME, pers. comm.2015).

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	**10**			
	NOT MET	**IN PROGRESS**	**MET**	**EXCEEDED**
Number of indicators in class	1	3	11	0
Percentage of indicators in class	7%	20%	73%	0%
Overall performance: 73% of the indicators are MET while 20% are still IN PROGRESS and 7% is not MET. In comparison to 2012, the governance EQO has slightly declined due to there being an indicator that was NOT MET which was not the case in previous years. The indicator that is NOT MET related to no legislation to appoint Honorary conservators that assist with monitoring, including of unauthorized secondary (off-mine) activities such as off-road driving, poaching and littering.				

EQO 11. Heritage and future

Aims of this EQO:

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

The Erongo Region and in particular the Central Namib is home to some of Namibia's key heritage resources. Archaeological history dating back to more than a million years of significant human evolutionary development and specific adaptations to extreme aridity and environmental uncertainty is evident. 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 artifacts 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.

The SEA identified this EQO a measure to safeguard the heritage resources in the region and in particular within the uranium mining areas. 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. In addition, Namibia's international image in terms of social, environmental and economic ethical conduct by the industry is assessed.

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).**			
Data Source	**SEMP Office**			
Status:			**MET**	

Google News as well as other prominent relevant media was used as the primary source of data. On these websites a search was run for articles pertaining to the Namib Uranium Province and its operations and performance. Google News was primarily used due to the fact that it covers hundreds of international news sources and is a free service. IAEA, World Nuclear News, Mining Journal, International Mining and Africa Mining Intelligence sites were also searched.

During research the articles that voiced any criticism of the operation or management of the Uranium Province was about 5% of the uranium related articles read. This included articles from *Southern Times Africa, Inter Press Service News Agency, Bloomberg* as well as an article reprint from *The Namibian* on AllAfrica.com. These articles comprised of reports of uranium workers having elevated rates of cancer and other illnesses after working at these uranium mines, problems with the water supply and quality at the mines as well as an article on the unfair short-notice retrenchment of workers which was allegedly a breach of contract.

Motivation of status: <10% of articles by international sources voiced any criticism on the operations and performance of the Namib Uranium Province therefore this 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.**
Data Source	**SEMP Office**
Status:	**MET**

The relevant articles that were researched showed no concrete evidence of unreliable, unethical and/or environmentally, socially and financially irresponsible conduct by operating uranium mines. All of these are the same articles that voiced criticism and mostly did so without providing concrete evidence to their claims. In 2013, the regulatory authorities did not encounter any environmental, social or financial irresponsibility by the uranium industry.

Motivation of status: No evidence of irresponsible conduct by the uranium mines within the year of 2013 was found therefore this indicator is considered as MET.

Desired Outcome 11.2.	**The integrity of archaeological and paleontological 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 paleontological assessment** **No unauthorised impact occurs**
Data Source	**NERMU/MET/NUA**
Status:	**MET**

All companies have commissioned and contracted a reputable archaeologist (mostly Dr John Kinahan) to conduct archaeological studies as part of their EIAs or before starting expansion projects. A few companies have also completed paleontological assessments (NUA 2013). Rössing stated that this was not applicable (alaskite deposits do not contain fossils). AREVA is planning to carry out an assessment before the start of full-scale mining.

Motivation of status: The archaeological assessment forms part of the EIA assessment process and all mines continues to adhere to this requirement, thus the indicator is MET.

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

Four mining companies (Table 34) published archaeological assessments or specialist reports in 2013, which were carried out by Dr John Kinahan according to both local and international standards (NUA 2013). Two of this company's previous archaeological assessment also included palaeontological assessments, also conducted by Dr Kinahan.

Table 34: List of mining companies with specialist archaeological surveys or reports conducted in 2013

Company	Archaeological assessment done by reputable archaeologist?	Palaeontological assessment done by reputable geologist?
Reptile Uranium	Yes, surveys of the Tumas and Ongolo mining license areas	Yes
Rössing Uranium	Yes, sensitivity mapping of ML-28 and contribution to the SEIA (Phase 2) for the proposed Rössing Uranium Z20 mining development	Not applicable
Swakop Uranium	Yes, Survey and assessment of Gen Botha's 1915 campaign camp and proposed amendments to the Husab Mine plan and infrastructure	No

Motivation of status: All companies continued to use the service of a reputable archaeologist to conduct their assessment of potential impacts on the archaeological and paleontological resources, therefore the indicator was 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.**
Data Source	**NERMU/MET**
Status:	**MET**

The assessment of this indicator focuses on whether there is archaeological research conducted in the Namib Desert in progress. Based on information obtained from the 2013 permit register of the National Heritage Council and the previous (2012) SEMP report, about five studies were conducted by stakeholders such as Quaternary Research Services and the University of Iowa (NHC 2013 and GSN 2012)(Table 35).

Table 35: Records of permits issued for archaeological studies in the Central Namibia, though not directly linked to uranium mining.

Applicant Name	Permit Date	Preliminary Report Date	Final Report Submission	Research Site	Research Conducted
1. Prof. Brigitte Senut	06/05/2013 07/05/ 2014	NONE	Oct 2013	Sperrgebiet and the Namib-Naukluft Park	Paleontological Research: Environments during the Palaeogene and Neogene period to understand the deposition of the sediments from those Eras
2. Prof. Brigitte Senut	06/05/2013 07/05/ 2014	NONE	Aug 2015	Sperrgebiet and the Namib-Naukluft Park	Temporary Export of Palaeontological Remains

Motivation of status: Research work on the Namib heritage/archaeology remained ongoing even beyond the uranium province. Therefore this indicator is 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.**			
Data Source	**NERMU/MET/NUA**			
Status:		**IN PROGRESS**		

Indicators 11.3.1.2, 11.3.1.3 and 11.3.1.4 are closely related and therefore assessed together. There is no further evidence or report back on the work of Dr Kinahan which was previously reported in the 2011 and 2012 SEMP reports leading to the development of a diachronic model to determine the effects of climatic and other environmental changes (GSN 2011 and 2012).

Motivation of status: Although there was no research specifically conducted in 2013, the diachronic model is an ongoing research and therefore these indicators remain IN PROGRESS

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Summary of performance: EQO 11

Total no. indicators assessed	**8**			
	NOT MET	**IN PROGRESS**	**MET**	**EXCEEDED**
Number of indicators in class	0	3	5	0
Percentage of indicators in class	0%	38%	62%	0%

Overall performance: The Heritage and Future EQO performed better than in 2012, 62% of the indicators are MET and 38% are 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.

Mine closure is one of the mining industry's toughest sustainable development challenges. It is therefore necessary for mines to incorporate socio-economic aspects, along with the more physical aspects, into their mine planning processes. Even though mining companies may not have sole responsibility for addressing the socio-economic impacts of mine closure, they are key players with significant power, influence and resources.

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.**
Data Source	**SEMP Office/CoM/MME**
Status:	**MET**

Operational mines are required to have a closure plan, while exploration companies just need a plan and financial provisions for site rehabilitation and retrenchments. All uranium companies have reported that the contents of their plans were consistent with the Namibian Mine Closure Framework (Table 36). Swakop Uranium does not yet have a closure plan but has made closure commitments in the EIA in line with the NMC framework. The framework was developed based on

IAEA guidelines and international good practice, while Namibian regulations and policies are not yet in place.

Feedback on the individual targets varied according to the history of mine development. For instance, Rössing's feasibility study was done in the early 1970s when closure planning was not considered in mine development and stakeholder involvement was unheard of. In general the closure planning process starts at the feasibility study stage. The plans are generally based on expert input, but only Langer Heinrich and Valencia Uranium obtained stakeholder input. Also, most plans considered site risks, opportunities and threats, as well as cumulative issues. The latter were not yet evaluated by AREVA and Swakop Uranium. Socioeconomic opportunities for communities and the workforce were included in the plans except for Swakop Uranium; and all companies have looked at the cost of demolition, rehabilitation and post-closure monitoring and maintenance.

Table 36: Contents of Closure Plans for uranium companies measure against the NMCF guideline

Closure plan:	AREVA	Bannerman	LHM	Rössing	Swakop U	Valencia Uranium
Planning process started at feasibility study stage	Yes	Yes	Yes	No	Yes	Yes
Was based on expert and stakeholders input	Y/N	No	Yes	No	Not yet	Yes
Considers site risks, opportunities, threats, and cumulative issues	Y/N	Yes	Yes	Yes	Not yet	Yes
Socioeconomic opportunities for communities and workforce	Yes	Yes	Yes	Yes	Not yet	Yes
Demolition, rehabilitation and post closure monitoring, maintenance	Yes	Yes	Yes	Yes	Yes	Yes
Contains accepted and agreed objectives, indicators and targets	No	No	To be reviewed	No	Some	No
Subjected to internal and external review	Yes	Yes	To be reviewed	Yes	Not yet	Yes
Written GRN approval	No	No	No	No	No	Yes
Consistent with IAEA guidelines	Yes	Yes	To be reviewed	Yes	Not yet	Yes
Namibian regulations and policies	N/A	N/A	N/A	Yes	N/A	N/A
Namibian Mine Closure Framework	Yes	Yes	Yes	Yes	Yes	Yes

A formal process to obtain approval is not yet in place because there are no regulations for mine closure. In the absence of regulations it is impossible to set accepted and agreed objectives, indicators and targets. At this stage companies rely on corporate head offices or consultants to review the closure plans as there are no external reviews by government agencies.

The Bannerman Resources mine closure planning was prepared at a high level with input from consultants and items such as ongoing groundwater monitoring, fencing and berming of excavations, and covering of the leach pad, have all been taken into consideration. Once approval to develop the mine is obtained, a more detailed closure plan will be developed. Reptile included closure plans for all projects as part of the EIAs conducted. The plans are not yet finalised and await further technical input from the feasibility studies still underway. Valencia Uranium's closure plan within the EIA/EMP was approved as part of the environmental clearance granted in 2008. The closure plan will be reviewed following detailed design and commencement of construction to ensure that the plan is most relevant at the start of operations.

Motivation of status: Uranium mines and exploration companies' closure plans are consistent with the IAEA guidelines, Namibian regulations and policies and the Namibian Mine Closure Framework. This Indicator is therefore rated as MET.

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.**
Data Source	**SEMP Office/CoM/MME**
Status:	**MET**

Indicators 12.2.1.1 and 12.2.1.2 are related and are therefore discussed together.

Closure cost estimates are contained in all closure plans and include aspects such as employee costs, social aspects, demolition and rehabilitation cost, closure monitoring and maintenance (Table 37). Mines in the development phase or under construction and exploration companies do not have to comply with these two indicators (Bannerman, Reptile, Swakop Uranium and Valencia Uranium).

Table 37: Closure financing provision for uranium companies

Closure financing:	AREVA	Bannerm.	LHM	Rössing	Swakop U	Valencia Uranium
Includes employee costs	Yes	Yes	Yes	Yes	No	Yes
Social aspects, exit strategy	Yes	No	Yes	Yes	No	Yes
Demolition and rehabilitation costs	Yes	Yes	Yes	Yes	Yes	Yes
Post-closure monitoring and maintenance	Yes	Yes	Yes	Yes	No	Yes
Project management	Yes	Yes	Yes	Yes	No	Yes
Closure cost estimations contained in the plan	Yes	No	Yes	Yes	No	Yes
Financial sureties are available	Yes	Yes	Yes	Yes	No	N/A

AREVA Namibia and Rio Tinto Rössing have set aside funds for closure; Langer Heinrich Mine has established a rehabilitation trust. Bannerman Resources' closure costs have not yet been estimated and although the risk assessments do take into account the social aspects and post-closure monitoring and maintenance; provisions have not yet been made. Reptile has not made financial provisions for closure as yet.

Motivation of status:

All operating mines have closure cost provision in their plans and have set aside a closure fund or a rehabilitation trust. The Indicator is therefore 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.**
Data Source	**SEMP Office/CoM/MME/ Ministry of Environment and Tourism**
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: the Indicator is in PROGRESS since the government is in the process of updating the relevant legislation in order to establish adequate regulations applicable to mine closure.

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Summary of performance: EQO 12				
Total no. indicators assessed				
	NOT MET	**IN PROGRESS**	**MET**	**EXCEEDED**
Number of indicators in class	0	1	3	0
Percentage of indicators in class	0%	25%	75%	0%
Overall performance: The EQO performance is the same as two reporting year, 75% of the indicators are rated MET while 25% are IN PROGRESS.				

GENERAL COMMENTS

The introduction of a yearly SEMP assessment on a big mineral province has been an uncommon concept, on which government, the uranium industry, NGOs and the public have embarked. With experience, the SEMP annual assessment was further refined over the past reporting years. In addition, the SEMP team has hosted various Roadshows with the following stakeholders:

- Department of Water Affairs,
- Ministry of Education,
- National Radiation Protection Authority,
- Farmers Water Working Group in the Swakop and Khan River,
- Swakopmund Municipality,
- Namport,
- Ministry of Environment and Tourism, and
- Namwater.

The objectives of the Roadshows are to rejuvenate the interest of stakeholders, gather real-time feedback, improve communication strategies, improve awareness of environmental issues and solutions associated with uranium mining in the central Namib, and improve SEMP production efficiency.

The uranium SEMP is a living document. Although there are still twelve (12) Environmental Quality Objectives, non-value adding indicators have been removed and newly reformulated indicators have been added to the SEMP framework. Below are suggestions that arise from some EQOs:

EQO 4:

- In the year under review, contributions to the water EQO were mainly made by NUA, with DWA's contribution very limited and in most cases not indicator specific. This has once again hindered the process of assessing the water EQO given that DWAF is the regulator for the water resources in the country.

EQO 5:

- Continuous monitoring of PM10 and dust fallout should be carried out to reduce data gaps and provide comprehensive datasets for better evaluation. As suggested by some stakeholders, there is a need to have additional PM10 samplers installed in the region to improve regional coverage because the existing stations are too far apart.

EQO 7:

- Indicator 7.2.1.1. and 7.2.1.2: The use of surveys to assess these indicators has a limitation, as they are conducted a year later and thus data collected may not reflect the true experience of tourist and operators satisfaction.
- Tour Operators expressed concern over the timing of the SEMP assessment i.e. reporting happens after impacts have occurred, making the SEMP re-active.
- A sustainable assessment method is required, operators are not keen to have an external person joining their tours to conduct the interviews and upon return from the tours, and tourists don't have the time to sit for interviews.

EQO 8:

- As before, the Ministry of Environment and Tourism perceives the commitment and actions of mining companies in managing secondary impacts on the national protected areas as

minimal. The same issue is however viewed differently by the mining companies, suggesting that there is still a communication gap that needs to be filled.

- While there are great efforts and results on the mitigation and rehabilitation of mining impacts on biodiversity, assessment of the actual indication of biodiversity properties recovery is still not well accounted for.

EQO 11:

- There is still a great need for the key stakeholders, particularly the NHC to commit to providing reliable data input toward the assessment of indicators 11.1.1.3, 11.1.1.4 and 11.1.1.5.
- Alternatively, the indicator should be re-defined and clarify what the “Model” to be developed entails, and who is accountable for the delivery of these indicators.

DISCUSSION and CONCLUSION

The uranium industry fell in Scenario 1, classified by the SEA as a category which only considers the existing mines plus the two under construction. Rio Tinto's Rössing Uranium and Paladin's Langer Heinrich are currently Namibia's where the only two producing uranium mines in 2013 and have produced 4141 tonnes of uranium. Although the upcoming Husab Mine was official opened in April 2013 with first production targeted for late 2015, the uranium market in 2013 was unfavourable. Rössing Mine announced both cost reductions and a retrenchment of 257 employees. Additional retrenchment and other cost cutting initiatives where taken in most uranium mining and exploration companies. Areva/Trekkopje Mine remains on care and maintenance. Like the Trekkopje Mine, Valencia is expected to continue with additional exploration due to low spot price at US$35/lb.

The 2013 SEMP operational table consisted of 122 indicators, 45 targets and 37 desired outcomes, distributed amongst 12 Environmental Quality objectives (EQOs); a slight reduction of the 125 indicators, 46 targets and 38 desired outcomes had in 2012 (Table 38). This resulted from indicators that where either combined or reformulated into newer indicators or indicators that were discontinued as they did not serve the desired outcome of the SEMP. Noticeably the Air Quality and Radiation (EQO 5) was changed to Air Quality, as the radiation part will be well represented under the Health EQO6. All indicators related to radiation where relocated to the Health EQO.

The overall indicator performance of 2013 is much better than the previous assessed years (2011 and 2012. 57 percent of the indicator are MET. Socio-Economic development (EQO1), Employment (EQO2) and Air Quality (EQO6) are the best performing where all indicators are MET (Figure 43). These are followed by EQO12 Mine Closure and Future Land use, Heritage and the Future (EQO11), Effect on Tourism (EQO7) and Governance (EQO10); although these also carry indicators that are IN PROGRESS (Figure 43). Like in 2012, 30% of the overall indicators are rated IN PROGRESS (Table 38 and Figure 42). Ten percent of the indicators are NOT MET. A larger percentage of the NOT MET indicators are rated under the Water EQO4, Infrastructure (EQO3), Education (EQO9) and Health (EQO6). As experienced in the previous year, the water data from DWAF is never made available to the SEMP. Correspondingly, to the absence of auditors, water and air monitoring at waste disposal sites, the ongoing tracks traffic still on the B2 road and the absence of cargo container data from Namport from the infrastructure EQO; add to the 10 % of indicator that are NOT MET(Table 38).

There is however indicators that were not measured (Figure 43). Indicator 6.1.1.1 "Public dose assessments produced by each new mine project include the cumulative impact of other operating mines" was reformulated in the year under review and therefore will only be assessed in 2014. Indicator 6.1.4.1 "Measured change in the number of fatal road accidents per road user over 1 year" from the Health EQO needs to be reconsidered as it is difficult to accurately identify which road accidents were attributed to uranium mining. The Ministry of Education merely don't take record of Indicator 9.1.1.2 from EQO9 "75% of grade 12 graduates obtain 25 points in six subjects with a D in English" and therefore it needs to be reformulated. Once again, the indicator measuring the Tourists' expectations in terms of their visual experience in the Central Namib is EXCEEDED.

Table 38: EQO Performance Trends

Status (%)	*NOT MET*	*IN PROGRESS*	*MET*	*EXCEEDED*
2013	***12 (10%)***	***36(30%)***	***70(57%)***	***1(1%)***
2012	***21 (16%)***	***37 (30%)***	***57 (46%)***	***1 (1%)***
2011	***14 (11%)***	***44 (33%)***	***64 (51%)***	***1 (1%)***

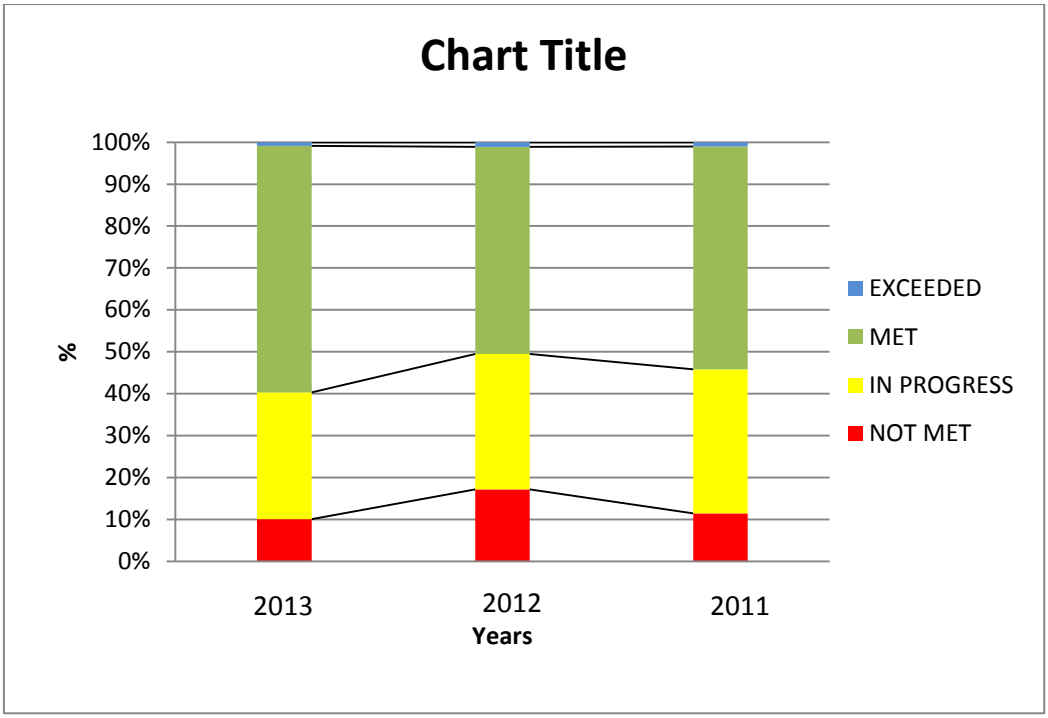

Figure 42: EQO Performance Trends

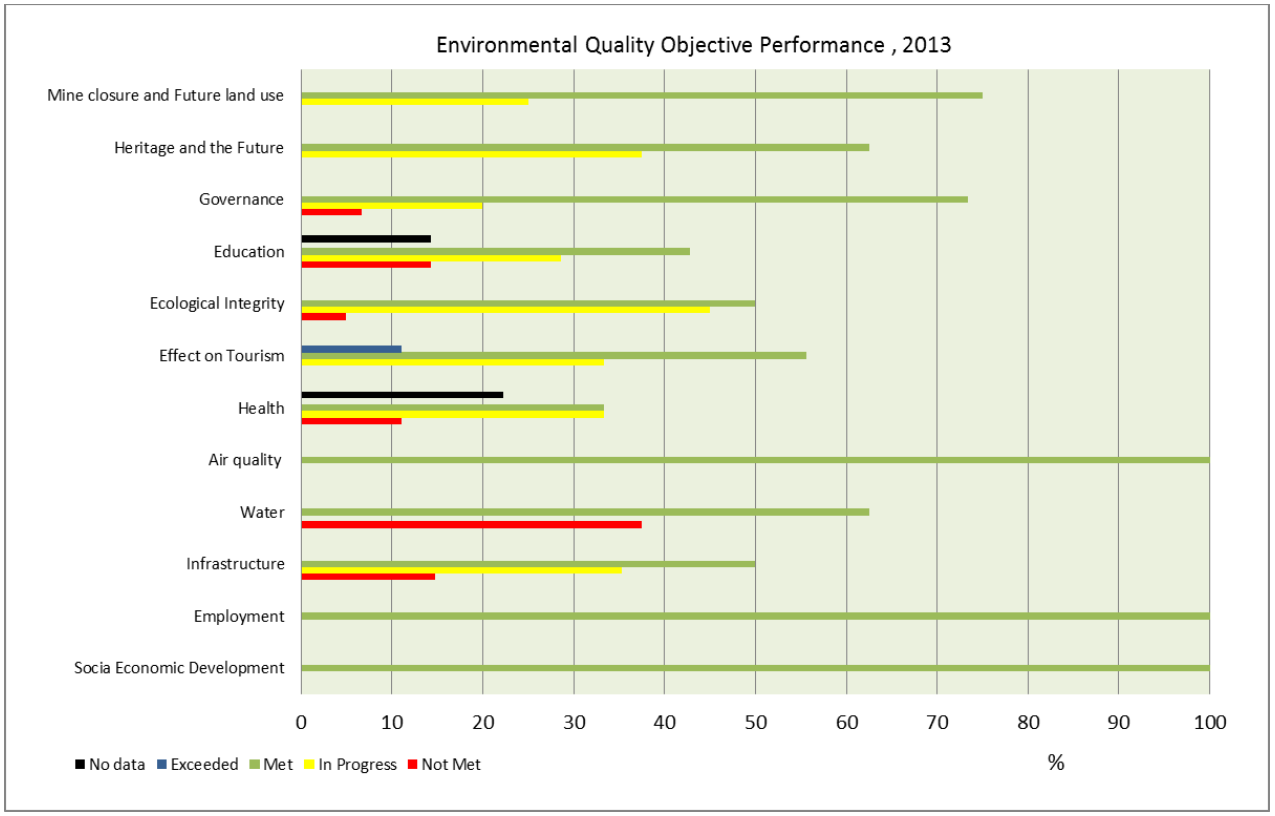

Figure 43: EQOs Performance in 2013

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Appendix

Appendix 1: Tourism Survey report for 2013

P.O. Box 953, Walvis Bay, Namibia
• tel +264-64-694199 • fax +264-64-694197
• gobabeb@gobabeb.org • www.gobabeb.org

SEMP REPORT FOR 2013: TOURISM SURVEY	
RESULTS AREA	Monitoring of indicators related to EQO 7 and EQO 8
Project	**SEMP 2013: Perceptions of tourists and tourism operators on developments associated with uranium mining and exploration**
Research Permit no.	NA
Duration of project	1 Nov 2014 to 31 Dec 2014
Date of report	8 April 2015
Principal Investigator/s	Hiskia Mbura
Collaborator/s	Assistance by Theo Wassenaar
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 third report (the first being a pilot study) 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 (GSN 2011). 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 a long-term monitoring effort with monitoring expected to carry on for a number of years. Hence the current report is a continuation of a long-term monitoring programme building on the foundation laid by the previous two surveys, the first of which was a pilot study with a very limited sample size.

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

Defining the questionnaires: We used the same two questionnaires that were designed for the initial pilot study and subsequently revised for the first full survey. One questionnaire was aimed at tourists and the other at operators. The tourist questionnaire consisted of 30 questions in six main topics and the operators' questionnaire consisted of 23 questions 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 as structured questions were deemed to be 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 tourist questionnaire was printed and copies distributed to tour operators in Swakopmund, Henties Bay and Walvis Bay between 07 November and 31 December 2014, with additional of the tour operators questionnaire emailed to more individual respondents. Although the intention was that a SEMP staff member conducts the interviews at completion of each tour excursion, it was in most cases not practical. In an instance where interviews could not be conducted by the SEMP staff, tour operators were requested to distribute the questionnaire to their clients. To the extent that aspects of the overall programme could be clarified by the interviewer, this could therefore have affected the outcome of the study, but none of the interviewed tourists needed clarification of the questions themselves.

Tour operators who are members of the Coastal Tourism Association of Namibia were requested through the CTAN chairperson to participate both by allowing us to ask their guests to complete a questionnaire, and by doing so themselves. Some tourists were also approached or asked to voluntarily participate in the survey through accommodation service providers, information centre and along the Swakopmund beach.

Analysis of results: In total 32 questionnaires were answered by tourists and 12 completed by operators themselves. Although the target number of respondents was 100 tourists and 20 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

Fifty questionnaires were distributed to the operators for their visitors to complete, and twelve more were done as personal interviews by one of us (HM). In total 32 tourist questionnaires were completed, which represents 52% response rate.

Respondent profiles

The respondents were interviewed at different locations within the Central Namib such as Swakopmund, Welwitschia Plains, Duineveld, Dune 7, Swakop and Khan rivers, although most were in Swakopmund. The greatest proportion (60 %) of the respondents is resident in Germany, 10% in Namibia and the rest (all < 7%) from a number of European countries and Australia (Figure 1). Two of the respondents (about 6%) did not answer questions on their age or nationality and about 19% did not indicate their gender. Of the foreign respondents, 44% (n=14) have visited Namibia before. The age of respondents ranged from 24 to 80 years with a mean of 52 years. Respondents once again came from a range of countries, but only five of those countries appeared in both years, with German residents being in the majority this time (Figure 1; see also Figure 1 in NERMU 2012 for a comparison).

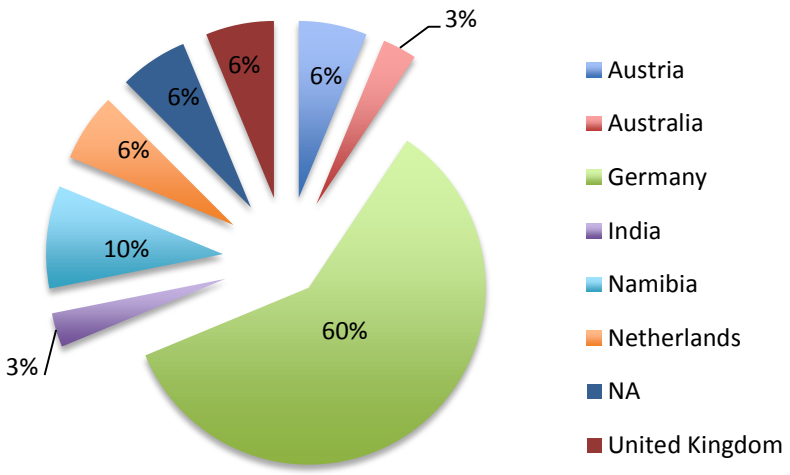

Figure 1. The composition of respondents in terms of the country of residence.

Different from the previous study, male respondents comprised the largest proportion at 44%, only 27% were female and 19% did not indicate the sex (marked as NA). As before, the majority (56%) of respondents received education at a tertiary level, 31% educated to secondary school level, 3% with only primary education and 10% (n=3) didn't indicate the education level.

Of the foreign visitors, about 44% have visited Namibia before, of which about 36% (n=5) of them have been to the central Namib before. Forty four percent of the respondents spent between 10 and 20 days on their current Namibian tour and only 3% between 20 and 30 days, with a median of 11.5 days across all of those who answered the question. Only nine of the foreign visitors who indicated to have visited the region previously were on the their third trip, there rest were here on their second trip.

Of the three Namibian residents, two visited the central Namib more than three times per year, while the third visited three times. One of the Namibian respondents has been the only person of those answering this question who visited the central Namib every year since 2000.

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

The highest score was again given to "Nature" as being the attraction that most tourists came to the Namib to experience. Unlike in the previous study, a majority of the respondents (53%, median 5) scored the aspect "Culture" as being of a relative high interest this time (Table 1). Although the category "Other" also received a large number of high scores, only 5 respondents scored this (Table 1).

Table 1: Responses of tourists when 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.

Topic	Percentage of scores in category					Median	Number of scores given
	Lowest				Highest		
	1	2	3	4	5		
Nature	6	3	0	6	84	5	31
Adventure tourism	18	14	29	18	21	3	28
Culture	0	7	13	27	53	5	30
Other	20	0	0	40	40	4	5

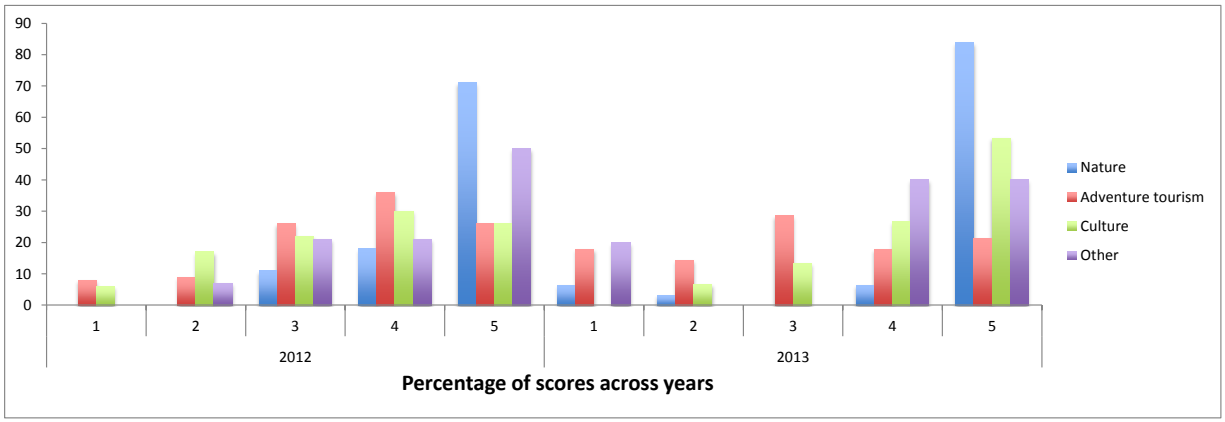

Figure 2: Comparison of tourist's scores on their interest of the Namib during the periods 2012 and 2013 on a 5-point scale (1=did not meet expectations, 5=exceeded expectations).

In response to the **Indicator 7.2.1.2** of the SEMP on whether expectations of tourists experience were met, similarly to the previous study the "scenic quality" and "sense of place" of the central Namib received the highest scores (Table 2, Figure 3). Nonetheless, a majority of the categories still mostly met or exceeded the expectations of the respondents, with a median score of 5 and 4 respectively (Figure 3). The category "Nature" also met or exceeded their expectations, with all but four respondents giving no scores below 3 resulting in an overall median score of 5 (Figure 3). The

remaining three categories ("Adventure tourism" and "Culture" and "Others") scored a median of 4, suggesting that the expectations of tourists were also met (Table 2).

Table 2: Responses of all tourist, when asked to estimate the extent to which their expectations of the central Namib experience were met on a 5-point scale (1=did not meet expectations, 5=exceeded expectations). Values are the percentage of the number of respondents that scored a particular aspect.

Topic	Percentage of scores in category					Median	Number of scores given
	Did not meet				Exceeded		
	1	2	3	4	5		
Scenic quality	6	0	3	23	68	5	31
Sense of place	7	0	7	54	32	4	28
Nature	6	0	6	22	66	5	32
Adventure tourism	7	11	29	29	25	4	28
Culture	3	7	31	31	28	4	29
Other*	50	-	-	25	25	4	4

* Photography = 50, Namibian Food = 25 and Hiking = 25

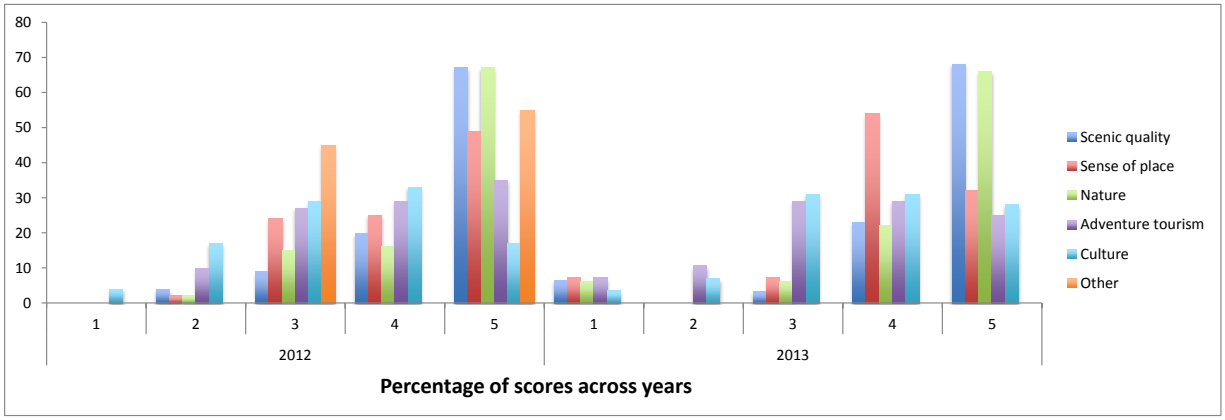

Figure 3: Comparison of tourist's scores on their experience of the Namib during the periods 2012 and 2013 on a 5-point scale (1=did not meet expectations, 5=exceeded expectations**).**

Only 13% (24% in 2012) of the respondents reported experiencing problems in accessing all the attractions they planned/wanted to visit and two did not provide answers to this question. The reason for not accessing the attractions is blamed on a lack of accommodation/camping facilities at the sites of interest (this respondent referred to the Skeleton Coast in a comment; thus not relevant for this study), a road/pass which was closed-off for reasons other than mining and tourists not being able to obtain park permits in time. When asked whether they encountered any developments that increased the attractiveness of the region, only 19% (35% in 2012) answered yes, with reasons being mainly the "Scenic quality" and unique wilderness experience. In contrast, when asked whether they encountered developments that decreased the attractiveness of the region, 34% (45% in 2012) answered yes, with the reasons (9 of 11 reasons given – all by foreign tourists) relating to mining activities i.e. water and electricity infrastructures. The only positive change identified between their previous and current visits was the reduction in off-road tracks caused during exploration activities. While the only negative change identified was the mining boom in the Namib.

Tourist perceptions and experience of mining

Ninety four percent of the respondents were aware that uranium mining occurred in the Namib with less than fifty percent (41%) having been aware of this before arriving in Namibia. Unlike in the

previous study when 47% supported Namibia's drive to establish a uranium mining industry, only 16% supported it in the current study. A larger percentage than before (44% vs. 22% in 2012) was against it, and 31% were uncertain. A further 9% considered this question not applicable.

Twenty five percent said that their tour operator did not inform them of the extent and impacts of mining, 66% said they did and the rest did not consider the question applicable. The largest number of respondents (75%) thought that the overall impacts of mining will be negative (only 3% 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 (63% each vs. 24% in 2012), followed by loss of ecological integrity (50%) and air pollution (38%). Social problems and loss of sense of place were the least important with each receiving a score of 24% and 6% respectively. Only 2 respondents thought that mining was an activity that should be allowed in a national park, while 3 thought that agriculture would be acceptable, 31 thought that tourism was an acceptable land use and none considered any other industries to be acceptable.

OPERATORS

Questionnaire response rates

The 2013 survey results present a different tour operators view on the extent to which different attractions in the Namib Desert forms part of their tour package. This was due to an improvement in sample size, with an increase from five to twelve for the current study. With this improvement in sample size, the summary of results presented below provides a slightly better view on the impact of mining on the tourism sector in the region, although this is probably still not close to statistically robust.

Respondent profiles

Eight of the respondents were based in Swakopmund, two in Walvis Bay and one each in Henties Bay and Windhoek. Most operators provide guided safaris and day or bus tours, two provide adventure tourism and one provides accommodation. All the respondents have been operators for more than ten years with 50% hosting groups of more than ten visitors on their tours, 33% hosts between one and five, and the rest (17%) host five to ten visitors (see Figure 4b). On the question of whether the central Namib was their core area of operations, 67% answered yes with 33% saying no (Figure 4a). Sixty seven percent of the respondents said their businesses have increased over the last five years, 25% said business remained the same and only 8% said it had decreased (Figure 4c).

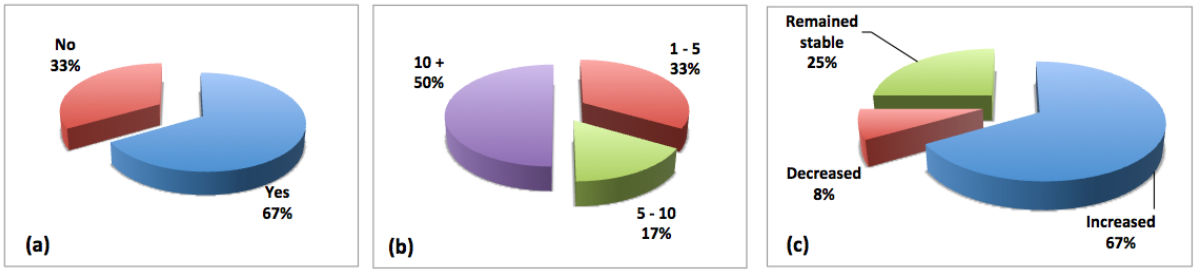

Figure 4: Respondents profile for the 2013 study: Figure on the left (a) shows the proportion of respondents for whom the central Namib is core to their tour operations. Figure (b) shows the proportion of respondents that have been in operation for three different lengths of time. Figure (c) shows the proportion respondents with three different levels of business performance over the past five years.

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

Although there were one or two of the respondents who did not give scores for one or another of the categories, most (10 or 11) rated the different attractions for the extent to which they form part of their packages. The outcomes of this question are provided in Table 3. The Giant Welwitschia and the

Swakop/Khan Rivers were the two attractions that did not have distinct rating of whether they are destinations of significance to all respondents (Table 3). However, the Swakop/Khan Rivers was highly significant to about 36% operators while 55% of the operators rated the Giant Welwitschia (Table 3).

Table 3: Responses of 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	Percentage of scores in category					Median	Number of scores given
	Not used at all				Highly significant		
	1	2	3	4	5		
Swakop / Khan River(s)	27	9	18	9	**36**	3	11
The giant Welwitschia	18	18	**55**	0	9	3	11
The Welwitschia flats	9	0	27	18	**36**	4	10
The coastline	9	0	18	18	**55**	5	11
Coastal dunes	9	9	0	18	**55**	5	10
Spitzkoppe	9	9	18	18	**36**	4	10
The moon landscape	9	18	**45**	0	18	3	10
Other*	0	0	**100**	0	0	3	1

* One respondent indicated Bloedkoppie and Mirabib as extra attractions.

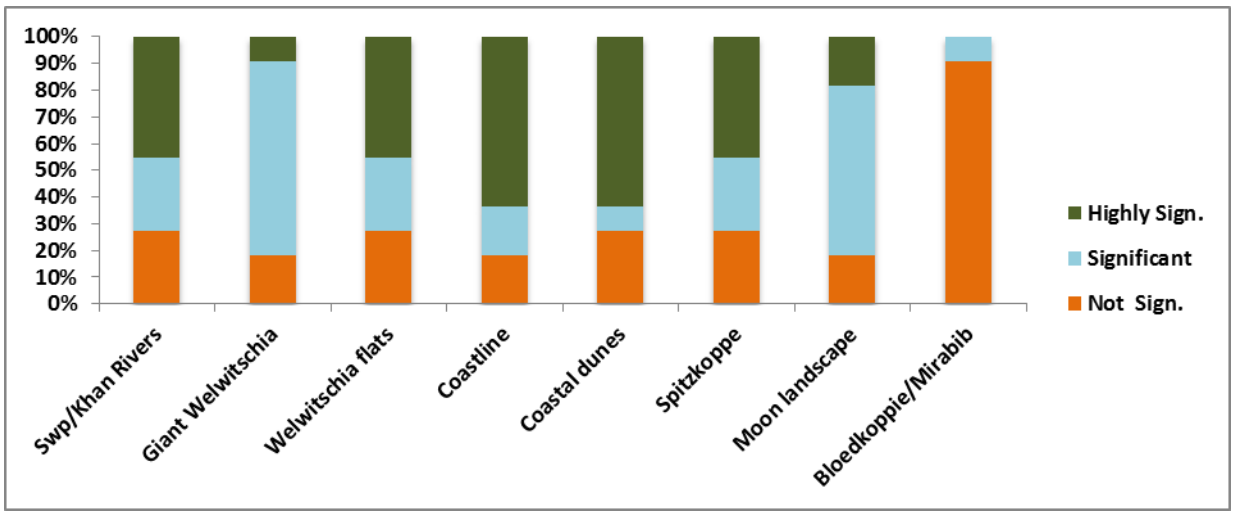

Figure 5: Shows a cluster of scores in terms of the significance of the respective attraction sites as important component(s) of the Central Namib's tour packages in percentage proportion. The site with least significance (Bloedkoppie/Mirabib) in this graph is not part of the initial SEMP listed Yellow/Red Flags areas reserved for tourism but listed by one operator as significant to their package.

Eleven of the twelve respondents answered the question of whether they enjoyed free access to the attractions, with eight saying yes and three saying no (the question was not applicable to the one respondent providing accommodation). Eight (of eleven answering) said they did not encounter developments that increased visual attractiveness of the region, but three said they did although they did not say which these were. On the other hand, six (of eleven answering) said they encountered developments that decreased visual attractiveness of the region. These were mainly ascribed to powerlines and pipelines to the mines and one claiming the presence of filming activities and off-road tracks. The only positive development listed by the operators is the tarred section of the C28 road running to the Langer Heinrich turn-off.

Operator perceptions and experience of mining

None of the operators took their guests to the Uranium Institute, neither did they take them to the Namib Information Centre. None currently include the uranium mines as part of their tour package.

However, 8 of the eleven operators said they often talk about uranium mining to their guests while only two indicated that they foresee uranium mines being a part of their tour packages. Eight operators supported Namibia's drive for establishing a uranium industry.

Additional comments (by five respondents) included a concern about health risks (increased cancer cases allegedly reported in the region) posed by dust and radiation emission from mining activities, and lenience in regulation of mining in conservation areas by regulatory institutions. One comment, not directly related to mining, was that unregulated self-drive off-road tourists causes negative impact on the Namib scenery by leaving their tracks all over.

Conclusions, challenges and future directives

TOURISTS

Overall, the central Namib's scenic beauty (Nature, Scenic quality and Sense of place) was still the key attraction and tourist's expectations were met or exceeded. In addition, tourist's perception and experience of the Namib remain positive overall, even while a large proportion (94%, 40% before they arrived in Namibia) of them had good knowledge of uranium mining and its consequent impacts. The majority thought that the overall impact of mines will be negative, and they were mostly concerned about the visual impacts, water pollution and the intactness of the Namib's ecosystems. Additionally, it appears that the perception of the tourists of mining in general is becoming more negative, with more respondents than last year being against mining in the central Namib.

The current study, with 32 respondents, is a slight drawback compared to the previous one. Also, as in the previous studies no sophisticated statistics were applied but the tallying of responses and evaluating percentages of classes. The number of surveyed/sampled respondents remained far below the 200 target set out in the 2011 SEMP as a representative size of tourist visiting the region. In addition, the respondents' profiles differed markedly from the previous study, which together with fluctuation in sample composition affects the statistical validity of the results.

This result re-enforces the importance of a continued monitoring of mining impacts on the environment and the need to improve on sampling techniques or approach. Nonetheless, the population of tourists sampled over the three years confirms that the Central Namib despite the presence of mining activities retains its tourism value and still of a great experience.

More than a quarter 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 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 continuously provided with a balanced perspective.

OPERATORS

Contrary to a drop in sample size on the tourist survey, an improvement on the operator's survey was achieved in the current study. Having a larger sample size this time, in spite of also not having applied sophisticated statistics offers a greater degree of confidence in terms of the results validity. The operator's results support the perception by the tourists that the Central Namib has not been significantly affected by mining activities in such a way that tourism is deteriorating. In total 12 tour operators participated in the survey, of whom eleven primarily conducts tours in the Namib and more than 70% regards all sites as significant or highly significant to their operations.

The median scores dropped by one or two levels down the scale for four of the attraction sites (Walvis-Swakop Dunes, Coastline, the Giant Welwitschia and Welwitschia Flats), increased by 1 level up the scale for the Swakop-Khan River and remained unchanged for Spitzkoppe. A larger proportion

of the operators surveyed also claimed that their business's performance has increased over the past five years. In addition, those whose business did not perform well during the same period were due to factors other than uranium mining such as market saturation and competition. Based on the data we have, it appears that the effect of uranium mining on tourism in the central Namib is currently minimal. However, this, together with the finding that the perception of tourists of mining appears to be more negative than in the past, simply underscores the importance of ongoing monitoring.

SUGGESTED IMPROVEMENTS AND CHANGES

While both the tourist's and tour operator's perceptions indicate that mining activities does not currently affect their tourism experience/services in the Namib, a few minor improvements remains crucial. The questionnaire currently used omits one key category in the section of tourist's interests in the Central Namib i.e. a category for scenic quality should be added to the questionnaire.

It also remains important that measures are put in place to ensure that a larger sample size is achieved, even though the 200-sample target (as set out in the 2011 SEMP report) for the tourists survey is unlikely to be met. Therefore, to ensure an improved and balanced tourist perceptions analysis, the relevant stakeholder (MET, CTAN, NERMU and Tertiary institutions e.g. the Polytechnic) should collaborate to address this. In this regard we have already held meetings with Mr Sem Shikongo, Director of Tourism at the MET, to discuss potential ways in which the MET could assist in expanding the sample size by distributing the questionnaire through their official channels.

However, it is also very clear to us that the tourist operators (and, because we rely on access to the tourists through the operators, therefore also the tourists themselves) will become questionnaire-saturated very quickly. In addition, there is a very difficult-to-resolve mismatch in the dates of the survey (2014) and the reporting period (2013). This mismatch makes it virtually impossible to obtain answers that relate to the reporting period. We therefore suggest that the frequency of the tourism survey should be changed to once every two years.

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Appendix 2: NERMU 2012-12.1: Baseline for the development of riparian vegetation monitoring programme For the Strategic Environmental Management Plan for the Uranium Rush

GOBABEB RESEARCH & TRAINING CENTRE | NERMU NAMIB ECOLOGICAL RESTORATION & MONITORING UNIT

P.O. BOX 953, WALVIS BAY, NAMIBIA
• tel +264-64-694199
• fax +264-64-694197
• gobabeb@gobabeb.org
• www.gobabeb.org

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, Hiskia Mbura
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], Titus Shuuya[1] and Hiskia Mbura[1]

[1]Namib Ecological Restoration and Monitoring Unit
Gobabeb Research and Training Centre
P.O. Box 953
Walvis Bay
theo.wassenaar@gobabeb.org

1 Introduction

1.1 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.

1.2 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.

1.3 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?

2 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.

3 Theory

3.1 Indicators of health

Although seasonal or longer fluctuations in its physiological state may occur, a plant in a normal state of health[3] is able to maintain turgor, grow and reproduce (Hopkins & Hüner 2009). Stressors such as disease, heat and, most pertinently for this study, water deficit, will result in fewer resources being mobilised for reproduction and growth in favour of survival (Lichtenthaler 1996). Plant water-deficit stress is defined as the state where a plant's water potential and turgor are decreased sufficiently to inhibit normal plant function (Hsiao 1973).

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, principally because a plant normally experiences cyclical (or even non-cyclical) periods of stress (Figure 44). This means that it is probably the cumulative effect of many stress periods that will eventually result in visible declines in reproduction and increases in dead plant parts (see Figure 44 for a conceptual model of this dynamic). At the least, depending on the stress level, it will probably take a year or more 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 (Chaves et al. 2002) and may only become apparent over a longer period.

On the other hand, photosynthesis is particularly sensitive to water stress (Hopkins & Hüner 2009), on the one hand making photosynthetic efficiency the ideal indicator of plant health on the

[3] 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.

individual plant level and potentially also on the population level, while on the other hand introducing a potentially large amount of individual variation into the mix.

Overall it is necessary to integrate all the variables for a more comprehensive understanding, but this will clearly take some time because the effect of water-deficit stress on many of the above variables will only manifest itself over longer periods. At this baseline stage, and for this report, we have therefore chosen to focus mostly on photosynthetic efficiency for its ease of application and direct measurement of plant stress status at a particular point in time.

3.2 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 the ephemeral rivers are not homogenous, but are separated into sections called compartments created by outcropping bedrock or narrowing of the river gorge (SAIEA 2010; **Figure 44**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 44**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 45**-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 44**B). In this case, the population stress state structure would be somewhere between the two extremes depicted in **Figure 45**. Finally, when all plants are experiencing stress independent of their distance to a production borehole, we expect relationship z in **Figure 44**B, and a population stress state structure like in **Figure 45**-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.

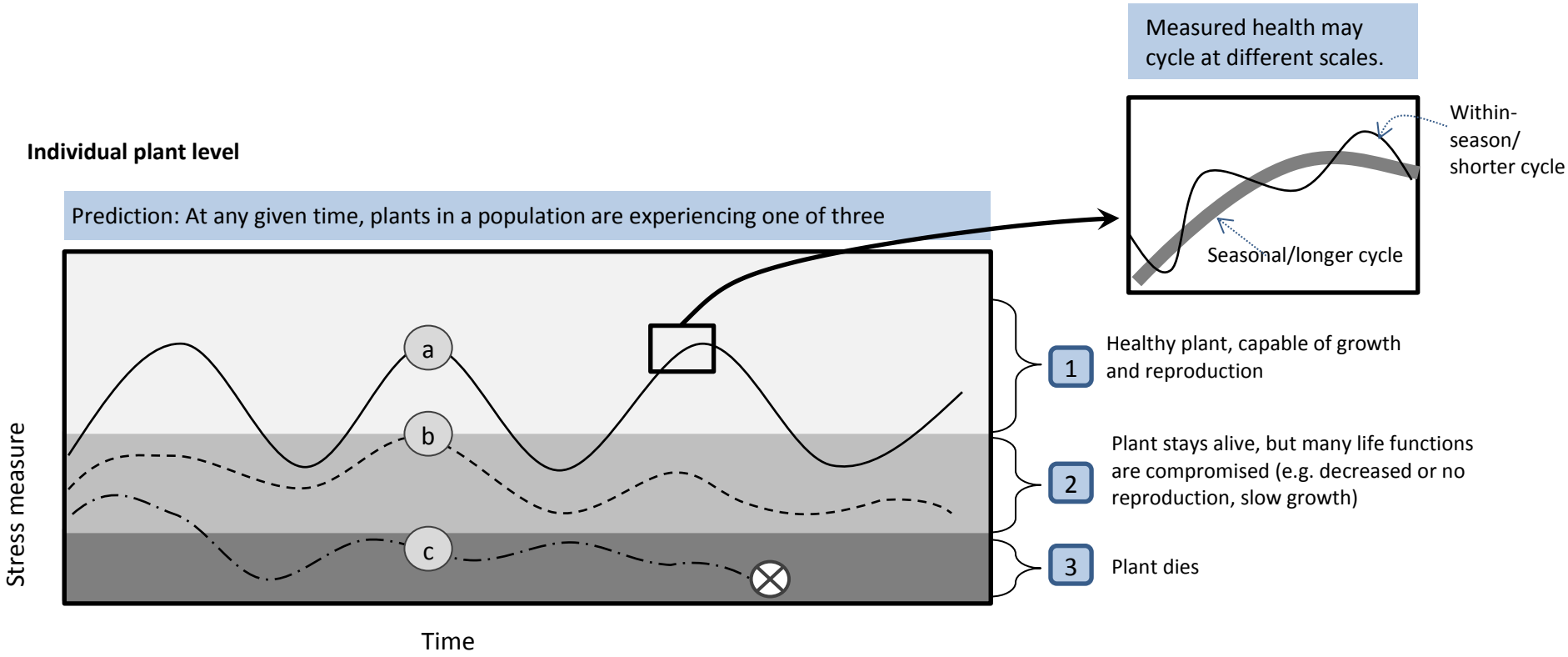


Figure 44. A diagram showing the conceptual changes in stress levels over time for individual plants in a population growing in a desert. The critical presumed stressor here is water, or more broadly defined plant-available moisture. Moisture supply will vary over time at different temporal scales, leading 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 (labelled 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.

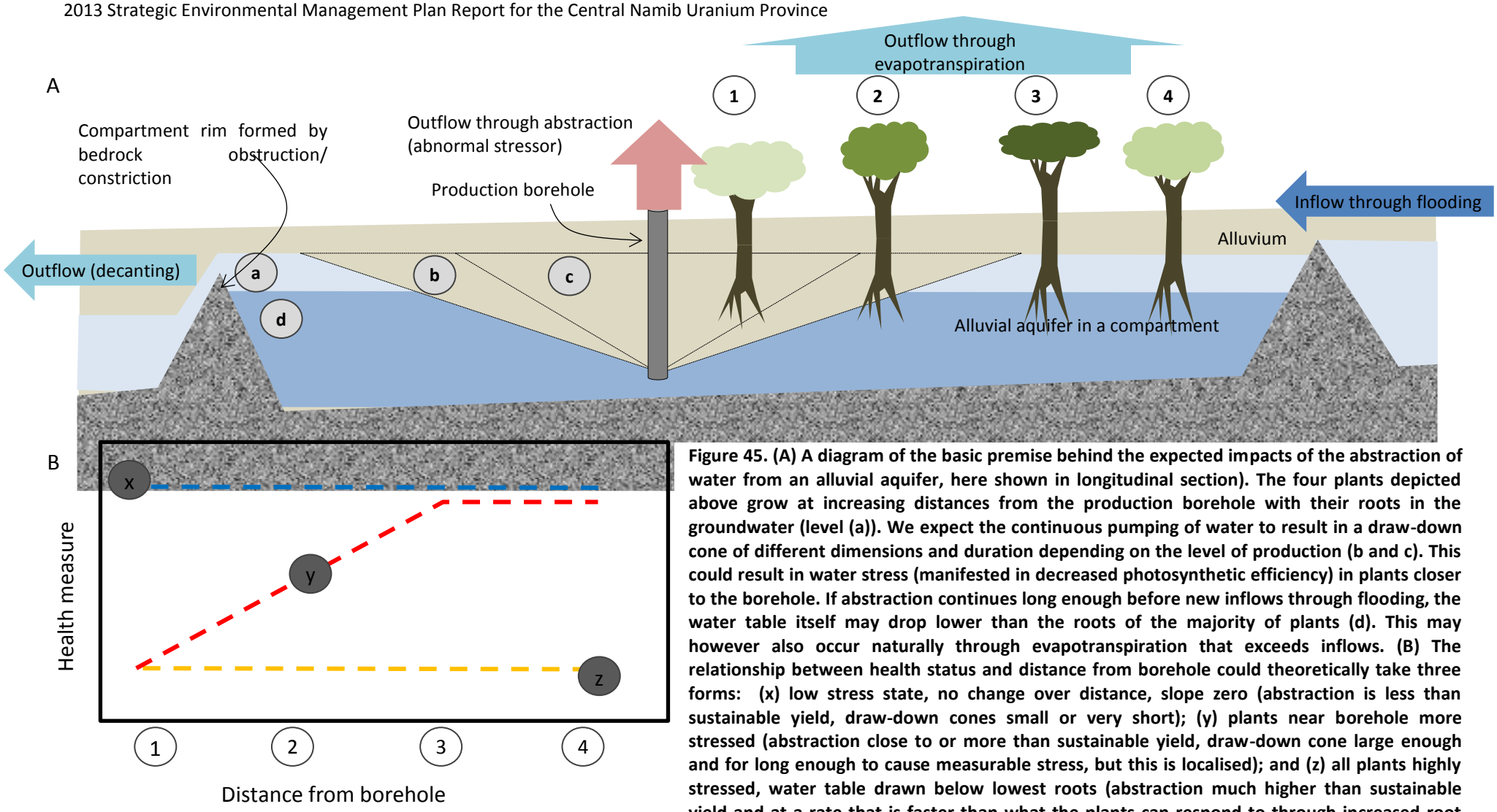
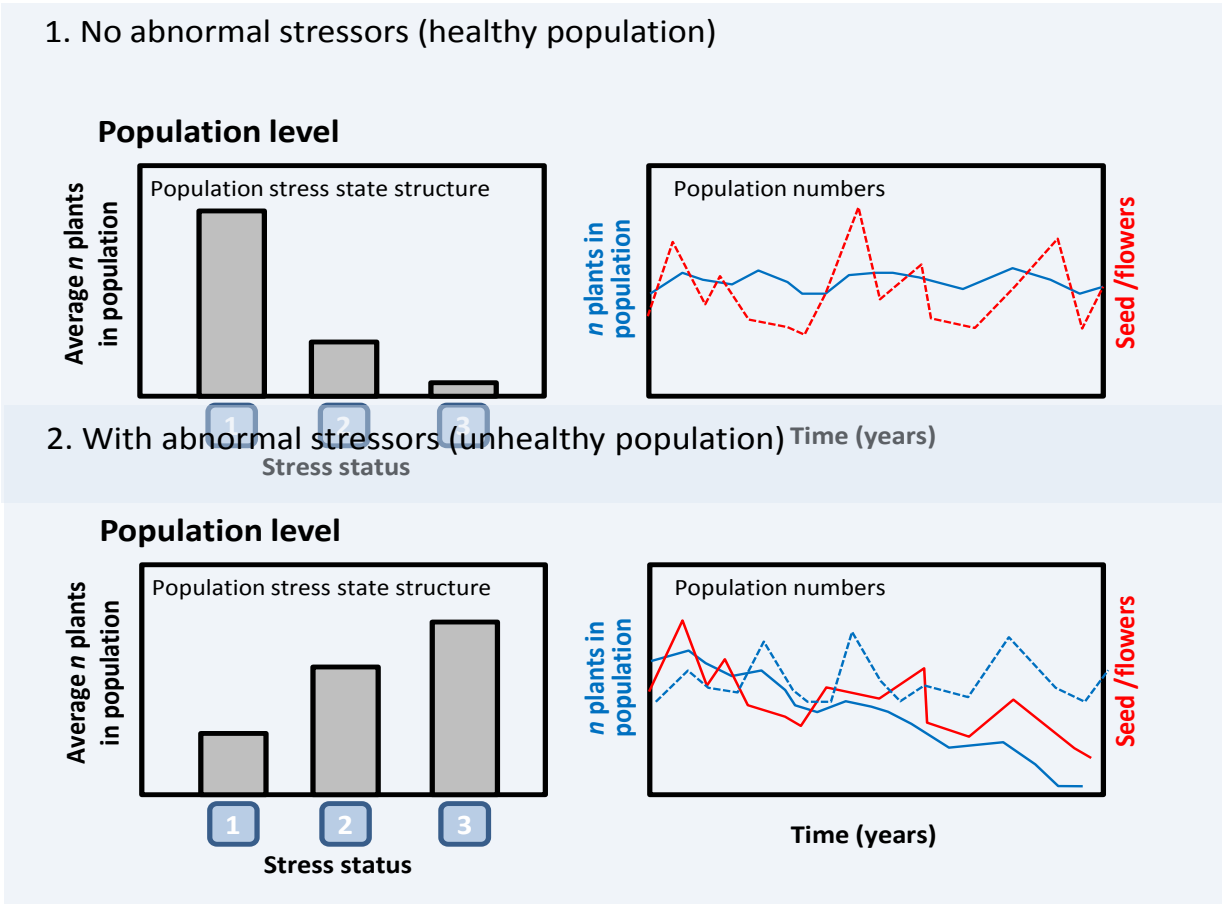


Figure 45. (A) A diagram of the basic premise behind the expected impacts of the abstraction of water from an alluvial aquifer, here shown in longitudinal section). The four plants depicted above grow at increasing distances from the production borehole with their roots in the groundwater (level (a)). 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, draw-down cone large enough and for long enough to cause measurable stress, but this is localised); and (z) all plants highly stressed, water table drawn below lowest roots (abstraction much higher than sustainable yield and at a rate that is faster than what the plants can respond to through increased root growth.



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

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 46. With reference to the stress states defined in Figure 44: 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.

3.3 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.

4 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 confluence of the Swakop and the Khan Rivers for 88 and 55km respectively up river (Figure 47). In the Swakop the study section ended at the eastern park boundary and in the Khan River at a point somewhat to the east of Valencia Mine. In the Kuiseb River the study site extended from within the Kuiseb Delta area for 91 km up river to Homeb (Figure 47).

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).

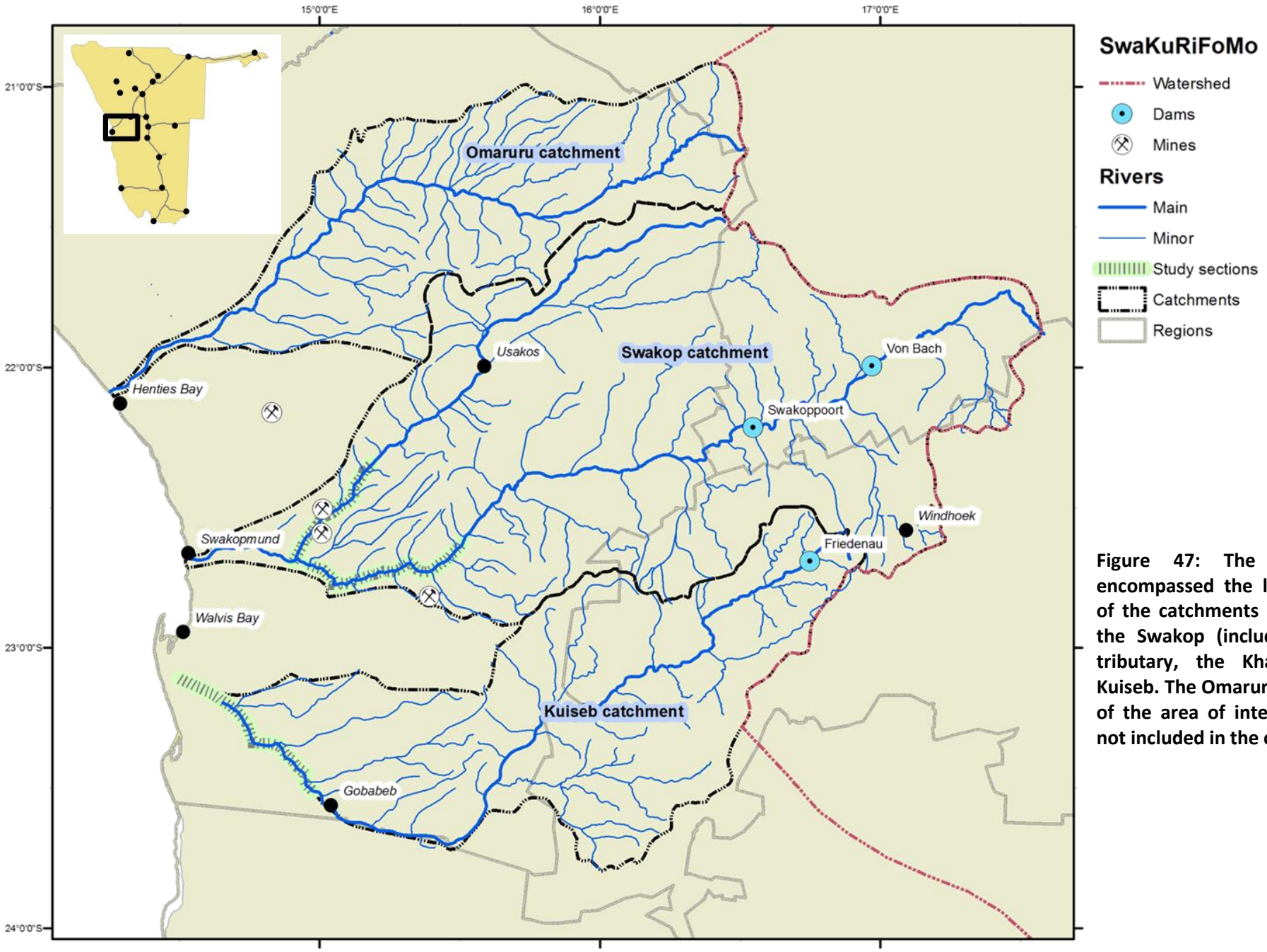


Figure 47: The study area encompassed the lower reaches of the catchments of two rivers: the Swakop (including its large tributary, the Khan) and the Kuiseb. The Omaruru River is part of the area of interest, but was not included in the current study.

5 Methods

Fieldwork was conducted in the Swakop, Kuiseb and Khan Rivers from December 2012 to April 2013 for the first, pilot phase and again in November and December 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).

5.1 Survey design

5.1.1 Principles of design, physiological variable

A systematic sampling design was used to collect samples with an initial random start (Gitzen et al., 2012). Two basic surveys of spatial vegetation health were made: 1) longitudinal "drive" transects along the length of the focal sections of each river, and 2) concentric bore-hole centred surveys. The first of these surveys – 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. Additionally, we measured an invasive *Prosopis* species (species name unknown). Variables measured were:

8. Transverse transects: canopy cover, density, diameter at breast height (DBH), height, visual and physiological vitality.
9. Borehole concentric transects: canopy cover, diameter at breast height (DBH), height, visual and physiological vitality.

5.1.2

5.1.3 Longitudinal ("drive") transects

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 camel thorn and ana tree were considered those trees which had not been moved from the place where they had fallen in the water course.

Counts were tallied over 200 m intervals (Figure 48) and these were later simplified to 2km sections. Tree counts were segregated to track the number of trees on the South floodplain, North floodplain and within the main water course separately, but later these were summed for each section. *C*amel thorn and ana trees were counted individually while the presence of *Prosopis* sp. were noted as present or absent in each 200 m interval. Occurrence of *Tapinanthus* sp., an aerial parasite, was noted on camel thorn and ana trees in each 200 m interval also.

Figure 48. 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, while 88 and 91km was sectioned in the Swakop and Kuiseb Rivers respectively.

5.1.4 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.

A Handy PEA (Plant Efficiency Analyser, Hansatech, Norfolk, UK) instrument was used to measure chlorophyll *a* fluorescence. Chlorophyll fluorescence can be used as a good indicator of photosynthetic efficiency (Stirbet, 2011). Five leaves samples were collected on the southern aspect of each sampled tree. Leaves samples were kept in brown paper bags and measured at night (one hour after sunset), to ensure maximum dark adaptation. Dark adapted leaves were exposed to a pulse of saturating light at an intensity of 3200 µmol $m^{-2}s^{-1}$, with a wavelength of 650 nm for between 0.01 and 1000 ms.

For the purposes of the current report and for the concentric transects, we have concentrated on the ratio F_V/F_M parameter, which represents the ratio of variable fluorescence (F_V) to maximum fluorescence (F_M). This ratio can be related to the maximum quantum yield of primary PSII photochemistry (photosynthetic efficiency) in higher plants, with the value in the range of 0.78–0.85 generally being considered as healthier or low stress level (Stirbet, 2011).

5.2 Numerical analyses

A Handy PEA software (v1.30 14/05/02) was used to average the samples from each focal tree, thereafter data were exported to the Microsoft excel for further analysis. The F_V/F_M parameter was plotted on a linear regression model against the distance from borehole to investigate the

relationship of tree health to the abstraction cone and the slopes of the relationships were tested for significant difference from zero and from each other.

5.3 Mapping and spatial analysis

ArcGIS 10 and Google Earth was used for all mapping and spatial analyses.

6 Results

6.1 Overall distribution of physiological health values

A total of 624 trees were measured at 39 boreholes across all three rivers. About 90% of all plants of all three species measured during Phase 2 showed values of Fv/Fm below 0.5, regardless of river or whether it was a production or monitoring borehole (Figure 49A). This overall poor health status becomes more evident when compared to readings taken of *Welwitschia mirabilis* in an unrelated study (pers. comm. T. Shuuya), as well as to the levels during Phase 1 of Swakurifomo and to random trees (not associated with boreholes) measured during the current phase (Figure 49B).

6.2 Longitudinal transects

A number of obvious patterns emerged from this part of the study, with the clearest one being a strong and definite difference between the three rivers (Figure 50). The Kuiseb River is evidently much healthier habitat for trees, both in terms of the relatively low mortality rates and the total number of trees (Figure 50). The Swakop especially contained larger numbers of dead ana tree, but camel thorn on the other hand seems to be less affected in both rivers (Figure 50, Figure 51). Overall the number of trees increases 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 50).

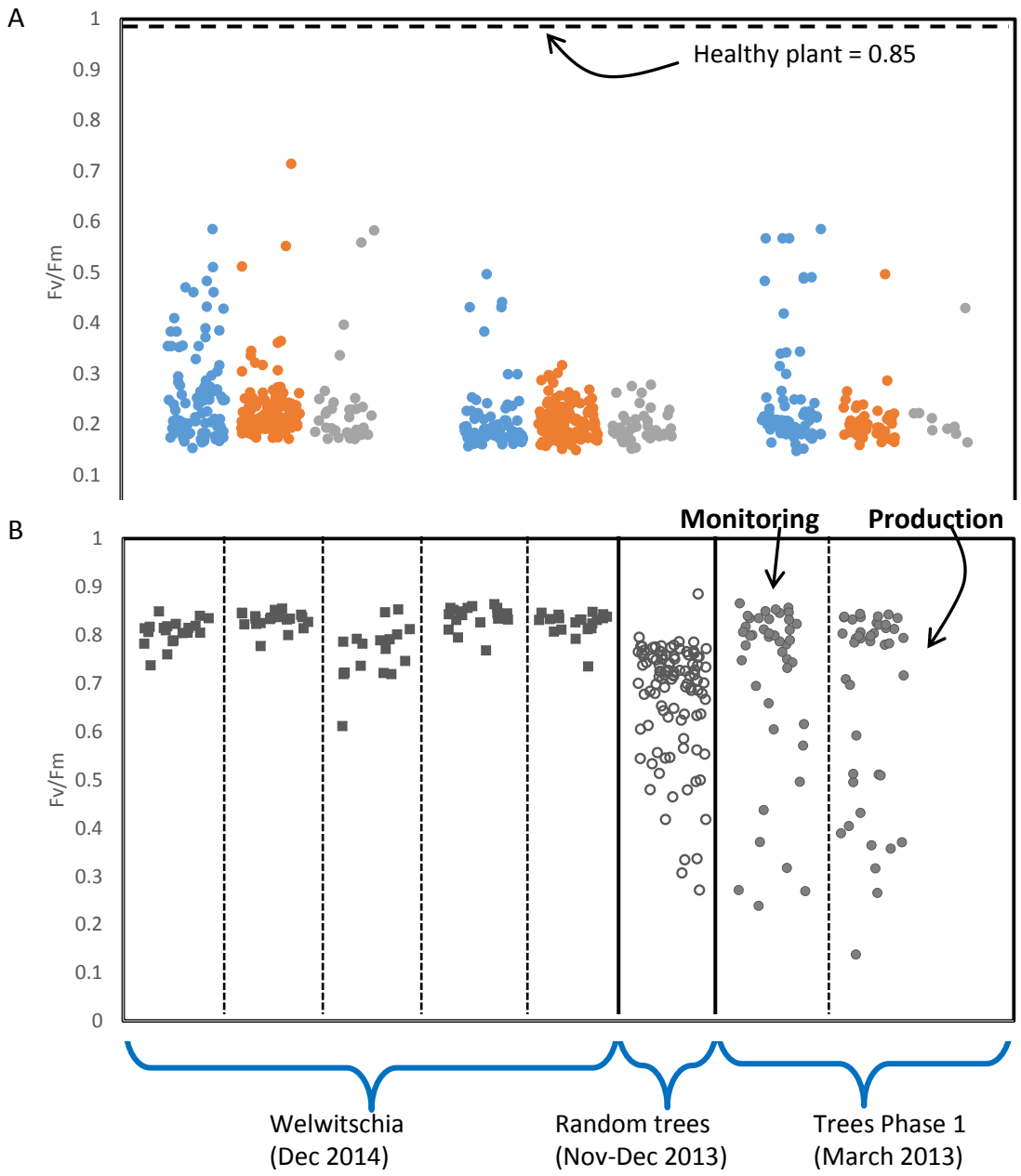


Figure 49. Scatter plots of values of Fv/Fm as found in the current study (A) and in other studies, including Phase 1 of Swakurifomo (B). "Unknown" in (A) refers to boreholes that could not be classified as production or monitoring at the time of writing. Data of Welwitschia health in (B) were taken from an unrelated study by one of us (T. Shuuya).

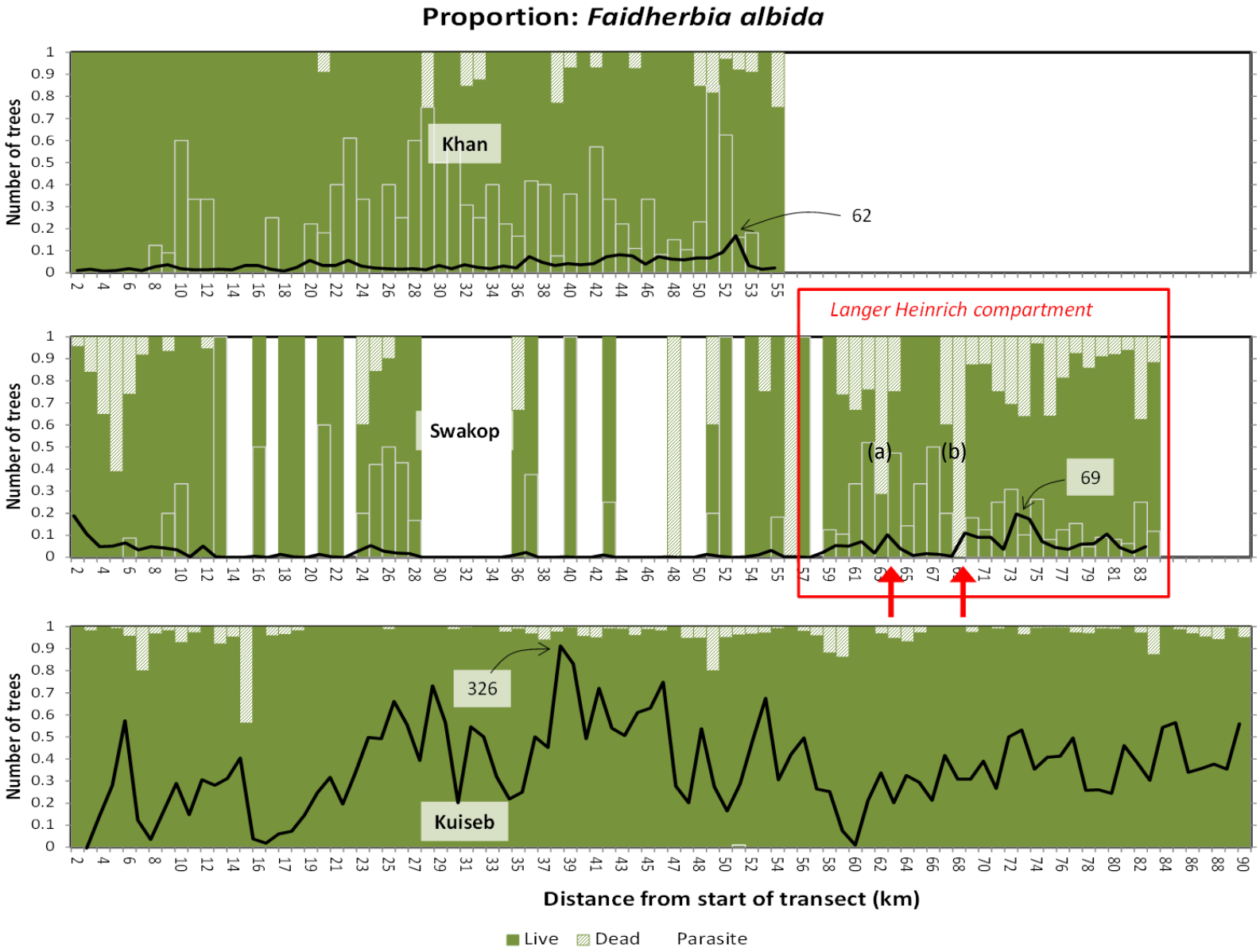


Figure 50. The proportion of ana trees that were either dead (hatched bars) or alive (solid green) in 2km sections of the three study rivers, from the westernmost start of the drive transect to the end of the study section in each. Solid black lines indicate the total number of trees (alive and dead) in each section, with the highest number indicated with an arrow. Additionally, the proportion of trees that supported parasites (in this case *Tapinanthus* sp.) is shown as white outlined bars. White areas within the study sections indicate the absence of trees of either species. The red outline denotes the region of the Langer Heinrich compartment in the Swakop River, one of the compartments in which active abstraction (by Langer Heinrich Mine) is occurring at the red arrow at (a). The red arrow at (b) indicates the location of a monitoring borehole.

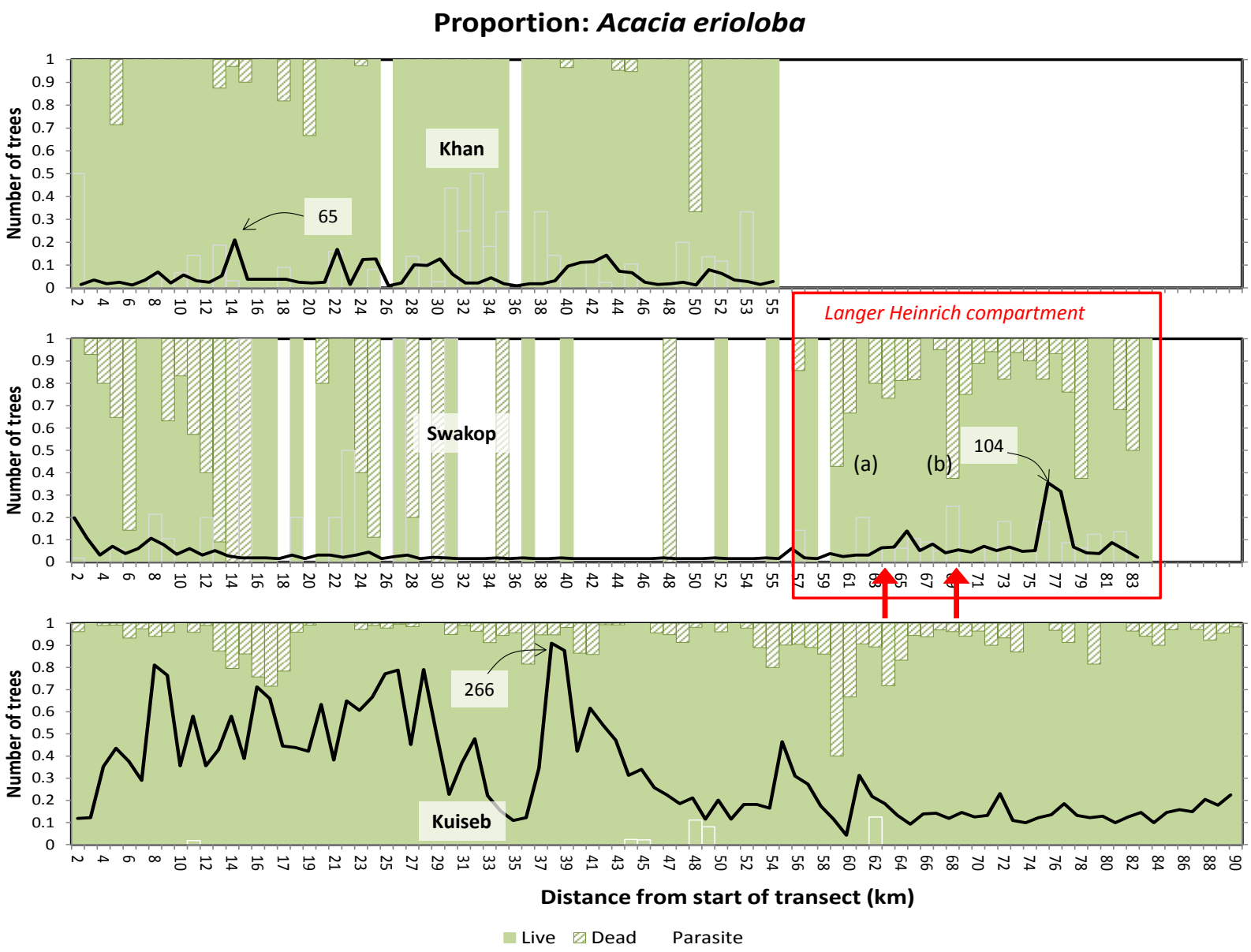


Figure 51. The proportion of camel thorn trees that were either dead (hatched bars) or alive (solid green) in 2km sections of the three study rivers, from the westernmost start of the drive transect to the end of the study section in each. Solid black lines indicate the total number of trees (alive and dead) in each section, with the highest number indicated with an arrow. Additionally, the proportion of trees that supported parasites (in this case Tapinanthus sp.) is shown as white outlined bars. White areas within the study sections indicate the absence of trees of either species. The red outline denotes the region of the Langer Heinrich compartment in the Swakop River, one of the compartments in which active abstraction (by Langer Heinrich Mine) is occurring at the red arrow at (a). The red arrow at (b) indicates the location of a monitoring borehole.

6.3 Borehole concentric transects

6.3.1 Physiological vitality (relationship between distance to borehole and Fv/Fm)

In the **Khan River**, most trees were not very healthy, with values of Fv/Fm being mostly below 0.5 and no indication of an increase of health away from production boreholes (Figure 52). In fact, the ana trees tended to be healthier closer to the borehole, although this non-significant trend was strongly driven by two trees that were relatively healthy (Figure 52). The slopes were not significantly different from zero for any of the relationships. Visual inspection of the graphs suggests that ana trees around monitoring holes may be slightly healthier than those around production holes, but this is a very tenuous effect (Figure 52).

In the **Swakop River**, the pattern was much the same, with the exception that the many Prosopis trees appeared to be somewhat healthier than the two native species (Figure 53). Again, there were no significant relationships between health and distance to borehole.

The study section of the **Kuiseb River** had no Prosopis trees, but all trees were again relatively stressed with low Fv/Fm values across the board (Figure 54). As in the other two rivers, there were no significant relationships between health and distance from borehole.

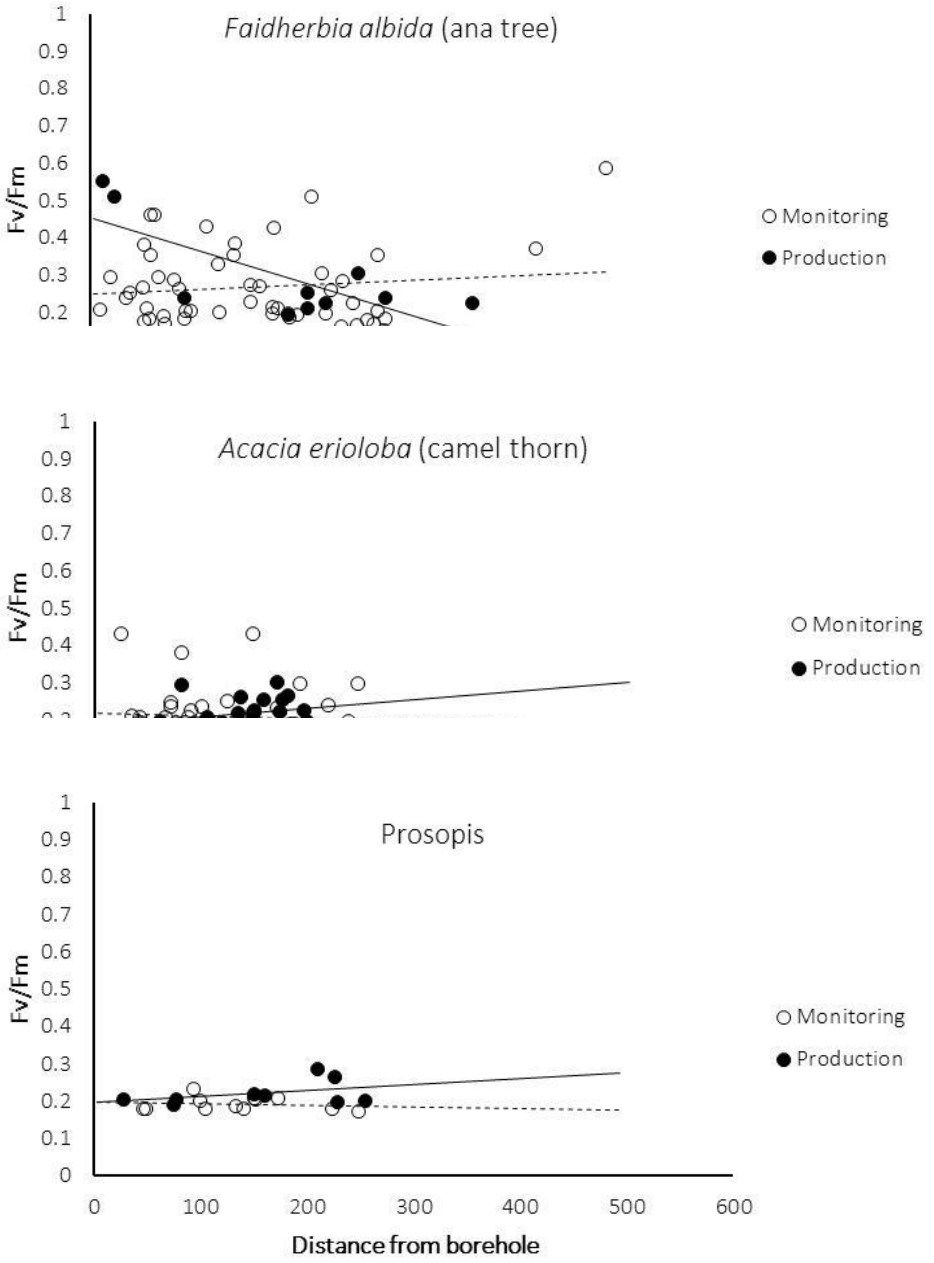


Figure 52. The relationship between tree health (Fv/Fm) and distance to borehole for monitoring (open circles, dashed regression line) and production holes (closed circles, solid regression line) in the Khan River for three tree species. None of the regressions were significantly different from zero. A healthy plant is generally considered to have an Fv/Fm ratio of 0.85.

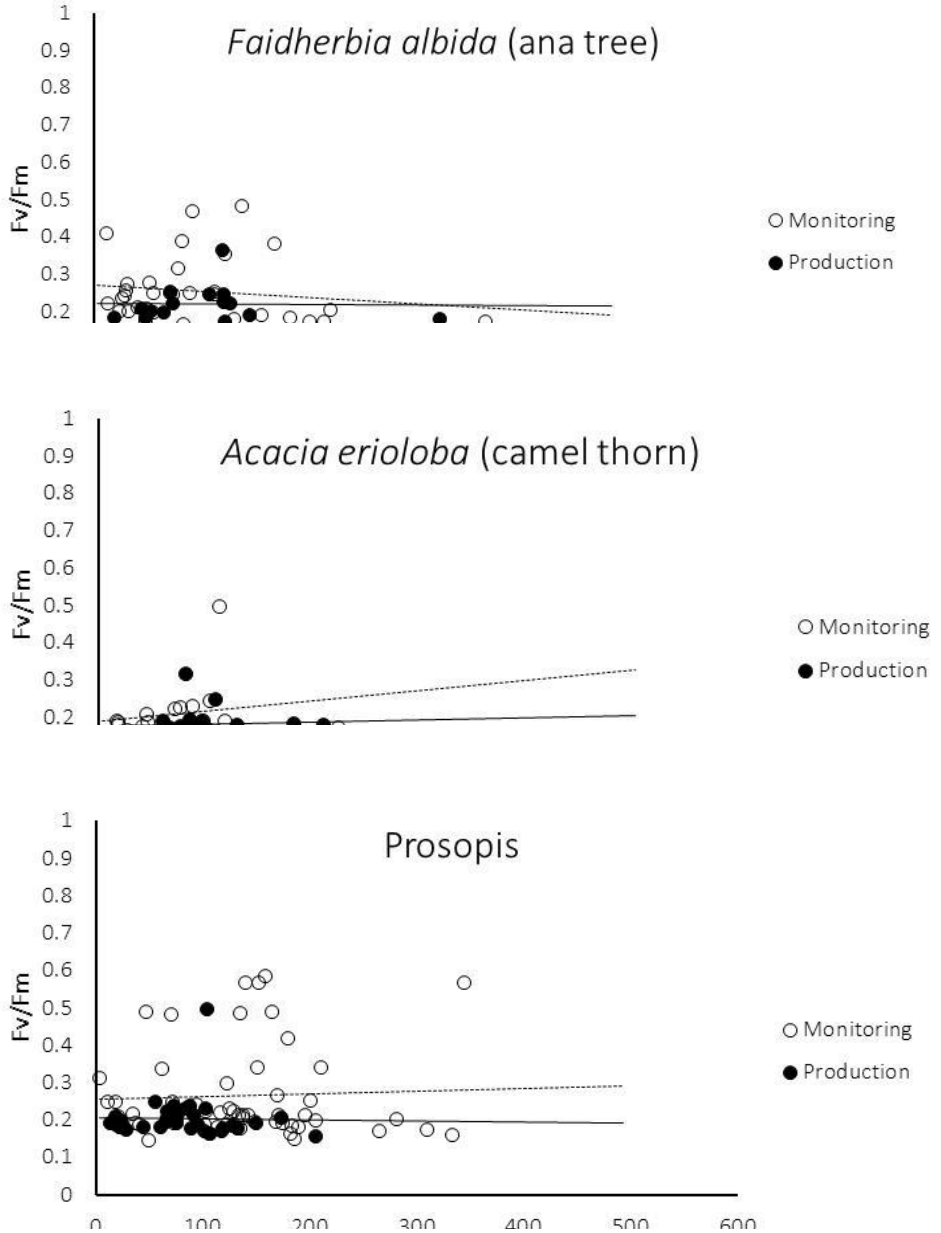


Figure 53. The relationship between tree health (Fv/Fm) and distance to borehole for monitoring (open circles, dashed regression line) and production holes (closed circles, solid regression line) in the Swakop River for three tree species. None of the regressions were significantly different from zero. A healthy plant is generally considered to have an Fv/Fm ratio of 0.85.

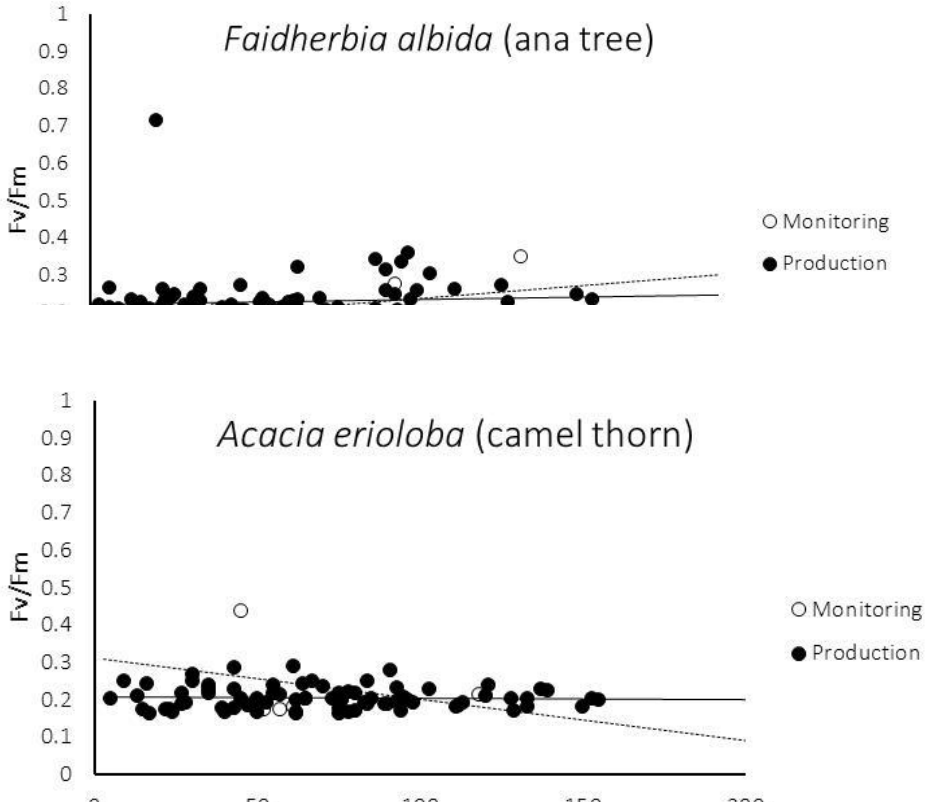


Figure 54. The relationship between tree health (Fv/Fm) and distance to borehole for monitoring (open circles, dashed regression line) and production holes (closed circles, solid regression line) in the Kuiseb River for two tree species (there were no Prosopis trees in the study section of the Kuiseb River). None of the regressions were significantly different from zero. A healthy plant is generally considered to have an Fv/Fm ratio of 0.85.

7 Discussion

Our results exhibit interesting spatial patterns of tree health and mortality within and across the different study sites. While the Swakop River seems to have most population (higher mortality and more sections without trees) of unhealthy trees, all trees including those in the Kuiseb River appear to be relatively stressed. Trees at all study sites had values lower than the 0.85 Fv/Fm which is the accepted index for healthy plants. In addition, the results indicates that tree health may to certain level be affected by seasonal variation, as trees sampled in Phase 1 (March 2012, Fig 5B) of this study were healthier than then those sampled during the current phase (Nov and Dec 2013, Fig 5A).

Overall, there is no clear relationship of mortality patterns and locality of boreholes, as stress patterns were relatively similar across the ecosystems irrespective of tree distance from the production or monitoring boreholes. Although comparing the current results to Phase 1 results (refer to Appendix 3 of 2012 SEMP Report) it is evident that this could just be because everything is now stressed. To understand this, an analysis of actual borehole dynamics (water table and pumping rates) is needed and for this data should be obtained from the mining companies.

Parasites do not also seem to be associated with higher mortalities, but rather confined to particular sections making it difficult to determine whether they are the result of stress or whether they just add to stress. In certain sections of the Swakop River prosopis species were recorded (non in the Kuiseb), perhaps increasing competition and thus could be an important driver or modifier of the relationship.

While the studies managed to achieve an integral component of the SEMP and NERMU's key objectives, that of setting-up a long-term monitoring programme, more questions than answers starts emerging. For instance an immediate question now is, what happens after flooding and recharge of aquifers that could be influence ecosystem health? To find an answer to this question and many other that arise from our study, the monitoring should be continued.

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